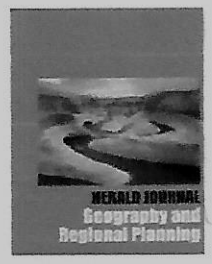
HERALD JOURNAL
Geography and Regional Planning

HERALD JOURNAL OF GEOGRAPHY AND REGIONAL PLANNING



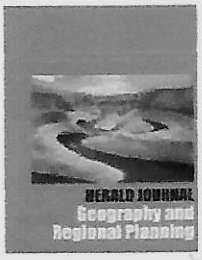
INDEXING
CONFERENCE
HANDLING CHARGES
ONLINE SUBMISSION

ISSN ONLINE: 2350 - 2185

CLICK TO SUBMIT MANUSCRIPT ONLINE

EDITORIAL BOARD MEMBERS

HERALD JOURNAL OF GEOGRAPHY AND REGIONAL PLANNING



INDEXING
CONFERENCE
HANDLING CHARGES
ONLINE SUBMISSION

TABLE OF CONTENT: JANUARY 2015, 4 (1)

Full length Research Paper

Herald Journal of Geography and Regional Planning
ISSN ONLINE 2350 – 2193

REVIEWER GUIDE

PART A: *Editorial Office Use Only*

SECTION I

Reviewer's Name:	
E-Mail:	
Manuscript Number:	**HJGRP-15-092**
Title:	**AN EVALUATION OF THE EFFECTS OF ABATTOIR WASTE EFFLUENTS ON ITS RESIDENTIAL ENVIRONS IN MINNA, NIGER STATE, NIGERIA**
Authors.	
Date Sent	16-01 – 2015
Expected Date	26-01 - 2015
Areas of specialization (if you wish for your names and affiliation to be uploaded as a reviewer for HJGRP):	Environmental Engineering, Water and Wastewater Management and Modelling, Solid Waste Management, Surface and ground water pollution evaluation and control, System Dynamics Modelling.
Affiliation	University of Lagos, Nigeria

PART B: *Reviewer Only*

SECTION II: Comments per Section of Manuscript

General comment:	**The article is relevant to environmental pollution and management. The language and presentation is fair. The errors in the articles have been corrected and shown in red. Wrong literature citations are indicated in blue. Suggested comments are shown green.**
Introduction:	**The introduction is fair. The author has NOT followed the format specified in the Instructions to authors in citing literature. These should be corrected to conform with the Journal's standard.**
Methodology:	**Methodology used was investigative. There is the need to show the Study area and delineate the abattoirs where the survey was carried out.**
Results:	**The results obtained are well presented in Tables and Charts**

Discussion:	**The discussions were carried out along with the results and the conclusions itemized. However, some of the Plates shown on the appendix were not referred to in the body of the article. These plates are either removed or cited in the body of the article.**

Bibliography/References:	**Adequate and relevant.**
From The Editorial Office:	**Authors are advised to reduce the number of self citations of previous studies within their paper in order to uphold the credibility of the journal. Articles with self citations may not stand the chance of being accepted.**
Decision:	**The article may be accepted after the necessary corrections.**

SECTION III - Please rate the following: *(1 = Excellent) (2 = Good) (3 = Fair) (4 = poor)*

Originality:	**2**
Contribution To The Field:	**2**
Technical Quality:	**2**
Clarity Of Presentation :	**3**
Depth Of Research:	3

SECTION IV - Recommandation: (*Kindly Mark With An X*)

Accept As Is:	
Requires Minor Corrections:	X
Requires Moderate Revision:	
Requires Major Revision:	
Submit To Another Publication Such As:	
Reject On Grounds Of (Please Be Specific):	

SECTION V: Additional Comments

- Please add any additional comments (Including comments/suggestions regarding online supplementary materials, if any):

Herald Journal of Geography and Regional Planning Vol. 4 (1), pp. 008 –015 January, 2015
Available online http://www.heraldjournals.org/hjgrp/archive.htm

ISSN : 2350 – 2185

Full Length Research Paper

An evaluation of the effects of abattoir wastes/effluents on its residential environs in Minna, Niger state, Nigeria

Anunobi I. Anthony, Adedayo F. Olatunde, Oyetola A. Stephen, Umar D. Salihu and Ayuba Philip

Department of Architecture, Federal University of Technology, Minna, Niger State, Nigeria

Accepted January 28, 2015 Received December 13, 2014

Abstract

The abattoir as a meat processing industry world-wide is saddled with the responsibility of maintaining good standards of hygiene in terms of waste management. Wastes are generated in diverse forms in abattoirs, these include, solid or semi-solid wastes, liquid wastes and gases. If these effluents or contaminants are not adequately and efficiently managed, the negative impact on the residential environs and human health cannot be overemphasized. Hygiene must be key in all abattoir operations. This research evaluated the impact of waste effluent from selected abattoirs on residential environs in Minna, Niger State, Nigeria. Primary data was gathered through the observation method. While the secondary data was gathered from related literatures. Data analysis by simple statistical methods showed a significant relationship between poor waste management and bad environmental impact. This study concludes that good waste management is key to good residential environs. Recommendations include, Operators of abattoirs must consider the integration of modern sustainable waste management systems, Government must provide the enabling infrastructure, rules and regulations for the proper monitoring and enforcement of good hygiene practices, Zoning laws should provide the minimum standards of between 100m to 200m around the abattoir location in terms of buffers.

