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Research Paper

Infrastructure Challenges: the Review of Environmental And Health Implication of Abattoir operation in A Developing Country

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ABSTRACT: *Infrastructure provision in Nigeria began as far back as 1917 when colonial government promulgated the township ordinance in an attempt to solve environmental and public health related issues among other things.One of the most persistent and challenging problems still facing developing nations' cities and urban centers is inadequacy of urban infrastructure and subsequent deterioration.The implications of these inadequacy and deterioration of services, result to worsening of urban environmental and individual health conditions. This paper review infrastructure challenges, environmental and health implication of abattoir operation in a developing countryby identifying operational requirements of a standard abattoirs and operational process, abattoir wastes generation, disposal techniques, and characteristics of the abattoir wastes and their environmental impacts, prevalence of diseases amongpatient, and correlation coefficients of infections and prevalence of tuberculosis in human and bovine. The findings revealed that, abattoir operation and management have direct and indirect impacts on the environment and public health of residents within abattoir vicinities. These are pollution (noise, air(offensive odour) and water. it is recommended that waste generated should be disposed by rendering techniques as one of the best options. Adequate facilities for hygienic operation should be provided.Public health personals should certify day-to-day operational processes and public should be enlightenedon the negative impact of the operational process.*

Keywords: *Infrastructure, Abattoir, Environmental, Health*

I. INTRODUCTION

Infrastructure is an umbrella covering facilities necessary for a system to function efficiently. It is also the totality of basic physical facilities upon which a system depend on to function i.e. economic, social, physical or environmental. However, its provision in developing nations are either minimal, inefficient, overstretched or absent.The report on Nigeria is like any other developing nation revealed the same pattern (Onibokun, 1996; Agbola, 1998; Nubi, 2000; Ajanlekoko, 2001; Oyedele, 2006). The challenges of infrastructure in developing nations are numerous; these include finance, technology for development, maintenance and design etc.and its failure poses a lot of danger to the environment and health of humanity. Oyedele, (2012) reported that, most infrastructure are decayed and need repair or replacement. Ogu (1999), also reported that inadequacy of infrastructure services and deteriorating urban environment are inter connected.

The implication of the lack of this services among other things, include the worsening of urban environmental conditions and heath of individuals,decay and routine maintenance is virtually non-existent (Oyedele, 2012). Abattoir Act 1988 defined abattoir as "any premises used for, or in connection with the slaughter of animals whose meat is intended for human consumption and include a slaughter house, but does not include a place situated on a farm". Animals in this case include cattle, sheep, pigs, goats and other acquine animals. Alonge (2005) defined abattoir as "a premises approved and registered by the controlling authority for hygienic slaughter and inspection of animals, processing and effective preservation and storage of meat products for human consumption". Slaughter houses act as the starting point in the meat industry, where stock come from farms or markets to enter the food chain.

The most important issue in all meat processing plants is maintenance of proper hygiene and adequate sanitary conditions. While slaughtering of animals results in meat supply and useful by products like leather and skin, livestock waste spills can introduce enteric pathogens and excess nutrients into surface waters and can also contaminate ground waters (Meadows 1995).

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Abattoir operations produce a characteristic highly organic waste with relatively high levels of suspended solid, liquid and fat. The solid waste includes condemned meat, undigested ingest, bones, horns, hairs and aborted fetuses. The liquid waste is usually composed of dissolved solids, blood, gut content, urine and water (Akinro et al, 2009). Animal food is always microbiologically contaminated by organisms living in it naturally or entering it from surroundings such as those resulting from processing operations (Lewicki 1993). Meat quality control therefore is a system that regulates the measure of extrinsic materials such as chemical residues, toxins, pathogenic micro-organisms and putrified tissues which could be present in meat and are deleterious to human health (Olusaga et al, 2000). In the production of animals for food, more attention should be focused on the interaction between the production processes and environmental conditions this is to avoid contaminations by bacteria and the associated health risk. Abattoir waste has been known to pollute, land, air as well as sources of waters around it.And water borne diseases such as typhoid fever, dysentery, and diarrhea have been found associated with it (Bello et al, 2009). It on this note, this paper review the health and environmental impact of abattoir operation in a developing country.

Operations And Requirements Of A Standard Abattoir

The location of abattoir shall be suitable i.e. distant from residential area that will not cause danger, annoyance and damage to the persons and one's property. The location of abattoir shall not be in an area risk of flooding, land collapse, causing construction damages. There shall be enough spaces for lairage, road, parking, office, waste water treatment, and other necessary areas. The road in abattoir area shall be maintained in good working condition and free from dust. Entrance and exit for live animals and carcass shall be separated. Water drainage system shall be in place. The location of the abattoir shall have convenient transportation and adequate public utility. The abattoir shall have fences to protect entrance of person and animals, such as dogs and cats. The abattoir shall not be located in the risk area which can be contaminated with hazardous substances from agriculture and manufacturing industry. (TAS, 2004)

For food safety reasons, the layout of an abattoir must provide for the prevention of cross contamination and adequate separation of incompatible activities. The construction of the building and the equipment used in abattoirs must prevent proper slaughter and processing, allow for ease of cleaning and sanitation and be properly maintained (Ontario, 1995). Every approved abattoir shall be supplied with electricity at a tension sufficient to provide adequate lighting, heating and cold storage. The dressing area and bleeding area of every approved abattoir shall be provided with a sink and soap or detergent for the washing of hands together with a hose connection for the supply of a high pressure water jet of at least 2 atmospheres for washing carcasses. Every approved abattoir shall be supplied with water in sufficient quantity to comply with regulations made under this Act, and in any event shall be piped at a pressure of not less than 2 atmospheres. All water supplied to the abattoir shall meet the standard of portability required for human consumption in urban areas (Abattoir Act, 1988)

