

## PIGGERY WASTE MANAGEMENT PRACTICES AND ENVIRONMENTAL IMPLICATIONS ON HUMAN HEALTH IN RIVERS STATE, NIGERIA.

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### ABSTRACT

Most pig farms are built within 1 km of residential homes in Rivers State, Nigeria. Despite their enormous importance in terms of meat production and generations of employment, pig farms often pose environmental risks to human and animal life through the pollution of water / soil and air. This waste is produced in particular in the form of pig excrement, litter and mortalities on the farm. This research therefore examined the types and amounts of piggery waste generated by the farms and the different management practices used by the farms. The study also assessed the environmental implications of the waste generated. The determinants of the level of impact of piggery waste on human health were also determined. 240 pig farmers and 250 households (victims of environmental pollution) were randomly selected from the five pig farms in Rivers State, Nigeria. The results showed that 55% of respondents generated less than 200 kg of faeces per month and an average monthly faeces waste of 400 kg. About 65% of farms have sold, rinsed or burned their pig waste, while others have either buried the waste or used a combination of two or more disposal methods. About 63% of residents in affected households either resolved to permanently close their doors and windows, or verbally complain to farm management about their protest against foul odors. While 19 per cent of the residents formally report their complaints and hand them over to the government for redress, 18 per cent engaged in open clashes with farm management to protest the pollution of the environment. The number of piglets reared, the agricultural experience, the farming system, the amount of feces generated and the number of dead piglets was all significant determinants at the 1% probability level. Similarly, the distance between poultry farms and residential households, the frequency of sanitation visits, and the frequency of waste disposal were significant determinants at a 5% probability level. To mitigate the environmental health risks posed by piggery waste, piggery farms must recognize and respect a distance of 1 km between the piggery production unit and residential houses, maintain adequate and timely hygiene and observe a high level of discipline in the disposal of waste from their piggery site.

**Keywords:** Pig, wastes, Pollution, Health, Mitigation.

### INTRODUCTION

Pig farming is highly profitable and thus a popular choice of livestock production in Rivers State Nigeria. Pig meat (pork) is a good source of animal protein, skin, fat and provides materials used for clothing, ingredients for processed foods, cosmetics and other medical uses (Abiola *et al.*, 2015). Ajala and Osuhor (2004) reported pig farming as a means to generate the country's GDP and also combat malnutrition of animal protein. With this and many other publications enlightening people on the benefits and profitability of pig farming, the State has experienced a major hike in the production of pigs, over the past five years.

Despite its profitability, there is a major problem associated with pig farming, that is waste management. Industrial pig farming however poses numerous threats to the environment and human health as pig wastes and faeces often spread to surrounding neighborhoods, polluting the air and water with toxic waste particles (FAO 2013; Wendee, 2017). Attempts have been made by industrial pig farmers to devise means of managing these wastes but apart from using the waste as manure and burying the waste, small scale pig farmers have little choice but to locate their farms in remote areas far from urban residence in an effort to reduce the felt effects of the waste on the environment and human health while taking on considerable risk themselves.

The most effective way to manage waste is by recycling. Countries like Britain and Singapore make use of methane gas generated from swine waste to power farm machineries, but that is not the norm in Rivers State of Nigeria. Pig waste in rivers state is stored in ditches and lagoons, it is then covered and left to decompose and integrate with the soil, while this may seem to be an effective method of pig waste disposal, a lot of dangers are associated with this system.

Waste from these farms have the potential to carry pathogens, bacteria and heavy metals that are toxic when ingested (Wendee 2017). Pig wastes also contribute to ground water pollution in form of ground water seepage and waste spray, the contents of this spray causes mucosal irritation, respiratory ailment, increased stress and also high blood pressure

(Horton, et al 2009). Swine waste also has effects on water quality as well as air quality, toxic elements like nitrates and ammonia seep into the water table close to the base of the ditches and lagoons and contaminates the ground water (Warrick, 1995). More so, studies have shown that people living close to pig farms suffer a variety of adverse health effects, including respiratory diseases, infections, increased risk of cancer and other health risks due to air pollution from pig farms (environmental health perspectives 2016).

