

**FACTORS INFLUENCING MANAGEMENT OF SLAUGHTERHOUSE
WASTE IN NAIROBI, KIAMBU, KAJIADO AND MACHAKOS
COUNTIES**

By

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**A RESEARCH PROJECT REPORT SUBMITTED IN FULFILLMENT
OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS
DEGREE IN PROJECT PLANNING AND MANAGEMENT OF THE
UNIVERSITY OF NAIROBI**

2019

DECLARATION

This research project report is my original work and has never been presented for any award of degree in any other university

Sign-----Date-----

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This research project report has been submitted for examination with my approval as the university supervisor.

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DEDICATION

I dedicate this research work to my lovely children Bryan, Peter and Evelyn for their support, encouragement and sacrifice that ensured my successful completion of the project.

I also dedicate this work to my late wife Jane for her desire for me to scale greater academic heights in search of knowledge for my benefit and humanity. I hope it will inspire the children towards their own pursuit of academic development.

ACKNOWLEDGEMENT

I acknowledge the Almighty God for the gift of good health, peace of mind, courage and strength that enabled me to complete this project. I wish to thank the University of Nairobi for granting me the opportunity to pursue this course in project planning and management, building my capacity to contribute to building the nation.

I sincerely acknowledge my supervisor Prof. Harriet Kidombo for the invaluable guidance and support that she provided towards development of this research document.

I am greatly indebted to all my lecturers and examiners for imparting the knowledge and skills to me through the various units of the program, ensuring my successful completion of the course. I recognize the important role played by the Department of Extra-mural Studies and the library staff in my studies. Further acknowledgment goes to all my classmates and in particular, members of my study group whose interaction with was immensely useful in the learning process.

Special mention goes to the County Directors of Veterinary Services in Nairobi, Kiambu, Kajjido and Machakos counties for facilitating my access to their slaughterhouses during the research period. Lastly I wish to sincerely acknowledge my colleagues at work place including the head of Veterinary Public Health Department, Dr. Nicholas Ayore and the Senior Deputy Director of Veterinary Services, Dr. Thomas Dulu for their invaluable support.

Table of Contents

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
Table of Contents	v
LIST OF FIGURES	viii
LIST OF TABLES	ix
ABBREVIATIONS AND ACRONYMS	xi
ABSTRACT	1
CHAPTER ONE	2
1.1 Background to the study	2
1.2 Statement of the problem	7
1.3 Purpose of the study	8
1.4 Objectives of the study	8
1.5 Research questions	9
1.6 Significance of the study	9
1.7 Delimitations of the study	10
1.8 Limitations of the study	10
1.9 Basic assumptions of the study	10
1.10 Definitions of significant terms as used in the study	10
1.11 Organization of the study	11
CHAPTER TWO	13
2.1 Introduction	13
2.2 Compliance with laws and regulations governing slaughterhouse operations	13
2.3 Standard operating procedures and slaughterhouse waste management	16
2.4 Biogas production and slaughterhouse waste management	16
2.5 Theoretical Framework	19

2.6 Conceptual Framework	19
2.7 Gaps in the Literature Review	22
2.8 Summary of the Literature Review	22
CHAPTER THREE	24
3.1 Introduction.....	24
3.2 Research Design.....	24
3.3 Target Population.....	24
3.4 Sample size and sampling procedure.....	24
3.5 Method of Data Collection.....	25
3.6 Validity of the instruments.....	27
3.7 Reliability of the instruments.....	27
3.8 Data Analysis Techniques.....	27
3.9 Ethical Issues	27
3.10 Operational Definition of Variables.....	28
CHAPTER FOUR.....	30
4.1 Introduction.....	30
4.2 Questionnaire Return Rate	30
4.3 Demographic Background of Respondents (Managers)	30
4.4 Compliance with laws and regulations governing slaughterhouse operations.....	33
4.5 Standard Operating Procedures for slaughterhouse waste management.....	41
4.6 Prevalence of Biogas Production.	42
4.8 Demographic background of respondents (Meat inspectors).....	46
4.9 Compliance with laws and regulations governing slaughterhouses operations	48
4.10 SOPs for Slaughterhouse waste management	49
4.11 Closure of the slaughterhouse by regulatory authorities	51
4.12 Biogas production in slaughterhouses.....	53
4.13 Observation method	56
CHAPTER FIVE	58

5.1 Introduction.....	58
5.2 Summary of Findings.....	58
5.3 Discussion of Findings.....	60
5.4 Conclusion of the Findings	61
5.5 Recommendations.....	62
5.6 Suggestions for further Research	62
REFERENCES	63
APPENDICES	66
(i) APPENDIX I: TRANSMITTAL LETTER.....	66
(ii) APPENDIX II: QUESTIONNAIRE AND OBSERVATION SCHEDULE	68
1.0 Background.....	68
2.0 Questionnaire	68
(iii) APPENDIX III: SAMPLING FRAME.....	74

LIST OF FIGURES

Figure 1.1: Conceptual Framework.....	21
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LIST OF TABLES

Table 1: Number of cattle, sheep and goats slaughtered in Nairobi (1996 - 2000).....	5
Table 2: Number of cattle, sheep, goats and camels slaughtered (2000 - 2005).....	6
Table 3: National Projected Meat Production and Demand.....	7
Table 4: Sample size of respondents from the local slaughterhouses.....	25
Table 5: Operational definition of variables.....	28
Table 6: Distribution of gender of the slaughterhouse managers.....	32
Table 7: Age distribution of respondents.....	32
Table 8: Respondent's duration of time worked at the slaughterhouse.....	33
Table 9: Highest academic qualification.....	34
Table 10: General level of waste management	35
Table 11: Working condition of the waste management facilities.....	35
Table 12: Demand level for manure from the slaughterhouse.....	36
Table 13: Frequency level of manure disposal from the facility.....	37
Table 14: Level of involvement of environmental regulatory.....	38
Table 15: Slaughterhouse inspection and environmental concerns.....	38
Table 16: Slaughterhouse inspection reports.....	39
Table 17: Closure of the slaughterhouse.....	39
Table 18: Reasons for threatening closure of the slaughterhouses.....	40
Table 19: Non-compliance with slaughterhouse waste management regulations.....	41
Table 20: Environmental audit reports.....	42

Table 21: Standard Operating Procedures for waste handling and disposal.....	43
Table 22: Training workers on SOPs.....	43
Table 23: Awareness of biogas production in slaughterhouses.....	44
Table 24: Introduction of biogas plant in the slaughterhouse.....	45
Table 25: Benefits of biogas plant in a slaughterhouse.....	45
Table 26: Consideration for biogas plant in slaughterhouse.....	46
Table 27: Improvement of waste management at the slaughterhouse.....	47
Table 28: Distribution of the gender of the meat inspectors.....	48
Table 29: Age distribution of the respondents.....	48
Table 30: Duration worked in the slaughterhouse.....	49
Table 31: Compliance with laws and regulations.....	50
Table 32: SOPs for Slaughterhouse waste management.....	51
Table 33: Training workers on SOPs for waste handling and disposal.....	51
Table 34: Reasons for lack of SOPs in the slaughterhouse.....	52
Table 35: Closure of the slaughterhouse.....	53
Table 36: Closure of the slaughterhouses.....	54
Table 37: Awareness of biogas production in slaughterhouses.....	55
Table 38: Introduction of biogas plant in the slaughterhouse.....	55
Table 39: Benefits of biogas plant in a slaughterhouse.....	56
Table 40: Consideration for biogas plant in slaughterhouse.....	57
Table 41: Slaughterhouse waste disposal facilities.....	57

ABBREVIATIONS AND ACRONYMS

BOD	Biological Oxygen Demand
CH₄	Methane
CO₂	Carbon dioxide
DVO	District Veterinary Officer
EMCA	Environmental Management Coordination Act
FAO	Food and Agricultural Organization
GHG	Greenhouse Gases
IGAD	Intergovernmental Authority on Development
KEBS	Kenya Bureau of Standards
KPLC	Kenya Power Lighting Company
LPG	Liquefied Petroleum Gas
NEMA	National Environmental Management Authority
NMIS	National Meat Inspection Services
PDVS	Provincial Director of Veterinary Services
SDGs	Sustainable Development Goals
SOP	Standard Operating Procedures
UNEP	United Nations Environmental Program
UNIDO	United Nations Industrial and Development Organization
UNESCO	United Nations Educational Scientific and Cultural Organization
USD	United States Dollar
WHO	World Health Organization

ABSTRACT

Management of solid waste and waste water in developing countries has been handled over the years with relative success. However, one area that has not received proper attention is management of the waste generated by urban slaughterhouses. Although slaughterhouse wastes could be of potential benefits, they are a major source of public health and environmental hazards if not properly managed. The City of Nairobi has the largest per capita consumption of red meat in Kenya at 10.25 Kg and the demand is set to increase, due to the ever expanding population. Consequently, waste generation from the slaughterhouses that supplies meat to the City is expected to increase and if not managed well, will cause environmental pollution. Non-compliance with the laws and regulations can result in closure of affected slaughterhouses and disrupt meat trade. The purpose of this study was to establish the factors influencing management of waste generated by the local large category slaughterhouses in Kiambu, Nairobi, Kajiado and Machakos counties supplying meat to Nairobi. The study objectives were; to establish the extent to which compliance with regulations governing slaughterhouse operations influences waste management; to determine the extent to which standard operating procedures influences waste management; and to investigate the extent to which biogas production influences waste management. The target population was 18 local large category slaughterhouses in Nairobi, Kiambu, Kajiado and Machakos counties that supply meat to Nairobi. The sample size was 34 respondents comprising 17 managers and 17 meat inspectors and was determined using Taro Yamane's formula, in view of the small target population size. The sampling procedure used was total enumeration. The study used descriptive research design and data was collected using questionnaires, observation method and document review. Findings established that although majority of the slaughterhouse managers sampled expressed satisfaction with the level of waste management, half of the slaughterhouses had their waste handling and disposal facilities in poor working condition. Close to 40% of the slaughterhouses had been threatened with closure in the last five years. Nearly half of the slaughterhouses sampled did not have SOPs to guide waste management. Only Nyongara slaughterhouse in Dagoretti complex had a biogas plant. From the findings, the study made the following recommendations; stepping up enforcement of the regulations to increase compliance, conduct business opportunity seminars for slaughterhouse operators and the public on commercial utilization of slaughterhouse waste, develop SOPs for use by all slaughterhouses.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Management of solid waste and waste water in developing countries has been handled over the years with relative success. However, one area that has not received proper attention is management of the waste generated by urban slaughterhouses. The United Nations Environmental Program (UNEP) Basel Convention (1989) defined waste as substances or objects which are disposed of, or are intended to be disposed of, or are required to be disposed of by the provisions of national law. Slaughterhouse waste is defined generally as all waste occurring in a slaughterhouse as a result of slaughtering and the waste generated from the operations of a slaughterhouse (W. Weiers & R. Fischer, 1978). The major waste associated with slaughterhouse operations are blood, dung, hooves, horns, bones and slurry which are disposed of on land and wastewater that is washed into waterways, leading to pollution of the environment. Average solid waste generation from cattle slaughterhouses is 27.5 % of the animal weight. In case of goats and sheep slaughterhouse, average waste generation amounts to 17 % of animal weight, (Cedindia, 2011). It is important to manage slaughterhouse waste well in order to avoid potential risks to the environment and public health.

Although slaughterhouse wastes could be of potential benefits, they are a major source of public health and environmental hazards if they are not properly managed. It has been found that unattended solid waste will decay and become breeding places for bacteria and viruses, which may result in many illnesses to both humans and other living organisms. It will also lead to polluted air and bad odor. Chances of epidemics are very high unless the authorities responsible take action to manage the waste effectively (Kumar, 1989). Contamination of water bodies by slaughterhouse wastes have been reported to constitute significant environmental and public health hazards (World Bank, 1998; Coker et al, 2001; Nafarnda et al, 2006; Osibanjo and Adie, 2007). The consequences of infection by pathogens originating from poor slaughterhouse waste management can range from temporary morbidity to mortality, especially in high-risk individuals (Nafarnda et al, 2012). Besides, reduced life expectancy in most developing countries especially in sub-Saharan Africa has been associated with inadequate and hazardous waste management, among other factors (WHO,

2005). Additionally, given the pollution potential of slaughterhouse wastes (Ezeohaa and Ugwuishiwu, 2011); there is adverse effect on air quality, environment, potable water supplies and aquatic life which negatively impacts health and well-being. Furthermore, it has been reported that piling up of slaughterhouse wastes within the environment can cause pollution and subsequently produce methane gas that intensifies greenhouse effect (Adeyemo, 2002). In view of the environmental and health risks that have been highlighted, it is important that management of waste generated by operations of slaughterhouses should be accorded the significant attention it deserves in order to minimize impact on access to safe water, environmental sustainability, sanitation and human health in line with the global Sustainable Development Goals (SDGs).

Poor sanitation and lack of clean water as a result of pollution from slaughterhouse waste impacts public health. A report by the World Health Organization (WHO) Regional Office for Africa of six African countries (WHO, 2005) concluded that the main environmental health factors causing morbidity and mortality are related to inadequate access to safe water supplies, inadequate sanitation and inadequate solid and hazardous waste management. As reported, more than 44% of the population has no access to safe drinking water, less than 37% have access to safe sanitation and air pollution remains one of the leading causes of child morbidity (WHO, 2002). Furthermore, some 1.7 million young children die each year from diarrheal disease associated with contaminated water, poor sanitation and hygiene and a further 1.4 million child deaths from respiratory infections were attributable to indoor pollution (Cairncross et al, 2003). While the significance and impact of environmental interventions cannot be underestimated in terms of disease prevention and the subsequent impact on all areas of the MDGs (Morse et al, 2010), the practice of proper management of wastes generated in slaughterhouses in developing countries become imperative. The authorities must therefore ensure that slaughterhouse operators comply fully with laws and regulations concerning waste handling and disposal, in order to secure a sanitary environment, access to safe drinking water and consequently, reduce occurrence of diseases among the communities in the neighborhood of the slaughterhouses.

