QUANTIFICATION OF WASTE MATERIALS GENERATED IN MAJOR ABATTOIRS IN MINNA, NIGER STATE

BY

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2000/10881EA

DEPARTMENT OF AGRICULTURAL ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NIGER STATE

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG.) AGRICULTURAL ENGINEERING FEDERAL UNIVERSITY TECHNOLOGY, MINNA.

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CERTIFICATION

This project entitled "Quantifying of Major Abattoir Waste in Minna Niger state" by Chidiebere Daniel Ibeadotam meets the regulations governing the award of the degree of Bachelor of Engineering (B.ENG) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

Dr(Deacon) O. Chukwu
Project Supervisor.

02/11/2006
Date

External Examiner

02/11/2006
Date

Dr.(Mrs) Z. D. Osunde
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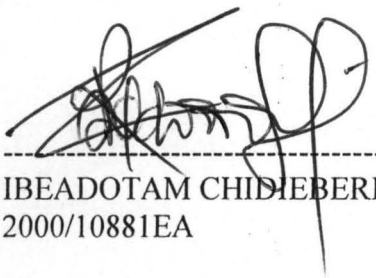
3/12/07
Date

DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communication. Published and unpublished works of others were duly referenced in the text.



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02/11/2006
DATE

DEDICATION

I solemnly dedicate this project to God Almighty, The giver of life. And to my parents Mr. and Mrs. D. Ibeadotam and Rev.(Canon) Emeka Ukaejiofo for their unquantifiable support all through my childhood till now.

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ABSTRACT

This project work attempts to investigate abattoir waste by quantifying the amount of waste generated in abattoirs in Minna, Niger State. The work opines that there is need for adequate data on the amount of waste generated, to aid treatment of any kind. Questionnaires were administered as a tool for collecting data from the abattoirs visited. Coupled with this, physical interview as well as physical assessment and survey were carried out to ascertain the true data. Pictures were also taken to aid the data obtained. Tables 4.1 were used to present the data for easy evaluation and analysis .Which showed that average blood produced by cows and goats, where 33.33 and 42 respectively. The rate of pollution was found to be high, because wastes were dumped and released indiscriminately without due consideration to the environmental implications. If dumping is continued, it will cause a lot of health hazards to man and his environment. It is recommended that adequate assessment of abattoir waste generation should be carried out in order to help in the design and construction of waste treatment structures.

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CHAPTER ONE

1.0 INTRODUCTION

Waste can be defined as any solid or material that is suspended, dissolved or transported in water (including sediment) which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause or to be reasonably likely to cause the water source polluted. (Act 36 of 1998). Waste has always been a major source of worry for man, it is mainly generated from man's dare need to improve its living condition through the production of more food for its consumption. But these processes have rather left him with serious problems in its wake. Such problems include the devastation of lives and property which occurred due to the 1982 floods in Ibadan, Lagos, Port-Harcourt and Aba in Nigeria (Raymond, 1984) and most recently the spread of bird flu in different part of the country. Indeed in many respect waste management is becoming too costly to human society in terms of the economic and financial commitment that is involved and the future implication.

Waste can be generated in several forms such as: abattoir waste, industrial waste, agricultural waste, domestic waste (household waste)

Abattoir waste management can be defined as a waste or wastewater from an abattoir which could consist of animal faeces, blood, fat, animal trimming, paunch content and urine. The question today is whether technology and good management can solve the environmental problem which abattoirs has helped to cause. However based on current knowledge, no Minna abattoir operates on a closed water circuit. The reason is those wastewaters generated by abattoir contain high level of pollutants which in most cases are harmful to both man and his environment. The most widely used route for discharge of

waste from abattoir is municipal sewage. As a result attention has been mainly focused on problems connected to treatment of waste at the end of the production line once the product and its resulting, have been produced. Edward, (1980).

Most abattoir aims at optimising the recovery of edible portions from the meat for human consumption but significant quantities of secondary wastes materials which are not suitable for human consumption are generated. Since water is often used to wash excessive waste solids to drain. The method used in handling, treatment and disposal of abattoir waste should be put into consideration, as waste dumped in the open environment; storm drainage, channels, creeks lagoons and other impoundment points could cause serious environmental pollutions and hazards which in most cases adversely affects the air , water and probably the soil condition and can also constitutes public nuisance.

Improper abattoir waste management can also bring about other adverse environmental problems for instance effluents which are produced during the slaughtering process due to high content of animal fat, waste blood and any cleaning detergents, micro organisms from wastes discharged may also impair the flow of surface water. Large release of chlorofluorocarbons (CFCs) which pollute the air, noise from both animals and machines (if any), and depletion of dissolved oxygen in surface water may cause the deaths of fishes and other aquatic animals.

1.1 AIM

The aim of this project is to assess the major abattoir wastes generated in Minna Niger State, Nigeria. There is needed to encourage waste reuse and a need for data for the treatment of abattoir wastes.

1.2 Objectives of the study

i. To assess the various types of wastes generated from abattoirs in Minna, Niger State.

ii. To consider the environmental implications and impact associated with waste generated from these abattoir

iii. To have adequate data on water produced in various abattoirs in Minna.

1.3 Statement of the problem

The various implications and problems associated with abattoir waste quantification are:

i. To provide adequate data of the waste produced in various abattoirs.

ii. To assess the methods and ways of treating the various waste generated.

1.4 Justification of the study

The needs for adequate control and effective utilization of waste, in order to reduce environmental hazards calls for this project write up.

i. Adequate knowledge and information of the quantity /types of waste generated would in many respect help the abattoir manager to manage the waste obtained.

ii. Proper design of the abattoir with the installation of good facilities would help in treatment of waste.

iii. Continuous education on new methods of handling, treating waste would be of great help.

iv. Managers will be enabled by adequate control measure and management process aimed at preventing the impact of the generated waste to the environment.

1.5 Scope of study

This project will be limited to the following:

i. Identification of the different types of waste, sources and quantities of wastes generated on the various abattoir based on their output.
ii. Identification of the various type of waste discharge structure in the abattoir.
iii. Assessment of the impact of waste generated and their disposal on the standard of environment.
iv. Identification of type of waste treatment and disposal method in the abattoir.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General

Waste can be defined as any matter, whether gaseous, liquid or solid or combinations there of, which is left after the completion of a process Kelvin, (1984). Most waste are potential source of material when recycled, but it is unfortunate that waste are not regarded as such due to lack of knowledge on the potentials of waste and the technology involve in conversion Waste when released in gaseous form is regarded as emission and in most cases it is dangerous to the harmful to the environment.

Abattoir has over the years been a major contributor of most of the waste problems. These due to the processors not managing slaughter waste properly as dung and slurry washed are into water ways. An abattoir can be defined as a premise approved and registered by the controlling authority for hygienic slaughtering and inspection of animals processing and effective preservation and storage of meat products for human consumption Alonge, (1991). Some of the major activities that takes place in an abattoir includes:

- Receiving and holding of livestock's.
- Slaughter and carcass dressing of animals
- Chilling of carcass product.
- Carcass boning and packaging.
- Freezing of finished carcass and cur toned product.
- Rendering process.
- Drying of skins
- Treatment of wastewater
- Transport processed product.

Slaughtering of animals result in meat supply and useful by products like leather, skin and bone for productions of breakable plates, bone meal etc. Livestock waste spills or piles contaminate groundwater and pollute the Environment at large.