The layout of every approved abattoir shall be such that hanging rail transport for carcasses in the suspended position is provided in such length and arrangement that the total number of animals to be slaughtered in one day can be dressed in one continuous operation without touching or contaminating each other. All equipment used in an approved abattoir shall be of non- degenerating metal or plastic and shall include - easily washable metal or plastic wheeled containers for the removal of stomachs and intestines of slaughtered animals; hooks, trays and tables to permit the inspection of offal and heads; and equipment for holding, cutting, scrapping, hoisting of carcasses or their parts (Abattoir Act, 1988)

Meat shall be inspected by a meat inspector or veterinary officer at the abattoir at the time of slaughter for the purpose of ascertaining whether it is fit for human consumption. The whole carcass together with all the offal, head, feet and hide shall be presented for inspection and be identified with the animal previously notified as intended for slaughter in accordance with section 24. In the event of any abnormal cutting or removal of parts before inspection The whole carcass may be seized and destroyed by the meat inspector after written notice to the owner or his agent in charge of the abattoir of his intention to do so, stating his reasons (Abattoir Act, 1988)

A Typical Abattoir Operational Process In Developing Country

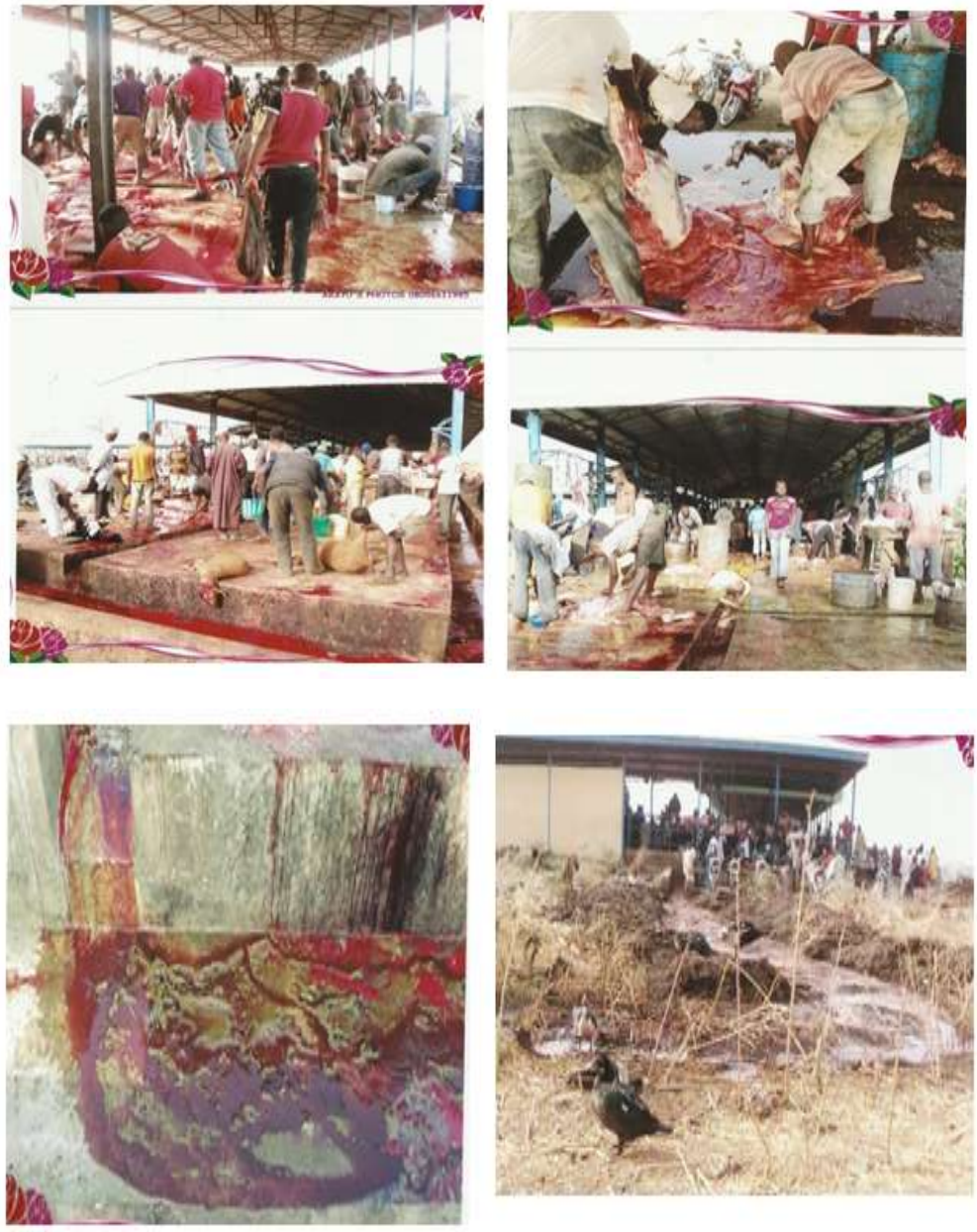

Plate 6: Bauchi Abattoir Showing Blood Waste

Quantity of abattoir waste generation.

