# AN ASSESSMENT OF THE VARIOUS METHODS OF SLAUGHTER HOUSE WASTE MANAGEMENT AND DISPOSAL IN NAIROBI COUNTY

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A project report submitted in partial fulfillment of requirements for a Bachelor of Veterinary Medicine Degree of University of Nairobi

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**DECLARATION**

I Kitui Evans Juma do declare that this project report hereby submitted in partial fulfillment of the requirement for the degree of Bachelor of Veterinary Medicine at The University of Nairobi is my own work and has not been submitted by any other person for an award of any degree at any other institution of higher learning.

Signed…………………………………………………………………………..

Date…………………………………………………………………………..

KITUI EVANS JUMA - J30/2056/2010

This project has been submitted for examination with my approval as a university supervisor

Signed………………………………………………...............................................

Date…………………………………………………………………………….

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**DEDICATION**

This project is dedicated to my family who offered me moral, spiritual and financial support, my friends for their social support, my relatives for their constant encouragement and my university, the University of Nairobi, for nurturing me into who I am today. I am glad of you all.

## ACKNOWLEDGEMENT

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## ABSTRACT

The study was carried out in seven slaughterhouses four of which are located within Nairobi county and the other three located within Kiambu and Kajiado counties. The Dagoretti, Ndumbuini and  Kiserian slaughter houses were sampled for study due to their close proximity to Nairobi city and because some butchers from the city collect meat from the said slaughter houses for sale to the city dwellers.

The objective of the study was to evaluate the various types of wastes generated at these slaughter houses and how these wastes are managed/handled. Various ways on how the slaughter house wastes could be reduced at minimum running costs and without endangering the environment around the abattoirs were also assessed.

Data to aid in the study was obtained through questionnaires handed out to workers in the slaughter houses, individual interviews, and physical observation after visiting the various slaughter houses.

It was revealed that in most slaughter houses, blood and ingesta were the most unwanted parts of a carcass after slaughter and that these constituted the larger part of slaughter house wastes discarded from the abattoirs.

It was also noted that the wastes arising from blood and ingesta combined with the large volume of water used to wash off these wastes constituted the greatest proportion of environmental hazards associated with day to day slaughter house activities.

Ways that could be used in reducing the percentage live weight of a cow that is considered as waste to a minimum were suggested.

## INTRODUCTION

Slaughterhouse wastes in pose a serious threat to the environment and the general population at large because of poor waste management practices which results into adverse impacts on water, land and air. (Water being the most affected). The adjacent land of most slaughterhouses is often marshy due to improper drainage of waste water arising from washings in the slaughterhouses.

Land pollution occurs when solid wastes such as hides, hooves, horns and ingesta/dung are left unattended on open land. When the rain falls, these wastes are washed into nearby sewerage channels or streams.

The average volume of water needed for processing slaughtered cattle is approximately 110 litres per head and between 80-90% of this is returned to the environment as waste water. When this is multiplied by the number of animals slaughtered per day, then it is seen that a large volume of liquid waste is generated during the slaughtering process.

It has been shown that waste water from slaughterhouses alter the total solids, pH, temperature and turbidity of water bodies when the two mix. This is due to the blood and gut contents that are washed off the carcass and the slaughterhouse floors. Depletion of dissolved oxygen in water by the blood and other organic materials results in death of marine life. Both aquatic plants and animals are affected.

Moreover, the air close to the slaughterhouses is usually offensive due to decaying flesh of condemned parts that are not discarded promptly, gut contents from slaughtered animals and cow dung from animals being brought in for slaughter.

The major reason for high volumes of wastes generated and difficulty in waste management by slaughterhouses in Nairobi County is the absence of proper waste water drainage channels in the county and lack proper knowledge on ways of recycling the slaughter house wastes produced. It is observed that if there is a way of re-using all the wastes generated at the various slaughterhouses then environmental pollution would be reduced significantly.

The various types of animals slaughtered in the slaughter houses visited include Cows, Pigs, Sheep and Goats. Cows were seen to generate the largest amount of wastes compared to pigs, sheep and goats.

# CHAPTER 1

## 1.0 STUDY OBJECTIVES

The general objective of this study was to determine whether slaughter houses in Nairobi County practice efficient slaughterhouse waste management and treatment before disposal.