Keywords: Abattoir, waste management, effluents, residential environs, pollution.

INTRODUCTION

Abattoirs are special facilities meant as buildings for animal meat processing for human consumption. Lots of works have shown the impact of abattoir effluents on residential environs as a result of improperly managed abattoir waste. The effect of such abattoir waste effluents on the residential environ is often overlooked. The demand for more meat products as a result of population growth has led to forced- outputs from abattoirs and its attendant waste generation effects. These effluents in most cases are disposed of in the worst of ways thereby occasioning pollution of the immediate environment and beyond (Akinroet al., 2009). In present day Nigeria abattoirs no longer get the desired attention. In most cases sanitation is the biggest observable problem (Alonge, 2005). The need to evaluate the environmental impact of abattoir activities and its human health implication is paramount. Abattoirs are an important component of the human environment as it is supposed to provide well processed meat products for human consumption(Singh and Neelam 2011). A huge variety of effluents from abattoirs with contaminating implications on the surrounding environs come as a direct consequence of poor waste management in and around the abattoirs (Abiade -Paul et al, 2006,Adelagan, 2002&Adeyemo, 2002). In Nigeria, numerous abattoir buildings/designs are obsolete, varied and without uniformity. Inconsistent government policies, poor level of funding and non- existence of insurance scheme for butchers are among others are the challenges to proper waste management in abattoirs. The net result is deterioration of slaughter houses, improper meat inspection and compromise of public interest. The numerous waste and microbial organisms produced during abattoir operations not only pose a significant challenge to effective environmental management but also are associated with decreased quality of life among animal and human population (Abiade -Paul et al, 2006) (Adeyemo, 2002), (Esona et al., 2004) , 9Nwanta and

*Corresponding Author E-mail Address:arcadedayo@gmail.com

Table 1: Basis for calculating Waste generation

Waste Type	Cow(kg)	Goat/Sheep(kg)
Blood	12.60	0.72
Intestinal Contents	8.00	1.25
Waste Tissue	6.40	0.80
Bone	11.80	2.06

Animal units: Cow = 454 kg (1000 pounds), Goat/ Sheep = 45.4 kg (100 pounds)
Source: *(Aniebo et al., 2009)*

Achi 2002).The total amount of waste produced per animal slaughtered is approximately 35% of its total weight (World Bank, (1998).

Sources of Waste in Abattoirs and treatment/disposal methods in Nigeria

Sources of waste in abattoirs are grouped as follows: - a) Lairagus /animal pens; b) Bleeding /stunning; c) Carcass processing/cleaning; d) Offal processing; and e) By-products processing. The composition of abattoir effluents differ on a daily basis based on the kind and population of stock processed (Litchfield, 1980).The types of wastes generated by a Head of cow or goat/sheep is shown below in Table 1.

Causes and Environmental Impact of Poor Waste Management in Nigerian Abattoirs

Abattoirs are an important component of the human environment as it is supposed to provide well processed meat products for human consumption Singh and Neelam (2011).A similar study undertaken in Araromi abattoir which accounts for almost two third of the total number animals slaughter in Akure, Nigeria showed that mismanaged wastes caused the contamination of the surrounding surface waters and subsequently, the underlying aquifers. This kind of poor wastes management has caused health problems (Akinro et al., 2009). The impact of poor waste disposal method is illustrated by reports of the species of pathogenic bacteria isolated from the solid waste and effluents (Litchfield, 1980). Reports have shown that the poor state of abattoirs is serious source of embarrassment to the Nigerian environment (Akinro et al., 2009). It also stated that these wastes that pile up in abattoirs can be washed by surface runoff to contaminate ground water and surface waters which also occurs in market places and streets (Meadows 1995). Abattoir wastes piled up within the premises can cause pollution leading to the production of methane gas that will contribute to the green house effect a factor in Global Warming (Adeyemo, 2002).