Various studies have shown that the characteristics of abattoir waste and effluent vary from day to day depending on the numbers and type of stocks being processed (Keely and Quin 1979, Litchfield 1980, Tove 1985, Adeyemo et al, 2007). Sridhar (1998) reports that a cow brought for slaughtering produces 328kg of waste in the form of dung, bones, blood, horn, and hoof. Robert (2005) submitted that on average 45% of each live beef animal, 53% of each sheep, 34% of each pig consists of non-meat substances.

Table 1: Quantity of waste generated in some selected countries

Country	No. of animals	Weight in Kg
U.S.A	9 billion	2952billion
Canada	650 million	213200million
European Union	300 million	98400million
Nigeria	100 million	32800million
Rwanda	108, 056	35,442368

Source: Afler Sidhar (1998)

Table 2: Quantity of waste generation in some selected abattoirs in Nigeria.

Town	No. of Cattle	Weight in Kg
Gombe	50	16,400
Bauchi	25	8,200
Lagos	1000	328,000
Ogbomoso	15	4920
Jos	45	14706

Source: AflerSidhar (1998)

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Waste Disposal Technique

Abattoir wastes are mainly two types' solid waste which include condemned meat, undigested indigesta, bones, hairs, horns and aborted foetuses and abattoir liquid waste which include dissolve solids, blood, gut content, urine and water. (Akinro et al, 2009). Abattoir, liquid waste because of its peculiar nature should be disposed of using technical methods, Such as nitrification.However in most developing countries which include Nigeria. Adeyemo (2007) observed that the method of disposal is dumping. Dumping refer to disposal by leaving waste in fields, on unused acreage or in waterways discharge directly on land or into channels, ponds and streams around the abattoirs.

Plate1. Most waterways at the Bodija abattoir are filled with solid wastes dumped as observed here.

Plate2. The main drainage filled to the brim with waste fluid and solid wastes from cleaning processes.

Okinro et al (2009) reported that Animals Slaughtered in Ararami Abattoir alone accounts for about 6.5% of the total animals in Akure the Capital of Ondo State. The waste from the slaughter and dressing grounds in the abattoir are washed into open drainages untreated. At Zoo town Port-Harcourt slaughter house waste are channeled directly into a portion of one of the tributaries of the River Niger in Nigeria (Odeyemi 1991). In Bodija abattoir Ibadan Adeyemi et al (2011) reported that waste from slaughtering and dressing grounds in Bodija abattoir are washed into drainages untreated and dumped. In Oko-Oba abattoir Agege Lagos waste from the 1000 cattle slaughtered daily are washed into the Lagoon and open drainages (Medwell Journals 2011).

In Inkil abattoir the main abattoir in Bauchi town the writer observed that waste from the abattoir operation is dumped on open space and the liquid channeled into open drainages A B.B.C report monitored in Gombe on 10th October, 2011 stated that waste from Bacharawa abattoir in Ungogo Local Government in Kano was channeled into open drainage and adjacent pond. In Tamale Ghana et al (2011) reported that waste from tamale abattoir was channeled into streams. In Kumasi abattoir for instance the solid waste from the abattoir is dumped into the Subin River about a kilometer upstream. (Weabong 2011). In Blantyre Abattoir Malawi the waste from the abattoir is discharged into the Mchesa Stream (Kosamu et al 2011). In Kigali abattoir Ruwanda waste from the Kigali abattoir is discharged into the Mpazi River (Muhirwaet al, 2007).

Environmental And Health Implication Of The Wastes
Essential Elements And Their Environmental Impacts

The elements of Nitrogen and phosphorous are essential nutrients for life. Nitrogen can exist in the environment in several forms, whereas phosphorous is usually present as phosphates (Johns et al 2010)

Table 3: Common forms of Nitrogen and Phosphorous in the Environment.

Nutrients	Forms	Chemical Formula
Nitrogen	Ammonia	NH_3
	Amine (organic)	NH_2
	Nitrite	NO_2
	Nitrate	NO_3
	Nitrogen gas	N_2
	Nitrous Oxide	N_2O_3
Phosphorous	Phosphate	PO_4

Source: (Johns et al 2010)

Many organisms are able to grow if these two nutrients are available even if soluble carbon (i.e BOD) is not, for example photosynthetic organisms (particularly all micro-algae) can obtain carbon as carbon dioxide from the air and can obtain energy from photosynthesis. Some micro algae can grow even if oxygen is not abundant but phosphorous is present. Notable examples of this type of organism are the toxic blue-green algae which can fix carbon and nitrogen from the air and energy from the sun. Consequently treatment of waste water to reduce BOD will not prevent problems on final disposal of waste water if it contains high quantities of nitrogen and phosphorous.

Ammonia levels in waste water may be constrained by discharged licence conditions (i.e less than $10mg/L^1$). Furthermore ammonia will be converted into nitrate by bacteria process which depletes a river of oxygen.

The presence of Nitrate (an oxide form of ammonia) in waste water leads to problems with both lands (i.e) irrigation and disposal to water bodies. Nitrate added to land suffers three fates.

1) Uptake by plants (typically no more than 350kg/N/ha/yr
2) Conversion of nitrous oxide and nitrogen gas by soil bacteria and subsequent release to the atmosphere.
3) Leaching into ground water.