The specific objectives of the study were:

   a) To determine the various wastes produced within slaughter houses in Nairobi County.

   b) To determine the various measures put in place to treat these wastes before they are released from the slaughter houses.

# CHAPTER 2

## LITERATURE REVIEW

### 2.1 Review of the main study

Slaughter house waste is defined as any body part cut off during preparation of the carcass in the slaughter house and also comprises waste water and blood from the slaughter houses (*Insam H, 2001*). Slaughter house wastes are a potential reservoir of bacterial, viral, parasitic and prion pathogens capable of infecting both animals and humans. Improper handling and disposal of these wastes may thus lead to contamination of the environment e.g. water and soil and eventually cause disease in animals and people living close to these areas. A quick, cost effective and safe disposal method is therefore essential in order to reduce the risk of disease following animal slaughter (*Franke-Whittle, 2005*)

### 2.2 Magnitude of the Problem

With the growing annual per capita meat consumption, large numbers of animals are being slaughtered daily so as to meet the market demand. With increased numbers of animals being slaughtered comes increased amount of wastes that are produced and which have to be efficiently handled to minimize environmental contamination. This coupled with the outdated nature of most of the slaughter houses in the country means the meat industry does not meet the standards for discharge of effluents and wastes as laid down and notified under the Environmental Management Control Act (1999) (*Pravin K. Shah, 2009*)

### 2.3 Classification of Slaughter Houses

Slaughter houses may be divided into two categories on the basis of the quantity of wastes produced (*EPA, 1974*)

- Simple slaughter houses: This is a plant that slaughters animals and does very limited amount of by-product processing. Its main products are fresh meat in the form of whole, half or quarter carcasses or in smaller meat cuts.


- Complex slaughter houses: This is a plant that slaughters and does extensive processing of by-products. Usually at least three of the following operations take place: rendering, paunch and viscera handling, blood processing and hide & hair processing.

**2.4 Operations and Wastes produced during Slaughtering of Animals**

**Present scenario**

*2.4.1 Slaughtering*

To slaughter the animals in a humane way, stunning is prescribed. This is usually practiced in large animals e.g. bulls, cows and pigs but not in the small animals e.g. sheep and goats. Wastes during the slaughtering process include uncollected blood which flows out as blood vessels at the animal's neck are severed.

*2.4.2 Bleeding*

During the slaughtering process, blood collection is not done immediately on slaughtering and most of the blood goes down into the slaughter house drains and out into the sewages where it mixes with waste water from other activities. Blood of animals which can be collected for consumption or for use in animal feed industries is thus lost.
Due to inadequate facilities at the slaughter houses, very few slaughter houses collect blood.

*2.4.3 Dressing*

Some slaughter houses hoist their carcasses before skinning them while some don't. Wastes produced during skinning of the carcasses include hides and skins which are spread out on the floor of the slaughtering area. Similarly, legs, bones, hooves etc. are not removed immediately from the slaughtering area.

*2.4.4 Evisceration*

This particular process during slaughtering generates maximum amount of waste. Wastes produced at this stage will include: Ruminal contents, Uterus, Fetuses, Stomachs and the intestines, Urinary bladder, Meat trimmings etc. Condemned organs or condemned whole carcasses also form part of slaughter house wastes and should be disposed as soon as possible using the appropriate means while avoiding environmental contamination.

Some slaughter houses throw visceral material at the community bins while some sell these to people who go and wash them at their shops and thus create a pollution problem. (*Kumar, undated*)

*2.4.5 Cleaning of the Floors and walls after Slaughter*

During the above mentioned operations, the waste generated is of liquid and solid nature. The liquid wastes are usually washed away using tap water and allowed to join the drainage and sewer system as wastewater without any pre-treatment. The wastewater from slaughter houses is heavy in pollutants and should be treated before being allowed to mix with other forms of surface water.

# CHAPTER 3

## RESEARCH METHODOLOGY

### 3.1 Study Area

This study was carried out in slaughterhouses that are located within Nairobi County.Nairobi County had a population of 3.36 million people according to the 2009 census. With a growth rate of 4.1% annually, Nairobi's population can be currently estimated at 4.2 million people. Increasing numbers of people result in increased demand for protein to adequately meet the population's dietary requirements.