Global Best Practices (GBP) In Abattoir Waste Management

The GBP in waste management is the 3Rs of sustainable waste management, which is Reduce, Re-use and Re-cycle. The recommended waste treatment and disposal method for abattoirs are: - 1) Screening, 2) Incineration, 3) Land filling, 4) Skimming, 5) Primary Settling, 6) Blood Separation, 7) Protein Recovery and 8) Biological treatment such as composting and biomethanation (Global Food Policy Report 2012). The general design standards for abattoir according to Ethiopian Agricultural Research Organization (2010).Abattoir design is generally by Standards divided into two (2) activity areas, viz the dirty area and the clean area. While the factors for site selection include:

- Avoid source of contamination,
- Avoid rivers and water ways areas,
- Avoid areas with tall trees,
- Good site slope for good drainage,
- Site should be comfortably large.

In Nigeria, numerous studies have shown that in most cases existing abattoir designs are obsolete and varied and without uniformity Nwanta and Achi (2002).

STUDY AREA/METHODOLOGY

This study was carried out in Minna, the State capital of Niger State, North Central, Nigeria. Minna has a population density of approximately 3448 persons per km^2 [14]. The approach used for this study was **investigative.** It involved fieldwork and interviews. Samples were collected from seven abattoirs and the surrounding environs. These abattoirs are 1) F-Layout Abattoir, 2) Kpakungu Abattoir, 3) Maitunbi Abattoir, 4) Chanchaga Abattoir, 5) Paiko Abattoir, 6) Maikunkele Abattoir and 7) Garatu Abattoir the map in figure 1.1 shows the location of the sample sites. The field work was carried out between 5th March 2014 and 12th April 2014. Within the period, seven members each from the seven selected abattoir

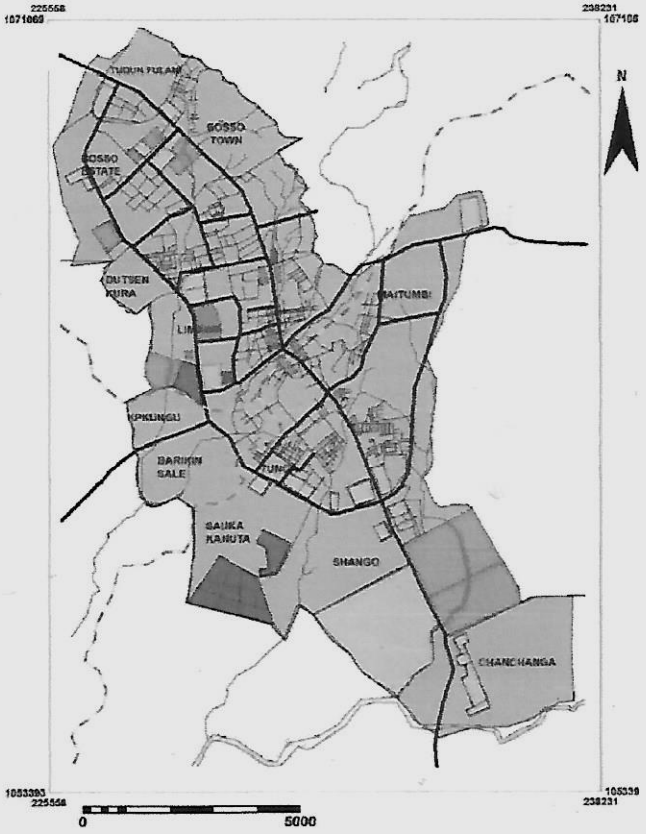


Figure 1a: Minna and its environs showing location of sample sites

Table 2: Number of Animals Slaughtered Per Week

ABATTOIR NAME	COW/WEEK	GOAT/ WEEK	TOTAL
F-LAYOUT	171	173	344
KPAKUNGU	13	28	41
MAITUNBI	23	37	60
CHANCHAGA	14	30	44
PAIKO	77	90	167
MAIKUNKELE	16	24	40
GARATU	9	14	23
TOTAL	323	396	719

Source: Field Work (2014)

neighbourhoods were interviewed with respect to the impact of the abattoirs on them and the environment. For the field observation, structured observation schedule was used. The schedule involved items checking for the type of pollutants within the premises, quantity or volume of different types of effluent from the abattoir operations and their impacts on the adjacent residential environ. A rating questionnaire was used to determine the perception of the people on issues related to the abattoir. Data gathered were collated, analyzed using SPSS, presented and discussed. Waste generation by mass per animal was quantified using Figure 1a.