Adequate management of these wastes would contribute to the creation of piggery resources and the improvement of commercial pork production, thus increasing the profitability of pig farming. Therefore, this study was conducted to examine the types and quantities of pig waste generated by pig farms, to determine the management strategies used by pig farms as well as to analyze the environmental implications of the waste generated and human health.

## MATERIALS AND METHODS

### Area of Study

Rivers State is one of Nigeria's 36 states with a population of 5,185,400, making it the sixth most populous state in Nigeria (Nigeria Administrative Division, 2014), with a total area of 11,077 km<sup>2</sup>. The state lies on latitude 4°45'59"N and longitude 6°49'39"E. It is bounded on the south by the Atlantic Ocean, on the north by the states of Imo, Abia and Anambra on the east by the state of Akwa Ibom and on the west by the states of Bayelsa and Delta. Before the discovery of oil in 1951, agriculture was the main occupation of the residents of Rivers State. Around the nineteenth century, the state was known as the Protectorate of the Petroleum Rivers because of its abundant palm oil and its core, the country's main source of revenue. The main socio-economic activities of the population are the production of arable crops, fishing, carpentry and construction and livestock. In Nigeria, the state ranks 6th in pork production with 60% of total pork production in Nigeria (Ministry of Agriculture, Livestock Unit, 2016).

### Data collection methods

Primary and secondary data sources were used in this research. Oral interviews and a structured questionnaire were used to collect primary data. Information on methods of disposal of pig waste and their implications for the environment was collected. In addition, journals, newsletters and other related publications were useful sources of information. Multistage sampling techniques were used to select the pig farm operators and respondent household heads who lived within 1 km of the piggery farm. In order to ensure uniform sample distribution, the five Rivers State pig production areas were carefully considered during data collection. The first step was to identify the areas using the Rivers State chapter of

the Piggery Association of Nigeria (PANOG). The areas are: South, East, North, West and East Rivers. The second step was to select Piggery farms based on their scale of operation: small, medium or large. Finally, a simple random selection at the farmer scale was made. A total of 240 farmers, including 120 smallholders, 60 medium and 60 other large scale farmers, were sampled for the study. It is hoped that the results of this study will provide a good representation of the state pig industry. For the victims of Piggery waste pollution, 50 individuals (heads of households) whose homes were located within 1 km of poultry farms were randomly sampled from each of the five zones; giving a total of 250 people (representing about 31%) of the 807 household heads in the area. These individuals were examined to determine the level / degree of impact of Piggery waste pollution on their health status. All data were collected between March and October 2018.

### Methods of data analysis

Descriptive statistics including the use of frequency tables, averages, etc. were used to describe the types and quantities of pig waste generated by pig producers, various management strategies applied by pig farms in the study area and their socio-economic parameters. A multinomial logit model was used to examine determinants of the level or degree of impact of piggery farm on human health. Generally, this model is considered appropriate when the response takes several possible values, which, in this case, represents the various implications of piggery waste for human health (the victims) in the neighborhood. According to the medical records of local health centers in affected farming communities, the most common health problems presented by these "victims" of Piggery's waste include: malaria, sneezing and responsiveness. Therefore, the model used here is capable of treating polytomic responses that is when the answers are more than two (Herman, 2008). Thus, the "victims" presenting with malaria as symptoms of the disease are represented by i, those with sneezing as symptoms are represented by j, while those presenting a state of rest with these symptoms are represented by k. All relevant explanatory variables were entered by X<sub>1</sub> ... X<sub>12</sub>.

The model is therefore mathematically expressed;

$$\text{Logit}(Y_{ijk}) = \alpha + \beta_1 X_1 + \dots + \beta_{12} X_{12} + e_i \dots \dots \dots (1)$$

Y = the probability that a selected individual will be a "victim" of poultry waste pollution in their environment

ijk = indicates that the victim has malaria,

j<sup>th</sup> victim sneezes and kth victim restive

α = the constant

β<sub>1</sub> = the predictive variable coefficient

X<sub>1</sub> ..... X<sub>12</sub> = Predictive variable values observed, ie independent (explanatory) variables