Nairobi is mainly a metropolitan city located 1661m above sea level and has a surface area of 696 km$^2$



A - Ndumbuini
B - Dagoretti
C - Dagoretti
D - Dagoretti
E - Kiamaiko
F - Njiiru
G – Kiserian

### 3.2 Study Design

This research was carried out between Nov 2014 and Jan 2015 in seven slaughterhouses four of which are located within Nairobi County and the other three located within Kiambu and Kajiado counties. Random sampling was done while obtaining information from workers at the slaughterhouses. The sampled population included: cattle traders, transporters, butchers (people slaughtering and dressing) and casual laborers (people herding animals into the stunning area, those who clean and those who transport wastes) at the slaughterhouses.

Administration of questionnaires, personal interviews and physical observation of activities at the slaughterhouses were done to obtain data for the research project.

Information gathered from each slaughter house included: Number of animals slaughtered per day, types of wastes generated at each slaughterhouse, method of disposal of the different parts of the slaughtered animal and wastes that may be turned into cash if properly disposed.

The data obtained was analysed by quantitative analysis using descriptive statistics and Microsoft Excel.

# CHAPTER 4

## RESULTS& DISCUSSION

### 4.1 Results

Thirteen bulls and cows were sampled at the various slaughter houses before slaughter to aid in finding the weights of the different body parts of the carcass as the animal was being dressed.

The live weights of the animals were noted down before killing was initiated then during dressing, the different body parts were weighed separately and the weight of each noted down.

Table 4.1:

|  | Live Weight | Dressed Carcass | Offals | Entrails | Head & Hooves | Hides | Ingesta |
|---|---|---|---|---|---|---|---|
| Animal 1 | 382 | 270 | 21 | 14 | 19 | 28 | 14 |
| Animal 2 | 326 | 244 | 15 | 9 | 16 | 23 | 10 |
| Animal 3 | 338 | 251 | 16 | 8 | 17 | 24 | 12 |
| Animal 4 | 333 | 249 | 17 | 9 | 16 | 25 | 8 |
| Animal 5 | 307 | 232 | 13 | 7 | 14 | 20 | 10 |
| Animal 6 | 361 | 268 | 18 | 11 | 18 | 25 | 11 |
| Animal 7 | 371 | 270 | 19 | 13 | 20 | 26 | 11 |
| Animal 8 | 361 | 269 | 18 | 9 | 17 | 25 | 9 |
| Animal 9 | 310 | 237 | 16 | 12 | 15 | 21 | 6 |
| Animal 10 | 353 | 259 | 19 | 10 | 18 | 24 | 10 |
| Animal 11 | 355 | 262 | 17 | 12 | 18 | 24 | 12 |
| Animal 12 | 364 | 271 | 20 | 8 | 19 | 26 | 10 |
| Animal 13 | 388 | 279 | 19 | 14 | 21 | 28 | 13 |

Table 4.1 shows the live weight of the sampled animals and the weights of the different body parts of the animals after slaughter.

Since collection of blood for weighing was difficult, the approximate weight of blood was obtained by subtracting the total weight of all body parts from the live weight of the animal before it was slaughtered.

The values obtained were then averaged and then converted into percentages used to give an estimate of the proportions of the different body parts in the slaughtered animals. See *Chart 4.1* in the next page.