Abattoirs are normally located near Urban centres and enormous amount of waste are produced, these waste from the abattoirs operations has always been source of nuisance, as conventional methods are often used in disposal of the animal wastes, carcasses and manure. However most municipal wastes dumped in water ways contain high levels of organic matter, which encourages rapid proliferation of oxygen consuming micro organism to deplete the water of its dissolved oxygen leading to septic condition (anoxia). Complete anoxia is lethal for aquatic lives while a partial reduction in the oxygen regime provides enormous stress for the fish population. It has been proven that live stock waste contamination can increase the level of nitrates in the ground water which may cause methaemoglobinemia or "blue baby syndrome" (Mitchell and Chet, 1978; meadows, 1995). Most animals feeds contain metals which are released at concentrated levels through blood and excretas of these animals. Metals end up leached out in streams during wet seasons and can lead to the death of earth worms that are normally responsible for the aeration of the soil. The effects of these are some times erosion as a result of decrease in soil break down.

In a case of giardiasis in Leeds (1980), 3000 people were infected due to pollutions from animal excreta's from abattoirs. Abattoir operations has over the years produce characteristic high organic waste with relatively high level of suspended solid, liquid and fat. The liquid waste is usually composed of dissolved solids, blood, gut contents, urine and water. Animal foods are always microbiologically contaminated by organisms living in it naturally or entering from the surrounding during processing operations Lewicki (1993) Washing and disinfection are the main procedures of securing the hygienic meat and meat products (Pezacki 1990, Widdyga et al 1996).

Furthermore animal waste pile (excreta) from abattoirs can help in fuel production like methane, can intensify the green house effect. Air borne wastes are generated from dust, fuel burning, and waste pile of which a good example is the use of tyre in the burning of goat skin in F-layout abattoir in Minna.

Slaughter houses have concentrated so much on the generation of meat supplies and useful bye products which has resulted to groundwater pollution. Table 2.1 below presented the effect of abattoir dump on groundwater in Ibadan.

Table 2.1 Abattoir effluents effects on native groundwater

Parameter	Olodo abattoir		Moniya abattoir	
	Test well	Control well	Test well	Control well
Ph	9.2	6.7	8.2	6.7
NO^-_3	25.2	19.7	25.8	7.8
Cl^-	98	26	66	40
k	1.8	1.1	5.2	1.4
Ca	40.4	20.1	34.4	20.7
Mg	39.6	9.1	18.5	9.9
Fe	1.13	0.07	5.51	0.46
Cu	0.02	0.02	0.04	0.02
Zn	0.09	0.08	0.65	0.10
Mn	0.61	0.52	0.07	0.10
Na	58	21	84	32
Dissolved oxygen	5.1	6.3	5.6	5.8
COD	375	85	500	108
Total solids	366	220	534	277
Suspended solids	131	92	234	100
Dissolved solids	235	128	320	177
Hardness	396	120	324	258
Alkalinity	108	100	116	65

-All values in mg/l except pH * 250m from abattoir in moniya
-All values are mean of five tests * 350 m from abattoir in olodo
Source: A.Y. Sangodoyin and O.M .Agbawhe, 1992)

2.2 TYPES OF ABATTOIR WASTE

- Solid wastes resulting from pre-treatment could be summarized as: Dewatered solids mainly hair, stomach fibres /residues. Fat/oil skimming, blood solids, hides, bones, hooves.
- Liquid wastes from water used for primary treatment.
- Air borne wastes from odours, dust, fuel burning emissions, noise.

2.3 ENVIRONMENTAL EFFECTS OF ABATTOIR WASTE

2.3.1 LIQUID WASTE

For hygienic reasons abattoirs uses large amounts of water in processing operations. This produces large amount of wastewater which are discharged mostly into municipal sewage drainage or streams in developing towns like they do in Minna Nigeria. These liquid wastes most times contain high level of BOD (biochemical oxygen demand), nitrogen, phosphorus and other nutrients that are harmful to health. Due to the economic situation of the country, little interest has been paid to the effects of liquid waste from abattoirs to the environment. This may not be unconnected with the slow movement of groundwater as well as slow degradation of many of the pollutants. Abattoir effluents produces leachates, that spread it's effect far beyond its boundaries George, (1987) linked NO_3^- problems in New Zealand to discharge from livestock effluents. In a developing city like Minna where the awareness of the effects of abattoir is low, it is not uncommon to tap water from shallow wells close to the abattoir. Without noticing the pollution effect of the leaihates from abattoir in an investigation carried out by Sanjodoyin and Agbawhe (1992) in Ibadan it was noticed that most of the liquid waste are discharged in streams close to the abattoir. This is a practise common in all parts of the country. Tables 2.2 and 2.2 below show the investigations

Table 2.2 Characteristics of the waste water from wash down of the abattoir

Parameters	Abattoir				Bayes LSD(P=0.05) Co-effient of variation	
	Sasa	bodija	feranjeba	moniya		
p.H	8.8	8.5	8.4	8.6	1.99	0.2
suspended solids	8834	15784	13984	10723	25.42	3687
dissolved solids	830	526	860	1125	29.35	288
volatile solids	7824	13411	11139	8240	25.85	3088
total solids	9664	16310	14844	11848	22.65	3510
phosphate	115	150	168	175	17.65	316
nitrate	120	79	86	105	19.07	21.9
COD	2200	2500	2220	2935	10.53	299

All values in mg/l except pH
Source: Sangodoyin and Agbawhe (1992).

The results of the analysed effluents from the four abattoir sites showed that the waste generated included (a) solid waste made up of paunch contents, horns, bones, and faecal components. (b) Slurry of suspended solids, fat, blood, scraps of tissue and soluble material of which the latter are washed in to open drains. This effluent contains high suspended solids (SS) and exhibited a high COD. In 1984 the World Health Organisation produced evidence that nitrate was responsible for "blue baby" birth and most of the compound are traced to liquid waste from abattoirs.

2.3.2 NITRATES:

It has been suggested that some form of stomach cancer results from presence of nitrate in water or food. The huge amount of excrement (i.e. urine and manure) which are used as manure leave nitrates in the soil. In Britain, the European Union identified 52 areas where nitrate concentrations exceeded the permitted nitrate levels and it is estimated that over a million people were affected. Bottled water were then suggested for feeding mothers and their children because it was noticed that boiling the water does not remove the nitrates from the water. It is known that nitrates are produced naturally by the soil through the microbial activities in the soil in which bacteria supply nitrogen to the plants as nitrates. Also when plants decay, they supply nitrate as deposits. Most of these nitrates also enter the soil through animal manures given to farmers as fertilizers and abattoir effluents discharged into the streams. Due to these the World Health Organisation had to set a standard for nitrate concentration in the soil which in most times may be exceeded as a result of abattoir activities which deposits nitrate into the soil through its waste materials. The recommended nitrate levels is a range of 50-100mg/l in public water supplies.

2.4 WASTE CHARACTERISTICS

2.4.1 Solids and emission waste.

It is important to note that for one to understand the methods of handling and disposing of waste. There is need for a vivid knowledge of the basic characteristics of the waste in question (hammer, 1968), it could either be industrial, mining, or meat processing industry. It is interesting to note that every product ends with a final product known as waste in the abattoir industry.

After every slaughtering of animals there is always blood waste which is as a result of processing the cow to provide meat for the consuming population.

Most times people always regard waste produced by the end user as the waste product. But though the most visible, it is often minimal when compared to the waste created in the process of production. It is known that manufacturing waste is by far the greatest product of many industries during production. In the U.S.A 93% of natural resources extracted are never transformed into goods, while 80% of goods sold are thrown away after only one use. 99% of resources in a good are waste within at least 6 weeks of sales.

