Spatial Distribution of Abattoir, Operators' Health Status, Waste Management and Perceived Health Implication on the Consumed Meat

AKINNUBI C. F.
Department Of Physical and Health Education
Obafemi Awolowo University Ile Ife Nigeria
fakinnubi@yahoo.com

AJAYI-VINCENT O.B.
Department Of Human Kinetics and Health Education
Ekiti State University Ado-Ekiti Nigeria
Ajajivincent2006@yahoo.com
&
AKINBODE. T
Department of Urban and Regional Planning
Federal University of Technology Akure Nigeria
temitopeakinbode@gmail.com

Abstract
This study investigated spatial distribution of abattoirs, operators' health status, waste management and perceived health implication on the consumed meat in two towns in Osun State Nigeria. It precisely examined the abattoirs' spatial distribution, environmental health officers' inspection, the medical checkup of the Abattoirs' operators, type and adequacy of facilities and equipment for use and the health implication on the consumed meat. Survey research design was embraced for the study. Eighty respondents consisting of 60 abattoir operators and 20 consumers from each town making a total of 160 respondents were drawn for the study. Random sampling technique was used for selection. Interview guide and self-constructed questionnaire validated by experts was used to collect the data, test retest method was also used for the reliability and was found reliable at 0.88 significant levels. The collected data were analyzed with percentages and inferential statistics of chi-square. A verbal interview with 20 consumers from each town was also used to investigate the health implication on the consumed meat. The findings showed that the abattoirs in the study areas were not evenly distributed, the environmental health officers' inspection to the abattoir were very rare, the abattoirs' operators rarely went for medical checkup, and the types of facilities and equipment used in the Abattoir were not adequate. The results also showed that diseases such as cholera, typhoid, diarrhoea and stomach pain were perceived health implications on the consumed meat. The findings further showed that poor sanitation and the abattoirs' health status will significantly influence the health of the consumers negatively in ile-ife and Modakeke town. The study recommends that enlightenment programmes by the 3 tiers of government should be mounted for the abattoir operators and environmental health officers' should inspect the Abattoir regularly.
Key Words: Spatial Distribution, Abattoir, Operators' Health Status, Waste Management, Health   Implication, Consumed Meat

Introduction

   Abattoir also known as slaughter house is place that is considered for butchery and dressing of animals so as to provide meat for the consumption of the general populace. The animals when being killed and dressed will be cut into pieces for individuals to buy for consumption. According to Brantz (2008) and Otter (2008), in the early nineteenth century the first communal slaughter house was located in France which was referred to as abattoir. It was a specific place that animals are slaughtered for human consumption. Bello, Kwaga & Raji, (2011) defined abattoir as any places that is approved and registered by the supervisory authority in which animals are slaughtered and dressed for human consumption. Banks & Wang (2004) reported that the first stages in meat processing take place in the abattoir (slaughterhouse). These comprise of slaughtering, bleeding, hide or hair removal, evisceration, offal removal, carcass washing, trimming, and carcass dressing. Further stages that can be term as secondary operations also occur on the same premises which include cutting, deboning, grinding, and processing into consumed products.

   The abattoir is to produce hygienically prepared meat by good handling of the animal using hygienic techniques for slaughtering and dressing. Abattoir operators are supposed to get out the eatable parts of slaughtered animals for human consumption (Fearon, Mensah, and Boateng (2014). The authors further stated

that waste materials in most cases, are got rid of without respect to thorough environmental management practices, thus making them harmful to humans and other terrestrial and aquatic life. Nwanta, Onunkwo & Ezenduka, (2011) explained that proper abattoir operation and management including efficient inspection of live animals which is the ante-mortem and the carcasses known as the post-mortem, and also the animal diseases, zoonosis as well as safeguarding good meat for their proposed use.

Prevalence of communicable diseases such as tuberculosis, tapeworm, trichinoses and all others are common in our abattoirs and slaughter houses in our environment today (Nwanta et al. 201l).   Fearon et al. (2014) reported that abattoir consists mainly of bones, undigested ingests and occasionally aborted foetuses as well as blood, urine, water, dissolved solids and gut contents all known as solid wastes. The authors further noted that abattoir unwanted materials are entirely organic matters and are left to decay and are hazardous and risky to human health in most regions of Africa, consequently producing bad odour in the environment.