Excessive loadings of nitrate, ammonia or organic nitrogen on to land will result in more nitrate being available than can be taken up by the plants or lost by denitrification. This will lead to nitrate contamination of ground water, which can render it unfit from human and animal consumption. This is a form of pollution which is extremely expensive to remediate. Nitrate in waste water discharge to rivers or lakes will lead to rapid and excessive algal growth and subsequent eutrophication of these water systems with attendant fish kills and unpleasant odors. Phosphorus has more insidious impact. Phosphate irrigated to land is taken up by plants to a small degree (on average 30kg/ha/yr). However it is relatively immobile in soils which can fix 800 – 1500kg/ha/yr depending on soil type. However the discharged of phosphorus to water systems promote growth of algae, and in the presence of low nitrogen concentrations particularly favour toxic blooms of blue-green algae. For these reasons, nutrient limits are being placed on waste water discharges particularly into water systems or on land. Typical limits vary considerably. They are compared with typical values found in abattoir waste water.

Table 4: Nitrogen and phosphorous concentration in abattoir waste water and its specified limits.

	Total Nitrogen concentration mg/L1	Total Phosphorous concentration mg/L1
Abattoir waste water	100 – 250	20 – 50
Regulatory limits	2 – 5	0.5 – 2.0

Source: (Johns et al 2010)

Table 5: concentration of N and P mg/L in other nutrients

Source	Nutrients	
	N	P
Blood	24,000	1500
Urine	148	40
Waste water	100 – 400	30 – 50
Typical limits	5 or less	0.5 – 2.0

Source: (Johns et al 2010)

Another large source of phosphorous is the use of phosphate base detergents. Other environmental problems include pollution of the soil with dung and the atmosphere with methane (a greenhouse gas). Manure also produces nitrous oxide which is the most damaging of the greenhouse gases being 320 times more effective than carbon dioxide at holding heat in the atmosphere (Barrett 2001) While slaughtering of animals results in significant meat supplies, a good source of protein and production of products such as leather, skin and bones, livestock waste spills can introduce enteric pathogens and excess nutrients into surface waters and can also contaminate ground water (Meadows 1995). Improper disposal abattoir waste can also lead to environmental pollution and other health hazard that may threaten animal and human health. (Alonge 1991).

Table 6: some human infections acquired from meat and handling of meat products.

Bacterial	**Viral**	**Parasitic**
Anthrax, Q-fever, Campy-lobacteriosis, ornithosis, bululisin, staph, food poisoning salmonellosis, brucellosis, erysipelas, clostridiosis, streptococcosis, tetanus, yerslniosis, listeriosis, glanders, leptrospirosis tuberculosis	Rift valley, fever, Newcastle disease, vesicular stomatic, contagious ecthya	Taeniosis Toxoplasmosis Echinococcosis (indirect) SarcosporidiosisTrichlorillosis Fungal dermertophytosis.

Source: Akinro et al (2009)

In a study of Akure Abattoir Akinro et al (2009) determined the physiochemical and biological organisms' characteristics of effluent from Arorami abattoir. He found that the mean PH in the sample water was 7.41 while WHO standard is 6.5 – 8.5 but the total dissolve solid (TDS) was far in excess at 240mg mm/L. Odour from the abattoir was foul (offensive) table 2 and 3.

Table 7: Physiochemical Characteristics of Abattoir Effluent.

Parameter tested	Mean
Temperature	$27.3^{o}C$ (± $9.25^{o}C$)
P.H	7.41 (± 0.26)
Colour	Dark brown
Odour	Foul
Conductivity	$19.0x10^{3}$ (± 8.25)
Acidity (ppm)	0.9 (± 0.13)
Alkalinity (mg/L)	0.4 (± 0.05)
Dissolved Oxygen (ppm)	2000 (± 2.31)
Total dissolved solid (mm/L)	240
Total suspended solid (mm/L)	480
Total solid (mm/L)	685
Biochemical oxygen demand (BOD) (mm/L)	42
Total Hardness	172.5
Chloride (mm/L)	4.6
Calcium	83
Magnesium	No
Aluminium	No
Lead	No
Iron	7.3

Source: Akinro et al (2009)

The high level of total suspended solids and conductivity indicates that the samples were heavily loaded with colloidal, organic, inorganic and suspended matters.

Table 8: Counts of Biological Organism in Samples Effluent per 100mL.

Sample	**Coliforms**	**Other enteric bacteria**
A	184	$7.30x10^{6}$
B	191	$7.64x10^{6}$
C	188	$7.10x10^{6}$
D	185	$7.43x10^{6}$
E	100	$7.25x10^{6}$

Source: Akinro et al (2009)

The result indicated that the various samples were infected with E.Coli and other enteric bacteria. It can be deduced from table 11 that all the water samples used for the test were polluted biologically beyond permissible limits. The presence of coliform staphylococcus aurens was confirmed in the abattoir. The presence of this bacteria in intolerable number obviously constitute a serious public health hazards as the presence of these microorganisms is associated with water borne diseases since the waste is discharge into the streams. Further observation showed that the surroundings of the abattoir gave offensive odour and bread mosquitoes and flies.

In Bodija Abattoir Ibadan Adeyemo (2007) found that improper disposal of waste at the abattoir was a major source of pollution of the stream where it was discharged. He also reported soil pollution due excessive dumping of dung. Offensive odour around the abattoir was also reported. He also reported the presence of wild carnivores, rodents and flies that are attracted to the abattoir. Similarly cadmus et al 2008 observed the presence of tuberculosis and other disease from the animals sceened and slaughtered of the abattoir table.