Chart 4.1
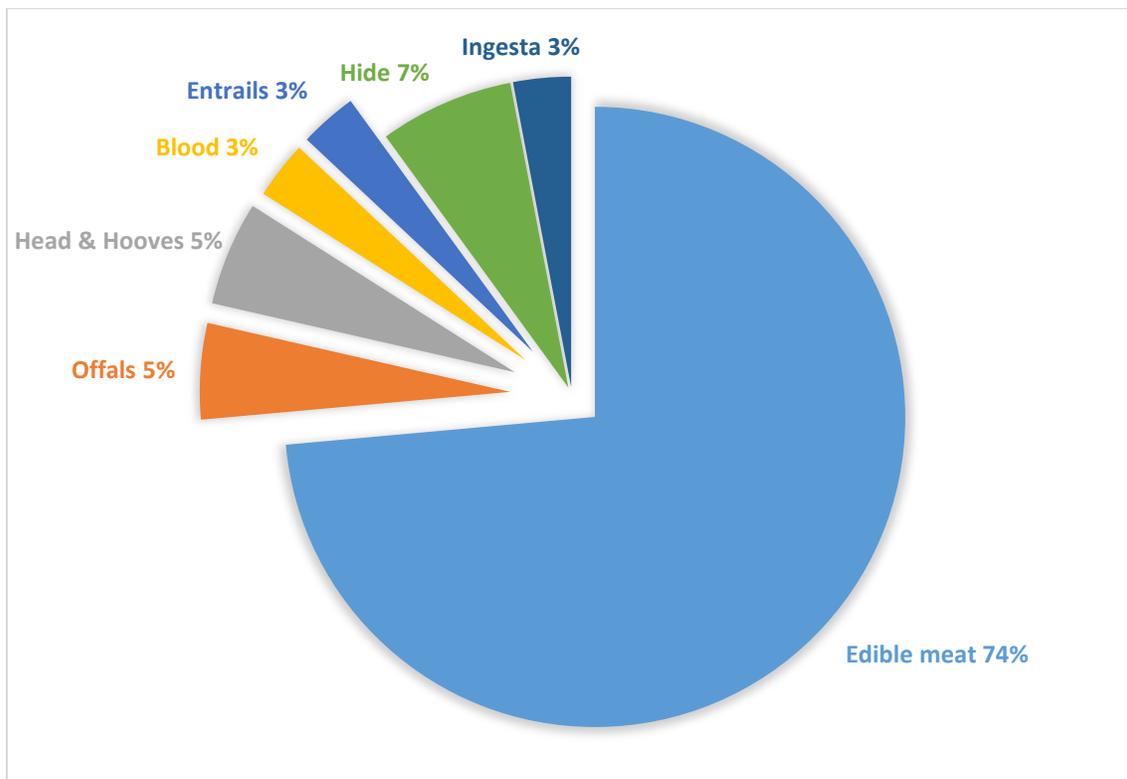


Chart 4.1 shows the proportions of the different body parts in a slaughtered animal.

Entrails: Stomach and Intestines
Ingesta: Undigested feed material in the stomach and intestines
Offal: Heart, lungs, liver, kidneys etc.

From the chart it is seen that edible meat which is comprised of the two sides of the dressed carcass constitutes the largest proportion of the slaughtered animal while Blood, Entrails and Ingesta constitute the least proportion of the slaughtered animal.

Although blood and ingesta form the smallest portion of the slaughtered animal, they are the wastes that pose the greatest problem in the slaughter houses in terms of handling and disposal.

Table 4.1

| Slaughterhouse | Main Species | Capacity | Uses of the different animal parts | | | | |
|---|---|---|---|---|---|---|---|
| | | | Blood | Entrails | Hide | Hooves | Ingesta |
| Ndumbuini | Pigs | >150/day | Disposed | Sold | Sold | Sold | Disposed |
| Dagoretti 1 | Beef (Shoats) | >100/day | Disposed | Sold | Sold | Sold | Recycled |
| Dagoretti 2 | Beef (Shoats) | >100/day | Disposed | Sold | Sold | Sold | Recycled |
| Dagoretti 3 | Beef (Shoats) | >100/day | Disposed | Sold | Sold | Sold | Recycled |
| Kiserian | Beef (Sheep) | >150/day | Recycled | Sold | Sold | Sold | Recycled |
| Kiamaiko | Sheep & Goats | >200/day | Disposed | Sold | Sold | Sold | Disposed |
| Njiiru | Beef (Goats) | >100/day | Disposed | Sold | Sold | Sold | Disposed |

Table 4.1 shows the killing capacity of sampled slaughterhouses as well as the use of the different animal parts.

From the table, data indicates that in the seven sampled slaughterhouses, 94% of the slaughtered animal comprised of edible meat, edible offal, entrails, hide and hooves which are fully utilized and hardly go to waste. It is also noticed that Blood and Ingesta, which comprise only 6% of the slaughtered animal, are the two types of wastes that are commonly disposed from the slaughterhouses in Nairobi and therefore pose the greatest risk to the environment.



Image 4.1.1: Uncollected blood draining onto the killing floor from a killed cow

## 4.2 Discussion

The cycle of operation in the slaughter houses is as follows:

- Animal traders bring their animals to the slaughter houses to sell.
- At the slaughterhouses, butchery owners from the city buy the live animals from the traders.
- The butchery owners then present the live animals to the abattoirs for slaughter at a small fee.
- The animal is slaughtered and typically the whole carcass is handed back to the butchery owner.