- $X_1$  = Distance from piggery to residential households (meters)  
 $X_2$  = Number of pigs (Units)  
 $X_3$  = Frequency of visit to sanitation staff at the barn (per month) (Units)  
 $X_4$  = age of the pig farm manager (years)  
 $X_5$  = Quantities of water used (liters)  
 $X_6$  = Number of farm labor (family and hired) (work day)  
 $X_7$  = experience of the pig farm in operation (years)  
 $X_8$  = Farm Operating System (Deep Litter = 1, others = 0)  
 $X_9$  = Quantity of faeces generated (kg)  
 $X_{10}$  = number of piglets / dead pigs (number)  
 $X_{11}$  = Frequency of waste disposal (per month)  
 $e_i$  = random (stochastic) factor external to the model

## RESULTS AND DISCUSSION

### Types and quantities of piggery waste generated by piggery farmers

Descriptive statistical analysis revealed that two main types of pig waste were generated on farms in the study area, namely faecal waste and dead pigs. About 55% of the respondents produced less than 200 kg of faeces per month, while the average monthly fecal waste was 400 kg (Table 1). Similarly, about 83.34% of farms lost up to 10 piglets per month, while the average monthly mortality rate was 7.4% (Table 1). This result is in line with the findings of Oneil (1992) and Schiffman (1998) who found that odours emanating from huge quantities of piggery waste generated continuously by farms, often increased the level of risk to human existence in the area. It is therefore difficult for officials from the Ministries of Health and Environment and Housing to adequately monitor and evaluate the activities of these pig farms to ensure a minimum level of compliance.

**Table 1. Types and quantities of piggery wastes generated per month**

Types	Frequency	Percentage
<b>Faecal waste (kg)</b>		
< 200kg	134	55.83
200 – 400kg	92	38.33
>400kg	14	5.84
Average: 400kg		
<b>Dead piglets</b>		
<5	102	42.50
5 -10	98	40.84
11 – 15	14	5.83
16 -20	14	5.83
>20	12	5.00
Average 7.4		

Source: Field survey, 2018

### Waste management strategies

Most piggery farms have developed a series of management strategies to dispose of their waste in a way that reduces their environmental impact, as shown in Table 2. The results showed that about 65% of farms sell, dispose of or burn piggery waste while 14.17% recycled waste (as manure) for crop production. However, this could become an environmental problem when manure is applied to land beyond the threshold of the host crop and its ability to use nutrients (Charles, 2008). The results also revealed that about 5.0% of the farms buried the waste in the ground, which could lead to groundwater contamination (Carr, 1994). While the burning of piggery waste causes air pollution that may pose a risk to humans and livestock (Anon, 2005), flushing of piggery wastes in form of slurry into nearby pits, streams and rivers may have adverse effects on human and aquatic life and the environment. Flushing can also result in a reduction

in the amount of dissolved oxygen and high water turbidity. This often threatens the natural habitats of many organisms in nearby water bodies. Huge amounts of organic and inorganic nutrients released as slurry are capable of permanently distorting the aquatic ecosystem. The results also showed that none of the farms had an environmentally friendly piggery waste management system that could completely limit the effect of the smell generated by the waste. This implies widespread pollution of the air, water and soil, as well as risks to the health of human and animal life in the localities. However, in order to provide a timely and inexpensive piggery waste management option, farms should incorporate crop farms such as vegetable farms, tree farms and / or orchards where they could occasionally spread pig waste as manure to keep the soil fertile. Moreover, this will equally help to prevent accumulation of waste in order to reduce the degree of environmental pollution in the neighborhood.

**Table 2. Waste Management strategies by farmers.**

Waste Management Method	Frequency	Percentage
Selling	48	20.00
Burying	12	5.00
Flushing into pit, stream and rivers	51	21.25
Burning	56	23.33
Recycling in crop production process	34	14.17
Other (combinations of method)	39	16.25
<b>Total</b>	<b>240</b>	<b>100</b>

Source: Field Survey, 2018.

### **Piggery waste management strategies**

The piggery waste coping strategies for farmers in the study area is presented in Table 3. The establishment of piggery farms within 1km of homes is a source of public concern. This study found that the most common symptoms observed by residents of households in the study areas were restiveness, malaria and sneezing. These symptoms can reduce the productivity of affected people (victims) who are economic agents and, by extension, the national economy. It is therefore important to consider strategies for victims to properly manage

environmental pollution problems caused by pig waste. About 63% of the residents of the affected households either resolved to close their doors and windows permanently (especially those adjacent to the instructions of the pig farms) or verbally complained to the farm management to register their protest against bad smells. Similarly, about 19% of the inhabitants formally reported their complaints and sent them to the government for redress, while about 18% of them often opted to openly confront the management of the farms to protest the pollution of the environment.