Though most solid waste from abattoirs are bones, slurry and punch contents, most of the wastes are suitable for degradation by micro-organisms with the exception of bones, husks and horns. The pollution potential of abattoirs has been estimated at over a million kg in Canada, 3 million kg in France (Festino and Aybart 1986).

Odours are generated as a result of microbial activities on the slurry wastes or the huge dump of horns and faeces on open fields. Emission waste is always very harmful to the senses of human. Slaughter house solid are made up of suspended solids and hair, fats, flesh, manure, grit and undigested feed Bulleal (1982). Therefore, parameters such as BOD (Biochemical oxygen demand), COD (Chemical oxygen demand) ratio and total or suspended solids ratio are used to estimate the feasibility of biological waste treatment process with specific waste. Solid waste with high organic content is transformable to activated sludge or composting. So for adequate management of solid and emission waste it is essential to know the basic characteristics of wastes.

2.4.2: Biochemical Oxygen Demand

It is the most analytical method used in waste treatment and pollution control. It is a measure of the organic material in the slurry and liquid waste which can be easily metabolized by aerobic bacteria, and which could cause depletion of oxygen and pollution of

waters. Thus BOD measures the amount of oxygen necessary to stabilize the decomposable organic matter in waste.

It is often written as BOD_5. It is the usual test that determines the amount of oxygen taken up by the bacteria metabolizing the material is 5 days under standard conditions of 20^{OC} temperature. It has been determined experimentally that the 5 day BOD is about 68% of the ultimate, when a reaction velocity co-efficient of 0.10 is used. The BOD demand usually varies in different types of waste. The BOD of beef waste water is higher than hog wastewater (Tritt and Schuchardt 1992). Due to this difference in BOD levels, BOD are estimated by first order equation:

$$\frac{dc}{dt} = -Kc \quad \text{- .....1}$$

Where K is the BOD rate constant and C is the waste concentration. And further differentiation equation will give:

$$B = A(1 - e - kt) \text{ - .....2}$$

These equations express the waste concentration in terms of the amount of oxygen required to biologically oxidize the waste, where

B = BOD exerted in time t.

A = Amount of oxygen to biologically oxidize the waste with increasing temperature.

T = Temperature

Ø = commonly taken as 1.047.

$$Kt = (K20)1.047(t - 20). \text{ - .....3}$$

BOD of most waste water effluents differs from one discharge point to another. They can be estimated using the relationship:

$$C\ bod = \frac{C_1 x\ Q_1 + C_2\ x\ Q_2 + \ldots\ldots\ldots C_n Q_n}{Q_1 + Q_2 + \ldots\ldots\ldots Q_n.}$$

Where C = Common concentration before joining the discharge path.

Q = Quantity of flow.

(Subscript) C1, C2, C3, .Cn = Concentrations of different point along the discharge path.

2.4.3 Chemical Oxygen Demand

It is a measure of the total amount of organic material which may eventually be oxidized by microbes. Large pieces of cellulose, bones, e.t.c are measured using a COD test. It is often faster than BOD since it is a rapid oxidation by the action of chemical. Like BOD (Biochemical oxygen demand), the COD of different waste differs. So the aim of all treatment is to reduce the level of the BOD or COD.

In COD the use of chemical is to hasten the rate of reaction involved in the breakdown of material discharged, from the abattoir. Sachon, (1986) estimated that the COD content of scalding water ranged from 5000 to 8000 mg/l and represented 20% of the daily polluting load from slaughter houses. It can also be estimated using equation 4 above:

$$\text{Or as}\quad C.O.D = \frac{3000\ (b - s)\ n}{\text{Sample volume.}} \quad - \ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where b = Volume of F.A.S used in blank sample

n = Normality of F.A.S

s = Volume of F.A.S used in original volume.

The strength of COD depends on the type of feed, storage time, age of animal e.t.c.

For example, the strength of abattoir waste are shown on the table below:

Table 2.3: BIOGAS FROM ABATTOIR WASTE.

WASTE	COMPARATIVE STRENGTH	B.O.D (mg/l)
Sillage	2000	40,000
Piggeries	500	10,000
Dairy produce	90	1,800
Poultry processing	50	1,000
Untreated sewage	20	400
Treated sewage	1	20

Source: Birkmose (2000).

2.4.4 Slurry of SS (Suspended Solids)

Most waste water produced in the abattoir contain high concentration of suspended solids from blood, scraps of tissues e.t.c. Suspended solids (SS) is a material which is organic or inorganic in suspension but not in solution, in a slurry.

2.4.5 Volatile Solids

Volatile components form about 70 - 82% of solid content of waste examined in Ibadan abattoirs. They are organic material in the total solids released from the abattoir which can be burnt away.

The residue represents salt grit in the original material. Volatile solids always have a high concentration of phosphate concentration which is largely from cleaning detergents used in the washing process. It contains a large proportion of fine material. It is one major characteristic of washed waste from abattoir.

2.5 METHOD OF WASTE HANDLING AND DISPOSAL.

The collection, transportation, processing and disposal of waste material, is known as waste management. Though the practice of re-using abattoir waste is not too common, this is gaining recognition with the extensive use of manure in different garden and farms all over the country. Abattoir waste is generally treated using biochemical processes which aids breakdown of the effluents. This is because the essential component of wastes are fats, proteins, nitrates and other biodegradable material.

Ponds are the simplest and the most common method used in abattoir waste handling. The major types of ponds are classified as : facultative, aerobic and anaerobic. The problem associated with waste can in general be overcome by four basic steps :

- Dumping - Which involves two practices (a) dumping (b) Covering?
- Physical treatment where dumping is not feasible.
- Return to land.
- Conventional treatment such as screening, grit removal, sedimentation, biological filter. Birkmose (2000).

2.5.1 Disposal of Waste

Disposal methods vary widely. In Australia the most common method of disposal of solid waste is land fill, these due to the land mass and low population of the country. Birkmose (2000) Although in terms of population Nigeria is dense but practises such as open land dumping is common which brings about high rate of flies, odours, and mosquitoes, Frequently, farmers and abattoirs workers dump waste in low lying land rather than processing the waste or dumping at designated dumps sites. Filling of wetlands have been a common practise for land reclamations in Bombay, Madras, Colombo. Wastes are illegally

dumped in water bodies of all kinds, while settlements are denied municipal collection services. More waste reaches the sea after being dumped illegally in drainage channels.

2.5.2 Waste Disposal in the Abattoirs

2.5.3 Rendering

Majority of wastes are collected by companies involved in rendering waste materials into bone meal, fat and tallow. Much of the product produced from these waste have commercial values. Today end products are disposed of as waste product with no commercial value.

The rendering process involves:

- The crushing and grinding of animal bye products followed by heat treatment to reduce the moisture content and kill micro organism. Separation of the melted fat (tallow) from the solid (bone and protein) is achieved through spinning or pressing.
- The solid fraction is then ground into powder; to become bone meal.

The oil (tallow) resulting from the rendering process is used in a wide range of industries depending on its quality and grade, The best quality fat, from carcases that are fit for human consumption, is rendered separately and can be used an human, animal and pet food.