According to Banks & Wang (2004), wastes generated by abattoirs consisted of animal parts that have no perceived value to the slaughterhouse operator or to the consumers. Ezeoha & Uguishiwu, (2011) stated that animal blood has high oxygen demand, which is discharged into surrounding streams Animal horns and bones when not properly disposed become unpleasant; they occupy useful space, attract flies, and with bad odour can cause irritation. According to Pike Research (2012), in urban areas nearly 2 billion tons of municipal solid wastes are generated worldwide. It was projected that this number will increase to about 50% by the year 2022. The author further stated that almost 75% of wastes generated particularly waste from abattoirs are gathered in open pits or as landfills. Presently and generally, waste management is one of the main challenges facing most developing countries universally (Pradham, 2008).

It was established that one of the government functions in the developed countries is to take care of the wastes in the environment; therefore, the collection, transfer and disposal of waste appropriately have generally meant to be done by governments (Pradham, 2008). Baabereyir, (2009) stated that in the developed countries, it was established that cities have dealt with the difficulty of waste accumulation and are coping with appropriate methods for treatment of disposed wastes, while cities in developing countries are still facing with the basic problem of waste accumulation as well as its disposal, in that between one-third and one-half of all generated wastes in those cities definitely remain uncollected.

Chukwu (2008) reported that abattoir wastes usually contain contaminants that may penetrate the ground water and spoil its quality. The ground water pollution of biotic nature can be detected through taste, odour, foaming or damage to crops. In fact ground water pollution has caused many viral diseases (Nwanta, Onunkwo & Ezenduka, 2011). According to Ezeoha, (2000), Salvato (1992), and Nwanta, et al. (2011) several studies have showed that the environments of nearly all abattoirs in Nigeria produce aggressive odours and rear mosquitoes as a result of the mounted solid wastes, faeces, carcass, horns and scraps of tissue. After heavy rainfall, the heaps of solid waste usually scatter and extent to other areas of the neighbourhood. In a study conducted Bello and Odeyemi (2009), it was revealed that the health and quality of life of an individual in their environment where abattoir activities take place are negatively obstructed and injurious to life.

Water is used in the abattoir for carcass washing after removing skin from cattle, calves, and sheep and after hair scrapping from pigs. Water is also used to clean the carcass, also for washing and sterilizing equipment and facilities during and after the slaughtering operation. Supportive facilities such as service facilities such as toilets and bathrooms for workers on site should also be available (Banks & Wang, 2004). The main sources of water contamination are from lairize, slaughtering, hide or hair removal, belly (intestine) handling, carcass washing, rendering, trimming, and cleanup operations. These contain a series of readily decomposable organic compounds, mainly fats and proteins, present in both particulate and melted forms (Wang, Hung, Lo, & Yapijakis, 2006). Omole & Ogbiye, (2013) reported that waste can affect water, land or air qualities if practices of management are not properly followed.

FAO (2014) concluded that pathogens from cattle waste could be communicated to humans through water-based regenerations. According to Hassan, Campbell, & Ademola (2014), wastes from animals when washed into the stream can endanger aquatic life and also the life of human being. Nwanta, Onunkwo & Ezenduka, (2011) opined that the ineffective meat inspection services and the resultant consumption of unwholesome meat by the public have become a major cause of concern to the general public. According to Fearon, Mensah & Boateng, (2014), the state of abattoirs where these animals are slaughtered and processed for meat is a major public health concern. It is therefore very necessary to investigate this study.

SPECIFIC OBJECTIVES
(a)   Determine the spatial distribution of abattoir in the study area
(b)   Examine the health officers' inspection to the Abattoir
(c)   Investigate the medical checkup of the Abattoirs' operators

(d)   Determine the type and adequacy of facilities and equipment (shelter, tap water, well water, fetching pail, overhead tank/reservoir, good sewer and toilet) for use in the Abattoir
(e)   Investigate perceived health implication on the consumed meat from Abattior