Typically the whole carcass because the butchery owners are handed the two sides of the carcass plus all the offals, the entrails, the head and the hooves belonging to the animal they submitted for slaughter.

The entrails (stomach and intestines) are sold in the city's butcheries either as *matumbo* or *mutura* which are local delicacies. The head and hooves are also boiled to produce meat and soup which is sold locally at low prices to the people.

The offals (liver, lungs, heart and kidneys) are favored as a delicacy by the general population and are also sold for consumption but at slightly higher prices than boned meat.

The hides which remain at the slaughterhouses are sold to local industries (e.g. tanneries) or to the *jua kali* artisans. In the local industries the hides undergo further processing into leather products such as shoes, hats and clothing. The *jua kali* artisans use the hides to make drums and sandals which they sell to the locals.



Image 4.2.1                     Image 4.2.2              Image 4.2.3

Image 4.2.1: Bovine carcasses ready for collection after dressing.

Image 4.2.2: Bovine head hung read for inspection.

Image 4.2.3: Collected hides ready for weighing before being sold.

The animal blood and ingesta, which form approximately 6% of the slaughtered animal, varied in their mode of disposal at the various slaughterhouses. The two types of wastes were also responsible for the greatest proportion of wastes generated in slaughterhouses in Nairobi County.

Of the sampled slaughterhouses, only one collected and re-used waste blood. The re-used blood in this case was used for biogas production. The remaining six slaughterhouses disposed the blood as waste into the environment. This small amount of blood requires a large volume of water to wash it off and thus a small proportion of the slaughtered animal becomes magnified at the point of disposal.



Image 4.2.4                                                     Image 4.2.5

Image 4.2.4 shows blood mixed with water draining away as slaughter house waste water

Image 4.2.5 shows a biogas digester at a slaughter house in Dagoretti where ingesta and other gut contents are used for the production of biogas.

Similarly, only 57.1% of the sampled slaughterhouses recycled the undigested feed and dung from the slaughtered animals by either production of biogas or through sale to the local farmers as manure for their farms.

Operations at all the slaughterhouses are regulated by the County Council of Nairobi while environmental hygiene is regulated by National Environment Management Authority (NEMA). Slaughterhouse operators are therefore forced to comply by trying to re-use all the parts of the slaughtered animal and this explains the relatively clean conditions at some of the slaughterhouses. However some of the operators still manage to deviate from set regulations and so the environment around the slaughterhouses is still characterized by bad odours emanating from slurry, undisposed condemned meat and sewages polluted by slaughterhouse waste water.

Large numbers of animals to be slaughtered and the need to maximize sales and distribute the product to different parts of the county require that stunning and dressing be done as early as 5.30am in the morning. Officers from the county offices and NEMA who arrive during official working hours (from 8.00am) find that most if not all of the animals have already been slaughtered and that disposal of wastes and cleaning of the premises has already been completed. This therefore makes it hard to determine whether the slaughterhouses are complying to set regulations or not.

When asked about the various ways to manage and reduce the various wastes reaching the environment, 30% of the respondents had no idea on ways to re-use the blood, while 20% had no idea on how to re-use the ingesta and slurry emanating from the slaughterhouse activities. All respondents were however willing to learn and take part in activities that would result in waste reduction.

Beside the questionnaires, personal observation revealed that a lot needs to be done in order to reduce slaughterhouse wastes and hence protect the environment from pollution.

When blood that is washed into the environment was compared to the amount of ingesta/dung discarded as waste, it was found that blood is the most unwanted part of the slaughtered animal. The blood is also the reason why a lot of waste water is generated in slaughterhouses since large volumes of water are needed to wash it off during cleaning compared to dung. Special attention therefore needs to be directed towards this particular waste.

# CHAPTER 5

**CONCLUSION**

Blood and Ingesta/dung which represent only 6% of the total animal slaughtered constitute the greatest portion of slaughterhouse wastes. Water used for washing away both types of wastes was found to pose the greatest risk to the environment. Most of the slaughterhouses had been found to be discharging raw/untreated waste water into open sewerage systems that pass close to people's homes and which eventually drain into nearby rivers. This therefore degraded the aquatic environment and polluted water used for drinking and irrigation.