Contamination of rivers and other water bodies with slaughterhouse wastewater effluents is a threat to aquatic life. According to Quinn and McFarlane (1989) and Sangodoyin and Agbawhe (1992), effluent discharge from slaughterhouses creates high demand for oxygen (BOD) in rivers and contamination of ground water and has the potential to create high

competition for oxygen within aquatic ecosystems. This leads to oxygen depletion, decreasing the aesthetic value of aquatic ecosystems. It does not only have adverse effect on aquatic life, but also on humans who dependent on this water for domestic purposes, (UNESCO, 2006; Krantz and Stein, 2005). In the recent past, the speed at which urbanization is taking place in Kenya represents a major challenge to water resource management, particularly the delivery of essential water, sanitation services and environmental protection. It is therefore imperative that slaughterhouses must have functional wastewater effluent treatment lagoons in order to avoid contamination of water bodies and safeguard public health and aquatic life.

The increasing human population growth in urban centers including Nairobi and its environs will result in increased demand for meat, exerting more pressure on the existing slaughterhouses in managing slaughterhouse waste. Slaughterhouse waste generation is one of the major impacts of the increasing slaughter rate of food animals as a result of the growing demand for animal protein. The per capita meat consumption in developing countries continues to increase tremendously with the rising demand, leading to increased livestock populations (FAO, 2010) and hence increased wastes generation from their slaughter. In addition, Adekosan and Sulaimon (2014) also state that the compounding contribution of slaughterhouse wastes to waste management problems in developing countries is likely to continue into the future in view of the growing demand for animal protein. Developing countries should therefore put in place innovative measures to cope with the expected increase in waste generation so as to forestall environmental pollution.

It has been stated before that the demand and production of meat in Nairobi City is set to increase tremendously as the population continues to grow, resulting in a corresponding increase in slaughterhouse waste generation. Nairobi County gets meat supply mainly from the following slaughterhouses categorized as local large and grouped as follows; Dagoretti complex in Kiambu County (Cooperative, Thiani, Mumu, Nyongara, Nyonjoro), Dandora complex in Nairobi County (Kayole, Dandora, Hurlingham, Kiamaiiko), Kiserian Complex in Kajicho County (Kiserian, Kitengela, Keekonyoke) and Mlolongo slaughterhouse in Machakos County. According to a study, End market Analysis of Kenya Livestock and Meat, Nairobi has the largest per capita consumption of red meat within Kenya which is 10.25 Kg. The National per capita consumption is 10.8Kg (Muthee, 2006). The Kenya Economic

Survey (1996-2000) showed that production of beef in Kenya was projected to increase from 353,128 Tons from 2007 to 434,113 Tons in 2014 and demand from 393,650 Tons to 483,113 Tons during the same period. Production of mutton and goat meat was projected to increase from 97,000 to 127,765 Tons and demand from 104,420 to 139,011 Tons (Muthee, 2006). The National slaughter figures for cattle rose from 1.219 million in 1996, peaked at 2.87 in 2000 and declined to 1.641 in 2004, while sheep and goats rose from 1.407 million in 1996, peaked at 4.572 in 2000 and declined to 3.851 in 2004. The peak slaughter in 2000 was attributed to drought conditions, (Muthee, 2006). This trend in growing demand and production of meat is expected to result in corresponding increased waste generation. In view of the above, slaughterhouses will need to have their capacity to handle waste management enhanced, while the authorities should ensure full enforcement of the laws and regulations concerning slaughterhouse waste management.

Slaughter figures trend for Nairobi is shown in the following table 1.

Table 1: Number of cattle, sheep and goats slaughtered in Nairobi (1996 - 2000)

Species	Year				
	1996	1997	1998	1999	2000
Cattle	28,641	30,052	32,801	35,120	38,998
Goats	28,938	22,741	14,279	15,600	29,378
Sheep	5,859	9,033	4,805	6,790	15,622
Total	63,438	61,826	51,885	57,510	83,998

Source: Nairobi PDVS Meat inspection reports (1996-2000).

The above table shows that the number of cattle, Sheep and goats slaughtered in Nairobi rose from 63,438 in 1996 to 83,998 in 2000.

Table 2: Number of cattle, sheep, goats and camels slaughtered (2000 - 2005)

Species	Year					
	2000	2001	2002	2003	2004	2005
Kitengela Slaughterhouse						
Cattle	852	546	544	758	2,681	1,748
Sheep	543	587	708	690	1,783	1,847
Goats	720	733	797	639	1,629	2,169
Sub-Total	2,115	1,866	2,049	2,087	6,093	5,764
Mlolongo Slaughterhouse						
Cattle	60	84	112	124	492	425
Sheep	502	494	504	702	800	1,018
Goats	521	540	900	952	896	952
Camels	1,217	1,477	1,173	868	957	1,004
Sub-Total	2,300	2,595	2,689	2,646	3,145	3,399
Kiserian Slaughterhouse						
Cattle	3,700	3,538	3,436	3,949	4,850	4,011
Sheep	3,199	2,744	3,533	5,184	7,816	6,268
Goats	3,622	2,418	2,066	3,319	5,529	5,051
Su-Total	10,521	8,700	9,035	12,452	18,195	15,330
Keekonyokie Slaughterhouse						
Cattle	-	5,267	5,232	6,971	8,769	8,471
Sheep	-	-	-	-	-	-
Goats	-	-	-	-	-	-
Camels	-	-	-	-	-	-
Sub-Total	-	5,267	5,232	6,971	8,769	8,471
Total	14,936	18,428	19,005	24,156	36,202	32,964

Source: DVO Kajado North and Machakos District Meat Inspection Reports (2000-2005)

The above table shows that the number of cattle, sheep, goats and camels slaughtered in Kajiado and Machakos counties rose from 14,936 in 2000 to 32,964 in 2005. The increasing

demand for beef, mutton and goat meat and the rising trend in slaughter figures for the slaughterhouses supplying Nairobi County, is expected to stretch the capacity of the facilities in terms of waste management with greater environmental pollution concerns. The growing population of Nairobi and the corresponding rise in demand for meat supplies is expected to increase waste generation from these slaughterhouses with environmental pollution consequences, if waste management challenges are not addressed. The National demand and production of meat was projected to increase as shown in the following table 3.

Table 3: National Projected Meat Production and Demand

Item		Year							
		2007	2008	2009	2010	2011	2012	2013	2014
Beef (Tons)	Production	353,128	363,563	374,470	385,704	397,275	409,193	421,469	434,113
	Demand	393,650	405,300	417,459	429,982	442,881	456,167	469,852	483,948
Mutton (Tons)	Production	44,320	45,457	47,821	50,308	52,924	55,676	58,571	61,617
	Demand	57,905	59,390	62,478	65,727	69,145	72,741	76,523	80,502
Goat Meat (Tons)	Production	52,680	54,440	56,237	58,092	60,009	61,989	64,035	66,148
	Demand	46,515	48,070	49,656	51,295	52,988	54,737	56,543	58,409

Source: Kenya Economic Survey 1996-2000

The increasing trend in meat production and demand will result in increased generation of waste in slaughterhouses in the country, including those supplying meat to Nairobi. The study sought to establish the factors influencing waste management in these slaughterhouses, problems faced by operators and suggest feasible solutions and recommendations for managing the increasing waste generation.

1.2 Statement of the problem

It has been sated that increasing human population growth in urban centers including Nairobi and its environs will result in increased demand for meat, exerting more pressure on the existing slaughterhouses in managing slaughterhouse waste. Nairobi city is a commercial hub in East Africa, hosting international organizations with a significant size of expatriate community who, together with the growing middle class influence demand for meat. The city has the largest per capita consumption of red meat in Kenya. Currently there is the problem of pilling up of manure and other solid wastes and discharge of raw wastewater

effluent and blood within most slaughterhouse premises and into nearby rivers. Nairobi River in particular is under threat of pollution from slaughterhouses in Dagoretti, Kikuyu Sub-County and Dandora, Kayole and Kiamaiko slaughterhouse in Nairobi County. Some slaughterhouses have been closed down for not complying with slaughterhouse operational regulations and polluting the environment. NEMA closed down 15 slaughterhouses at Kiamaiko in 2018, citing pollution of Nairobi River arising from discharge of untreated liquid waste into the river (J. Otieno, 2018). Closure of slaughterhouses disrupts meat trade and adversely affecting the local economy. It will be imperative for the relevant authorities to be more diligent in enforcing the regulations governing slaughterhouse operations in order to manage the expected increase in waste generation.

Waste management in slaughterhouses is governed by laws and regulations that must be complied with, in order to prevent environmental pollution and safeguard public health. The laws include the Meat Control Act Cap 356 of the laws of Kenya, with regulations cited as the Meat Control (Local Slaughterhouse) Regulations 2010, that governs slaughterhouse operations. The regulations include; provision of suitable manure sheds to store pouch manure for at least two days operations, sufficient incinerators or condemnation pits kept under lock and key by the inspecting officer; and compliance with the provisions of Environmental Management Coordination Act (EMCA) 1999 on acceptable slaughterhouses environmental pollution control, effluent treatment systems and solid waste disposal. However, despite the laws and regulations being in place, piling up of solid waste, polluted air and poor wastewater effluent discharge is still prevalent in some slaughterhouses in the country, indicating insufficient compliance with the regulations. This study aimed at establishing the factors influencing management of waste generated by the local large category slaughterhouses supplying meat (cattle, sheep, goats & camels) to Nairobi, in order to contain environmental pollution with the rising demand for meat.

1.3 Purpose of the study

The purpose of this study was to establish the factors influencing management of waste generated by local category slaughterhouses in Nairobi, Kiambu, Kajiado and Machakos counties that supply meat to Nairobi.

1.4 Objectives of the study

This study was guided by the following objectives;

1. To establish the extent to which compliance with regulations governing slaughterhouse operations influences management of waste generated by the local large category slaughterhouses in Nairobi and its environs.
2. To determine the extent to which the presence of standard operating procedures (SOPs) influences waste management in the local large category slaughterhouses in Nairobi and its environs.
3. To investigate the extent to which biogas production influences waste management in the local large category slaughterhouses in Nairobi and its environs.

1.5 Research questions

The research questions are as follows;

- 1) To what extent does compliance with regulations governing slaughterhouse operations influence waste management in the local large category slaughterhouses in Nairobi and its environs?
- 2) To what extent does the presence of standard operating procedures (SOPs) influence waste management in the local large category slaughterhouses in Nairobi and its environs?
- 3) To what extent does biogas production influence waste management in the local large category slaughterhouses in Nairobi and its environs?

1.6 Significance of the study

The study findings, conclusions and recommendations will be important to policy makers, researchers and other stakeholders involved in strengthening and enforcing the existing laws and regulations governing slaughterhouse operations and waste management. The regulations are enshrined in the Meat Control Act Cap 356 of the laws of Kenya, executed by the Directorate of Veterinary Services (DVS), and the Environmental Management Co-ordination Act (EMCA 1999 through the National Environmental Management Authority (NEMA). This will eliminate environmental pollution arising from accumulated and decayed solid waste in slaughterhouses and contamination of nearby water bodies with untreated

wastewater discharge, thereby safeguarding public health. The study is in line with Kenya Government commitment to the United Nations Sustainable Development Goals (SDGs). This includes efforts to protect the planet and address climate change arising from greenhouse gas emissions which is of global concern.

1.7 Delimitations of the study

The slaughterhouses were selected on the basis of being the major suppliers of meat to Nairobi and its environs, whose population is rapidly growing and showing increasing demand for meat. This growing demand for meat is projected to increase the number of animals slaughtered over the years and consequently result in high generation of waste. The slaughterhouses have close proximity to rivers flowing through the counties of Nairobi, Machakos, Kajiado and Kiambu which are threatened with pollution from wastewater effluent discharges into them. Nairobi River in particular is under threat of pollution from slaughterhouses in Dagoretti, Dandora, Kayole and Kiamaiko slaughterhouses.

1.8 Limitations of the study

The study involved costly travelling to slaughterhouses which are scattered and respondents could only be found in the early part of the day, due to the nature of slaughterhouse operations. The researcher made much use of the County and Sub-county offices concerned for the necessary protocol to facilitate cooperation and secure appointment with respondents at the slaughterhouses for data collection. The researcher collected data without the use of research assistant in order to cut the cost.

1.9 Basic assumptions of the study

The basic assumptions were that the respondents would cooperate and provide accurate, true and honest information. Data collection instruments took into account validity and reliability in facilitating accurate and objective analysis, useful conclusions and recommendations.

1.10 Definitions of significant terms as used in the study

Aquatic ecosystem: A water body where organisms live and depend on each other and also on their environment.

Biochemical Oxygen Demand (BOD): The amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period and used to measure the degree of organic pollution of water. It is an effective gauge of effectiveness of wastewater treatment plants.

Biogas: This is Methane gas produced through a process of anaerobic digestion of biomass (manure and human waste) which can be used for lighting, heating and production of electricity and organic fertilizer as a by-product.

Condemnation pit: Facility in a slaughterhouse where carcasses and parts of slaughtered animals are declared unfit for human consumption are disposed of.

Green House Gases (GHGs): Gases that trap heat in the atmosphere when emitted causing global warming and consequently climate change. They include Carbon dioxide, Methane, Nitrous oxide and Fluorinated gases.

Incinerator: Facility in a slaughterhouse where carcasses and parts of slaughtered animals are declared unfit for human consumption are disposed and completely burnt.

Local slaughterhouse: Any place or facility kept for the purpose of the slaughter of animals for human consumption locally and not for export. In Kenya it operates within the provisions of Meat control Act Cap 356, local slaughterhouse regulations- Legal Notice 110 of July 2010.