METHODOLOGY

Survey research design was embraced for the study. Population for this study comprised all abattoirs in Ile-Ife and Modakeke environment. Twenty abattoirs were selected from the entire slaughter house in the two environments. From each town, ten abattoirs with sixty respondents were selected making a total of 120 respondents were drawn for the study using simple random sampling technique for the selection. Twenty consumers from each town making a total of forty respondents were also interviewed verbally on this research topic to elicit some significant evidence to assist in the study. A self-constructed questionnaire titled "spatial distribution of abattoir, operators' health status, waste management and perceived health implication" (SDAOWH) and an interview guide were used for the study. The questionnaire consisted of two sections. Section A dealt with bio-data such variable as age, sex, religion, educational qualification and religion, while section B was constructed to provide information for objectives of the research topic. The section B was divided into sub-sections to cater for all the objectives. The researcher visited the abattoirs to observe and administer the questionnaire personally with the aid of four research assistance that were taught by the researchers how to effectively administer the questionnaire.

The questionnaire was validated by experts in the relevant field, while test retest method was used for the reliability of the instrument and was found reliable at 0.86 significant levels. The collected data for the study were analyzed descriptively with percentages and inferential statistics of chi-square.

Table 1: Frequency distribution of the demographic data of the respondents

AGE					
	25yrs and below	26-35yrs	36-45yrs	46-55yrs	56yrs and above
Ile-Ife	06 (10%)	16 (26.7%)	22 (36.7%)	08 (13.3%)	08 (13.3%)
Madakeke	10 (16.7%)	14 (23.3%)	20 (33.3%)	10 (16.7%)	06 (10%)
SEX					
	Male		Female		
Ile-Ife	56 (93.3%)		04 (6.7%)		
Madakeke	58 (96.7%)		02 (3.3%)		
EDUCATION					
	Illiterate	Primary six certificates	WASCE	NCE	Others
Ile-Ife	08 (13.3%)	24 (40%)	28 (46.7%)	0 (0%)	0 (0%)
Madakeke	14 (23.3%)	30 (50%)	16 (26.7%)	0 (0%)	0 (0%)
RELIGION					
	Christian		Muslim		Pagan
Ile-Ife	06 (10%)		54 (90%)		0 (0%)
Madakeke	04 (6.7%)		56 (93.3%)		0 (0%)

Table 1 above shows that the highest respondents' age identified by them ranges between 26-35yrs and 36-45 years in the two towns. Nearly all the respondents were male, primary six certificates and WASCE had the highest number of respondents. There were 08 (13.3%) respondents from Ile-Ife and 14 (23.3%) respondents from Modakeke were illiterates while no respondents from the two towns identified with national certificate of education (NCE) and others. As regards religion, nearly all the respondents were Muslim while only 6 (10%) respondents from ile-ife and 4(6.7%) respondents from Modakeke were Christian.

Research Question 1: Is the abattoirs (slaughter house) evenly spread in the study area?
Table 2: Descriptive analysis of the distance between abattoirs (slaughter house) in the study area

No	Town	Evenly spread	One sided	Not at all
1	Ile-Ife	0 (0%)	37 (61.7%)	23 (38.3%)
2	Modakeke	0 (0%)	48 (80%)	12 (20%)

From table 2 above, it was observed that the abattoirs (slaughter house) were not evenly spread. A total of 37 (61.7%) respondents from lle-ife and 48 (80%) respondents from Modakeke identified that the abattoirs (slaughter house) were congested in one side while 23 (38.3%) respondents from lle-ife and 12 (20%) respondents from Modakeke identified that the abattoirs (slaughter house) were not at all distributed evenly in these towns.

Research Question 2: How often do the Environmental health officers' inspect the Abattoir?
Table 3: Descriptive analysis of how often the Environmental health officers' inspect the Abattoir

No	Town	Frequently	Not frequently	Rarely	Never
1	Ile-Ife (60)	0 (0%)	12 (20%)	22 (36.7%)	26 (43.3%)
2	Modakeke (60)	0 (0%)	06 (10%)	38 (63.3%)	16 (26.7%)

Table 3 above indicates no respondents from both towns said the Abattoir were frequently inspected by the Environmental health officers. It was observed that 12 (20%) respondents from lle-ife and 06 (10%) respondents from Modakeke signified that the Abattoir were not frequently inspected by the 22 (36.7%) respondents from lle-ife and 38 (63.3%) respondents from Modakeke said that the Abattoir were rarely inspected by the Environmental health officers. It was also observed that 26   (43.3%) respondents from lle-ife and 26 (43.3%) respondents from Modakeke said that the abattoirs were never inspected.