Table 9: Sex and Age range distribution of different Animals slaughtered for food

		Cattle	Goats	Sheep	Pigs	Total
Sex	Male	3517	4518	24	189	8248
	Female	5211	2110	28	404	7753
Age	Young	1403	123	0196	1722	
	Aduk	7321	6505	52	397	1427
	<1 year	4	0 0	00		
	Total	8.7286.628	52593	1600		

Table 10: suspected diseases and conditions observed in animals slaughtered for food during the study

Disease/condition	Cattle	Goat	Sheep	Pigs
Tuberculosis	53 (0.61%)	2 (0.03%)	0 (0.00%)	0 (0.00%)
Slaughtered pregnant	82 (0.94%)	29 (0.44%)	0 (0.00%)	4 (0.67%)
Paraphistomosis	26 (0.3%)	25 (0.38%)	0 (0.00%)	0 (0.00%)
Slaughtered dead	20 (0.23%)	0 (0.00%)	0 (0.00%)	2 (0.34%)
Fascioliasis	88 (1.01%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Cysticercosis	5 (0.06%)	139 (2.1%)	0 (0.00%)	6 (1.01%)
Streptothricosis	8 (0.92%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Lumpy skin disease	3 (0.34%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Demodecosis	2 (0.02%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Dermatophilosis	2 (0.02%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Pyometra	1 (0.00%)	0(0.00%)	0(0.00%)	0(0.00%)
Lung abscess	3(0.03%)	0(0.00%)	0(0.00%)	0(0.00%)
Vaginal prolapses	2(0.08%)	0(0.00%)	0(0.00%)	0(0.00%)
CBPP	7(0.08%)	0(0.00%)	0(0.00%)	0(0.00%)
Ascariosis	0(0.00%)	0(0.00%)	0(0.00%)	10(1.69%)
Pimply gut	15(0.17%)	74(1.11%)	0(0.00%)	0(0.00%)

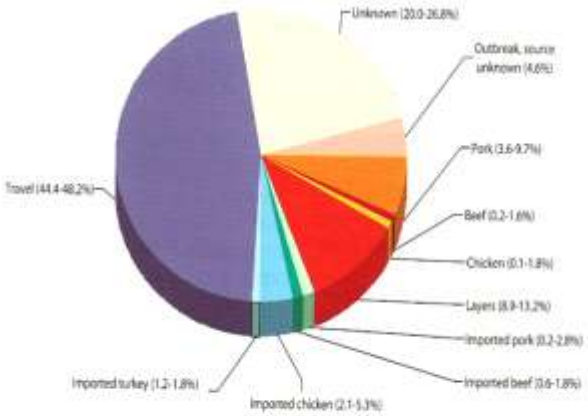
In his study of abattoir activities in Ogbomosho Bello et al (2009) found that bad odour limits residents' outdoor activities. 94% of the residents reported of increase in flies and mosquitoes. Microbial test carried out on sample of water at the abattoir and resident wells indicated pollution of water quality. Results revealed the contamination of water by the waste from the abattoir with a total of sixty-six (66) organism belonging to seven different generate of public health importance were isolated from the samples. Noise was another problem reported by the residents. He also reported elevated systems of headache, excessive coughing, and shortness of breath, heartburn, diagrrhea, typoid fever and general body weakness. In Inkil abattoir in Bauchi the writer observed offensive odour as you approached the abattoir. Also no proper waste disposal techniques are used in the abattoir. Waste is dumped on the surface and adjoins channels which attracted vectors like ducks etc. A B.B.C report monitored in Gombe on 10th October, 2011 residents in the neighborhood of Bacharawa Abattoir in Ungogo L.G.A Kano city complain of pungent smell emanating from polluted drains from the abattoir. They also reported that their water wells were polluted because when children are bathed the hairs on the body will stand and their body prolong itching. They also complain that they hardly stay outside their houses because of the smell.

Medical experts were reported by Adeyemi (2004) to have associated some diseases with abattoir activities which include pneumonia, diarrhea, typhoid fever, asthma, wool sorter diseases, respiratory and chest disease. E. Coli infection source was reported to be due to undercooked beef which has been contaminated in abattoirs with feasces containing the bacteria (Encarta 2005).

Cooper et al (1979) reported that abattoir effluent reaching streams contributed significant levels of nitrogen, phosphorus and biochemical oxygen demand and other nutrients resulting in stream pollution. George (1987) attributed excessive nitrate problem in New Zealand ground waters to concentrated livestock and manure usage. Sangodoyin et al (1992) also report ground water quality in the vicinity of the abattoir was adversely affected by seepage of abattoir effluent as well as the water quality of receiving streams Carolyn et al (1985) reported that pathogens from cattle can be transmitted to humans through water based recreation. In Tamale abattoir Ghana Woehonget al, (2011) reported that water quality of influents and effluents as well as noise generated at the abattoir exceed Ghana standards. Generally the influent met the recommended standard for treated water quality except for fecal and total Coliforms counts of 36 and 84 CFU respectively instead of OCFU recommended By EPA. The effluent was highly polluted and did not meet the set standard for effluents discharges into the environment.