Slaughterhouse waste: This consists of dung, slurry, blood, horns, hooves and other animal parts that are not used after slaughter and wastewater/effluent from slaughterhouse operations.

Standard Operating Procedure (SOP): A Standard Operating Procedure is defined by FAO as a document which describes the regularly recurring operations relevant to the quality of the investigation. The purpose of a SOP is to carry out the operations correctly and always in the same manner. A SOP should be available at the place where the work is done.

Wastewater Effluent Treatment Lagoon: A facility in slaughterhouses where wastewater/effluent is held prior to treatment and discharged into water bodies to prevent pollution.

1.11 Organization of the study

Chapter one looks at the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, delimitations of the study, limitations of the study, basic assumptions of the study and definition of significant terms as used in the study. Chapter two is the literature review that is relevant to the research topic. It includes the concept of waste management, compliance with laws and regulations governing operations slaughterhouses with regard to waste management, the use for standard operating procedures on slaughterhouse operations and waste management, biogas production

in slaughterhouse waste management, theoretical framework, conceptual framework and summary of the literature review. Chapter three consists of research design, target population, sample size and sampling procedure, methods of data collection, validity of the instruments, reliability of the instruments, data analysis techniques, ethical issues and operational definition of variables. Chapter four covers data analysis; while Chapter five covers the summary of the findings, discussion of the findings, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section is about literature on factors influencing slaughterhouse waste management. The Literature review looks at the concept of waste management and the status of management of waste generated from slaughterhouses, with regard to compliance with National laws on safeguarding the environmental from pollution in various countries of the world and in Kenya. It further highlights the legal framework that deals with slaughterhouse operations in Kenya, in particular the Meat Control Act Cap 356 of the laws of Kenya. The three areas of focus are; Compliance with the national laws and regulations governing operations of local large category slaughterhouses, Standard operating procedures in slaughterhouse operations with regard to waste management; and biogas production in slaughterhouses as some of the key factors influencing slaughterhouse waste management.

2.2 Compliance with laws and regulations governing slaughterhouse operations

Waste generation is a normal consequence of human activity which must be handled and disposed of properly without causing environmental pollution that is harmful to life.

Waste is defined by UNEP Basel Convention (1989), as substances or objects which are disposed of, or are intended to be disposed of, or are required to be disposed of by the provisions of national law. Waste is also defined by European Union Waste Framework Directive (2008), as an object the holder discards, intends to discard or is required to discard.

In any waste management process, there is a stage when waste will be temporarily stored or contained onsite where it is produced. This may be temporary or be a final disposal site. If storage is temporary, then subsequent stages will be the transfer or transport to a treatment facility or technology, followed by final disposal offsite, away from the waste generation site. It is important that waste is managed well in order to safeguard the environment from pollution and safeguard public health. This concept of waste management is applicable to slaughterhouses operations.

Governments are supposed to provide a legal and regulatory framework in which slaughterhouses operate with regard to waste management, in order to prevent environmental pollution in the surroundings. Most developing countries have long established laws and formal government structures to address their serious environmental problems, but few have been successful in alleviating those problems (Bell, 2002). This also applies to slaughterhouses where sanitary and environmental laws are not satisfactorily complied with. Generally, slaughterhouse operations in most developing countries including Nigeria generate large quantities of wastes, a trend that is likely to continue into the future given the future rising demand per capita meat consumption in developing countries (FAO, 2010). As stated by Vijayan et al. (2012), most of the slaughterhouses in India are more than 50 years old, without adequate basic amenities such as proper flooring, ventilation, water supply, lairage, and transport. The slaughterhouses have very low hygiene standards, posing serious public health and environmental hazards due to poor disposal of waste and highly polluted effluent discharge. In a study carried out by Maranan et al. (2008), on operations and waste management of slaughterhouses in Laguna Province of the Philippines, it was established that only 36.4% of all the eleven slaughterhouses were accredited with the National Meat Inspection Service (NMIS) and the rest operated illegally and did not meet the required standards for abattoir operations. Wastewater treatment facilities and lagoons were not functioning satisfactorily and the main problem was non-compliance with standards set by the authorities in the country. It is therefore imperative that strict enforcement of the standards and implementation of waste management programs be undertaken in order to safeguard the public against environmental pollution.

Public participation and education is important in dealing effectively with management of slaughterhouse waste. A lack of awareness, technical knowledge, legislation, policies, and strategies are major issues for waste management in most developing countries (Hwa, 2007). Inappropriate management of wastes is an increasing problem worldwide (Yáñez et al, 2002). Nonetheless, adequate knowledge and attitudes toward waste management appear to be very crucial in facilitating the development of environmentally friendly community waste behavior (Ehrampoush and Baghianimoghadam, 2005). It therefore suffices to say that education, particularly public health education remains a major tool in the quest to improve the knowledge, attitudes as well as practices related to environmental and public health issues (Abdul-Mutalib et al, 2012; Cabezas et al, 2013). Public involvement and empowerment

should be encouraged through education, public awareness, gender balance, participation, information exchange and networking.

Different approaches have been tried in dealing with waste management. The most commonly used method in developing countries is the traditional command and control system to environmental management which, according to Adelegan (2002), had not produced the desired result both economic and environmental wise in Nigeria. For the case in Nigeria, it was recommended that environmental policies should have a mix of the traditional command and control system and market-based instruments that include effluent charges and pollution taxes as incentives and disincentives in order to effectively secure compliance with environmental laws as it is public involving. A mix of approaches that are appropriate in a particular country should be explored and used to enhance compliance.

In Kenya just like other developing countries, laws and regulations governing slaughterhouse operations with regard to waste handling and disposal exist. The Meat Control Act Cap356 of the laws of Kenya specifies the regulations to be followed with respect to construction of slaughterhouses in order to maintain meat hygiene and the environment. Construction of slaughterhouses should be done on suitable sites with waste disposal systems of adequate size, arrangement for safe disposal of manure, blood, condemned carcasses and organs and lagoons for wastewater/effluent treatment in accordance with EMCA Act (KEBS, 2017). The regulations specifically stipulate that in hygiene practices, garbage, and filth or refuse whether liquid or solid shall not be allowed to accumulate in a slaughterhouse. In a typical slaughterhouse, manure should be regularly removed as soon as practicable and this depends on the capacity. The condemned carcasses and organs are either disposed of in the condemnation pit or should be incinerated. The liquid effluent should be subjected to treatment before it is finally released to the water bodies. In spite of the above regulations, most slaughterhouses continue to operate below the threshold of compliance with regulations regarding waste disposal resulting in environmental pollution. According to Torne et al. (2010), a functional wastewater effluent system ensures there is reduction of odor and organic load and contamination of treated wastewater prior to discharge into nearby water bodies. This will benefit surrounding residents and the aquatic organisms in the water bodies that may be discharged into by the treated wastewater effluent from the slaughterhouse. A study

by Koech et al. (2012) of Egerton University, to assess the status of treated slaughterhouse effluent from Dagoretti slaughterhouses in Kenya and its effect on the physico-chemical characteristics of Kavuthi stream revealed that although the slaughterhouse effluents were treated, it did not meet the NEMA standard for effluent discharge into the environment leading to pollution of the receiving water based on the parameters under investigation. The parameters included Biological Oxygen Demand (BOD) among others. The researchers recommended up-scaling of wastewater treatment system in order to meet the required standard. Strict enforcement of the laws and regulations and any other appropriate measures is necessary to ensure compliance to prevent pollution of water bodies.

Compliance with the laws and regulations is key in management of slaughterhouse waste. The study sought to assess the functional status of waste disposal facilities, whether or not the slaughterhouses were subjected to inspection and environmental audit and establish the reasons that limit compliance by slaughterhouses.

2.3 Standard operating procedures and slaughterhouse waste management

Standard operating procedures (SOPs) are very important in describing the activities necessary to complete tasks in accordance with industry regulations, provisional laws or the firm's own standards for running their operations. According to WHO (2002), slaughterhouse waste is a public health hazard and its disposal must be done by trained staff to ensure the waste is disposed of in properly maintained sites. Studies have been done showing the prevalence of SOPs for sanitary operations and training of workers on them. The SOPs in place are for ensuring that meat is not contaminated by pathogens. However, to the best knowledge of the researcher, no study has been done to establish the presence of training programs for workers in the SOPs concerning waste handling and disposal in the local large category slaughterhouses supplying meat to Nairobi and its environs. This study therefore sought to investigate and confirm the presence of training programs for workers on SOPs in waste disposal and establish their influence on waste management in the slaughterhouses.

2.4 Biogas production and slaughterhouse waste management

Slaughterhouse waste in form of manure and slurry is biomass that can be processed to produce biogas. This gas is methane which is produced by digestion that involves decomposition and fermentation of sewerage and manure using bacteria, in the absence of air

(anaerobic conditions), when slurry is fed into the digester. The Method is widespread in many parts of the country in Tanzania with livestock (Marree et al., 2007). According World Bank (2009), a study on slaughterhouses and waste systems in developing countries shows that intensive livestock producers are moving near urban centers or cities for access to processing infrastructure and better markets. Municipalities are being increasingly burdened by the need to provide livestock processing infrastructure to meet the ever growing demand for meat by especially the middle class segment. It has been stated that the growing demand will result in increased waste generation that must be addressed. Biogas production is a strategy that can be used in slaughterhouse waste management.

Biogas is a unique energy technology because it offers multifunctional and simultaneous benefits in public health, agricultural productivity, environmental sustainability and economic development. Torne et al. (2010) in a pilot integrated wastewater management scheme for small and medium scale slaughterhouses, a case of Bureau of Animal Industry Plant in Valenzuela City in Metro Manila, established that the bio-gas (methane) produced and used for heating water for cleaning saved the plant at least 2 liquefied petroleum gas (LPG) tanks per month amounting to USD 27.27. Severine et al., (2012) conducted a study to identify an economically and environmentally viable way of disposing and eliminating solid or liquid waste from Vingunguti slaughterhouse in Dar- es-Salaam, Tanzania. An anaerobic digester was considered for use to manage waste and produce biogas and bio-fertilizer on the premises of the slaughterhouse. Biogas technology was introduced in Kenya by the white settlers in mid1950s (IGAD, 2007). A private company “Tunnel Technology Limited” started the construction of biogas plants in various parts of the country in 1958 and by 1980, had constructed 150 units (IGAD, 2007). According to Kenya Shell Foundation Report (2007), there is potential to develop a biogas market in Kenya. It is evident that biogas production has various benefits for slaughterhouse operations including reducing pollution and saving energy costs and should therefore be promoted.

Various studies have been done to explore the viability of biogas production as a strategy to supplement other measures undertaken to manage slaughterhouse waste. UNIDO (2010) in a study; Converting Waste from Slaughter House to Energy for productive use that was carried out at Nyongara slaughterhouse in Dagoretti, a biogas plant that was established at the abattoir made use of the large amount of accumulated manure generated, to produce biogas energy to light up the abattoir and lower Greenhouse Gases (GHG) emissions to the

atmosphere. The biogas plant was established through collaborative effort of UNIDO, Kenya Industrial Research and Development Institute (KIRDI), UNEP and the owner of the slaughterhouse (UNIDO, 2010). The study demonstrated that one ton of animal waste produces over 100 cubic meters of biogas which has a concentration of 65% CH₄ and 35 % Carbon dioxide (CO₂). The potency of Methane is about 21 times that of CO₂ in trapping heat in the atmosphere. This would translate into approximately 1,500 cm³ of greenhouse gases emitted from the dumpsite from around 15,000 kg of waste per day, over and above the emissions from previous dumping. Daily, over 300 cattle and 100 goats are slaughtered and delivered by the four abattoirs of Dagoretti complex for a fee. In addition to the population of 4,000 living within 1 km radius, the nearby Thogoto forest supports a population of nearly 10,000 pastoralists bringing cattle, traders and others in slaughter services. Most of the 3,000 abattoir workers commute daily, mostly on foot from nearby areas. 40% of the abattoir area populace lives in the 2 km long Kware slum along the river Kabuthi. The study concluded that biogas from digestion of slaughter waste would uplift the living conditions of this population. Biogas for cooking would ease the financial and social burden of these families and reduce deforestation and land degradation.

Biogas production has a variety of benefits to the slaughterhouses, the local community and a global effort in reducing greenhouse gases release to the atmosphere. Biogas is clean energy and an important alternative to that derived from environmentally polluting fossil fuels. Furthermore electricity generated from biogas can provide employment to local youth and women, resulting in less pollution and environmental contamination and healthier life for the residents. Abattoirs have electricity, but as electric heating is costly, floor cleaning water is only warm. Hot water reduces the water required for cleaning. Total water use in all plants is 20,000 l/day. Daily amount of wastes generated from Dagoretti abattoirs is over 15 tons. In addition, the biogas process produces organic fertilizer (bio-fertilizer) that can increase agricultural yields by 10-40%. It also provides a catalyst for composting other agricultural waste in the farm and thereby increasing the amount and quality of organic fertilizer (FAO, 1996). It also reduces chemical fertilizer costs of farmers by reducing the amount of synthetic fertilizer used, encouraging organic crop production which is in high demand in developed countries. In view of the usefulness of biogas production as a viable strategy for slaughterhouse waste management as propounded in this chapter, the study sought to

establish the extent to which it is prevalent in the slaughterhouses under inquiry and its influence on waste management.

2.5 Theoretical Framework

The Principal-Agent theory as propounded by Stephen Ross and Barry Mitrick in the 1960s applies to this study. According to the theory, the public (as the principals) on whose behalf the politicians and bureaucrats (as agents) are supposed to govern is unable to hold the latter accountable because of insufficient information, the incompleteness of the contracts of employment and the problems of monitoring behavior (Walsh, 1995). The theory is premised on workers (principals) establishing a relationship with managers (agents) and delegate work to them. Principals and agents have different self-interests (Jensen and Mackling, 1976) which creates an agency problem and requires mechanisms to minimize the problem in each instance. There are two different uses of this theory which are the positivist approach and the general approach. The positivist approach is concerned with the relationship between owners and managers of large private or public corporations. On the other hand the general approach can be applied to buyer-supplier, lawyer-client, employer-employee and other examples.