RESULTS AND DISCUSSION

The number of animals slaughtered per week in the seven (7) selected abattoirs as presented in Table 2. This showed that about 48% of total animal output comes from the F-Layout abattoir alone, making it an abattoir of great

Table 3: Classes of Waste Generated Per Week in the Selected Abattoirs

Abattoir Name	Blood/Week (kg)	Intestinal Content/ Week (kg)	Bone/ Week (kg)	Waste Tissue/ Week(kg)	Total Waste Generated Per Week(kg)	Percentage Of Total Waste Generated
F-LAYOUT	2,279.16	1,584.25	2,234.10	1,232.80	7,330.31	45.78%
KPAKUNGU	183.96	139	211.08	105.6	639.64	3.99%
MAITUNBI	316.44	230.25	1094	564.8	2,205.49	13.78%
CHANCHAGA	198	728.5	227	113.6	1,267.10	7.91%
PAIKO	1035	728.5	1094	564.8	3,422.30	21.37%
MAIKUNKELE	211.88	158	238.24	121.6	729.72	4.56%
GARATU	123.48	89.5	135.04	68.8	416.82	2.61%
TOTAL	4,347.92	3,658.00	5,233.46	2,772.00	16,011.38	100%

Source: Field Work (2014)

interest/concern for waste effluent generation and its general impacts.

The volume of waste generated at the abattoirs is directly proportional to the number of slaughtered animal as shown in Table 3. The implication is that an abattoir like the F-layout will impact more negatively on the human environment than Garatu Abattoir which generates the least amount of waste among the seven selected abattoirs. Greater priority for waste management must be directed at abattoirs with high waste loads like the F-Layout and Paiko abattoirs. Rather than have many abattoirs of relatively small animal meat output in one town and its environs, government can centralize these operations in one large abattoir capable of servicing the entire area in Minna. By this, waste management issues will be restricted to that single abattoir site and solutions can easily be derived and applied. The F-Layout abattoir is capable of been retrofitted for this purpose.

The four waste types identified in the seven (7) selected abattoirs, the method of disposal and environmental impacts as presented in Table 4 It has been clearly shown that all the abattoirs practicing similar waste management techniques/methods produce similar environmental impacts on their residential environs. To mitigate these impacts, sustainable techniques/methods such as containment (composting), bio-treatment/reuse, recycle, energy recovery (biomethanation/biogas production e.g. from intestinal wastes), and finally hygienic land filling/incineration must be practiced. Where incineration is involved, the abattoir must be designed to accommodate a tall chimney for transporting smoke to high altitudes where its impacts is reduced to the minimum due to aerial spread. Possible uses for the smoke such as generation of heat energy for selected uses within the building can be devised.

Table 5 shows the human perception of the associated negative environmental impact(s) of abattoir effluents on its residential environs. 73.47% of respondents considered that abattoirs have negative impact on their residential environs. An unfavourable perception is therefore established due to the nature of air pollution that is found within the environment of the abattoir. The drainage within the abattoir also affects the various houses because it drains through the front of their house in open drains. There is therefore the need for concerted effort by government to mitigate this ugly trend immediately as the health implications cannot be overemphasized.

Figure 1 above shows the weekly percentage by mass of blood waste generated in the selected abattoirs. The percentage of blood waste generated within the study area showed that F-Layout has the highest percentage and this area also is predominantly a residential area. The amount of animal blood that sips into the soil is significant as it affects the ground water. The blood waste also affects nature of rodents that can infest the residential area. There is no attempt by the operators of the abattoir to collect and manage the waste in a clean manner hence the indiscriminate method of disposal. The F-Layout abattoir with 52% of all generated blood waste gives a good location for raw materials in processed blood-related products.

Figure 2 is an illustration of weekly Intestinal waste generation by mass in the selected abattoirs. Intestinal waste has been observed to be the main cause of drain blockage and smell within and around the abattoirs (Plate 1). The best way known for managing intestinal waste is composting. Compost facilities need to be installed to help convert this waste into fertilizers for agriculture; a new revenue source for the butchers or abattoir operators.

Figure 3 above shows that the F-Layout and Paiko abattoirs together generate 74% of bone waste of the seven (7) selected abattoirs. Bones constitute a lot to air

Table 4: Waste Type/Method of Disposal /Environmental Impact

Abattoir Name	Blood	Intestinal Contents	Bones	Waste Tissue	Environmental Impact(S)
F-Layout	Drained into the surrounding area.	Hipped within, Composting, washed away in surrounding area	Burning/sale for re-use, Disposed around	Burning/Burial	Odor, land/water pollution, air pollution (green house gas emission),bio-hazards.
Kpakungu	Drained into the surrounding area	Washed into nearby natural canal	Burning, Disposed around	Burning and Disposal into nearby natural canal	Odor, land/water pollution, air pollution (green house gas emission)
Maitunbi	Drained into nearby public gutter	Washed into nearby public gutter	Burning, Disposed around	Burning and Disposal into nearby public gutter	Odor, land/water pollution, air pollution (green house gas emission)
Chanchaga	Drained into nearby farmland and stream	Wash into nearby farmland and stream	Burning, Disposed around	Burning and Disposal into nearby farmland and stream	Odor, land/water pollution, air pollution (green house gas emission)
Paiko	Drained into nearby farmland and stream	Hipped within, Composting, washed away in surrounding area	Burning, Disposed around	Burning and Disposal into nearby farmland and stream	Odor, land/water pollution, air pollution (green house gas emission)
Maikunkele	Drained into nearby gully	Washed into nearby gully	Burning, Disposed around	Disposed into nearby gully	Odor, land/water pollution, air pollution (green house gas emission)
Garatu	Drained into nearby farmland and stream	Washed into nearby farmland and stream	Burning, Disposed around	Disposed into nearby farmland	Odor, land/water pollution, air pollution (green house gas emission)