2.5.4 Landfill

Disposing of waste in a landfill is the most traditional method of waste disposal, and remains a common practice in most developing countries. Historically, land fills were often established in disused mining voids or borrow pits. Running a land fill can minimise the effects of environmental problems and it is a relatively inexpensive method of disposing of waste materials. Its also very effective in the disposal of hair, stomach fibres/ residues. And fat/oil skimming. A modern landfill includes methods to contain leachate, such as clay or

plastic liners. Disposed waste should be compacted and covered to prevent windblown litters. Many land fills in other countries have gas extraction systems installed after they are closed to extract the gas generated by decomposing the waste remains. This gas is often used to generate power by burning the gas.

2.5.5 Burning

1. Dead animals may be burned in the abattoir site or it may be incinerated on site. No permit is required from DNR. There should be compliance with emission standards.

2. Burning of bones are done when the weather conditions is favourable, they should be burned to the level, where it will be easy to crush them for bone meals and products for breakable plate making. The teeth bone structure are always removed from the bones because they contain several compound which may cause disease.

3. Burning of hair are done in the abattoir premises during skin cleaning.

2.5.6 Burying

1. All dead animals, from the abattoir may be buried moderately well to excessively drained soil. Other soils may be used if artificial drainage is installed to maintain water level of more than two facts below the carcasses. It should be noted that the depth of burial shall not exceed six (6) feet. Buried animals must be immediately covered with a minimum of twenty four (24) inches of soil. The animal may be buried at the following distance.

- 200 feet from any public well.
- 500 feet from public residence.
- 100 feet from of surface water course.

2.6 Method of abattoir waste treatment.

2.6.1 Activated Sludge Process

Activated sludge process is a biological method of wastewater treatment. It is performed by a variable and mixed community of micro organisms in an aerobic aquatic environment. These micro organisms derive energy from carbonaceous organic matter in aerated waste water, for the production of new cells in a process known as *synthesis.* While simultaneously releasing energy through the conversion of this organic matter into compounds that contain lower energy, such as carbon dioxide and water in a process called *respiration.* A variable number of micro organisms in the system obtain energy by converting ammonia nitrogen to nitrate nitrogen in a process termed *nitrification.*

This consortium of micro organism, in the activated sludge process creates an acceptable quality of secondary waste water effluent and ensures stability in the micro – organism system. This process is one of the most effective methods of treating slaughter house waste.

2.6.2 Aerobic digestion

In aerobic digestion process micro organisms degrade in the presence of oxygen Belenger, (1986) described the operation of $1000m^3$ aerobic lagoon treating slaughter waste water. Though the system require daily maintenance by trained technician and daily drainage of accumulated sludge. Besides lagoons, extended aeration systems and tricking filters have been the most popular aerobic processes for the treatment of meat packing and slaughter house waste water. (Bull, 1982). High BOD removal are reported but effluent SS concentration are often elevated due to poor sludge settlement. Aerobic system, however could be used for final purification and nutrient removal, following physico-chemical or anaerobic treatment wherever slaughter houses must treat their waste water to river discharge standard.

2.6.3 Anaerobic digestion

In anaerobic digestion, organics are degraded by a diversity of bacteria into methane in the absence of oxygen. Anaerobic systems are used in Canada but they represent an interesting alternative for treatment at the plant. Anaerobic digestion is a natural process of decomposition and decay that takes place in the absence oxygen and by which organic matter is broken down to its simpler chemical component.

Anaerobic digestion process can be used to treat residue from slaughter house, livestock, and food processing industries. The waste water treatment sludge among other organic waste are turned into bio gas. Fibres from the waste can be used as soil conditioners and liquor, which can be used as liquid fertilisers. Though most post anaerobic digestion combination of fibre and liquids are termed digestate. Anaerobic treatment can be divided into two main categories low rate (lagoons) and high rate systems.

2.6.4 Biogas(gasification)

Gasification is used to convert organic materials directly into a synthetic gas of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam. Gasification is used in biomass power stations to produce renewable energy and heat. Slaughter houses, food packaging industries produces a lot of organic waste which can be converted into biogas. The energy potential of abattoir waste is as shown in the Table 2.5 below

Table 2.4 energy potential of agricultural waste

	Biogas m3 per tonne organic waste	Energy equivalent in heat oil (litres)
Cattle slurry	22	13
Pig slurry	22	14
Poultry manure	50-100	33-65
Abattoir gastro-intestinal waste	40-60	26-39
Abattoir fatty waste	>100	>65

-Biogas from agricultural and abattoir waste.
Source: Birkmose 2000.

Electricity generated from processed organic waste can displace electricity from fossil fuels. Such displacement has significant beneficial implications. First it reduces the economies over reliance on electricity from Dams (hydroelectricity) and generators. Secondly it reduces the level of carbon dioxide emission.

2.6.5 Pyrolysis

Pyrolysis of solid waste converts the materials into solid, liquid and gas products. Liquid oil and gas can be burnt to produce energy or refined into products. Waste is heated indirectly from external heat source and charred in the absence of air. It is a process of destructive distillation carried out in a closed vessel in an oxygen free environment.

2.6.6 Biofiltration

Biofiltration is very effective for managing odours problems. All odorous gases are released underneath the ground to a biofilter bed. The biofilter bed is constructed of materials such as concrete, block work and earth, and the beds layered with products such as compost and rice husks, coarse gravel, sand, pine bark and woodchips. Microorganisms in the bed break down organic and inorganic odours in aerobic microbial activity under damp conditions (humidification of odours).

2.6.7 Digesters

Digester is similar to septic tank in construction and operation. But digesters are much more controlled as the wastes treated are detained for a longer period prior to final discharge. It normally flows in a continuous basis thus providing time for optimum condition for raw waste to digest properly.

The digesters consist majorly of a pump, heat jacket, gas escape point, bafflers and bottom volume used for the removal of excess waste. The digesters contain high level of bacteria which work at different temperature normally below 40°C. These bacteria are responsible for the gradual breakdown of material deposited in it. Sometimes bacteria's work at higher temperature when thermophilic bacteria are used for the disintegration of waste produced. Waste usually enters at one end of the digester and the digested wastes are removed from the other end of the digester. The tank is sometimes single or double connection in series with different detention time and high temperature. Digesters require high insulation which is achieved by burial below the ground surface. And the release of hot water from boiler or gas line located at the top of the digester while the former is achieved by just burial below the surface.

2.6.8 Oxidation ditch

The oxidation ditch is a sort of equipment used for long –term aeration. It is similar to aerated lagoon, it consists of a long channel with depth 1.5 – 2m of an elliptical or circular shape equipped with aeration equipment called the rotor for generating a water flow and stirring water in the channel to supply oxygen. Though it requires a relatively large area, it has a simple structure and can be easily operated as well as being able to remove nitrogen easily. It is very efficient in the removal of BOD such that when BOD removal is performed, oxygen is produced after dipping depth of rotor is adjusted. Oxidation ditch is capable of treating waste that has not undergone primary sedimentation and also recycle sludge released after treatment had been done. The ditch contain more active bacteria with waste being oxidized faster thus with a much lower retention time of (½ – 1½ days).

CHAPTER THREE

3.0 METHODOLOGY

3.1 GENERAL

The methodology adopted in this study is the investigative approach, this includes abattoir visitation, and distribution of questionnaire to the management of the individual abattoirs spread across Minna, Also the assistance of experienced personnel in related fields of environmental management was consulted. This was done to get accurate information and references or guidance that is relevant to the study.

In the course of this investigation six (6) abattoirs were visited with five questionnaires administered to each abattoir visited. During the visits, interviews were conducted with some of the personnel of the abattoir who took the author round the abattoir.