The theory is relevant to this study where the public are the principals as they are affected by the environmental pollution arising from ineffective slaughterhouse waste management. The agents are the slaughterhouse managers or owners and the regulatory agencies. They are on behalf of the public, responsible for ensuring that the slaughter facilities are operated in compliance with the regulations so as to prevent environmental pollution and safeguard public health. The bureaucrats from the regulatory agencies are supposed to fully enforce the regulations to ensure compliance. Thus the three independent variables that are; compliance with regulations, SOPs and biogas production coupled with up-scaled enforcement of the regulations will concern the slaughterhouse managers and regulatory authorities (the agents) in assuring effective waste management. The public (principals) will benefit from a clean unpolluted environment in a cause-effect relationship arising from effective waste management.

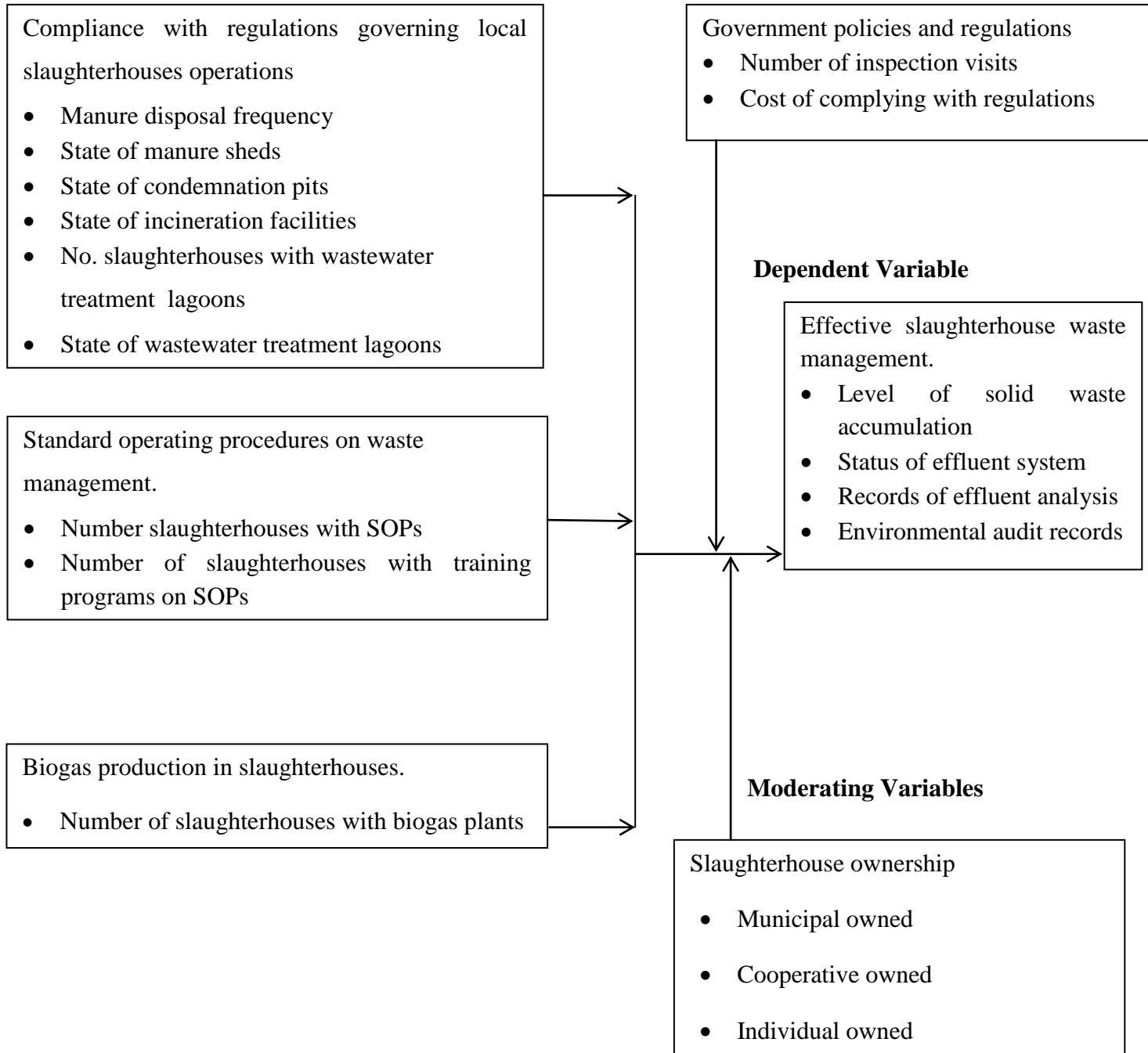
2.6 Conceptual Framework

The variables under investigation must show cause effect interrelationships. Conceptual framework is a logically developed, described and elaborated network of interrelationships

among the variables deemed to be integral to the dynamics that are being investigated, explaining the theory underlying these relationships describes the direction of the relationships (Mathooko et al, 2007). Mugenda and Mugenda (1999), states that conceptual framework is where researcher conceptualizes the relationship between variables in the study and shows the relationship graphically or diagrammatically. The variables are described as independent, independent, intervening and moderating. In this study the dependent variable is effective waste management in slaughterhouses. The independent variables are; compliance with regulations, training workers on standard operating procedures on waste disposal and prevalence of biogas production in slaughterhouses. The intervening variables are Government policies and regulations on slaughterhouse waste management, the cost of compliance with the regulations by the operators and the slaughterhouse income levels. The moderating variable is ownership of the slaughterhouses, whether municipal or privately owned and its influence on management. The variables show a cause effect Interrelationships that underpins this study.

Figure 1.1: Conceptual Framework

Independent Variables Intervening Variables



Compliance with regulations, presence of SOPs and adoption of biogas production will have a cause effect on management of slaughterhouse waste. If the existing regulations by NEMA and the Meat Control Act CAP 356 are strictly enforced to ensure compliance, proper

training of workers and slaughterhouse operators, waste management will improve. Enforcement may include penalties as in Nigeria. Biogas production can reduce accumulation of waste. All the above can be influenced by moderating variables namely; individual, municipal or co-operative ownership.

2.7 Gaps in the Literature Review

From the literature review, work has been done for instance on operations and waste management of slaughterhouses in Laguna Province of the Philippines, where it was established that only 36.4% of all the eleven slaughterhouses under the study were accredited with the National Meat Inspection Service (NMIS) and the rest operated illegally and did not meet the required standards for abattoir operations (Maranan et al. (2008). Majority of the slaughterhouses were not complying with regulations from authorities governing their operations. The work done by Koech et al. (2012) of Egerton University, to assess the status of treated slaughterhouse effluent from Dagoretti slaughterhouses in Kenya and its effect on the physico-chemical characteristics of Kavuthi stream established non-compliance with laws and regulations regarding wastewater effluent management. The gap still exists on the underlying reasons for non-compliance and the absence of SOPs to guide employees on waste management. Various studies have been done to explore the viability of biogas production as a strategy to supplement other measures undertaken to manage slaughterhouse waste. The study carried out at Nyongara slaughterhouse in Dagoretti by UNIDO in 2010 demonstrated the usefulness and benefits of biogas production in utilization of manure waste as a resource. However no study to the knowledge of the researcher has been undertaken to establish why other slaughterhouses have not adopted biogas production. The gaps between compliance, SOPs and biogas production and effective waste management still exist and require investigation.

2.8 Summary of the Literature Review

The Literature Review has shown that management of waste, including that generated from slaughterhouses in developed countries notably in Europe embraced the concept of waste Reduction, Reuse and Recycling and Recovery (4Rs). Asia and Africa has done it to a much lesser extent as open burning and dumping is more practiced. Environmental benefits of the 4Rs include reduction of greenhouse gases, reduction of air, land and water pollution and conservation of water and energy. Individual countries globally have institutions, backed by National laws and regulations that are responsible for ensuring protection and conservation of

the environment with regard to slaughterhouse waste management. In developing countries including Kenya, the laws and regulations are not fully complied with by a considerable portion of slaughterhouses, leading to poor waste management and environmental pollution. The usefulness of SOPs in slaughterhouse operations with respect waste handling and disposal has been documented. The review also shows how biogas production is useful in slaughterhouse waste management, with the benefits of environmental conservation and economic wellbeing for people. The conceptual framework of interrelationships between independent, intervening, moderating and dependent variables guided the study in investigating the factors influencing management of slaughterhouse waste in the target areas.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter consists of research methods used in the study. It includes research design, target population of the study, sample size and sampling selection, data collection instruments, pilot study, reliability and validity of research instruments, data collection procedures, data collection methods and data analysis techniques.

3.2 Research Design

Descriptive research survey design was adapted for the study. According to Abagi (1995) it is one that describes the state of affairs as it was or as it is in a social system. Descriptive research is concerned with describing, recording, analyzing and reporting conditions that exists or existed (Kothari, 2003). Survey methods are widely used to obtain data that is useful in evaluating present practices and in providing basis for decision making (Engelhart, 1972). This design is considered appropriate for the study as it will describe the current status of slaughterhouse waste management in the targeted areas. The findings will form the basis for recommendations for decision making with regard to the extent to which specific factors influence slaughterhouse waste management in the target area.

3.3 Target Population

A population is an entire group of individuals, events or objects having common characteristics that conform to a given specification. (Mugenda and Mugenda, 1999). The study targeted a total of 17 local large category slaughterhouses in Nairobi, Kiambu, Kajiado and Machakos counties slaughtering cattle, sheep and goats and camels. The respondents were the managers and meat inspectors drawn from these slaughterhouses. The slaughterhouses and their locations are shown in Appendix III: Sampling Frame.

3.4 Sample size and sampling procedure.

The researcher used Taro Yamane's formula in determining the sample size. The formula states that the desired sample size is a function of the target population and the maximum acceptable margin of error (known as the sampling error) and it is expressed mathematically thus;

$$n = \frac{N}{1 + Ne^2}$$

Where n = Desired sample

N = Population size

e = maximum acceptable margin of error (0.05).

The population size of slaughterhouse managers as respondents is 17 people. The desired sample is calculated by the formula as follows;

$$N=17, e=0.05, e^2=0.0025$$

$$n=17/1+17(0.0025) = 16.3069$$

The desired sample is therefore 17 slaughterhouse managers, which is 100 % of the total population.

The population size of meat inspectors as respondents 17 people. The desired sample is calculated by the formula as follows;

$$N=17, e=0.05, e^2=0.0025$$

$$n=17/1+17(0.0025) = 16.3069$$

The desired sample is 17 meat inspectors, which is 100% of the total population.

The sample size selection is indicated in the following Table 4

Table 4: Sample size of respondents from the local slaughterhouses

Respondents	Population Size	Sample Size	Proportion of population
Slaughterhouse managers	17	17	100%
Meat Inspectors	17	17	100%
Total	34	34 100 %	

Random selection gives equal and independent chance of being selected (Kothari, 1990). However since the sample size and the population size (Sampling frame) are the same as derived from Taro Yamane formula, all the 17 slaughterhouses in the four counties were selected to provide 17 managers and 17 meat inspectors as respondents for the questionnaire.

3.5 Method of Data Collection

Data collection is the process of gathering empirical evidence in order to gain new insights about a situation and answer questions that prompt undertaking of the research (Flick, 2002). In this study the survey method was used and primary data was collected through use of

questionnaires and observation. Data collection procedure was total enumeration of the targeted slaughterhouses in view of the sample size that was derived. Data was collected from 17 local large category slaughterhouses in Nairobi, Kiambu, Kajiado and Machakos counties which supply beef, mutton, goat and camel meat to Nairobi.

3.5.1 Questionnaires

A questionnaire is a series of written questions on a topic about which the respondents' opinions are sought (Gall and Borg, 1996). According to Flick (2002), questionnaires are useful in establishing the public opinion on an issue. A questionnaire was the research instrument used to collect data from managers and meat inspectors from all the 17 targeted slaughterhouses making up 34 respondents. The questions covered the three thematic areas of the research; Compliance with regulations governing slaughterhouse operations, Standard operating procedures and Bio-gas production. The primary data that was collected was the respondent's perceptions, opinions, feelings and attitude and practices on waste management in the slaughterhouses. The focus was mainly on the working condition of waste handling and disposal facilities namely; manure sheds, wastewater treatment lagoons, condemnation pits and incinerators. The questions in the questionnaire were open ended and closed types.

The researcher visited the slaughterhouses with a letter of permission from the Director of Veterinary Services. The letter explained the purpose of the study to the respondents so as to secure their co-operation. The County Directors of Veterinary Services from Nairobi, Kiambu, Kajiado and Machakos counties facilitated interview appointments with the respondents.

3.5.2 Piloting

The research instrument was pre-tested to a sample population using the test-retest method so as to determine its validity before actual study. The purpose of the pre-test was to identify the weakness, ambiguity, omissions, test whether the intended information was actually collected from each slaughterhouse and the length of data collection time in each slaughterhouse. This was meant to improve on its presentation and clarity in order to avoid resistance from the respondents. The pilot sampled two slaughterhouse managers and two meat inspectors, being 10% of the total respondents. The results showed that the questionnaire as constructed was useful for further data collection.

3.6 Validity of the instruments

According to Mugenda and Mugenda (1999), validity is the accuracy and meaningfulness of the inferences which are based on the research result. It is a degree to which results obtained from analysis of the data actually represents the phenomena under study. Content validity is obtained by seeking expert judgment of professionals and experts in the field of study (Mugenda and Mugenda, 1999).