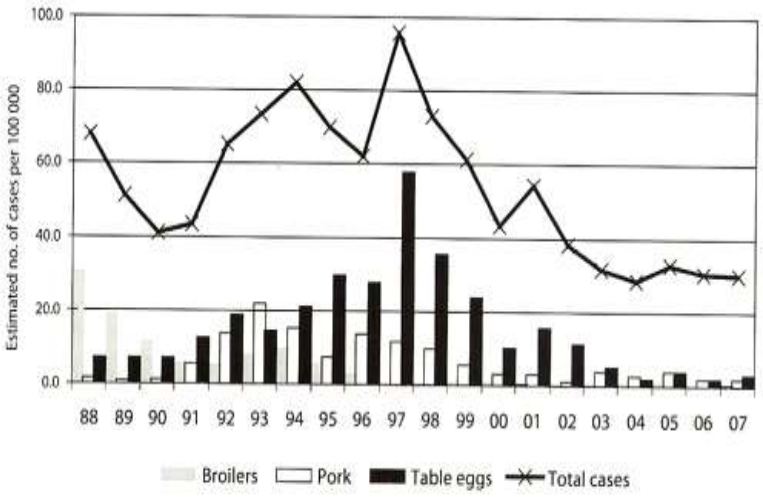
Salmonellosis

For example Wong, 2010 reported that data an epidemiological Surveillances and research of Danish Zoonosis centre Technical University of Denmark. Show the sources of 1647 registered cases of human Salmonellosis in Denmark for the year 2007. Fig. 7 & Fig. 8. It is also showed the trends and sources of human Salmonellosis in Denmark, 1988 – 2007



Estimated sources of 1 647 registered cases of human salmonellosis in Denmark, 2007. Source Danish Zoonosis Centre.

Fig. 7



Trends and sources of human salmonellosis in Denmark, 1988 to 2007. Source: Danish Zoonosis Centre.

Figure 8 show that Denmark experienced three major waves of human Salmonellosis incidence between 1988 and 2007 that were mainly associated with broilers, pork and eggs, respectively. Following the introduction of a control programme in broiler production in 1988, the broiler-associated Salmonellosis incidence (cases/100, 000) has been reduced from 30.8 in 1988 to 0.2 in 2007; following the implementation of a control programme in pig herds in 1993, the pork-associated Salmonellosis incidence has been reduced from 22.0 in 1993 to 2.0 in 2007; and the egg-associated Salmonellosis incidence has been reduced after implementation of a control programme in laying hen production in 1997, from 57.7 in 1997 to 3.3 in 2007.

Rift Valley Fever

(Rift Valley fever (RVF), caused by RVF virus is a mosquito-borne viral disease that is a significant global threat to humans and livestock.) Transmission in humans is via direct contact through infected animal products or contaminated foods or aborted foetuses and from bites of infected mosquitoes, most commonly the Andes species (Carsoet al., 2007). Humans infected with RVF virus typically develop mild self-limited febrile illness, but retinal degeneration, severe encephalitis, fatal hepatitis and hemorrhagic fever may also occur (Swanepoel and Coetzer, 2004). Swai 2010 revealed that a Survey in Tanza, Tanzania m November 2004 to determine exposure to RVF virus among the various occupational revealed that seroprevalence was 7.3, 1.5 and 9.5°/o respectively among the abattoir workers; livestock workers and other categories.

variables category no examined	%	no positive	prevalence(%)	occupation group
abattoir	41	20.6	3	7.32
livestock farmer	67	33.6	1	1.50
non-livestock keepers	38	19.1	0	0
veterinary inspectors	11	5.52	0	0
other	42	21.1	4	9.5

Table of the proportion of individuals in each category of variable investigated during the study (n=199) Other studies showed the prevalence of infection in other parts of Africa. E.g 14.8% (Olaleyeet al, 1996). In Nigeria, 24.4% (Nabethet al, 2001) in Mauritania and 22.3% in Senegal (Wilson et al, 1994)

Escherichia Coli 0157:117

(Escherichia coli 01 57:H7, is one of hundreds of strains of the bacterium Escherichia coli, is an emerging cause of food borne illness). While most strains are harmless and live in the intestines of healthy humans and animals, this particular strain produces a powerful toxin that can cause severe illness. (It was first identified as a cause of illness in 1982 during an outbreak of severe bloody diarrhea traced to contaminated hamburgers. (IDPH, 2009)) Zailaniet al 2010 reported that (Cattle are a principal reservoir of enter hemorrhagic Escherichia coil (EHEC)). Recent surveillance data by Michael et al, (2009) mentioned that prevalence rates of E. coil 0157:H7 in cattle are much higher than was estimated several years ago. Results of a recent study of cattle at slaughter houses in the U.S. during the summer months revealed E. coil 0157:117 in faecal samples of 28% of animals tested. E. coil 0157:117 has a bovine reservoir and can be transmitted by undercooked ground beef and unpasteurized milk this bacterium can also be spread from person to person by focal-oral transmission, with person-to-person transmission most commonly being seen in families, child care centres and custodial institutions.