Source: *Field Work (2014)*

Table 5: Negative Environmental/Human Health Impact as Perceived by Neighbourhood inhabitants

Abattoir Name	None	Bad	Very Bad	Extremely Bad	Total
F-LAYOUT	0	1	4	2	7
KPAKUNGU	0	0	6	1	7
MAITUNBI	0	0	0	7	7
CHANCHAGA	4	3	0	0	7
PAIKO	5	1	1	0	7
MAIKUNKELE	0	1	6	0	7
GARATU	4	3	0	0	7
TOTAL	13	9	17	10	49
PERCENTAGES(%)	26.53%	18.38%	34.69%	20.40%	100%

Source: Field Work (2014)

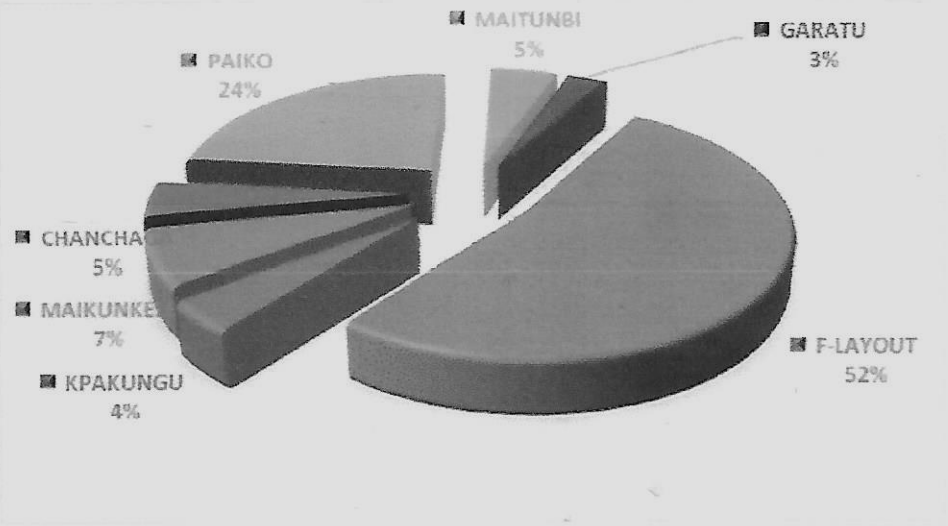


Figure 1: Blood Waste Generated Weekly in the Selected Abattoirs.
Source: Field Work (2014)

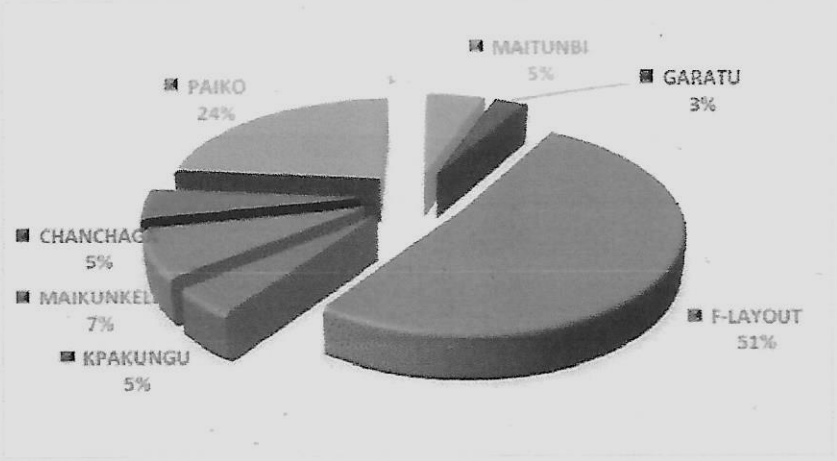


Figure 2: Intestinal Content Waste Generated Weekly in the Selected Abattoirs.
Source: Field Work (2014)

Plate 1: Poor Massive Intestinal Waste Disposal.
Source: Field Work (2014)