3.7 Reliability of the instruments

An instrument is reliable when it can measure a variable accurately and consistently and obtain the same results under the same conditions over time (Mugenda and Mugenda, 1999). The instruments for the study; questionnaire was pre-tested and improved upon to ensure reliability during the actual data collection. Pretesting which was done during the piloting stage used the test-retest method where the survey instrument was used on two respondents twice at an interval of a month to test its reliability.

3.8 Data Analysis Techniques

Data was collected through questionnaires administered to slaughterhouse managers and meat inspectors, processed, tabulated and organized along the thematic areas of the study. Coding and tabulation was used to produce frequency distribution tables and percentages. The type of analysis was descriptive, indicating distribution of the variables in the sample of study using measures of central tendency with particular reference to arithmetic mean. The analysis and interpretation of data was carried out based on the results of the questionnaire which dealt with the quantitative analysis of data.

3.9 Ethical Issues

The researcher made prior arrangements with the respondents for interviews and briefed them on the purpose of the study. The respondents were assured of confidentiality in view of the slaughterhouses sensitivity with regard to public health safety and environmental concerns. Permission was sought from the Director of Veterinary Services and the respective County Directors of Veterinary Services to visit slaughterhouses and collect data from the respondents.

3.10 Operational Definition of Variables

Operational definition shows how the variables under study are to be measured (Rubin and Babbie, 2011). The following table shows the operational definition of variables in this study.

Table 5: Operational definition of variables

Objectives	Independent Variables	Indicators	Measurement Scale	Type of Analysis
To establish the extent to which compliance with regulations governing slaughterhouse operations influences waste management in the local large category slaughterhouses in Nairobi and its environs.	Compliance with laws and regulations.	<ul style="list-style-type: none"> • State of manure sheds. • Manure disposal frequency. • State of condemnation pits. • State of incinerators. • Number of slaughterhouses with wastewater treatment facilities. • State of wastewater effluent treatment lagoons. 	Ordinal: High (70-100%) Medium (60-69%) Low (Below 60%) Lickert scale	Descriptive: Frequency, Percentages
To determine the extent to which the presence of standard operating procedures influences waste management in the local large category slaughterhouses in Nairobi and its environs. .	Standard Operating Procedures	<ul style="list-style-type: none"> • Number of slaughterhouses with SOPs • Number of slaughterhouses with SOPs training programs for workers. 	Ratio	Descriptive: Frequency, Percentages

To investigate the extent to which biogas production influences waste management in the local large category slaughterhouses in Nairobi and its environs.	Biogas production	Number of slaughterhouses with biogas plants	Ratio	Descriptive: Frequency Percentages
	Dependent Variable			
	Effective waste management.	<ul style="list-style-type: none"> • Level of solid waste accumulation • Records of wastewater effluent analysis • Inspection reports • Environmental audit records 	Ordinal: High (70-100%) Medium (60-69%) Low (Below 60%) Lickert scale Ratio	Descriptive: Frequency Percentages

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

Chapter four contains data analysis, presentation and interpretation of the research findings. It gives the results and interpretation of the study in the following areas: Return rate of questionnaire, respondents' profiles and the dependent variable which was waste management in the local large category slaughterhouses supplying meat to Nairobi and its environs. Further analysis was done on the independent variables which included; establishing the extent to which compliance with regulations governing slaughterhouse operations influences waste management, to determine the extent to which presence of standard operating procedures influences slaughterhouse waste management and to investigate the extent to which biogas production influences slaughterhouse waste management.

4.2 Questionnaire Return Rate

Out of the 33 questionnaires dropped, 30 were adequately filled and collected indicating a 90.9% return rate. This high return rate of 90.9% was achievable because the target population of 34 respondents was small, which allowed the researcher to have a better control of the questionnaire administration. The researcher was able to administer and collect the questionnaires immediately after the respondents completed them for each of the 34 respondents. This return rate was above 90% of the administered questionnaire and therefore was deemed adequate for the analysis as cited by Mugenda and Mugenda (2003).

4.3 Demographic Background of Respondents (Managers)

This section analyzes the respondent's profiles which include their gender, their academic qualifications and the duration they have worked in the slaughterhouse. The background is important and relevant to the study because it gives the researcher an opportunity to get information that is valid and reliable.

4.3.1 Distribution of the Respondents by Gender

The slaughterhouse managers were asked to indicate their gender. Their responses are shown in the following table 4.6

Table 6: Distribution of gender of the slaughterhouse managers

Gender of the respondent	Frequency	Percentage
a) Male	14	93.3
b) Female	1	6.7
Total	15	100.0

Table 4.6 Shows male respondents were 14 (93.3%), way more than the female respondent who was only 1(6.7%). These results indicate that males were predominantly the slaughterhouse managers. Increasing opportunities for women to participate in managing slaughterhouses could improve management of the facilities.

4.3.2 Age Distribution of the Respondents

The respondents were asked to indicate their respective ages from categorized age brackets. Their responses are shown in Table 4.7

Table 7: Age distribution of respondents

Age of respondent (years)	Frequency	Percentage
30 and below	0	0.0
31 – 40	4	26.7
41 – 50	6	40.0
Above 50	5	33.3
Total	15	100.0

Table 4.7 shows that none of the slaughterhouse managers was 30 years of age and below, 4 (26.7%) respondents were in age bracket of 31-40 years while 6 (40.0%) respondents were between 41-50 years of age, then 5 (33.3%) respondents were above 50 years of age. The results indicate that majority of the respondents fell in the middle age bracket pointing out that, for one to become a slaughterhouse manager they require to rise up the ranks and gain the requisite experience.

4.3.3 Duration of time worked in the slaughterhouse

The respondents were asked to indicate for how long they had worked in their respective slaughterhouses. Their responses are shown in Table 4.8

Table 8: Respondent’s duration of time worked at the slaughterhouse

For how long (years) the respondent has worked at the slaughterhouse	Frequency	Percentage
Less than 1	1	6.7
1 – 3	1	6.7
4 – 7	3	2.0
8 and above	11	84.6
Total	15	100.0

Table 4.8 shows that only 1(6.7%) respondent had worked as the slaughterhouse manager for less than a year, another 1 (6.7%) responded had worked for between one and three years while 3 (20.0%) indicated that they had worked the slaughterhouses for between 4 & 7 years and finally 11 (84.6%) respondents had over eight years of experience in the slaughterhouses. This trend indicates a relatively low turnover of managers that could result in complacency with regard to adherence to operational regulations.

4.3.4 Highest academic qualification of the respondents.

The respondents were asked to indicate their highest academic qualification. Table 4.9 shows their responses.

Table 9: Highest academic qualification

Respondent’s highest academic qualification	Frequency	Percentage
Degree level	2	13.4
Diploma level	5	33.3
Secondary level	5	33.3
Primary level	3	20.0
Total	15	100.0

Table 4.9 shows that only 2 (13.4%) of the total respondents had attained university degrees while 5 (33.3%) respondents had attained diploma level of education. Another 5 (33.3%) respondents had attained secondary education and another smaller percentage 3 (20.0%) went up to primary level. These results show a spread distribution of academic qualifications. This indicates that the job of a slaughterhouse manager needs more of hands-on experience than the highly advanced academic qualifications

4.4 Compliance with laws and regulations governing slaughterhouse operations

The researcher sought to establish the extent to which compliance with regulations influences waste management.

4.4.1 General level of waste management in the slaughterhouse

The respondents were asked to indicate, in their opinion, how they viewed the general level of waste management in their slaughterhouse. Their responses are shown in Table 4.10

Table 10: General level of waste management

How the respondent viewed the general level of waste management in their slaughterhouse	Frequency	Percentage
High level	4	26.7
Medium level	9	60.0
Low level	2	13.3
Total	15	100.0

Table 4.10 shows that 4 (26.7%) of the total respondents viewed the general level of waste management in their slaughterhouse to be high while 9 (60.0%) respondents viewed the general level to be medium. Only 2 (13.3%) viewed the general level to be low. These results show that the level of waste management from the managers' perspective is not very wanting but there was still an opportunity for improvement.

4.4.2 Working condition of the waste management facilities

The respondents were asked about the working condition of the waste management facilities in the slaughterhouse. Their responses are shown in Table 4.11

Table 11: Working condition of the waste management facilities

The working condition of the following waste management facilities	Good	Fair	Poor	Total
1) Manure disposal shed	4 (26.7%)	6 (40.0%)	5 (33.3%)	15 (100%)
2) Condemnation pit	7 (46.7%)	5 (33.3%)	3 (20.0%)	15 (100%)
3) Incinerator	3 (20.0%)	0 (26.9%)	12 (80.0%)	15 (100%)
4) Wastewater effluent treatment lagoons	5 (33.3%)	3 (20.0%)	7 (46.7%)	15 (100%)

Table 4.11 above shows that 4 (26.7%) of the manure disposal sheds were in good working condition, 6 (40.0%) were in fair working condition while another 5 (33.3%) were in poor working condition. Generally, the results show that manure disposal sheds have not been kept in the best working conditions to ensure environmental safety. The table also shows that most of the condemnation pits 7 (46.7%) were in good working condition, another 5 (33.3%) were in fair working condition while only 3 (20.0%) were in poor working condition. From the table, most of the slaughterhouses, 12 (80.0%) did not have incinerators or if they existed, they were in a deplorable condition. Only 3 (20.0%) slaughterhouse managers confirmed to have incinerators in good working condition. Lack of incinerators means wastes such as dead fetuses, condemned carcasses and organs could not be properly disposed or destroyed posing a great environmental hazard. Finally from the table above, majority of the slaughterhouses 7 (46.7%) did not have water effluent treatment lagoons, 3 (20.0%) slaughterhouses had fairly working lagoons while 5 (33.3%) had their lagoons in good working conditions. Lack of water effluent treatment lagoons means that raw effluent could easily be discharged into nearby drainage systems, waterways and rivers posing a health risk to a wider proximity of population.

4.4.3 Demand level for manure from the slaughterhouse

The respondents were asked to indicate the level of demand for manure from the slaughterhouse. Their responses are shown in Table 4.12

Table 12: Demand level for manure from the slaughterhouse

Demand level for manure from the slaughterhouse	Frequency	Percentage
a) High	5	33.3
b) Medium	3	20.0
c) Low	7	46.7
Total	15	100.0

Table 4.12 above shows that the demand for manure was low for most of the slaughterhouses 7 (46.7%) while only 5 (33.3%) of the managers indicated a high demand of manure from their slaughterhouses. 3 managers indicated a fair level of demand for manure from their slaughterhouses. A low demand for manure means piling of waste that result in air and water pollution as well as other environmental hazards.

4.4.4 Frequency level of manure disposal

The respondents were asked to indicate the frequency level of manure disposal from the slaughterhouses. Their responses are shown in Table 4.13

Table 13: Frequency level of manure disposal from the facility

Frequency level of manure disposal from the facility	Frequency	Percentage
a) High level	3	20.0
b) Medium level	6	40.0
c) Low level	6	40.0
Total	15	100.0

Table 4.13 above table shows that the frequency level of manure disposal was at medium 6 (40.0%) and low 6 (40.0%) as compared to 3 (20.0%) of the responses which indicated a high frequency level of manure disposal. Some of the managers also indicated that the frequency

of the kills was low. Low frequency of manure disposal indicates relates to piling up of heaps of undisposed manure that may result in huge environmental pollution and public health hazards.

4.4.5 Involvement of environmental regulatory authority

The respondents were asked to indicate in their opinion, what is the level of involvement of environmental regulatory authority in waste disposal of their slaughterhouse. Their responses are shown in Table 4.14

Table 14: Level of involvement of environmental regulatory

Level of involvement of environmental regulatory authority in waste disposal of the slaughterhouse	Frequency	Percentage
a) High level	11	73.3
b) Medium level	3	20.0
c) Low level	1	6.7
Total	15	100.0

Table 4.14 above shows a high level of involvement 11 (73.3%) of environmental regulatory authority in waste disposal of the slaughterhouse. Only 1 (6.7%) respondent indicated a low level and other 3 (20.0%) indicating a fair level of involvement. Slaughterhouses by the nature of their activities attract a high attention of the environmental regulatory authorities.

4.4.6 Slaughterhouse visits and environmental concerns

The respondents were asked to indicate whether the slaughterhouse has been visited for inspection with regard to environmental concerns due to poor waste disposal. Their responses are shown in Table 4.15

Table 15: Slaughterhouse inspection and environmental concerns

Whether the slaughterhouse has been visited for inspection with regard to environmental concerns due to poor waste disposal	Frequency	Percentage
a) Yes	15	100
b) No	0	0
Total	15	100.0

Table 4.15 above shows an absolute affirmation 15 (100%) that the environmental regulatory authority has been fully discharging her duty in ensuring that the slaughterhouses manage their waste and keep the environment safe and clean.

4.4.7 Slaughterhouse Inspection Report

The respondents were asked to indicate whether the slaughterhouse had inspection reports. Their responses are shown in Table 4.16

Table 16: Slaughterhouse inspection reports

Whether the slaughterhouse has an inspection report	Frequency	Percentage
a) Yes	13	86.7
b) No	2	13.3
Total	15	100.0

From table 4.16 above most of the slaughterhouses had inspection reports 13 (86.7%). Only 2 (13.3%) slaughterhouse managers did not have. Inspection reports are necessary an indicator of consistent compliance with existing environmental laws and regulations.

4.4.8 Closure of slaughterhouses by regulatory authorities

The respondents were asked to indicate whether the slaughterhouse had been threatened for closure in the last five years by veterinary, public health authorities or NEMA. Their responses are shown in Table 4.17

Table 17: Closure of the slaughterhouse

Whether the slaughterhouse has been threatened for closure in the last five years by veterinary, public health authorities or NEMA	Frequency	Percentage
a) Yes	6	40.0
b) No	9	60.0
Total	15	100.0

Table 4.17 above shows that 6 (40%) had been threatened for closure in the last five years by veterinary, public health authorities or NEMA while 9 (60.0%) had not been threatened. This shows that close to half of the slaughterhouses may have been operating lower than the threshold regarding waste management and environmental protection.