3.2 PROCEDURE FOR DATA COLLECTION

3.2.1 SITE VISITATION

Six abattoirs in total were selected for the research work. The abattoirs were located in various parts of the minna. The abattoirs visited included.

1. F. layout abattoirs
2. Chanchaga slaughter slab
3. Kpakungu slaughter slab
4. Maitunbi slaughter slab
5. Manukulu slaughter slab
6. Maikunkele slaughter slab

3.2.1.1 HOW THE ASSESSMENTS OF WASTE WAS DONE

The quantification of the abattoir waste, which depends on the number of Cow, goats slaughtered, quantity of tissues, blood per cow, goat and the point of discharge of discharge of abattoir effluents, nature of the wastes, type of wastes and if types of waste were mixed or segregated. Most data were collected using participant observation and informal interview.

3.2.2 ADMINISTRATION OF QUESTIONNAIRES

A total of 18 questionnaires were administrated to the six abattoirs visited, three questionnaires were administered at each of the site visited. The questionnaire consists of the following sections.

SECTION A: It contains questions on the name of the name, location, date of interview, hours of work and number of employees.

SECTION B: This contains the various activities that take place in the abattoir like number of goats and cows slaughtered quantities of blood, tissues and intestinal contents.

SECTION C: This section contains the forms of water supply and method with which the waste are discharged.

SECTION D: This section contains various methods adopted by the abattoir at disposal of the various waste generated.

SECTION E: This deals with the various sewage management methods applied to the waste generated.

SECTION F: This deals with the various effort made by the government in order to make sure the environment is not polluted. The various questions asked in this section of the questionnaire were structured in other to give adequate information about the various abattoirs so as to aid the provisions of answers to the problems caused by these abattoirs. The questionnaires provided information on the types of waste generated, sources and problems associated with the waste generated in relation to the environment, it also provided in

formations on how the waste were managed to abate pollutions and the rating of the abattoirs in line with environment protection specifications. The details of the format are provided on the appendix 1 (behind).

3.3 METHOD OF ANALYSIS

Type of analysis and method of presentation was determined by the nature and type of data required to achieve the objective of the study. The data's are in general term bits of information and facts which make up the needed material for the subject which they relate. Tabular presentation were used to summaries the information gathered and pictures were used to further explain the level of damage being done to the respective places of concentration. For the purpose of analysis in this investigative study, objectives are classified into groups and presented in tables for easy assess to the informations on ground.

3.4 PROBLEMS ENCOUNTERED

Most of the abattoirs visited were located in areas where easy access are not granted as the roads that leads to the various abattoir are not tarred making it difficult for vehicles to ply. That results in the use of motor bikes popularly known as "okada" to the various abattoirs. The entire abattoir visited there were difficulties in locating the various management staffs as some don't often come to work. Also there was real problem of communication when interviews were conducted with some of the staffs of the abattoirs.

In some of the abattoirs visited and questionnaires administrated, answers giving were restricted as the questionnaires were misunderstood as a plot by the Government to assess their bad practice especially when pictures were taken. There were also problems of inadequate data on the amount of blood per cow and goats, quantity of tissue and weight of the cow and goat as one had to use unconventional method to assess the quantity of blood and intestinal content.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

The work covered most parts of Minna. The survey was completed after collecting 18 of the questionnaire samples distributed and given out in six abattoirs visited.

The following findings were established out of the abattoirs visited it was noted that only one of the abattoir has large area for activities, providing not just slaughter area but large holding area for animals. It was also noticed that there was no visible building for slaughter activities in all but one abattoir (Minna abattoir).

4.1 DESCRIPTION OF THE ABATTIOR VISITED

The various abattoirs visited where Local Government owned except Minna abattoir (F lay out) that is owned by the State Government. They all lacked the basic facilities needed in a standard abattoir except for Minna abattoir ironically all the facilities provided has been destroyed by those working in the abattoir. The activity in the abattoir ranges from slaughtering of cows, goats and the distribution, sales, of abattoir waste for fertilizer, breakable plate and blood meal making.

Most of the abattoirs are situated a little bit out of town which is due to the quantity of waste generated and their effect on the immediate environment. The waste generated ranges from animal excreta, bones skin trimming and punch content. Most waste from remains of grass feed eaten by the animals are dumped on open ground in the abattoir, so also are the bones while the abattoir effluent are allowed to flow into either a sewage or an open ground were it is left to constitute nuisance.

The entire abattoir visited poses nuisance such as flies, mosquito and odours from the animal holding area, dumped excreta, dumped bones and waste water stagnant a various position of the abattoir. Local Farms are located at various positions around the abattoir.

4.2 Information on the respondents and the activities of the abattoir

Each abattoir provides an average of 31.2 employments and a total 46.3 direct or indirect employment of which Minna abattoir has the highest rate of employment of 101 employees. Table 4.5 shows the summaries of all the activities carried out in the entire abattoirs visited. The entire abattoirs visited slaughtered less than 10 cows except for Minna abattoir that slaughters an average of 70 cows daily which is too much for a single abattoir. Also it was established that the entire abattoir slaughter a average of below 10 goats daily excluding Minna abattoir which slaughter a average of 73 goats daily.

The average land mass of the various abattoir were estimated as 0.854ha of land with Minna abattoir having the largest of 5ha of land, also from a rough estimate of cows and goat intestinal content it shows that between 10-50kg of content are discharged daily. Depending on the size and feeding rate of the cow and goat before slaughter. Usually cow and goat consumed about 2.5% - 3% of its body weight Adamu, (1999). This actually justifies the quantity of intestinal content.

On the quantity of punch content it is estimated that goat and cow slaughtered produce below 10kg of punch while the quantity of blood per cow and goat is estimated to be a average 33.3 litres and 4 litres. Quantity of tissue was also estimated to be below 10kg for both cow and goat.

Table 4.1: Table summaries the various activities that take place in the abattoirs

Activities	Minna	kpakungu	Maitunbi	mainukulu	Chanchaga	Maikunkele
Number of workers.	101	10	19	5	20	15
Hours of work per day.	5	3	3	2	4	3
Area of abattoir (ha)	5	0.025	0.025	0.025	0.025	0.025
No of cows slaughtered per day.	71	3	3	1	4	4
No of goats slaughtered per day.	73	8	7	5	10	8
Quantity of blood per cow (L).	33.33	33.33	33.33	33.33	33.33	33.33
Quantity of blood per goat (L).	4.2	4.2	4.2	4.2	4.2	4.2
Quantity of intestinal content per cow.(Kg)	13.5	12.5	13	13	13	13
Quantity of intestinal content per goat.(Kg)	6.25	5..5	5.75	5.75	5.75	5.75
Quantity of tissues per cow.(Kg)	Below 10	Below 10	Below 10	Below 10	Below 10	Below 10
Quantity of tissues per goat.(Kg)	Below 10	Below 10	Below 10	Below 10	Below 10	Below 10

Plate 1, 2, 3 and 4 below shows the quantity of blood, intestinal content and excreta dumps

