

AN ANALYSIS OF ANIMAL WASTE AND ITS MANAGEMENT IN IKARA LOCAL GOVERNMENT AREA OF KADUNA STATE

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ABSTRACT

This study assessed the nature of animal waste and factors militating against its management in Ikara Local Government Area. The ten wards in the study area were used for this study. A sample of 380 farmers was surveyed by means of a self-administered questionnaire which was administered using convenient sampling techniques based on population size. The study revealed that in Ikara Local Government Area, Kurmin Kogi has the highest amount of animal waste, with 33,400kg or 23.32% of the total animal waste generated. It was also observed that goats contributed the highest source of animal waste, with cattle as the next major contributor. The study revealed most of the farming households in the study area still engage in inefficient management practices such as open dumping, burying and burning of their agricultural wastes. The current management option is not perfect and a framework to ensure adequate management system and the collection facilities is not available. However, some farmers reuse their crop remnants for organic fertilizers and in other cases sell them. Nearly one-third of the farmers reported that ignorance of the benefits and strategies of animal waste management is one of the reasons for poor utilization of animal droppings in the study area. Hence, it is suggested that intensive mass literacy programmes on the economics of animal waste management be undertaken in the study area. Awareness activities to educate the communities on the health hazards and environmental consequences of piled or poorly dumped animal wastes and burning should also be pursued. By involving the farmers and other stakeholders, government should come up with appropriate policies and legislative measures to discourage dumping and burning of animal wastes.

Keywords: Waste, Animal, Management, Environment, Ikara Local Government Area

INTRODUCTION

The by-products of agricultural activities are usually referred to as “agricultural waste” because they are not the primary products. These wastes chiefly take the form of crop residues (residual stalks, straw, leaves, roots, husks, shells etcetera) and animal waste (manure and slurry). Agricultural wastes are widely available, renewable and virtually free, hence they can be an important resource. They can be converted into heat, steam, charcoal, methanol, ethanol, bio diesel as well as raw materials, animal feed, composting, energy and biogas construction (James, 2010). Agricultural waste management is the collection, transportation, processing, treatment, recycling or disposal of agricultural waste materials to reduce their adverse effects on human health, amenities and environment. Agricultural waste represents valuable resources as ground cover to reduce erosion, fertilizer to nourish the crops, source of energy among others (William, 2005).

Animal wastes (or manure) are mainly the droppings of livestock. The main constituents of this waste are organic material, moisture and ash. The quantity of manure produced generally depends on the amount of feed consumed, the quality of the feed and the live weight of the animal (Duku, Gu and Hagan, 2011). Livestock generate huge amount of animal dung daily which can be converted into biogas by anaerobic digestion. Animal wastes particularly ruminant offer potential for both direct and combustible fuel and as input to produce biogas.

Estimates made in 1985 puts the number of cattle, sheep, goats, horses and pigs as well as poultry in Nigeria as 166 million. These produce 227,500 tonnes of animal waste daily. Animal waste can be converted to biogas and estimates show that this is of the order of $5.36 \times 10^9 \text{ m}^3$ which has energy content amounting to $2.93 \times 10^9 \text{ KWh}$ (Sambo, 2009). The utilization of animal waste (Cattle, Sheep, Goat, and Poultry) for agriculture in general and in urban agriculture has been a traditional source of manure for food production in Nigeria. In the pre-colonial era, the use of animal waste for food production was highly effective and efficient because there was less reliance on modern agricultural inputs like hybrid feeds, insecticides and chemicals for animal rearing and production (Westerman, and Bicudo, 2005).

Most waste management activities in Nigeria are mainly concerned with reduction of public health hazards, dust and obnoxious odours (Taiwo and Osinowo, 2001). Adequate management scheme for efficient collection and treatment of animal waste for food production requires much investment which is not often available and if available, is used for more prioritized sectors like, health care, road construction and education. The decision to integrate waste into urban agriculture specifically and agriculture in general has thus been left as the sole responsibility of the individual farmer who knows little or nothing about the possible health and environmental impact that could be inherited from the use of animal waste.