Transmission

Transmission is by the faecal-oral route. (Humans can be infected by direct contact with animal or human carriers; transmission by fomites, including water and food, is also common. Birds are potential vectors. Human outbreaks are often associated with eating improperly cooked or prepared animal products, particularly ground beef but also un-pasteurized milk). (Occupationally acquired E. coil O157:H7 infection is a risk for farmers, abattoir workers and laboratory staff. There have been reports of laboratory staff becoming infected with E. coil 0157:H7 while working with the organisms. (Anon, 2001)) (Escherichia coli 0157:117 infections occur worldwide (Rice et al, 2003). There are estimated 73,000 annual cases of infection in USA (DBMD). Incidence Rate for Escherichia coil 0157:H7): approx I in 3,726 or 0.03% or 73,000 people in USA. Extrapolation of Incidence Rate for Escherichia coli 0 157:117 to Countries and Regions: The following table attempts to extrapolate the above incidence rate for Escherichia coil 0157:117 to the populations of various countries and regions. These incidence extrapolations for Escherichia coli 01 57:H7 are only estimates and may have very limited relevance to the actual incidence of E. coil 01 57:H7 in any region: (Statistics, 2007). Based

on US, UK, Canadian or Australian prevalence. The calculation is automated and does not take into account any genetic, cultural, environmental, social, racial or other differences across the various countries and regions

Brucellosis/ Undulant Fever.

(Available evidence from sub-Saharan Africa Supports the hypothesis that transmitted to humans is primarily from livestock reserviours of brucellosis. The risk to human is a functioning of risk in livestock and the human effective contract rate (Baba et al, 2001). Contacts are both direct, often through contamination with infected animals, particularly when they are aborting and indirect mainly through the consumption of un-pasteurized milk a common practice in Sub-Saharan Africa. Beyond consumers and farmers Abattoir, animal health and other workers are at high risk of occupational exposure. For example 517 of occupational infections of Abattoir workers in South Africa, veterinaries and farm workers in Ethiopia ((Mauff, 1980; Seboxa, 1982)) Mutanda, 1998) reported 13.3% disease in Kampala was due to brucellosis). (Brucellosis is an infection in animals and man caused by any member of the gerrudBrucella. In man it is known as undulant fever). It is a disease of the reticuloenthelial system (spleen and lymph mode etc) which may localize in the reproductive system. (From the human health point of view, the disease is important because the causative organism can cause undulant fever in man. Infection occurs often by the drinking of infected milk. However, most cases in humans are occupational and occur in cattle farmers, laboratory workers, veterinarians and butchers). Henry, (1988) reported that in 1931, two cases of undulant fever, diagnosed clinically were reported by the Nigeria Medical Association Authorities.

Brucellosis in humans is a multisystamic, acute to chronic, disease characterized by fever headache, joint pains, muscular skeletal pains, sweating, malaise and body wasting. Because of these rather nonspecific signs, this has caused tremendous problems with the chemical diagnoses of brucellosis in Sub-Saharan Africa where it is constantly Mis-diagnosed as Malaria which is very prevalent (Maidawaet al, 2000). Other diseases from which it is difficult to distinguish chemically are typhoid, rheumatic fever and other conditions causing pyrexia, frequently diagnosed as pyrexia of unknown origin (PUD) (Baba et al; 2001)

Tuberculosis

In a study carried by Abdullahi, (2007) he showed the prevalence of Tuberculosis in human in the three Tuberculosis Hospitals in Bauchi, Maiduguri and Yola between 2001 and 2005 presented in the prevalence of Bovine of tuberculosis in the study abattoirs Tables 29 and the results of correlation coefficient of infection and prevalence of tuberculosis in Human and Bovine present table 31 and Risk factors Table 32

%	No. Of Patients Examined	No Infected With TB	Prevalence (%)
Hospital			
Bauchi BTH	10841	322	2.9
Maiduguri CH	2926	258	8.8
Yola FMC	5196	205	3.9
Total	18963	785	4.1
Mean	6321	262	4.1
Year			
2001	3735	104	2.8
2002	3724	129	3.5
2003	3481	169	4.9
2004	3663	187	5.1
2005	4360	785	4.1
Total mean	3793	157	2.1
Season			
Jan-Mar	5149	231	4.5
Apr- Jun	4566	184	4.0
Jul-Sep	4333	166	3.8
Oct-Dec	4915	204	4.2
Total	18963	785	4.1
Mean	4741	196	4.1
Sex			
Male	13746	581	4.2
Female	5217	204	3.9
Total	18963	785	4.1
Mean	9482	393	4.1

In the three hospitals combined a total of 18,963 patients were examined within the study period consisting of 10,841, 2,926 and 5196 patients from BauchiBayara TB Hospital, Maiduguri Chest Hospital and Yola Federal Medical Centre respectively of these number, 322 patients were diagnosed positive for

tuberculosis in Bauchi, 258 in Maiduguri and 205 in Yola, with a prevalence of 2.9%, 8.8% and 3.9% respectively. Fig. 9, Table 29

Prevalence Of Bovine Tuberculosis

The Prevalence of Bovine (Cattle) Tuberculosis in the three abattoirs in Bauchi, Maiduguri and Yola from 2001-2005 is presented in Table 30 over the period of study in the three abattoir combined, a total of 198, 942 cattle were slaughtered and examined for tuberculosis lesion in various organs. Of the number of cattle examined 2755 were infected with tuberculosis Maiduguri abattoir has the highest number of cattle infected with 1,110 cattle, followed by Yola with 830 and Bauchi abattoir with 815 tuberculosis infected cattle. The prevalence rates of 1.5%, 1.3% and 1.4% of bovine tuberculosis were encountered in Bauchi Maiduguri and Yola respectively.

Prevalence of bovine(cattle) tuberculosis in the study of abattoirs betweem 2001 and 2005.