4.4.9 Reasons for considering closure of the slaughterhouses

The respondents were asked to indicate reasons why the slaughterhouse has been threatened for closure in the last five years by veterinary, public health authorities or NEMA. Their responses are shown in Table 4.18

Table 18: Reasons for threatening closure of the slaughterhouses

Reasons why the slaughterhouse has been threatened for closure in the last five years by veterinary, public health authorities or NEMA	a) Yes	b) No	Total
1) Manure disposal frequency was not adequate	1 (6.7%)	14 (93.3%)	15
2) Condemnation pit was not in satisfactory operating state	11 (73.3%)	4 (26.7%)	15
3) Incinerator was not in satisfactory operating state	2 (13.3%)	13 (86.7%)	15
4) Wastewater effluent treatment lagoons were not in satisfactory operating state	3 (20.0%)	12 (80.0%)	15
5) Other (Specify) N/A	0 (0.0%)	15 (100%)	15

Table 4.18 above shows that manure disposal frequency not being adequate (6.7%) was not a major reason for the threatened closure of the slaughterhouse but condemnation pits were reported to be a major threat to the smooth operations of majority of the slaughterhouses. As a result of many slaughterhouses not having incinerators, then it results that lack of properly operating incinerators would not be a major threat for the closure of the facilities safe for 2 (13.3%) slaughterhouses. Managers also reported that wastewater effluent treatment lagoons not being in satisfactory operating state was not a major threat to the operations of majority of the facilities 12 (80.0%). The managers did not site other threats to the operations of their slaughterhouses (0%).

4.4.10 Non-compliance with slaughterhouse waste management regulations

The respondents were asked to confirm the reasons hindering them from managing waste in the slaughterhouse in accordance with regulations from authorities. Their responses are shown in Table 4.19

Table 19: Non-compliance with slaughterhouse waste management regulations

Reasons hindering proper management of waste in the slaughterhouse in accordance with regulations from authorities	Yes	No	Total
1) Lack of awareness of the regulations and procedures	1 (6.7%)	14 (93.3%)	15
2) Maintenance of the waste disposal facilities is costly	11 (73.3%)	4 (26.7%)	15
3) Land for expansion of waste disposal facilities is not available	2 (13.3%)	13 (86.7%)	15
4) Inadequate personnel for waste disposal	3 (20.0%)	12 (80.0%)	15

From table 4.19 above, most managers 14 (93.3) were aware of the regulations and procedures. The managers, 11 (73.3%), also reported that it was costly for the waste disposal facilities to be adequately managed but confirmed that land was not a major hindering factor to their proper management of the slaughterhouses 13 (86.7). From the report of the respondents, they did not majorly suffer inadequacy of the personnel for waste disposal 12 (80.0%). Waste management is a critical area for any slaughterhouse due to the nature of its activities.

4.4.11 Environmental audit reports of the slaughterhouses

The respondents were asked to indicate whether they had environmental audit reports of the slaughter houses. Their responses are shown in Table 4.20

Table 20: Environmental audit reports

Whether the respondent has environmental audit reports of the slaughter houses	Frequency	Percentage
a) Yes	12	80.0
b) No	3	20.0
Total	15	100.0

From table 4.20 above, majority 12 (80.0%) confirmed to have environmental audit reports of the slaughter houses. Only 3 (20.0%) reported not to have the Environmental Audit reports of the slaughter houses. Environmental audit reports contain the overall status of the facilities concerned with environmental safety and protection.

4.5 Standard Operating Procedures for slaughterhouse waste management

The researcher sought to determine the extent to which the presence of SOPs influences waste management in the slaughterhouses.

4.5.1 SOPs for Slaughterhouse waste handling and disposal

The respondents were asked to indicate whether their Slaughterhouses had Standard Operating Procedures (SOPs) for waste handling and disposal. Their responses are shown in Table 4.21

Table 21: Standard Operating Procedures for waste handling and disposal

Whether the Slaughterhouse has SOPs for waste handling and disposal	Frequency	Percentage
a) Yes	7	46.7
b) No	8	53.3
Total	15	100.0

Table 4.21 above shows close to half 7 (46.7%) of the slaughterhouses had SOPs to guide their operations with another more than half 8 (53.3%) confirming to operate without any SOPs. SOPs are very important in describes the activities necessary to complete tasks in accordance with industry regulations, provisional laws or the firm’s own standards for running their operations.

4.5.2 Training workers on SOPs for waste handling and disposal

The respondents were asked to indicate whether workers in their respective slaughterhouses had been trained on SOPs for waste handling and disposal. Their responses are shown in Table 4.22

Table 22: Training workers on SOPs

Whether workers trained on SOPs for waste handling and disposal	Frequency	Percentage
a) Yes	6	40.0
b) No	9	60.0
Total	15	100.0

Table 4.21 above shows that 6 (40.0%) of the slaughterhouses managers had their workers trained on SOPs for waste handling and disposal while 9 (60.0%) did not have their workers trained on SOPs for waste handling and disposal. Lack of training of the staff means the SOPs cannot be used and therefore their purpose is thwarted.

4.6 Prevalence of Biogas Production.

The researcher sought to investigate the extent to which prevalence of biogas production influences slaughterhouse waste management.

4.6.1 Awareness of biogas production in slaughterhouses

The respondents were asked to indicate whether they were aware of biogas production in slaughterhouses. Their responses are shown in Table 4.24

Table 23: Awareness of biogas production in slaughterhouses

Whether the respondent is aware of biogas production in slaughterhouses	Frequency	Percentage
a) Yes	14	93.3
b) No	1	6.7
Total	15	100.0

From Table 4.24 above, most of the slaughterhouse managers 14 (93.3%) were aware of biogas production in slaughterhouses while only 1 (6.7%) manager did not have knowledge of biogas production in slaughterhouses. Biogas is Methane produced through a process of anaerobic digestion of biomass (manure and human waste) which can be used for lighting, heating and production of electricity and organic fertilizer as a by-product.

4.6.2 Introduction of biogas plant in the slaughterhouse

The respondents were asked to indicate whether they had considered having biogas plant in their slaughterhouse. Their responses are shown in Table 4.25

Table 24: Introduction of biogas plant in the slaughterhouse

Whether the respondent has considered having biogas plant in their slaughterhouse	Frequency	Percentage
a) Yes	12	80.0
b) No	3	20.0
Total	15	100.0

From Table 4.25 above, 12 (80.0%) managers respondent in affirmation while another 3 (20.0%) managers had not considered having biogas plant in their slaughterhouse. Biogas is an alternative source of clean fuel.

4.6.3 Benefits of biogas plant in a slaughterhouse

The respondents were asked, in their opinion, what benefits they expected from biogas production in slaughterhouse. Their responses are shown in Table 4.26

Table 25: Benefits of biogas plant in a slaughterhouse

Reasons why respondent has considered having biogas plant in their slaughterhouse	Frequency	Percentage
1) Lighting, water heating, and reduced cost of electricity from KPLC	12	80.0%
2) Sell Biogas to customers and get income	1	6.7%
3) Improve management of SH waste – through increased rate of manure disposal	2	13.3%
Total	15	100.0%

From Table 4.26 above, 12 (80.0%) slaughterhouse managers considered having a biogas plant for the purpose of lighting, water heating and reduced electricity bills, only 1 (6.7%) respondent was interested in selling power to the county for financial gain and another 2 (13.3%) managers considered a biogas plant to improve on waste management in the slaughterhouse. Biogas provides alternative source of energy to subsidize on the overall power cost of production.

4.6.4 Consideration for biogas plant in slaughterhouse

The respondents were asked, in their opinion, why they had not considered setting up a biogas production plant in their slaughterhouse. Their responses are shown in Table 4.27

Table 26: Consideration for biogas plant in slaughterhouse

Reasons why respondent has not considered having biogas plant in their slaughterhouse	Frequency	Percentage
a) I do not have much information on biogas production	6	40.0%
b) It is too costly	3	20.0%
c) Other (Specify)	6	40.0%
Total	15	100.0%

From Table 4.27 above, 12 (80.0%) slaughterhouse managers did not consider having a biogas plant because they lack sufficient information on biogas production, another 3 (20.0%) respondents reported that setting up a biogas plant and/or running it would be costly to the slaughterhouse. Finally, 6 (40.0%) other manager had other reasons not mentioned in this study to not consider biogas plant. Biogas in a source of energy that is clean and less costly especially in maintenance costs.

4.6.5 Recommendations to improve waste management

The respondents were asked to indicate the actions that they would recommend for improvement of waste disposal at their slaughterhouse. Their responses are shown in Table 4.28

Table 27: Improvement of waste management at the slaughterhouse

Actions that the respondent recommends for improvement of waste disposal at their slaughterhouse	Frequency	Percentage
1) Explore market for manure	3	20.0%
2) Manure sheds need improvement	2	13.3%
3) Biogas plant to be installed	8	53.4%
4) Explore market for by-products including horns, hooves, blood and others	2	13.3%
Total	15	100.0%

Table 4.28 above shows that majority of the respondents 8 (53.4%) would consider setting up a biogas plant. Another 3 (20.0%) managers preferred exploring market for the manure while 2 (13.3%) managers preferred improvement of the manure sheds to accommodate more manure. Lastly, 2 (13.3%) managers recommended that a market for other slaughterhouse by-products should be sought. A biogas plant and a consistent market for the other by-products would mean reduced cost of production and increased sales and profits while eliminating piling up of waste.

4.8 Demographic background of respondents (Meat inspectors)

This section analyzes the respondent's background which includes their gender, their academic qualifications and the duration they have worked in the slaughterhouse. The background is important and relevant to the study because it gives the researcher an opportunity to get information that is valid and reliable.

4.8.1 Distribution of the respondents (meat inspectors) by gender

The slaughterhouse meat inspectors were asked to indicate their gender. Their responses are shown in Table 4.29

Table 28: Distribution of the gender of the meat inspectors

Gender of the respondent	Frequency	Percentage
a) Male	12	80
b) Female	3	20
Total	15	100.0

Table 4.29 Shows male respondents were 12 (80%), while the female respondents were 3 (20%). These results indicate that males were still dominant as slaughterhouse managers.

4.8.2 Age Distribution of the Respondents

The respondents were asked to indicate their respective ages from categorized age brackets. Their responses are shown in Table 4.30

Table 29: Age distribution of the respondents

The age of respondent (years)	Frequency	Percentage
a) 30 and below	0	0.0
b) 31 – 40	1	6.7
c) 41 – 50	10	66.7
d) Above 50	4	26.6
Total	15	100.0

Table 4.30 shows that all the meat inspectors were more than 30 years of age and only 1 (6.7%) meat inspector was aged between 31 and 40 years of age. Most of the inspectors, however, 10 (66.7%) ranged between 41 and 50 years and only 4 (26.6%) meat inspectors were aged beyond 50 years of age. The caliber of slaughterhouses requires meat inspectors with some high level of hands-on experience.

4.8.3 Duration worked in the slaughterhouse

The respondents were asked to indicate for how long they had worked as meat inspectors in their respective slaughterhouses. Their responses are shown in Table 4.31

Table 30: Duration worked in the slaughterhouse

For how long the respondent has worked in the slaughterhouse (years)	Frequency	Percentage
a) Less than 1	3	20.0
b) 1 – 3	7	46.7
c) 4 – 7	4	26.6
d) 8 and above	1	6.7
Total	15	100.0

Table 4.31 shows that only 3(20.0%) respondents had worked as the meat inspectors for less than a year with majority 7 (46.7%) of the meat inspectors having served in the slaughterhouses for a period ranging between 1 and 3 years. 4 (26.6%) other inspectors had worked in the facilities for between 4 and 7 years and only 1 (6.7%) meat inspector was aged 8 years and above. Majority of the meat inspector experience was spread between 1 and 7 years of age which is also a logical period of the normal learning curve.

4.9 Compliance with laws and regulations governing slaughterhouses operations

This section analyses the level of adherence to the laws and regulations stipulated for slaughterhouse operations with regard to waste management.

4.9.1 Compliance with laws and regulations

The respondents were asked to indicate whether, in their opinion, the slaughterhouse was operating in compliance with regulations with regard to waste management. Their responses are shown in Table 4.31

Table 31: Compliance with laws and regulations

Slaughterhouse is operating in compliance with regulations governing slaughterhouses	Frequency	Percentage
Strongly agree	0	0.0
Agree	13	86.7
Neither agree or disagree	0	0.0
Disagree	2	13.3
Strongly disagree	0	0.0
Total	15	100.0

Table 4.32 above shows that most of the meat inspectors 13 (86.7%) agreed that their slaughterhouse was operating in compliance with laws and regulations governing slaughterhouses operations with regard to waste management while only 2 (13.3%) inspectors reported that their slaughterhouses were not operating in compliance with laws and regulations governing slaughterhouses operations with regard to waste management. Compliance with laws and regulations is key in waste management.

4.10 SOPs for Slaughterhouse waste management

The section analyses the prevalence of SOPs in targeted slaughterhouses and also establish whether the workers were trained on their application.

4.10.1 Prevalence of SOPs in the slaughterhouses

The respondents were asked to indicate whether there was a standard operating procedure (SOPs) for waste handling and disposal in the slaughterhouse. Their responses are shown in Table 4.33

Table 32: SOPs for Slaughterhouse waste management

There is a standard operating procedure for waste management in the slaughterhouse	Frequency	Percentage
a. Yes	6	40.0
b. No	9	60.0
Total	15	100.0

From table 4.33 above, 6 (40.0%) meat inspectors confirmed that their slaughterhouses had SOPs for waste disposal management in the slaughterhouse while a higher 9 (60.0%) meat inspectors reported that their slaughterhouses were operating without SOPs for waste disposal management. SOPs help workers to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.