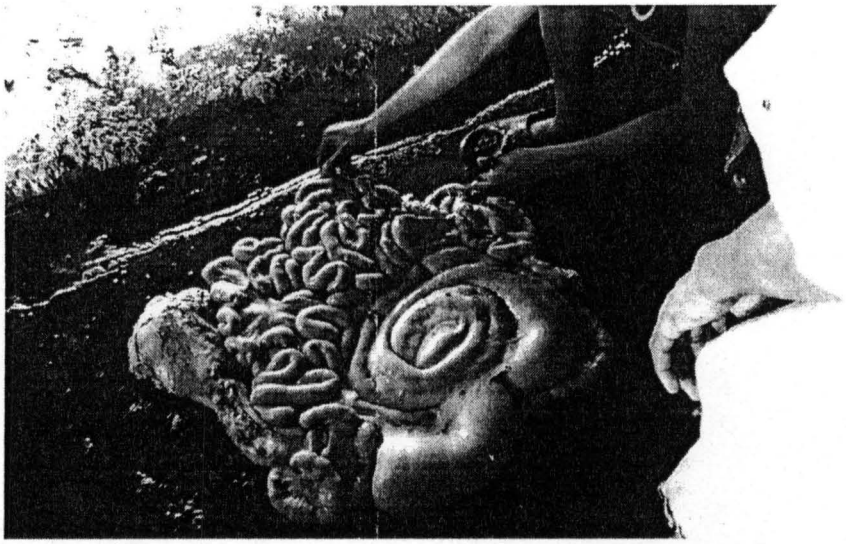

Plate 1: Removal of intestinal contents taking place at minna abattoir

Plate 2: Intestinal content dumped and excreta dumped at maitunbi slaughter slab

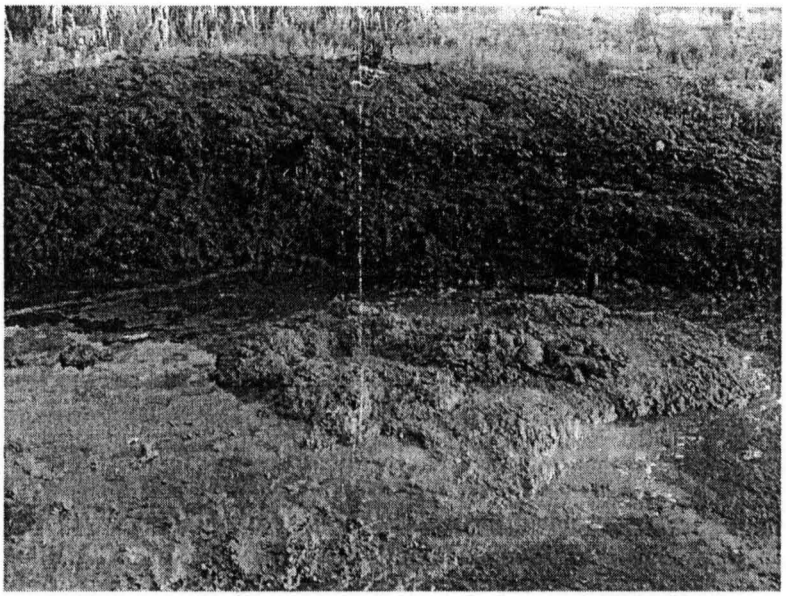

Plate 3: Intestinal content mixed with excreta and dumped in an open ground at Minna abattoir.

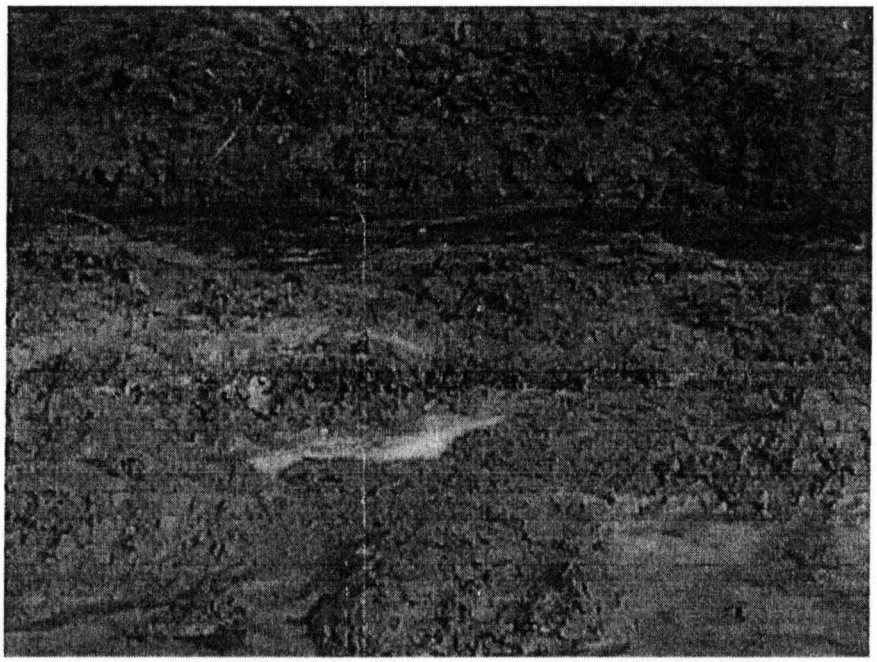

Plate 4: Intestinal content mixed with blood at maikunkele slaughter slab

4.3 Water Supply and Government effort to enhance pollution free environment

Table 4.2 shows the summaries of water supply and government effort or activities aimed at ending the problems caused by the abattoirs. Out of the eighteen questionnaires administered in the six abattoirs visited it was established that three of the six abattoir uses well as their water sources while two abattoirs use streams and one abattoir uses only pipe water as its source of water supply which is located at Mainukulu slaughter slab. It was also noted that two abattoirs use both well and pipe water as its major supplies of water.

From all the data gathered it was noted that 42.36% of the abattoir uses well, 42.36% uses pipe water while 15.28% uses streams.

Point of discharge of all the abattoirs were established to be the streams except for chanchaga slaughter slab which discharges it's liquid waste into a pond. This is shown on plate 5 below

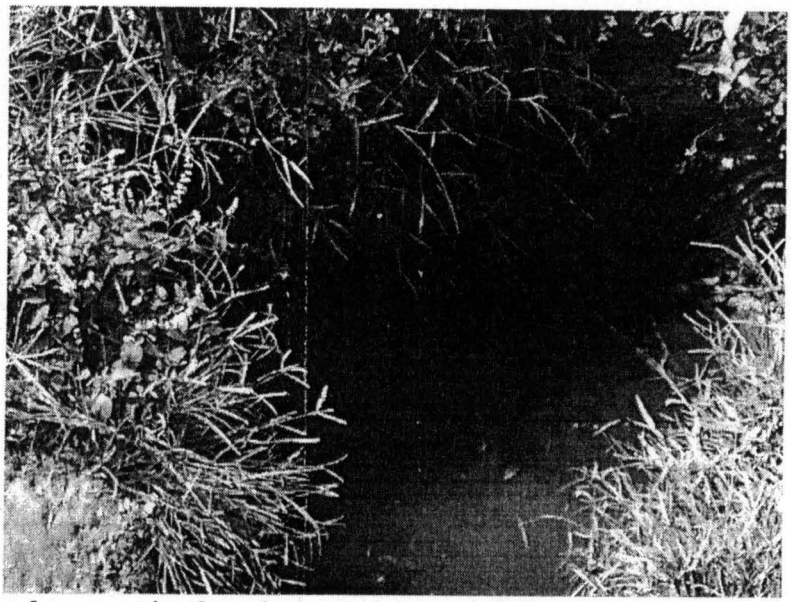

Plate 5: Pond present in chanchaga slaughter slab for the discharge of liquid wastes

83.3% of the wastes generated are all discharged in the streams and 16.67% are discharged in ponds untreated which in a way pollute the ground and surface waters. All the abattoir indicated that they discharge abattoir waste separately from domestic waste as

indicated in the table 4.2 and there was general acceptance that the nature of waste produced are in liquid, solid and slurry forms. Also all the abattoirs agreed to generation of waste from the bones, excreta, paunch content, urine and wash water except for Minna abattoir which gathers the bones and blood for sale to companies which produces blood meal and bone mill, these indicate that 100% of all the abattoir produces some type of waste.