Research Question 3: How often do the Abattoirs' operators go for medical checkup?
Table 4: Descriptive analysis of how often do the Abattoirs' operators go for medical checkup

No	Location	Frequently	Not frequently	Rarely	Not ever
	Ile-Ife	0 (0%)	09 (15%)	09 (15%)	31 (51.7%)
	Modakeke	0 (0%)	06 (10%)	26 (43.3%)	28 (46.7%)

From the table 4 above, it was observed that none of respondents (Abattoirs' operators) from the two towns identified themselves with going for medical checkup frequently. A total of 09 (15%) respondents from lle-ife and 26 (43.3%) respondents from Modakeke said they rarely went for medical checkup, while 31 (51.7%) respondents from lle-ife and 28 (46.7%) respondents from Modakeke reported that they never went for medical checkup.

Research Question 4: What are the types and adequacy of the facilities and equipment (shelter, tap water, well water, fetching pail, overhead tank, water good sewer and toilet etc.) used in the Abattoir

Table 5: Descriptive analysis of types and adequacy of facilities and equipment (shelter, tap water, well water, fetching pail, overhead tank, water good sewer and toilet etc.) used in the Abattoir

No	Types	Ile-Ife 60 (100%)		Modakeke 60 (100%)	
		Yes	No	Yes	No
1.	Shelter	60 (100%)	0 (0%)	60(100%)	0 (0%)
2.	Standard slaughter house/Abattoir	0 (0%)	60 (100%)	0 (0%)	60 (100%)
3.	tap water	16 (26.7%)	44 (73.3%)	10 (16.7%)	50 (83.3%)
4.	well water	56 (93.3%)	04 (6.7%)	52 (86.7%)	08 (13.3%)
5.	Fetching pail	48 (80%)	12 (20%)	48 (80%)	12 (20%)
6.	Overhead tank water	12 (20%)	48 (80%)	09 (15%)	51 (85%)
7.	Good sewer	10 (16.7%)	50 (83.3%)	08 (13.3%)	52 (86.7%)
8.	Toilet	02 (3.3%)	58 (96.7%)	0 (0%)	60 (100%)
9.	Bathroom	02(3.3%)	58 (96.7%)	0 (0%)	60 (100%)
10.	Incinerator	0 (0%)	60 (100%)	0 (0%)	60 (100%)
11.	Land filling	60 (100%)	0 (0%)	60 (100%)	0 (0%)
12.	Waste bin	34 (56.7%)	26 (43.3%)	23 (38.3%)	37 (61.7%)
13.	Cold-room	0 (0%)	60 (100%)	0 (0%)	60 (100%)
14.	Freezer	0 (0%)	60 (100%)	0 (0%)	60 (100%)
15.	Electricity	0 (0%)	60 (100%)	0 (0%)	60 (100%)

Table 5 above shows that from the two towns, all the respondents identified with having shelter as one of the type of facilities and equipment and were being adequate, while none of the respondents from the two towns said there was a standard slaughter house/Abattoir where they operated. A total of 16 (26.7%) respondents from Ile-Ife and 10 (16.7%) respondents from Modakeke said they there were tap water in the abattior, 56 (93.3%) respondents from Ile-Ife and 52 (86.7%) respondents from Modakeke said that they used well water in the abattior, while 12 (20%) respondents from Ile-Ife and 09 (15%) respondents from Modakeke said they had overhead tank in the abattior. As regard good sewer, 10 (16.7%) respondents from Ile-Ife and 08 (1 3.3%) respondents from Modakeke signified. According to the respondents, 02 (3.3%) respondents from Ile-Ife and 0 (0%) respondents from Modakeke signified that there were no toilet and bathroom in their abattoirs respectively. None of the respondents from Ile-Ife and Modakeke said, they had incinerator, cold room, freezer and electricity in their abattoirs while all the respondents from both towns said they practiced land filling as a means of managing their wastes.

Research Question 5: What are the perceived health implications on the consumed meat from abattior?