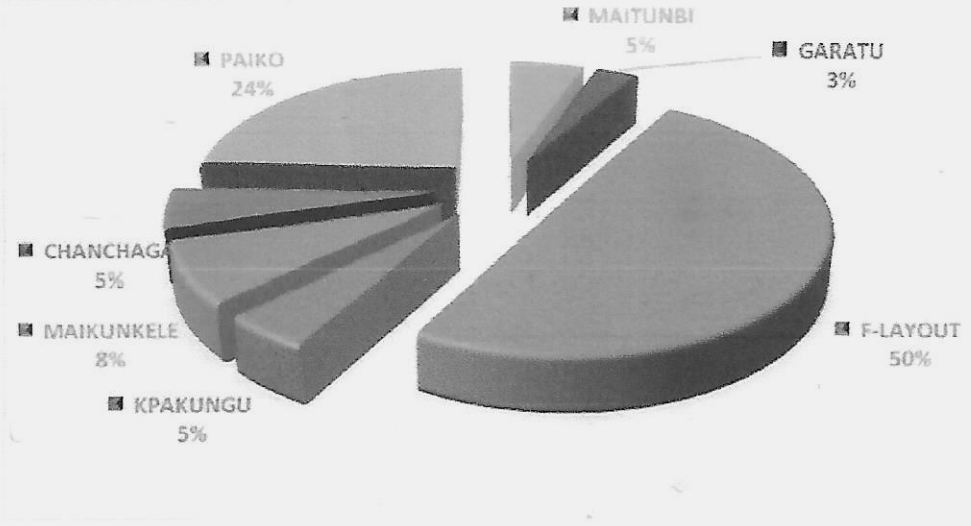


Figure 3: Shows Bone Waste Generated Weekly in the Selected Abattoirs.
Source: Field Work (2014)

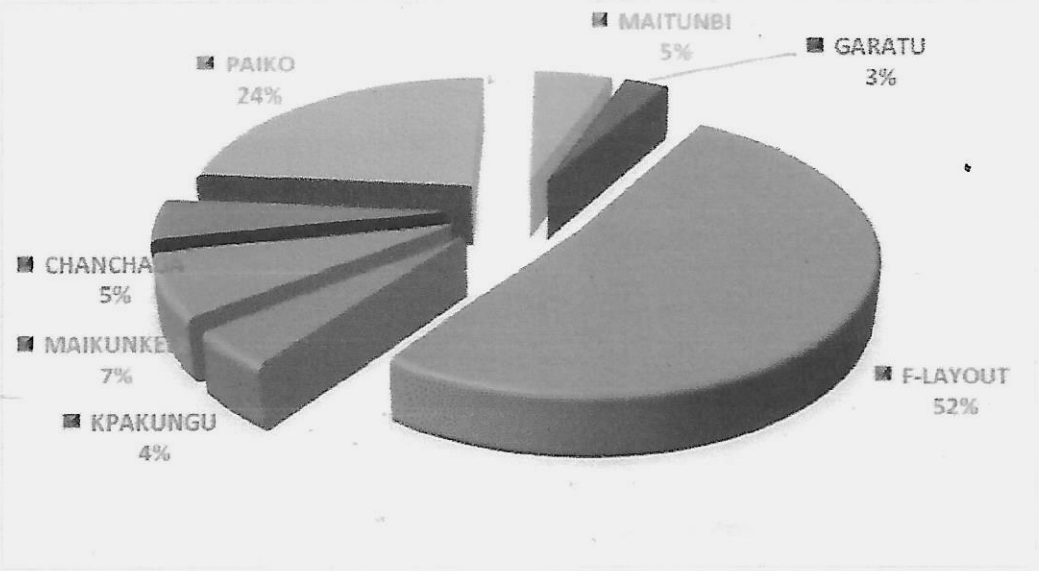


Figure 4: Shows Waste Tissue Generated Weekly in the Selected Abattoirs.
Source: Author's Field Work(2014)

pollution as they are mostly /wastefully burnt away(Plate 3) causing air pollution in their wake. Bones can be harvested for recycling in the enamel industries, hence the need for bone harvesting in all the abattoir as a source of raw material for industry. Abattoirs must find a good market for bones rather than incinerating them.

Figures 4 above illustrates the volumes of waste tissue waste generated in all the selected abattoirs. The F - Layout and Paikoabattoirs generally due their animal meat outputs, have generated 76% of all tissue wastes. The other abattoirs generated between 4% and 9% of tissue waste. These tissues have been observed to be processed by incineration (Plate 4), a burning process that emits a lot of smoke/fumes into the atmosphere leading to air pollution within the environs. Incineration can be have less negative impact when butane gas from biomethanation/biogas production process using the intestinal waste is utilized as fuel for the incineration rather than used vehicle tyres and timber. These tissues (hides/skin) can be processed as raw materials for leather products industry.