It was also observed that the condemned meat room was not emptied regularly and that the rotting flesh inside this rooms contributed to the bad odours at some of the slaughterhouses and also to the increased number of flies seen in some of the premises.

# CHAPTER 6

## RECOMMENDATIONS

In trying to reduce the amount of slaughterhouse wastes generated in Nairobi County then the following recommendations should be taken into consideration:

- ✓ Slaughterhouse operators should be encouraged to collect the blood and sell it to local animal feed industries who would prepare blood meals for production animals.
  The blood could also be used in production of pet food.

- ✓ Biogas production could also be achieved through the use of wastes such as gut contents and blood. The biogas can in turn be used to power up the slaughterhouses hence drastically reducing the operational costs.

- ✓ Raw/untreated slaughterhouse waste water mixed with blood should not be allowed to flow into rivers or into municipal sewer channels. Treatment must be done to improve the effluent quality before discharging the waste water from the premises.

- ✓ Educating workers at the slaughterhouses on the importance of proper slaughterhouse waste management and disposal will also ensure that most of the wastes will be properly handled and disposed without endangering the environment.

If all the above is done, then there will be a reduction in the amount of slaughterhouse wastes generated and increase in employment opportunities to the people residing in the county.

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**APPENDIX**

The raw data as collected is highlighted in this section.

**Table 2.1: The different live weights, in kilograms, of thirteen bulls and cows randomly sampled at the various slaughter houses before slaughter.**

| | |
|---|---|
| Animal 1 | 382 |
| Animal 2 | 326 |
| Animal 3 | 338 |
| Animal 4 | 333 |
| Animal 5 | 307 |
| Animal 6 | 361 |
| Animal 7 | 371 |
| Animal 8 | 361 |
| Animal 9 | 310 |
| Animal 10 | 353 |
| Animal 11 | 355 |
| Animal 12 | 364 |
| Animal 13 | 388 |

**Table 2.2: Weight, in kilograms, of both sides of the carcass after the dressing and slaughtering process is complete.**

|  | Half 1 | Half 2 |
|---|---|---|
| Animal 1 | 134 | 136 |
| Animal 2 | 124 | 120 |
| Animal 3 | 126 | 125 |
| Animal 4 | 123 | 126 |
| Animal 5 | 116 | 116 |
| Animal 6 | 135 | 133 |
| Animal 7 | 135 | 135 |
| Animal 8 | 135 | 134 |
| Animal 9 | 118 | 119 |
| Animal 10 | 131 | 128 |
| Animal 11 | 134 | 128 |
| Animal 12 | 135 | 136 |
| Animal 13 | 139 | 140 |

**Table 2.3: Weight, in kilograms, of other parts of the slaughtered animal**

|  | Offals | Entrails | Head & Hooves | Hide | Ingesta |
|---|---|---|---|---|---|
| Animal 1 | 21 | 14 | 19 | 28 | 14 |
| Animal 2 | 15 | 9 | 16 | 23 | 10 |
| Animal 3 | 16 | 8 | 17 | 24 | 12 |
| Animal 4 | 17 | 9 | 16 | 25 | 8 |
| Animal 5 | 13 | 7 | 14 | 20 | 10 |
| Animal 6 | 18 | 11 | 18 | 25 | 11 |
| Animal 7 | 19 | 13 | 20 | 26 | 11 |
| Animal 8 | 18 | 9 | 17 | 25 | 9 |
| Animal 9 | 16 | 12 | 15 | 21 | 6 |
| Animal 10 | 19 | 10 | 18 | 24 | 10 |
| Animal 11 | 17 | 12 | 18 | 24 | 12 |
| Animal 12 | 20 | 8 | 19 | 26 | 10 |
| Animal 13 | 19 | 14 | 21 | 28 | 13 |

**Table 2.4:Table showing the level of awareness by various respondents on the wastes generated by slaughterhouse activities.**

| Waste | Blood | Slurry/Dung | Entrails | Hooves | Skin |
|---|---|---|---|---|---|
| **Total No. of Respondents** | 40 | 40 | 40 | 40 | 40 |
| **No. of Respondents saying its waste** | 40 | 40 | 0 | 0 | 2 |
| **No. of Respondents listing the waste as reusable** | 28 | 32 | 0 | 0 | 2 |
| **No. of Respondents willing to learn ways on waste reduction** | 40 | 40 | 40 | 40 | 40 |