Waste utilization for agriculture including poultry waste is not a new phenomenon in Africa but a traditional method of providing nutrients for plants, enhancing soil quality and creating livelihood for farmers. The utilization of waste for urban agriculture has recently become an important phenomenon in developmental research due to its role in curbing urban food and unemployment problems for the growing urban population. Recent studies (Mackie, Stroot and Varel, 1998; Westerman *et al.*, 2005) have provided evidences of environmental, social and economic contributions of waste utilization for urban food production. However, a major problem to contend with remains how waste (wastewater, municipal waste, cattle waste, poultry waste etc.) can best be managed for healthy food production with minimal negative health implications (Allison, Hams, Hofny-Collins, and Stevens, 1998). One of the principles of Agenda 21, adopted in Rio in 1992, is that sound waste management should include safer recovery of any form of waste and the promotion of environmentally sound waste treatment that enhances integration of and changes to a more sustainable pattern. This principle has been accepted by most countries including Nigeria who were signatories to the concept.

A number of related studies are accessible and few of them are examined to put this study in proper perspective. Study by Kwaghe, Gwary, Abdulsalam and Oppong-Yeboah (2011) on economic analysis of agricultural waste management among farming households in Jere Local Government area of Bornu State, Nigeria, showed that animal waste (mainly cattle) is generated by 85% of farmers and reuse is the major waste management method while other farmers still practice dumping and burning of their farm waste. The quantities of animal waste were 103 tonnes. Also, Fafioye and John-Dewole (2012) investigated the effect of open

dumping of animal wastes on the farm workers' health and the environment using farms in Odeda, Nigeria. The study revealed that the level of waste disposal education of the workers significantly affects the method of disposal being employed on the farm.

Animal waste management is a growing public concern in many countries in Africa, including Nigeria (Abebaw, 2008). The first goal of any waste management system is to maximize the economic benefit from the waste resource and maintain acceptable environmental standards. Animal waste characteristics and management have been well investigated in European and American agricultural cultures. However investigation of these issues for academic and policy purposes in many developing countries is usually taken for granted. For sustainable agricultural and environmental management, such issues can no longer be overlooked.

Informed opinion and observation revealed that a large volume of animal droppings and crop residue generated in Ikara Local Government Area (LGA) is still disposed of by adopting low-cost approaches. The level of animal dropping and crop residue management and recycling in Kaduna State and Ikara LGA is very low. This could be as a result of inadequate knowledge on crop and animal waste disposal, management and recycling strategies by the farmers (Okoye, 1978). Also, Ikara, like any other northern Nigerian society is agrarian with appreciable level of animal rearing, where several tons of animal droppings, considering HRWC (2010)'s position on waste management are either abused or left unused. That is the basis of this study using Ikara LGA of Kaduna state as the spatial focus, to advance the frontier of knowledge on waste management, sustainable agricultural practices and environmental policy making processes.

This paper provides empirical information on the characteristics and management of animal droppings in Ikara LGA of Kaduna state. The specific objectives are to characterize the quantity and composition of animal waste generated in the area, identify the management techniques adopted by farmers in Ikara LGA for animal waste management, determine the re-use value of animal waste from the study area and examine the factors militating against efficient management of animal waste in the area

STUDY AREA

The study area, Ikara local government area (LGA) was created out of former Zaria Native authority following the local government reforms of 1976. At the time of creation, it comprised of Ikara, Kubau and Makarfi districts. However in 1996, the local government area was reduced in size with the creation of Makarfi and Kubau local government areas respectively. Ikara is located between Latitudes $11^{\circ}22'N$ to $11^{\circ}31'N$ of the equator and Longitudes $8^{\circ}21'E$ to $8^{\circ}28'E$ of the Greenwich meridian. Ikara has seven (7) districts namely, Ikara, Saulawa, Auchan, Kurmin/Kogi, Furana, Pala and Paki (See Fig 1) and ten (10) wards which are Ikara, Janfalan, Pala, KurminKogi, Saulawa Rumi, Auchan, Kuya, Paki and Saya-Saya.

Ikara lies on the high plains of Hausa land, of height ranging from 550 to 750 metres showing a general regional slope to the south and a relative relief of 30 to 45 meters. The plains on which Ikara is situated are parts of the vast, gently undulating plains scenery, which extends almost unbroken from Sokoto to Lake Chad and beyond. The area is drained by river Kaduna and characterized by high stream frequencies and drainage density. Ikara has a tropical continental climate. The temperature gets to its peak of about $33^{\circ}C$ in April and drops to its

lowest around August with a value of about 26.6°C. The continentality of its climate is more pronounced during the dry season especially in December and January (Ayoade, 1996).