4.10.2 Training slaughterhouse workers on SOPs

The respondents were also asked to indicate how often workers were trained on the procedure of waste disposal management. Their responses are shown in Table 4.34

Table 33: Training workers on SOPs for waste handling and disposal

How often workers are trained on the procedure of waste disposal management	Frequency	Percentage
1) During induction following employment	3	20.0
2) Annually	0	0.0
3) Ad hoc	2	13.3
4) N/A	10	66.7
Total	15	100.0

From table 4.34 above, 3 (20%) meat inspectors reported that their workers were trained only during induction while another 2 (13.3%) meat inspectors reported that their workers were trained whenever there was a critical need to train them. Majority of the respondents 10 (66.7%) actually reported that their workers were never trained formally. Workers can only use SOPs for waste management after training.

4.10.3 Lack of SOPs in the slaughterhouse

The respondents were asked to give reasons why there were no standard operating procedures for waste disposal management in the slaughterhouse. Their responses are shown in Table 4.35

Table 34: Reasons for lack of SOPs in the slaughterhouse

Reasons why there are no standard operating procedure for waste disposal management in the slaughterhouse	Frequency	Percentage
1) Not aware of the need	4	26.7%
2) Aware but not considered implementing	2	13.3%
3) Others (N/A)	9	60.0%
Total	15	100.0%

From table 4.35 above, 4 (26.7%) meat inspectors confirmed that they were actually not aware of the need for SOPs for waste disposal management in the slaughterhouse while 2 (12.2%) meat inspectors were aware but disinterested in having the SOPs for waste disposal management in their slaughterhouses. To a majority of the meat inspectors, the issue of SOPs was not a concern as far as waste management is concerned. The nature, form and model of operations affect waste management to a great extent in organizations.

4.11 Closure of the slaughterhouse by regulatory authorities

A slaughterhouse may be closed down by inspecting regulatory authorities if it is deemed to be non-compliant with the stipulated laws and regulations that protect the environment from pollution, or in the event of disease outbreak

4.11.1 Consideration of closure of slaughterhouse

The respondents were asked to indicate whether the slaughterhouse had been considered for closure in the last three years. Their responses are shown in Table 4.36.

Table 35: Closure of the slaughterhouse

Whether the slaughterhouse has been considered for closure in the last three years	Frequency	Percentage
a) Yes	8	53.3
b) No	7	46.7
Total	15	100.0

Table 4.36 above shows that 8 (53.3%) meat inspectors agreed that the slaughterhouses had been considered for closure in the last three years while another 7 (46.7%) reported that their slaughterhouses had not been considered for closure in the last three years. Meat inspectors have a responsibility of ensuring that the environment within which meat is processed is safe clean and conducive both for the workers and the products.

4.11.2 Reasons for considering closure of the slaughterhouses

The respondents were asked to give reasons for the slaughterhouse to have been considered for closure in the last three years. Their responses are shown in Table 4.37

Table 36: Closure of the slaughterhouses

Reasons for the slaughterhouse to have been considered for closure in the last three years	Yes Freq.	No Freq.	Total
a) Environmental pollution (air, wastewater, solid waste)	2 (13.3%)	13 (86.7%)	15
b) Lack of water for washing	0 (0%)	15 (100%)	15
c) Renovations of wear and tear of facilities	7 (46.7%)	8 (53.3%)	15
d) Violation of slaughtering rules (odd hours slaughtering)	0 (0%)	15 (100%)	15
e) Outbreak of animal diseases	8 (53.3%)	7 (46.7%)	15
f) Other (Specify)	0 (0)	15 (100%)	15

Table 4.37 above shows that 13 (86.7%) meat inspectors linked the threat of their slaughterhouse closure to environmental pollution while another 7 (46.7%) meat inspectors reported that closure was for poor facilities that needed renovations and /or repairs. 8 (53.3%) meat inspectors attributed the threat of closure of their facilities to outbreak of animal diseases. Most of the times, closure of facilities such as slaughterhouses is as a result of unguarded environmental pollution arising from poor waste management.

4.12 Biogas production in slaughterhouses

The researcher sought to investigate the extent to which prevalence of biogas production influences slaughterhouse waste management.

4.12.1 Awareness of biogas production in slaughterhouses

The respondents were asked to indicate whether they were aware of biogas production in slaughterhouses. Their responses are shown in Table 4.38

Table 37: Awareness of biogas production in slaughterhouses

Whether the respondent is aware of biogas production in slaughterhouses	Frequency	Percentage
a. Yes	10	66.7%
b. No	5	33.3%
Total	15	100.0%

From Table 4.38 above, 10 (66.7%) meat inspectors confirmed to be aware of biogas production in slaughterhouses while 5 (33.3%) meat inspectors were not aware of biogas production in slaughterhouses. Adoption of available technologies such as biogas production in slaughterhouses can complement the measures that are commonly used to manage waste disposal.

4.12.2 Introduction of biogas plant in the slaughterhouse

The respondents were asked to indicate whether the slaughterhouse management had considered having a biogas plant. Their responses are shown in Table 4.39

Table 38: Introduction of biogas plant in the slaughterhouse

Whether the slaughterhouse management has considered having a biogas plant	Frequency	Percentage
Yes	11	73.3%
No	4	26.7%
Total	15	100.0

From Table 4.39 above, 11 (73.3%) meat inspectors confirmed that their slaughterhouse management had considered having a biogas plant while the other 4 (26.7%) inspectors reported that their slaughterhouse management had not considered having a biogas plant for their slaughterhouses. A biogas plant utilizes waste from the slaughterhouse and therefore eliminates the pileup of manure.

4.12.3 Benefits of biogas plant in a slaughterhouse

The respondents were asked to indicate what benefits they did expect from biogas production in slaughterhouse. Their responses are shown in Table 4.40

Table 39: Benefits of biogas plant in a slaughterhouse

Benefits do you expect from biogas production in slaughterhouse	Frequency	Percentage
1) Electricity generation	13	86.6%
2) Fertilizer production	1	6.7%
3) Other (Specify)	1	6.7%
Total	15	100.0

Table 4.40 above shows that most 11 (73.3%) meat inspectors were expecting to generate electricity through biogas while another 1 (6.7%) meat inspector expected to generate fertilizer from the biogas plant. 1 (6.7%) other respondent had not actually planned on the use of the biogas plant. Counties could start programs for sensitizing slaughterhouse owners and managers and other stakeholders on adoption of biogas production in waste management and source of power alternatives.

4.12.4 Consideration for biogas plant in slaughterhouse

The respondents were asked to indicate reasons for not adopting biogas production in slaughterhouse. Their responses are shown in Table 4.41

Table 40: Consideration for biogas plant in slaughterhouse

Reasons for not adopting biogas production in slaughterhouse	Frequency	Percentage
1) I do not have much information on biogas production	3	20.0%
2) It is too costly	3	20.0%
3) Others (specify)	9	60.0%
Total	15	100.0

Table 4.41 above shows that 3 (20.0%) meat inspectors did not have much information on biogas production while another (20.0%) meat inspector reported that the biogas project was too costly for the organization. Majority 9 (60.0%) other respondent had other reasons not mentioned in this study for not adopting biogas production. Meat inspectors as officials dealing with quality and standards would be expected to have some knowledge on green forms of energy.

4.13 Observation method

The researcher with the meat inspectors and managers visited the waste disposal facilities to assess their working condition and functional status and made the following observations as shown in Table 4.42.

Table 41: Slaughterhouse waste disposal facilities

Working condition of Slaughterhouse waste disposal facilities	Good	Fair	Poor	Total
Manure shed	6 (40.0%)	3 (20.0%)	6 (40.0%)	15
Condemnation pit	11 (73.3%)	0 (0%)	4 (26.7)	15
Incinerator	3 (20.0%)	8(53.3%)	4 (26.7%)	15
Wastewater effluent treatment lagoons	8 (53.3%)	5 (33.4%)	2 (13.3%)	15
Biogas production facility	1 (6.7%)	9 (60.0%)	5 (33.3%)	15

Table 4.42 above shows that for 6 (40.0%) meat inspectors their manure shed were in good working conditions while for another 6 (40.0%) meat inspectors the manure sheds were in dire need of repairs and renovation. 3 (20.0%) meat inspectors reported a fair performance of their manure sheds. From the same table above, 11 (73.3%) of the meat inspectors confirmed that their condemnation pits were in good working conditions while only 4 (26.7%) reported poor condition of their condemnation pits. Only 3 (20.0%) meat inspectors indicated that their incinerators were in good working conditions while another 8 (53.3%) reported a fair condition of their incinerators and the other 4 (26.7%) meat inspectors reported that their incinerators were in bad condition or were not there altogether. Wastewater effluent treatment lagoons for 8 (53.3%) slaughterhouses were in good working condition with another 5 (33.4%) meat inspectors reporting that their wastewater effluent treatment lagoons were in fair working condition and the last 2 (13.3%) meat inspectors reporting poor working conditions for their wastewater effluent treatment lagoons.

From the same table above, Biogas production facility for 1 (6.7%) was in good working condition while 9 (60.0%) meat inspectors reported that their wastewater effluent treatment lagoons were in fair condition and then the last 5 (33.4%) meat inspectors reported a poor working condition for their wastewater effluent treatment lagoons.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarized the study findings. The discussions provided a basis upon which conclusions and recommendations were advanced in order to address the factors influencing management of waste generated by the local large category slaughterhouses in Kiambu, Nairobi, Kajiado and Machakos counties that supply meat to Nairobi.

5.2 Summary of Findings

The summary of findings from data analysis for each specific objective of the study is presented.

5.2.1 Compliance with regulations governing slaughterhouse operations

The findings showed that although majority of managers of the slaughterhouses sampled expressed satisfaction with the level of waste management, it was established that in about half of the slaughterhouses, waste handling and disposal facilities namely; manure disposal sheds, condemnation pits, incinerators and wastewater effluent treatment lagoons were not kept in the best working condition. Some of them were operating without incinerators and wastewater treatment lagoons. Furthermore, most managers revealed that demand for manure and the frequency of disposal was fairly low with heaps of undisposed decaying waste piling up, posing pollution problems and health risks. Further still, the findings revealed that most slaughterhouses had inspection reports, an indicator of consistent compliance with existing environmental laws and regulations.

The poor working condition of waste handling and disposal facilities in some of the slaughterhouses results in ineffective waste management. The piling up and decay of heaps of manure and other solid wastes in the slaughterhouses for long periods without disposal cause air pollution which may result in respiratory infections and production of methane gas that intensifies greenhouse effect. Where waste water effluent treatment lagoons were non-existent, there was discharge of raw untreated effluent into nearby drainage systems, rivers and other water bodies causing pollution and therefore posing threat to human and aquatic life. Lastly closure of slaughterhouses because of environmental pollution disrupts meat trade. The findings lead to the conclusion that in order for slaughterhouses to operate while

securing the environment and safeguard public health, the regulatory authorities need to step-up enforcement of the relevant laws and regulations to ensure compliance.

5.2.2 Standard Operating Procedures in slaughterhouse operations

The findings revealed that close to half of the slaughterhouses sampled did not have SOPs to guide their operations with regard to waste handling and disposal. For those that had SOPs, less than half of them trained their workers on their use. The slaughterhouses that did not have SOPs on waste handling and disposal demonstrated unsatisfactory waste management status. The findings further revealed that most meat inspectors were actually aware of the need for SOPs for waste disposal management and were interested in having them to guide their slaughterhouses operations.

The findings lead to the conclusion that to achieve effective waste management, SOPs should be developed and their use made mandatory in all slaughterhouses. SOPs are very important in describing the activities necessary to complete tasks in accordance with industry regulations, provisional laws or the firm's own standards for running their operations.

5.2.3 Biogas production and slaughterhouse operations

The findings established that out of the 17 slaughterhouses sampled; only Nyongara in Dagoretti had a biogas plant in operation. However most of the slaughterhouse managers were aware of the benefits of biogas production but lacked sufficient information to enable them adopt the venture.

The opportunity cost of not having biogas production in slaughterhouses include high operational costs arising from exorbitant electricity bills, reduced profit margins and continued piling heaps of manure waste. A biogas plant utilizes waste from the slaughterhouse thereby reducing manure waste accumulation by big margins. It also provides alternative source of energy to subsidize on the overall power cost of production. It is clean and less costly especially in maintenance costs. In addition, lack of awareness by one third of meat inspectors on biogas production in slaughterhouses forfeits the opportunity to exploit the technology that has proved useful in waste management and a source of green power. The findings lead to the conclusion that in order to achieve effective waste management, there is a need for sensitization and education of slaughterhouse owners and managers to adopt biogas production as a viable strategy.

5.3 Discussion of Findings

The findings of the study show that the independent variables of compliance with regulations, standing operating procedures and biogas production and the dependent variable of effective waste management were positively correlated.

5.3.1 Compliance with laws and regulations

The first objective of the study was to establish the extent to which compliance with regulations governing slaughterhouse operations influences waste management in the local large category slaughterhouses supplying meat to Nairobi and its environs. It was established that compliance with laws and regulations greatly influenced waste management. Most slaughterhouses were fairly compliant with regulations and waste management was satisfactory unlike the rest that were less compliant. Close to half of the meat inspectors revealed that their slaughterhouses had been threatened with closure because of environmental pollution which was linked to poor condition of waste handling and disposal facilities. Closure of slaughterhouses disrupts meat trade resulting in loss of income to the industry players. The findings also established a high level of involvement by the regulatory authorities based on the availability of inspection and environmental audit reports in the compliant slaughterhouses. Conclusions were therefore made that in order to ensure full compliance, the relevant regulatory authorities need to step-up enforcement of the laws and regulations of the industry while carrying out sensitization and education of the slaughterhouse owners, managers, workers and the public on the matter. Furthermore market for manure and other by products such as hoofs and horns can be explored in order to reduce the piling up of the waste and generate income to the slaughterhouse owners.