%	No. Of Cattle Examined	No cattle Infected With TB	Prevalence(%)
Abattoir			
Bauchi	56104	815	1.5
Maiduguri	82899	1110	1.3
Yola	59938	83	1.4
Total	198942	2755	1.4
Mean	66314	918	1.4
Year			
2001	44307	555	1.3
2002	37829	496	1.3
2003	36761	479	1.3
2004	36989	525	1.4
2005	43056	700	1.6
Total	198942	2755	1.4
mean	39788	551	1.4
Season			
Jan-Mar	52032	804	1.5
Apr- Jun	53325	766	1.4
Jul-Sep	48687	570	1.2
Oct-Dec	44898	615	1.4
Total	1198942	2755	1.4
Mean	49736	689	1.4
Sex			
Male	103031	1185	4.2
Female	95911	1570	3.9
Total	198942	2755	4.1
Mean	99471	1378	4.1

Correlation of infection and Prevalence of Human and Bovine Tuberculosis Both infection and prevalence of human tuberculosis were highly correlated with infection and prevalence of tuberculosis in human at $P<0.01$ level of significance. Similarly, prevalence of human tuberculosis and prevalence of bovine tuberculosis were correlated with their respective infection rates at $P<0.01$ level of significance Table 30.

Associated Risk Factors And Tuberculosis Among The Cattle Headers.

The associated risk factors of tuberculosis among the representative cattle headers whose either milk sample and or sputum specimen were collected from their household is presented in Table 31. The result apart from other things revealed that 281 (93.7%) of the respondents keep cattle in their households Risk factors associated with tuberculosis in human in adamawa, borno and bauchi state.

Risk factors	states			
	Adamawa (n=100)	Borno(N=100)	Bauchi(N=100)	Total
(n=300%)				

	(%)	(%)	(&)	
Household	< 10	25(25.00)	32(32.00)	16(16.00) 73(24.33)
	≥ 10	62(62.00)	57(57.00)	68(68.00) 187(62.33)
Keep cattle		94(94.00)	89(89.00)	98(98.00) 281(93.00)
Consume milk		70(70.00)	68(68.00)	86(86.00) 227(75.67)
Pasteurize milk		34(34.00)	42(42.00)	52(52.00) 128(42.67)
Milk cows with mastitis		26(26.00)	45(45.00)	35(35.00) 106(35.33)
Milk with cough/emaciation		08(08.00)	14(14.00)	16(16.00) 38(12.67)
Member of family with lymhadentis		21(21.00)	12(12.00)	20(20.00) 53(17.67)
Member of family with cough/emaciation		07(07.00)	10(10.00)	09(09.00) 26(25.67)
Death in a family due to cough/emaciation		08(08.00)	04(04.00)	07(07.00) 19(6.33)

Number might not be total 100% because of missing or response failure

Correlation coefficient of infection and prevalence of tuberculosis in human bovine.

tuberculosis	infection in human	prevalence in human	infection in bovine
prevalence in human	0.804**		
infection in bovine	0.000**	0.804**	
prevalence in bovine	0.804**	1.000**	

** = < 0.01.

(Association between reported risk factors and the presence if at least one positive sputum from the headsmen in the cattle heads visited an all the three locations combined is presented in table 14 p 88. Among the households that keep cattle, eight mycobacterium isolate were detected in the sputum of headsmen) Relationship between Human and Bovine Tuberculosis (Abdullahi (2007). Found out that infection and prevalence of tuberculosis in human are strongly correlated to the infection and prevalence of tuberculosis in bovine and vice versa. It could be suggested that the proportion of Tuberculosis in human and bovine can be directly or indirectly related.) (For instance Colleens et al, (1995) have reported that mycobacterium tuberculosis produces pulmonary tuberculosis in human, domestic and wild animals). In another study), (Garbaet al. 2004 reported that 89, 20.5% of 39 mycobacteria isolated from human patients were M. boris.)

II. Conclusion

This review has revealed that abattoir activities and management have direct and indirect effects on environment and health of people especially residents within abattoir vicinity. It indicated that there are negative impacts of abattoir activities on air, land and water quality for residents within abattoir vicinity as well as adjacent areas and downstream environments. The health quality of residents living in abattoir vicinity was observed to have reduced due to effects of pollutants from abattoir activities. Reduced outdoor recreation, contamination of water bodies and environment, increased prevalence of diseases have necessitated the intervention of authorities to control and improve abattoir activities more so, that the review has shown limited or improper disposal of abattoir waste. In order to protect the health of Nigerians and our environment, we need

a regulated animal's waste disposal system which is sensible, superior to the dumping regime and properly enforced.

Recommendation

- Our abattoirs lack waste disposal facilities.
- Abattoir waste should be properly disposed of Because of the peculiar nature of abattoir waste special treatment techniques should be adopted such.
- Source reduction by ensuring efficient blood recovery.
- Change from phosphate base detergents. Nitrification etc.
- Butchers should be well trained in handling meat and importance of sanitation.
- Adequate facilities such as water electrical for cold rooms and covered vehicles are provided for operations.
- Veterinary inspectors should be properly trained so as to ensure strict inspection of animal before and after slaughtering.
- Legislative measures are also necessary.
- Laws and Guidelines should be enforced on zoning land use and waste regulation to control the location and management of abattoirs.
- Licensing of abattoirs and certification of all operators as well as training should be made. Public awareness and enlightenment on possible impacts of pollution from abattoir waste should be embarked upon by relevant agencies.
- There should be full coordination and cooperation between medical and veterinary services

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