Table 6: Descriptive analysis of perceived health implication on the consumed meat from abattior

S/N	Diseases	Ile-Ife		Modakeke	
		Strongly agreed	Strongly disagreed	Strongly agreed	Strongly disagreed
1.	Diarrhoea	53 (88.3%)	07(11.7%)	48(80%)	12(20%)
2.	Cholera	52(86.7%)	08(13.3%)	50(83.3%)	10(16.7%)
3.	Stomach pain	48(80%)	12(20%)	54(90%)	06(10%)
4.	Typhoid	37(61.7%)	23(38.3%)	44(73.3%)	16(26.7%)
5.	Dysentary	21(35%)	39(65%)	35(58.3%)	25(41.7%)

From the table 6 above, 53 (88.3%) respondents from lle-ife and 48(80%) respondents from Modakeke reported that they perceived Diarrhoea as a health implication on the consumed meat from abattoir, 52(86.7%) respondents from lle-ife and 50 (83.3%) respondents from Modakeke identified that that they perceived Cholera as a health implication on the consum   ed meat from abattoir, 48(80%) respondents from lle-ife and 54(90%) respondents from Modakeke said that they perceived stomach pains as a health implication on the consumed meat from abattoir, while 37(6.7%) respondents from lle-ife and 16(26.7%) respondents from Modakeke reported that they perceived typhoid as a health implication on the consumed meat from abattoir. This implied that therevwere perceived health implications on consumed meat.

Research hypothesis 1: Poor sanitation will not significantly influence the health of the consumers negatively in ile-ife and Modakeke town.

Table 7: Descriptive and chi-square analysis of negative significant influence of poor sanitation on the health of the consumers in ile-ife and Modakeke town.

S/N	Level	Ile-Ife	Modakeke	Total	%	(x^2) value	P	df	Decision
1.	Yes	18	17	35	29.2				
2.	No	42	43	85	70.8	14.624	3.321	2	Sig
	Total	60	60	120	100				

From table 7 above, the responses of the respondents on significant influence of poor sanitation on the health of the consumers in ile-ife and Modakeke town was shown. Chi-square table of analysis was used to test if there will be no significant influence of poor sanitation on health of the consumers negatively in ile-ife and Modakeke town. The data analysis showed that (x^2) value = 14.624, P= 3.321, df= 2, $P< 0.05$ alpha level. Based on this finding, the null hypothesis which stated that poor sanitation will not significantly influence the health of the consumers negatively in Ile-ife and Modakeke town was rejected. Therefore poor sanitation will significantly influence the health of the consumers negatively in Ile-Ife and Modakeke town.

Research hypothesis 2: The abattoir operators' health status will not significantly influence the health of the consumers negatively in Ile-Ife and Modakeke town.

Table 7: Descriptive and chi-square analysis of negative significant influence of abattoir operators' health status on the health of the consumers in ile-ife and Modakeke town.

S/N	Level	Ile-Ife	Modakeke	Total	%	x^2 value	P	df	Decision
		Frequency	Frequency						
1	Frequently	0	0	0					
2	Not frequently	09	06	15	12.5	12. 426	2.412	3	Sig
3	Rarely	20	26	46	38.3				
4	Not ever	31	28	59	49.2				
	Total	60	60	120	100				

Table 4 showed the descriptive and chi-square analysis of significant influence of abattoir operators' health status on the health of the consumers in ile-ife and Modakeke town. To test if the influence observed was statistically significant, chi-square analysis was used to test. The data analysis showed the calculated x^2 value 12.426, p= 2.214, df= 3, p< 0.05 alpha level. Based on this result, the null hypothesis which stated that the abattoir operators' health status will not significantly influence the health of the consumers negatively in ile-ife and Modakeke town was rejected. Hence, the abattoir operators' health status will significantly influence the health of the consumers negatively in ile-ife and Modakeke town.

DISCUSSION

 One of the results revealed that the abattoirs (slaughter house) were not evenly distributed at all in these two towns because; they were congested in one side of the town than the other.

    Another finding showed that the Environmental health officers did not go round to inspect the Abattoir. This is in line with Nwanta, Onunkwo & Ezenduka, (2011) that the ineffective meat inspection services and the resultant consumption of unwholesome meat by the public have become a major cause of concern to the general public.

    It was also revealed that the respondents (Abattoirs' operators) from the two towns were not used to going for medical checkup.