5.3.2 Standard operating procedures in slaughterhouse operations

The influence of standard operating procedures on waste management in the local large category slaughterhouses in Nairobi and its environs formed the second objective of this study. Findings indicated that half of the slaughterhouses sampled were operating without any SOPs with regard to waste handling and disposal. SOPs are very important in describing the activities necessary to complete tasks in accordance with industry regulations, provisional laws or the firm's own standards for running their operations. According to WHO (2002), slaughterhouse waste is a public health hazard and its disposal must be done by trained staff.

Where SOPs exist, staff should be trained to use them in their operations. Lack of training of the staff means the SOPs cannot be applied and therefore handling and disposal of waste will be haphazard. The findings leads to the conclusion that the use of SOPs should be introduced to contribute to effective managing of slaughterhouse waste.

5.3.3 Biogas production and slaughterhouse operations

The third objective sought to investigate the extent to which biogas production influences waste management in the local large category slaughterhouses in Nairobi and its environs.

It was established that biogas production considerably influenced waste management at Nyongara Slaughterhouse in Dagoretti. The rest of the slaughterhouses that did not have biogas production fared badly in waste management. Knowledge and implementation of waste management projects such as biogas production can be a game changer in management of waste among slaughterhouses. Conclusions were therefore made that in order to improve on waste management; counties could start programs for sensitizing and educating slaughterhouse owners and managers and other stakeholders on the benefits of biogas production. The benefits include reduced piling up of waste, lighting, heating, reduced electricity power bills and increased incomes.

5.4 Conclusion of the Findings

The study established that the relevant agencies need to step-up enforcement of the laws and regulations governing operations of slaughterhouses in order to ensure full compliance by the slaughterhouse owners. Public involvement should be encouraged by empowerment through education, public awareness, gender balance, participation, information exchange and networking. Full compliance and public awareness leads to effective management of slaughterhouse waste while securing the environment and safeguarding public health. With regard to an orderly and consistent manner of waste handling and disposal, the relevant regulatory agencies should develop SOPs for mandatory use in all the local large category slaughterhouses supplying meat to Nairobi and its environs. To promote adoption of biogas production as a strategy in waste management, Counties could start sensitization and awareness programs for slaughterhouse operators on the importance of biogas in waste management and green power alternatives. The findings and conclusions derived from this study could, if considered by the drivers of the meat industry, prepare slaughterhouses to cope with the expected increase in waste generation as a result of the projected growing

demand for animal protein. This will address the anticipated environmental pollution concerns and contribute towards the global efforts to protect the planet and address climate change arising from greenhouse gas emissions in line with the United Nations Sustainable Development Goals.

5.5 Recommendations

Based on the findings of study the researcher recommends that;

- 1) The relevant authorities undertake measures to step up enforcement of the laws and regulations governing slaughterhouse operations to ensure full compliance.
- 2) County authorities undertake public involvement through awareness creation, education, participation, information exchange and networking on environmental issues arising from slaughterhouse waste management.
- 3) The relevant government agencies and other stakeholders conduct business opportunity seminars for slaughterhouse operators and the public on utilization of slaughterhouse waste for income generation.
- 4) Standard Operating Procedures should be developed for use by all slaughterhouses to guide the operations and standardize waste management approach.
- 5) The government and other relevant stakeholders undertake promotion of biogas production in slaughterhouses.

5.6 Suggestions for further Research

Based on the findings of the study, the researcher suggests that;

- 1) Further study is undertaken on the influence of enforcing compliance with laws and regulations, use of standard operating procedures and adoption of biogas production for effective slaughterhouse waste management.
- 2) Further research may be carried to consider business opportunities in utilization of waste products such as bones, horns, hooves, tendons, blood and others for other uses. Such uses may include manufacturing of animal feeds, ornamental goods among others.

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APPENDICES

(i) APPENDIX I: TRANSMITTAL LETTER

Nelson Lubanga Ombwayo

P.O Private Bag

Code 00625 Kangemi

NAIROBI

15/1/2014

To: Whoever it may concern.

Dear respondent,

RE: ACADEMIC RESEARCH

I am a postgraduate student at the University of Nairobi pursuing a Masters degree in Project Planning and Management. I am carrying out research for my final year project which is a requirement for completion of the degree program.

The topic of study is to establish the factors influencing management of waste generated by the major local slaughterhouses supplying meat to Nairobi. A case for Kiambu, Nairobi, Kajiado and Machakos counties. The study is expected to be used by stakeholders in the meat industry including slaughterhouse operators, the surrounding communities, policy makers and implementers, environmental authorities and investors wishing to invest in waste management infrastructure.

You have been selected as one of the target respondents who will assist in generating sufficient data for my final report. This is purely an academic research and any information provided will be treated most confidentially.

Thanking you in advance.

Nelson Lubanga Ombwayo

REPUBLIC OF KENYA



MINISTRY OF AGRICULTURE, LIVESTOCK & FISHERIES
STATE DEPARTMENT OF LIVESTOCK
Office of the Director of Veterinary Services

Telephone: 020 – 8043441

E-mail: veterinarydep@gmail.com

VETERINARY RESEARCH
LABORATORIES
PRIVATE BAG, 00625
KANGEMI, **NAIROBI**
16TH JANUARY, 2013

When replying, please quote:

REF: *All correspondences should
be addressed to:*

The Director of Veterinary
Services

To: Slaughterhouse managers

RE: PERMISSION TO VISIT SLAUGHTERHOUSES

The bearer, Nelson Lubanga Ombwayo is an officer working in the State Department of Livestock, Directorate of Veterinary Services at Kabete and is currently pursuing his post graduate studies at the University of Nairobi. The purpose of this study is to establish the factors influencing management of waste generated by the major local slaughterhouses supplying meat to Nairobi. A case for Kiambu, Nairobi, Kajiado and Machakos Counties.

The purpose of this letter is to request you to allow him carry out research in your slaughterhouse through questionnaire and interviews as partial fulfillment of his award of Master of Arts in Project Planning and Management at the University of Nairobi.

Best regards.

Dr. Thomas Daido Dulu

For: DIRECTOR OF VETERINARY SERVICES

**(ii) APPENDIX II: QUESTIONNAIRE AND OBSERVATION SCHEDULE
ASSESSMENT OF FACTORS INFLUENCING WASTE
MANAGEMENT IN SLAUGHTER HOUSES SUPPLYING MEAT TO
NAIROBI COUNTY**

1.0 Background

I am a postgraduate student at the University of Nairobi pursuing a Masters degree in Project Planning and Management. I am carrying out research for my final year project which is a requirement for completion of the degree program. I would like to establish the factors influencing management of waste generated by the major local slaughterhouses supplying meat to Nairobi. A case for Kiambu, Nairobi, Kajiado and Machakos counties. The study is expected to be used by stakeholders in the meat industry including slaughterhouse operators, the surrounding communities, policy makers and implementers, environmental authorities and investors wishing to invest in waste management infrastructure. You have been selected as one of the respondents who will assist in generating sufficient data for this research. This is purely an academic research and any information provided will be treated **Most Confidentially**.

2.0 Questionnaire

PART (A): Questionnaire for slaughterhouse managers.

County-----Slaughterhouse-----Manager-----Signature-----Date----

I). Demographic Background

(Please tick where appropriate)

- 1) Gender: Male [] b) Female []
- 2) Age: (a) Below 30 years [] b) 30-40 years [] c) 41-50 years [] Over 50 years []
- 3) Duration in the slaughterhouse
 - a) Less than 1 year [] b) 1-3 years [] c) 4-7 years [] d) Over 8 years []
- 4) Academic qualifications
 - a) Degree [] b) Diploma [] c) Secondary [] d) Primary []
 - Others (Specify) -----

II) Compliance with regulations governing local slaughterhouses operations

1. In your opinion how do you view the general level of waste management in your slaughterhouse

- a) High (70-100%) [] b) Medium (60-69%) [] c) Low (Below 60%) []

2. What is the working condition of the following waste management facilities in the slaughterhouse? (Tick where appropriate)

Facility	Very Good (90-100%)	Good (70 – 89%)	Fair (50 – 69%)	Poor (30-49%)	Very Poor (Below 29%)
Manure disposal shed					
Condemnation pit					
Incinerator					
Wastewater effluent treatment lagoons					
Other(Specify)					

2. How do you dispose of manure?

- a) -----
 b) -----
 c) -----
 d) -----

3. What is the level of demand for manure from the slaughterhouse?

- a) High (70-100%) [] b) Medium (60-69%) [] c) Low (Below 60%) []

4. What is the frequency level of manure disposal from the slaughterhouse

- a) High (70-100%) [] b) Medium (60-69%) [] c) Low (Below 60%) []

6. What do you know about environmental regulations applicable to slaughterhouses?

- a) -----
 b) -----
 c) -----
 d) -----

7. In your opinion, what is the level of involvement of environmental regulatory authority in waste disposal of the slaughterhouse?

- a) High (70-100%) [] b) Medium (60-69%) [] c) Low (Below 60%) []

8. Has the slaughterhouse been visited for inspection with regard to environmental concerns due to poor waste disposal?

Yes [] b) No []

5. If the answer above is yes, do you have an inspection report?

a) Yes [] b) No []

11. Has the slaughterhouse been threatened for closure in the last five years by veterinary, public health authorities or NEMA?

a) Yes [] b) No []

12. If yes, what were the reasons?

a) Manure disposal frequency was not adequate []

b) Condemnation pit was not in satisfactory operating state []

c) Incinerator was not in satisfactory operating state []

d) Wastewater effluent treatment lagoons were not in satisfactory operating state []

e) Other (Specify) -----

13. In your opinion, what are the reasons hindering you from managing waste in the slaughterhouse in accordance with regulations from authorities?

a) Lack of awareness of the regulations and procedures []

b) Lack of budgetary provision for maintenance of waste disposal facilities []

c) Inadequate personnel for waste disposal []

d) Other (Specify) -----

III) Standard Operating Procedures for slaughterhouse waste management.

1. Does the Slaughterhouse have Standard Operating Procedures (SOPs) for waste handling and disposal?

a) Yes [] b) No []

2. If the answer to the above question is yes, are workers trained on SOPs for waste handling and disposal?

Yes [] b) No []

3. Waste disposal workers have poor working conditions

a) Strongly agree [] b) Agree [] c) Neutral [] d) Disagree [] e) Strongly disagree []

IV) Prevalence of biogas technology

1. Are you aware of biogas production in slaughterhouses?

- a) Yes [] b) No []

2. If yes, in which slaughterhouses?

3. Have you considered having biogas plant in your slaughterhouse?

- a) Yes [] b) No []

4. If yes, what benefits do you expect from biogas production in slaughterhouse?

- a) Electricity generation []
b) Fertilizer production []
c) Other (Specify)-----

5. If the answer in No, what are the reasons?

6. I do not have much information on biogas production []

7. It is too costly []

8. Other (Specify) -----

PART B: Questionnaire for meat inspectors.

Meat Inspector-----Slaughterhouse-----County-----

I). Demographic Background

(Please tick where appropriate)

1. Gender: Male [] b) Female []
2. Age: Below 30 years [] b) 30-40 [] c) 41-50 [] Above 50 []
3. How long have you worked in the slaughterhouse?
a) Less than 1 year [] b) 1-3 years [] c) 4-7 years [] e) Over 8 years []

II) Compliance with regulations governing local slaughterhouses operations

4. The slaughterhouse is operating in compliance with regulations governing local slaughterhouses operations with regard to waste management.

- a) Strongly agree [] b) Agree [] c) Neither agree or Disagree []
d) Disagree [] e) Strongly disagree []

6. If disagree, what in your opinion are the major reasons?

- a) -----
b) -----
c) -----
d) -----

PART C: Observation schedule

Working condition of Slaughterhouse waste disposal facilities

Facility	Good	Fair	Poor
Manure shed			
Condemnation pit			
Incinerator			
Wastewater effluent treatment lagoons			
Biogas production facility			

Remarks:

(iii) APPENDIX III: SAMPLING FRAME

Local Large Category Slaughterhouses in Nairobi, Kiambu, Kajiado and Machakos Counties serving Nairobi

Slaughterhouse	Location	Animals Slaughtered
Dandora	Njiru, Nairobi	Cattle, Sheep & Goats
Kayole	Kayole, Nairobi	Cattle, Sheep & Goats
Nyonjoro	Dagoretti, Nairobi	Cattle, Sheep & Goats
Kiamaiko	Kariobangi, Nairobi	Sheep & Goats
Dagoretti (Cooperative)	Dagoretti, Kiambu	Cattle, Sheep & Goats
Nyongara	Dagoretti, Kiambu	Cattle, Sheep & Goats
Thiani	Dagoretti, Kiambu	Cattle, Sheep & Goats
Mumu	Dagoretti, Kiambu	Cattle, Sheep & Goats
Muiru	Wangige, Kiambu	Cattle, Sheep & Goats
Bahati	Limuru, Kiambu	Cattle, Sheep & Goats
Thika (Municipality)	Thika, Kiambu	Cattle, Sheep & Goats
Ruiru	Ruiru, Kiambu	Cattle, Sheep & Goats
Kiserian	Kiserian, Kajiado	Cattle, Sheep & Goats
Keekonyokie	Kiserian, Kajiado	Cattle, Sheep & Goats
Ngong	Ongata Rongai, Kajiado	Cattle, Sheep & Goats
Olekesasi	Ongata Rongai, Kajiado	Cattle, Sheep & Goats
Suswa	Suswa, Kajiado	Cattle, Sheep & Goats
Mlololongo	Mlolongo, Machakos	Sheep and Goats