Figure 5 is an illustration of the length of buffer from the selected abattoirs to the closest human habitation. The allowable buffer is such that will reduce or eliminate the negative effects of the abattoirs on its environs. The farther the buffer length, the less the impact of the

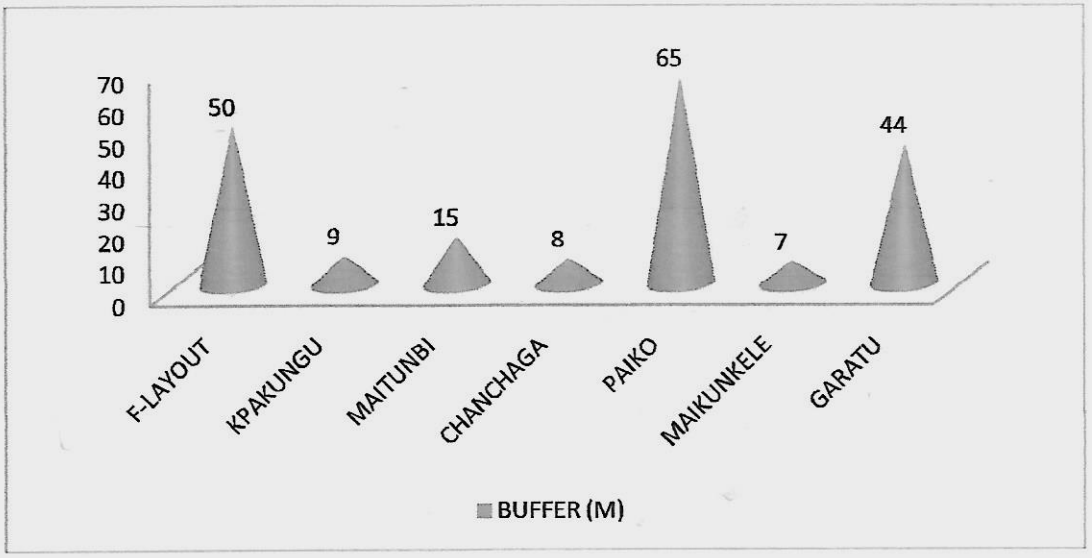


Figure 5: Buffer LengthsbetweenSelected Abattoirs and the Closest Human Habitation.
Source: Field Work (2014)

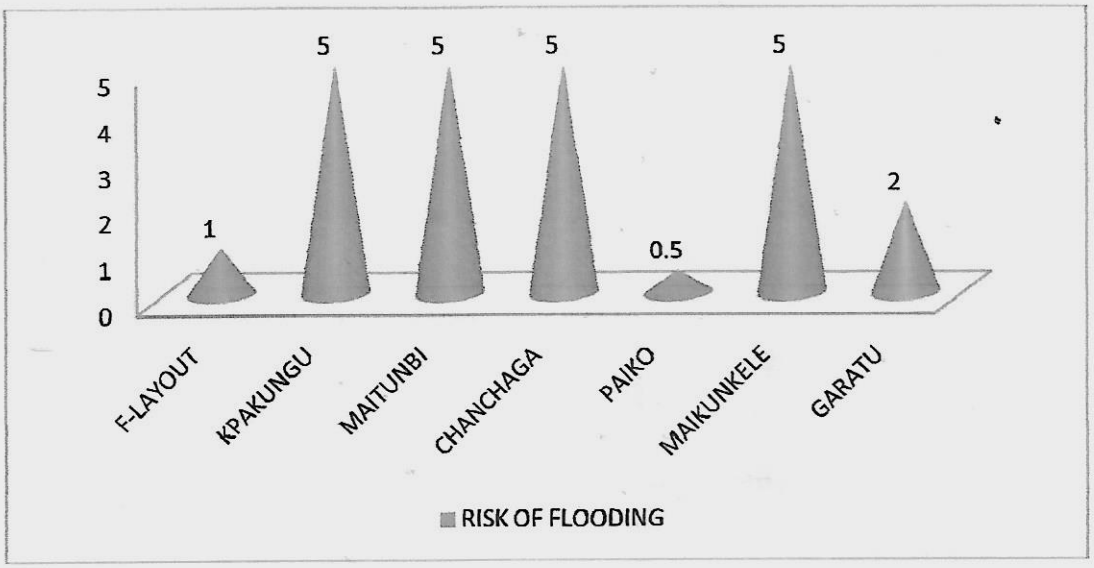


Figure 6: *Risk of Flooding from the Selected Abattoirs.*
Source: *Field Work (2014)*
(Rating:'1' as lowest and '5' as highest)

effluents on the surrounding environs. This is so because distance in space helps to reduce impacts from abattoirs. The impact on Paiko at 65metres buffer length will be less than that of Maikunkele with 7 metres buffer length. In terms of buffers, the abattoir should be located as far as possible from the closest habitation within the range of 100m to 200m.