    The results revealed that shelter as one of the type of facilities and equipment was used, but there was no standard slaughter house/Abattoir. Tap water and overhead tank were not well embraced.

     It was further observed from the finding that incinerator was not used as a means of wastes management which is a very good way for waste management , while landfilling was embraced, this landfill did litter the environment thereby causing threat or hazard to the health of the consumers and abattoir operators. This agrees with Ezeoha, (2000) and Nwanta, et al. (2011) that nearly all abattoirs' environment in Nigeria produce aggressive odours and rear mosquitoes as a result of the mounted solid wastes, faeces, carcass, horns and scraps of tissue. After heavy rainfall, the heaps of solid waste usually scatter and extent to other areas of the neighbourhood. And Fearon et al. (2014) that waste materials in most cases, are got rid of without respect to thorough environmental management practices, thus making them harmful to humans and other terrestrial and aquatic life.

    Results also showed that good sewer, cold room, freezer and electricity were not available in the abattoirs for use in the two towns.

    Another finding showed that there were no toilet and bathroom in the abattoirs used for the study in the two towns. This contradicts Banks & Wang (2004) that supportive facilities known as service facilities which are toilets and bathrooms for workers on site should also be available.

      Another finding showed that there was well water in the abattoirs used for the study. This favours Banks & Wang (2004) which stated that water is used in the abattoir for carcass washing after removing skin from cattle, calves, and sheep and after hair scrapping from pigs. Water is also used to clean the carcass, also for washing and sterilizing equipment and facilities during and after the slaughtering operation.

    It was also observed from the findings that diarrhea, cholera, and stomach pain were found to perceived health implication on the consumed meat from abattoir. All these are caused by pathogens. This cooperates with FAO (2014) that pathogens from cattle waste could be communicated to humans through water-based regenerations.

One of the results of this study involved verbal interview with 40 consumers who were from the two towns. Thirty six out of 40 respondents from both towns said that there was no borehole water and tap water, well water was adequate in the abattoir visited by them and that there was no standardize waste management. Thirty eight out of 40 respondents from the two towns added that there was no toilet and bathroom for these abattoirs, so it became problem for people going to purchase meat to ease themselves during their visit. Secondly, the abattoir operators themselves visited the bushes around them to defecate and ease themselves when need be. All the respondents agreed that the abattoirs in the two towns were not evenly distributed. In some areas in both towns, there were more abattoirs than other areas.

CONCLUSION
The following conclusions were made:
- The abattoirs in the study areas were not evenly distributed.
- The environmental health officers' rarely went to inspect the abattoir, it was also said that environmental health officers' did not always visit some areas at all.
- Some of the Abattior operators rarely went for medical checkup, while some did not go for medical checkup at all.
- The types of facilities and equipment used in the Abattoir were not adequate, the Standard slaughter house/Abattoir was not embraced instead it was the shelter that was used.
- Diseases such as cholera, typhoid, diarrhoea and stomach pain were perceived to be health implications due to poor sanitation and Abbatior operators health status.
- Poor sanitation and the abattoirs' health status will significantly influence the health of the consumers negatively in ile-ife and Modakeke town.

RECOMMENDATION
The following recommendations were drawn:
- The abattoirs should be well distributed in the study for easy accessibility to the consumers. The government should plan this in strategic locations.
- Environmental health officers' should inspect the abattoir very often.
- Abattoir operators should always visit the health center/ hospital for medical checkup.
- The types of facilities and equipment used in the Abattoir should be adequate. The Standardize and modern facilities and equipment should be embraced.
- Good sanitation should be applied to the abattoirs to reduce or possibly eliminate diseases such as cholera, typhoid, diarrhoea and stomach pain which were perceived to be common among the consumers.
- In order for the workers of Abattoir to provide meat that is clean and fit for human consumption, they must have access to potable hot and cold water and it should be conveniently located. Sanitary facilities (i.e. toilet and washing facilities) for both operators and customers should be made available.
- There should be proper disposal of rendered materials and other residuals including hides, bones, feathers, blood, and animal fat. Much of these materials may be decomposed on-site by burying them underground if the Abattoir have sufficient available land. In this case appropriate setbacks from water ways and neighbours must be observed.
- Enlightenment programme by the 3 tiers of government should be mounted for the abattoir for a healthy living.