**Table 3. Piggery wastes coping strategies among neighbouring households**

Piggery waste coping strategies	Frequency	Percentage
Close door	48	20.00
Complaints	104	43.33
Reports	45	18.75
Confrontation	43	17.92
<b>Total</b>	<b>240</b>	<b>100</b>

Source: Field Survey, 2018

### **Pig waste and human health: the relationship**

The proximity of many pig farms to residential households has often raised a lot of concern for humans and the environment. On many occasions, residents living within 1km of farms complain of sleep disturbances, malaria, sneezing and / or nausea. Cases of cholera epidemics, reptiles (mainly snakes) and wild animal's attacks are usually common. All of these factors have serious consequences for the productivity of the victims of the attack and, by extension, for the national economy. This section therefore analyzed the determinants of human health impact of human waste, as shown in Table 4. A multinomial logit model was used to account for the relationship. The number of piglets kept, the experience of the farm manager, the farming system,

the amount of feces generated and the number of dead piglets were all determining factors at the 1% probability level. Similarly, the distance between pig farms and residential households, the frequency of visits by sanitarians, the frequency of waste disposal by loggers, were significant determinants with a probability of 5%. The level of the log-likelihood function also confirmed the goodness of the fit of the model and the relevance of the identified determinants. These results pose a significant challenge to piggery farms, local health authorities, residential households and even the government, to ensure a safe and secure environment for citizens. Engler (2006) and Grant and Marshalleck (2008) partially corroborated this position.

**Table 4. Determinants of the level of impact of piggery wastes on human health in the environment: Multinomial Logit model analysis**

Variable	Coefficient	Std Error	t-value
Constant	4.136*	1.157	3.575
Distance of piggery farm ( $x_1$ )	3.532**	1.341	2.634
Number of piglets ( $x_2$ )	10.101*	3.089	3.634
Frequency of visit of sanitation officials ( $x_3$ )	0.097**	0.050	3.269
Age of piggery farm (yrs) ( $x_4$ )	0.672	0.426	1.940
Quantity of water used/month (ltrs) ( $x_5$ )	0.108	0.068	1.577
Farm labour used (man - hour) ( $x_6$ )	0.058	0.034	1.588
Farming experience of farm managers (yrs) ( $x_7$ )	3.012*	0.186	1.580
System of operation of the farm ( $x_8$ )	2.634*	0.534	16.194
Quantities of faecal materials generated (kg) ( $x_9$ )	0.178*	0.019	4933
Number of dead piglets (No) ( $x_{10}$ )	9.800*	0.702	9.368
Frequency of waste clearance/month ( $x_{11}$ )	12.743**	5.956	13.960
Log-like hood function		57.312	2.140

\*Means significant at 1% level, \*\* Means significant at 5% level

### CONCLUSION

The study found that despite the enormous benefits to the piggery business, waste generated in the form of pig excrement, offal, dead pigs is an environmental nuisance detrimental to human health and animal. The pig farm's production activities have the effect of degrading surrounding surface water and / or groundwater and polluting the environment by the emission of foul odors; thus causing tremendous discomfort, especially for those living less than 1 km from piggery farms. It was also observed that the distance from pig farms to residential areas, the frequency of sanitation visits, and the clearance of piggery farm waste were among the significant determinants of the level of piggery house waste impact on the environment.

### RECOMMENDATIONS

In order to mitigate the environmental impact of these wastes, control agencies must therefore strictly enforce existing sanitation / health policies aimed at the preservation and protection of the environment, particularly as recommended by the state and federal environmental protection agencies in Nigeria. Piggery farms that do not respect the 1 km distance between residents should be encouraged to travel to very remote locations to reduce or eliminate the risk of environmental pollution / health hazards. Again, there is a need to ensure that all livestock operations have sufficient access to an adequate supply of water and other sanitary items that can be deployed to keep their environment clean and safe at all times.

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