Figure 6 above indicates the risk of flooding from the selected abattoirs. Abattoir located in flood plains will be key problem in the rainy season due to the great risk of flooding that they constitute. Abattoirs such as Kpakungu, Maitunbi, Chanchaga and Maikunkele with very high risk of flooding, have had their effluents washed down to the surrounding environs thereby contaminating land, surface and underground aquifers and polluting the air. These abattoirs can have their effluent contained within their compound. This containment can be through site planning of drainages to channel waste to a predetermined receptor, design of high capacity septic and soak-away pits to receive and soak-away liquid/fluid

waste; biomethanation and composting of dung/intestinal wastes for biogas production and manure for agriculture. As for abattoirs such as the F-Layout, Paiko and Garatu, the risk of flooding is minimal and can easily be mitigated for the high risk area/abattoirs.

CONCLUSION AND RECOMMENDATIONS

From the data and analysis results obtained above, it is the conclusion of this study that wastes from the selected abattoirs are sources of danger to their residential environs and human health. The need to introduce/practice good waste management methods cannot be overemphasized. s

It is therefore the recommendation of this study that:-

a) A few of the small abattoirs in Minna be closed and their activities collapsed into three abattoirs for easy administrative management and effective waste management.

b)Operators of abattoirs must consider the integration of modern and sustainable waste management techniques/methods/systems such as composting (energy recovery), bone harvesting, blood processing, tissues reuse and biogas production (biomethanation).

c) Government must provide the enabling infrastructure (sewage system), portable water and electricity to enable proper abattoir operation and good waste disposal.

d) Containment practices by proper drainage capacity calculation and drainage soak-away mechanism must be incorporated with all open drains covered and secured.

e) Sanitation must be observed immediately after daily meat processing operations to reduce waste accumulation.

f) Town planning glaws should be looked into to regulate indiscriminate location of abattoirs in populated residential environs. Buffer zones must be protected from encroachment.

g) Rather than wash away blood or drain into public sewer system the most effective way of handling blood waste is 'reuse' by collecting and processing it into solid (flakes) particles used in agro-feeds for fish in fishery industries.

REFERENCES

Abiade-Paul CU, Kene IC, Chah KF (2006). Occurrence and Antibiogram of Salmonellae in effluent from Nsukka Munincipal abattoir. Nigerian Vet J.1: 48-53.

Adelagan JA (2002). Environmental policy and slaughter house waste in Nigeria. In: Pro Aceedings of the 28th WEDC conference, India.

Adeyemo OK (2002). Unhygienic operations of a city abattoir in South Western Nigeria: environmental implication. AJEAM/RAGEE 2002.4(1): 23-27.

Akinro AO, Ologunagba IB, Olotu Y (2009). Environmental implications of unhygienic operation of a city abattoir in

Akure, Western Nigeria. ARPN Journal of Engineering and Applied Sciences. 4: 311-315.

Alonge DO (2005). Meat and milk hygiene in the tropics. Ibadan, Nigeria, Farmose Press.

Aniebo AO, Wekhe SN, Okoli IC (2009). Abattoir blood waste generation in Rivers State and its environmental implications in the Niger Delta. Toxicological and Environmental Chemistry. 91(4): 619-625.

Esona MD, Umoh JU, Kwaga JKP (2004). The prevalence and antibiogram of Salmonellaspp and Escherischia coli from meat, milk, bovine rectal swabs and human stool in Zaria, Nigeria. J. of Animal Production Res.Vol. 19 (12): 7-19.

Ethiopian Agricultural Research Organization (2010). Cattle Milk and Meat Production and Market Systems and Opportunities for Market Orientation in FogeraWoreda, Amhara Region, Ethiopia. Retrieved from www.ipms-ethiopia.org

Global Food Policy Report (2012). Environmental Protection Agency, Basic Information about Food Waste. Retrieved from www.books.google.com.ng/bookss?isbn=0896295532

Litchfield JH, (1980). Salmonella food poisoning. In: Safety of Food (2nd edition). Connecticut. AVI Publishing Company, Inc. Provide page number

Meadows JH (1995). Livestock legacy. Environmental Health Perspective. Retrieved from www.ncbi.nlm.nih.gov/pmc/articles/PMC1519243

Nwanta JA, Achi LB (2002). Efficient collection, transportation and hygienic disposal of urban solid waste as a tool for environmental health management in Nigeria. Proceedings of the first national conference on the Environmental health society of Nigeria.

Singh VP, Neelam S (2011). A survey report on Impact of Abattoir Activities Management on the environments. Retrieved from www.biblio.com

World Bank, (1998). Meat Processing and Rendering: Pollution Prevention and Abatement Handbook, Environmental Department. 1st Edition. Washington DC. World Bank.

Citation: Anunobi AI, Adedayo OF, Oyetola SA, Umar SD, Ayuba P (2015) An evaluation of the effects of abattoir wastes/effluents on its residential environs in Minna, Niger state, Nigeria. Herald J. Geogr. Rgnl. Plann. Vol. 4 (1), pp. 007 – 015