REFERENCES
Baabereyir, A. (2009). *Urban environmental problems in, Ghana: a case study of social and environmental injustice in solid waste management in Accra and Sekondi Takoradi. PhD thesis of University of Nottingham. Accessed from the University of Nottingham repository:*
http://eprints.nottingham.ac.ukl 10847/1 /Fullthesis_pdfcopy.pdf.

Banks, JC. and Wang, Z (2004). *Treatment of Meat Wastes.' Handbook of Industrial and Hazardous Wastes Treatment, Second Edition*. University of Southampton, England; Marcel Dekker Inc., Philadelphia.

Bello, M., Lawan,, Kwaga, J. K. P, Raji, M. A. (2011). Assessment of carcass contamination with E. coli 0157 before and after washing with water at abattoirs in Nigeria. *International Journal of Food Microbiology*: (150) 184-186.

Bello, Y. O. and Oyedemi, D. T. A. (2009). The impact of abattoir activities and management in residential neighbourhoods: A case study Ogbomoso, *Nigeria. J Soc Sci.; 19(2): 121-127.*

Brantz, D. (2008). Animal Bodies, Human Health, and the Reform of Slaughterhouses in Nineteenth-Century Berlin: in Meat, Modernity and the Rise of the Slaughterhouse, edited by P. Young Lee. Durham: University of New Hampshire Press. Pp.71-88.

Chukwu, O. (2008). Analysis of groundwater pollution from abattoir waste in Minna, Nigeria. *Res. J Dairy Sci.*, 2:74-77.

Ezeoha, S. L and Ugwuishii, B. 0 (2011). Status of Abattoir Wastes Research in Nigeria: *Nigerian Journal of Technology*, *vol. 30, No. 2*, pp. 143-148.

Ezeoha, S. L. (2000). Pollution and Biogas Production Potentials of Abattoir Wastes. Unpublished M. Eng. Project Report, Department of Agricultural Engineering, University of Nigeria, Nsukka, Nigeria, 2000.

Fearon, J., Mensah, S. B. and Boateng, V. (2014). Abattoir operations, waste generation and management in the Tamale metropolis: Case study of the Tamale slaughterhouse: *Journal of Public Health and Epidemiology*. *Vol. 6(l),* pp. 14- 19. DOl: J0.5897/JPH E2013.0574.

Food and Agriculture Organization of the United Nations (FAO) (2014). *Wageningen UR Livestock Research.*

Hassan, I. A., Campbell, C. 1 and Ademola, T. G (2014). Effect of Abattoir Effluent on surrounding underground water quality: A Case Study of Governor road abattoir at Ikotun, Lagos state: *IJAPBC Vol. 3(4), Oct - Dec. 2014, ISSN:* 2277 — 4688.

Nwanta, J. A., Onunkwo, J. and Ezenduka, E. (2011). Analysis of Nsukka Metropolitan abattoir solid waste and its bacterial contents in south eastern Nigeria: public health implications. *http://www.ncbi nlm.nih.gov/pubmed/20146999*. Retrieved 11th June, 2011.

Omole, D. 0 and Ogbiye, A. S. (2013). An Evaluation of Slaughterhouse Wastes in South-West Nigeria. *American Journal of Environmental Protection*. Vol. 2, No. 3, 2013, pp. 85-89. Doi: 10.1 1648/j.ajep. 0203.12.

Otter, C. (2008). Civilizing Slaughter: The Development pf the British Public Abattoir, 1850-1910: *in Meat, Modernity and the Rise of the Slaughterhouse*, edited by P.Young Lee. Durham: University of New Hampshire Press; pp. 89-106

Pike Research (2012). Waste to Energy technology Markets. *Retrieved from*
http.//www.pikeresearch. com/research/waste-to-energy -technology-markets.

Pradham, M. U. (2008). *Sustainable solid waste management in a mountain ecosystem*, Darjeeling, India.

Salvato,J. A. (1992). Environmental Engineering and Sanitation, 4th Edition, John Wiley, N. Y., 1992

Wang, L.K., Hung, Y., Lo, H.H. & Yapijakis, C. (2006) Waste Treatment in the Food Processing   Industry, CRS Press (Boca Raton, USA).