From further investigation it was observed that most of the receiving streams are used for domestic and irrigation purpose by local farmers around the area of the abattoir. Especially maitumbi slaughter slab which is located in a swampy environment.

The entire abattoirs under investigation claim they have been visited by sanitary inspector from environmental agency at one time or the other. They also claims that government made no provision of material for treatment to enhance the safety of the discharges from the abattoirs. Finally there was also general acceptance by abattoir workers that there is no provision of direct waste evaluating personnel by the government indicating 100% neglect on the part of the government on the amount of waste generated.

Table 4.2: Water supply and Government activities.

	Minna	Kpakungu	Maitunbi	Maikunkele	chanchaga	Mainukulu
Sources of water	Well	Stream	Stream Pipe borne	Well	Pipe borne Well	Pipe borne
Point of discharge.	Stream	Stream	Stream	Stream	pond	Stream
Are the waste discharged separately	Yes	Yes	Yes	Yes	yes	Yes
Nature of waste	Liquid Solid slurry	Liquid Solid Slurry	Liquid Solid Slurry	Liquid Solid Slurry	Liquid Solid Slurry	Liquid Solid Slurry
Type of abattoir waste generated	bone excreta urine washing fluid	bone excreta urine washing fluid	bone excreta urine washing fluid	bone excreta urine washing fluid	bone excreta urine washing fluid	bone excreta urine washing fluid
Uses of receiving stream	irrigation and domestic purpose	irrigation and domestic purpose	irrigation and domestic purpose	irrigation and domestic purpose	irrigation and domestic purpose	irrigation an domestic purpose
Sanitary inspectors visit	Yes	Yes	Yes	Yes	Yes	Yes
Provision of material for treatment.	No	No	No	No	No	No
Evaluating personnel	Non	Non	Non	Non	Non	Non

4.3 Disposal effort and sewage management

With respect to the information provided by the respondents which were summarized in Table 4.3, it was established that all the effluents were discharged mixed. No regards was given to methods of management and the entire abattoir do not apply any form of treatment to the effluents before discharge.

There was also general acceptance that various abattoir discharge are continuous during the duration of the slaughtering and processing of Minna abattoir claimed not to

dumping waste because it could be cleared at any time, While the other abattoir accepted dumping as general method of disposal. Topography of the various abattoir visited allowed gravity flow except maitunbi slaughter slab which is located in a swampy area with stagnant water in the area.

There was basically no attempt at waste recycling in almost all the abattoirs visited except in Minna abattoir who claims they sale the bones and blood to bone and blood meal manufactures after dumping huge deposit of bones as can be noticed in plate 6 and 7. As for type of toilet used the entire abattoir indicated the use of bush except for Minna abattoir which claims to have a water cistern indicating that 16.67% of the entire abattoir has water cistern while 83.33% of the abattoir use the bush. Also the entire abattoir agreed to not giving their waste any form of treatment.

Table 4.3 Summary of Effort at Disposal and Sewage Management for the entire abattoir

	Minna	chanchaga	maitunbi	maikunkele	kpakungu	Mainukulu
Effluents type disposed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed
Kind of treatment applied	Non	Non	Non	Non	Non	Non
Frequency of discharge	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Does Topography allow gravity flow	Yes	Yes	No	Yes	Yes	Yes
Any attempt at recycling	Non	Non	Non	Non	Non	Non
Type of toilet	Water cistern	Bush	Bush	Bush	Bush	Bush
Treatment and discharge	Non	Non	Non	Non	Non	Non

Plate 6: Gathered horns at minna abattoir

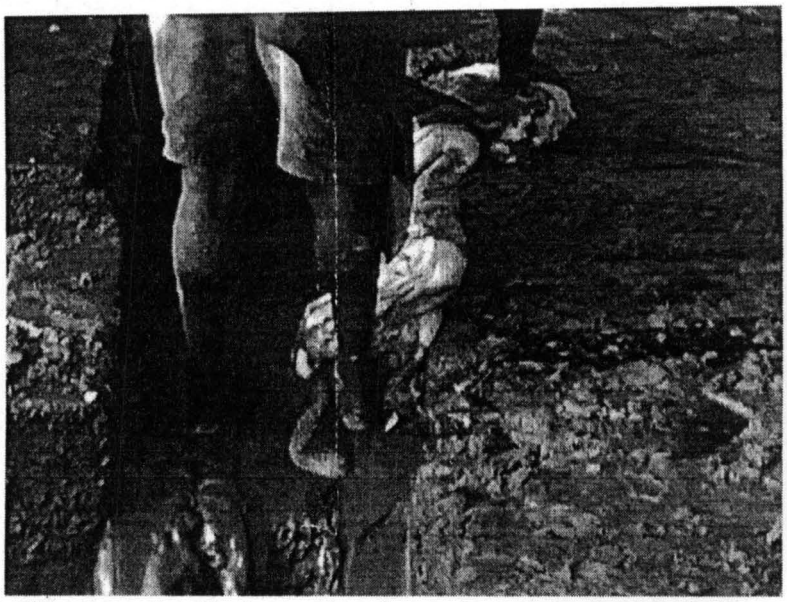

Plate 7: Waste water discharge at minna abattoir untreated2.72

4.4 Health Impacts

Environmental problems faced by communities and settlements /residents around the abattoir include: air pollutions from smoke, odours from burnt hair and skins, excreta of animals and odour from waste water and blood content. Most cities like Minna suffer from odour. A vivid example is in the Kpakungu abattoir in Minna.

Other health problems are diseases from flies, mosquitoes and rodents. Diseases which include malaria, diarrhoea, dysentery e.t.c. Some infection acquired from meat and food handlings are anthrax, Q- fever, campylo bacteria, Newcastle disease, and rift valley amongst others. Long term health problems like asthma, bronchitis, hepatises, jaundice, and typhoid too have been faced by communities based on statistics. It is known that the largest percentages of people affected are women and children.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study has provided data base for which waste from the various abattoirs can be estimated which would help the agricultural engineers to take the necessary procedure or precaution while trying to proffer solutions to the problems noticed in the abattoir.

It should be noted that due to urbanization there would always be increase in population which would in turn increase consumption of meat, therefore good information on the abattoir waste will go a long way to estimate possible problems and proffer suggestions on how to curb the menace created by abattoir waste. Finally this quantification would go long way in assessing the impact of waste on the environment at large.

5.2 RECOMMENDATIONS

The problems of waste generated in an abattoir can be better managed and corrected if proper assessment of the amount of waste generated are properly documented. This would help in accurate prediction of the best method to manage the waste generated. In order to reduce the rate of pollution, it is recommended that the excrement must be discharged or disposed of into soils at rates not exceeding the recommended rates given by the environmental body. This is with a view to avoiding salt accumulation and nitrate accumulation in the soil.

The data of the quantification will aid the development of appropriate technology which will take care of all the waste being generated in the abattoir including waste water treatment and recycling for irrigation purpose. There should be extensive use of compost and biogas produced from waste decomposing in the generation of electricity for the abattoir and

the environment at large. The abattoir electricity supply would in a way help in the generation of revenue for the local government.

Anti odour chemicals should be used to suppress odour form animal waste and flies nuisance in the environment, also wedge wire screen should be used to remove the suspended solid material from the effluents prior to discharge to streams. The use of aerobic digestion method should be practised since it takes lower retention time to reduce the BOD. Another method is the trickling filter aerobic method which can take smaller land size.

It was also suggested that the use of more sophisticated weighing equipment to determine the daily intestinal content per animal is needed. Finally waste assessment and quantification should be integrated as part of activities carried out in the abattoir. This would go a long way in reducing the effects of waste generated to the environment and additional abattoir should be built to compliment the only existing one (Minna abattoir) as large amount of waste are generated in relatively small area which is not good for the Minna environment.

REFERENCE

Abiola, .S .S (1995); Assessment of abattoir and slaughter slab operations in Oyo State, Nigeria. Journal of animal production, 5: 54-46.

Abimbola Sangodoyin (1993), Considerations by contamination of Groundwater by Waste Disposal Systems in Nigeria. Environmental Technology, vol 14, Pp957-964

A. Y. Sangodoyin and O.M. Agbawhe (1992), Environmental Study on Surface and Groundwater Pollutants from Abattoir Effluents. Bio resource Technology, vol41, 193-200.

Clement Solomon, Peter Cassey and Andrew Lake. (1998) Tricking Filter: Achieving Nitrification. U.S Environmental Protection Agency, National Small flow clearing house Pp 1-2

D.I .Masse and L Masse (2000); Characterisation of waste water from hog slaughter houses in eastern Canada and evaluating of their plant waste water treatment systems Canadian agricultural engineering, 42: 139 – 145.

Edward, (1980), in Gasse. J K R (1984); Composting of Agricultural and other waste 2nd Edition Pp20.

EI- Sharkawl (1970) and Raymond C. C (1974); Agricultural Waste Management Problems, Process and approach. Department of agricultural Engineering Council University Ithaca New York Harcourt B. J Press London, Pp 140-143

Environment protection agency (EPA) (2005) Anaerobic Digestion: benefits for waste management, Agricultural energy, and environment.

Hammer. M. J and C. L. Weber (1968); field studies of an anaerobic lagoon treating slaughter house waste. Proceeding Purdue industrial waste conference, 22: 126-137.

Hillman. L. H (1970) pollution Factors associated with excessive poultry litter (Manure) Application in Arkansas. Proceedings of Agricultural Engineering waste management conference Cornell University Ithaca New York. 4: 110-111

Hill M. E. (1972) "Heavy Manure Applications benefit or waste P'' Proceeding on animal waste management conference, cornell University Ithaca, New York. Third edition Pp30.

Kelvin .T.P (1984); An Introduction to Global Environmental issue "nitrate and other dangerous organic chemicals". Butter and Tanner Limited. Frome and London. Pp 145-147.

Olanike .k. Adeyemo, (2002) Unhygienic Operation of a City Abattoir in South Western Nigeria." Environmental implication" 4:23-28.

Ogbonna .O (1992), Resource Mapping of Agricultural Waste and Residue NCAE, Silsoe Harcourt B. J Press Pp 131-142

APPENDIX 1

Research questionnaire

QUESTIONNAIRES ON THE ASSESSMENT OF MAJOR ABATTOIR WASTES IN MINNA, NIGER STATE

The interview questionnaire is strictly for research purpose and any information given or released will be treated with maximum confidentiality.

SECTION A

GENERAL

1. Name of Abattoir .....

2. Address/Location of Abattoir.....

3. Date of Interview.....

4. Hours of work ☐

5. No of Employees ☐

6. Sex of Respondent Male ☐ Female ☐ .

SECTION B

ACTIVITIES OF THE ABATTOIR

1. Number of Cows Slaughtered per day.

(a) Below10 ☐ (b) 11-20 ☐ (c) 21-30 ☐ (d) 31-40 ☐ (e) 41-50 ☐

(f) Above 50 ☐ Specify.

2. Number of Goats slaughtered per day.

(a)Below 10 ☐ (b) 11-20 ☐ (c) 21-30 ☐ (d) 31-40 ☐ (e) 41-50 ☐

(f) Above 50 ☐ Specify

3. Quantity of Intestinal Contents per Cow.

(a) Below 10kg ☐ (b) 11-50kg ☐ (c) 51-100kg ☐

(d) Above 100kg ☐

4. Quantity of Intestinal Contents per Goat.

☐ ☐ ☐

(a) Below 10 kg (b) 11-50 Kg (c) 51-100 Kg

(d) Above 100 kg

5. Quantity of Tissues per Cow

(a) Below 10 Kg (b) 11-50 Kg (c) 51 – 100 Kg

(d) Above 100 Kg

6. Quantity of Tissues per Goat.

(a) Below 10 Kg (b) 11-50Kg (c) 51-100 Kg

(d) Above 100 Kg

7. Quantity of Blood per Cow.

(a) Below 10 litres (b) 11-50 litres (c) 51-100 litres

(d) Above 100 litres

8. Quantity of Blood per Goat.

(a) Below 10 litres (b) 11-50 litres (c) 51-100 litres

(d) Above 100 litres

SECTION C

WATER SUPPLY/ DISCHARGES

1. Sources of Water for the Abattoir (a) Well (b) Borehole (c) River

(d) Pipe borne water

2. Point of Discharge of Abattoir Effluents. (a) Sewer (b) [illegible] (c) Streams

(d) Water course (e) Others Specify

3. Do you discharge the following waste (a) Domestic waste (b) [illegible]oir wastes

(c) Canteen wastes. Separately?

Please give details.....

.....

.....

4. Nature of Abattoir Waste (a) Liquid (b) Solid [illegible]y

(d) Other Specify

5. Types of Abattoir Waste Generated. (a) Bones ☐ (b) Skins ☐ (c) Excreta ☐

(d) Punch Content ☐ (e) Blood ☐ (f) Urine ☐ (g) Washing Fluids ☐

6. Uses of Receiving Stream (a) Domestic washing ☐ (b) Irrigation ☐

SECTION D

EFFORT AT DISPOSAL

(1) Are the different types of Effluents mixed? ☐ Segregated? ☐

(2) Is treatment of any kind employed (a) Yes ☐ (b) No ☐

If yes please give details.....
.....
.....

(3) What is the frequency of intermittent discharges?
Is dumping necessary?

.....

.....

(4) Does the topography of the area allow gravity flow? .....

(5) Are the effluents used for any purpose? Any attempt at waste recycling. (a) Yes ☐

(b) No ☐

SECTION E

SEWAGE MANAGEMENT

(1) What type of toilet do you use? (a) Water cittern ☐ (b) Pit Latrine ☐

(c) a and b ☐ (d) Bush ☐

(2) How do you treat and discharge your waste. ?

(a) Deposited in burrow pits or trenched and covered ☐

(b) Chlorination and discharged into lagoons ☐

(c) Use of septic tank ☐ (d) all of the above ☐ (e) none of the above ☐

SECTION F

GOVERNMENT ACTIVITES IN MAKING SURE THAT THE ENVIRONMENT IS NOT POLLUTED

(1) Have the Abattoir been visited by Sanitary Inspectors. (a) Yes ☐ (b) No ☐

(2) Is there any provision of materials for treatment? (a) Yes ☐ (b) No ☐

(3) Is there any provision of direct waste evaluating personal? (a) Yes ☐ (b) no ☐

(4) Total number of people working directly or indirectly in the Abattoir?

.....