The population of Ikara is at 193,926 as of the 2006 Nigerian census. The economy of Ikara local government area revolves around agriculture. About 80% of the population in the study area engage in farming. The agricultural activity in the study area can be categorized into arable, tree crop and livestock farming. Crop farming is the main agricultural activity in the area. Crops are produced both during the rainy season and the dry season. A lot of farming takes place in the study area where most of the farm products supplied to the capital city of Kaduna are produced (Haruna, 2007).

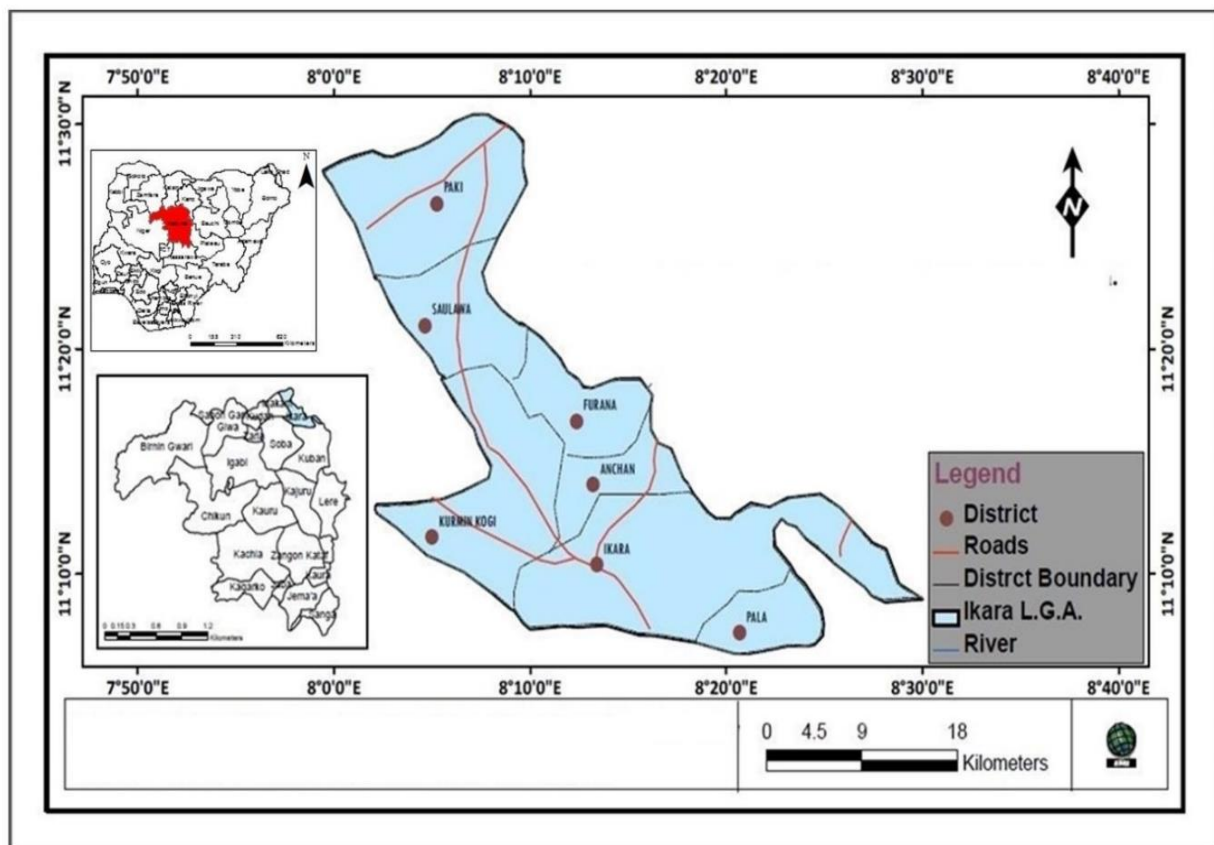


Figure 1: Ikara Local Government Area: Study Area
SOURCE: Modified from Administrative Map of Kaduna State

MATERIALS AND METHODS

In order to achieve the aim and objectives of the study, the research utilized majorly primary data. The primary data were obtained by field measurement and a structured questionnaire. Types of data gathered include farmyard characteristics, types of animal waste, sources and utilization, composition and volume of animal waste, disposal techniques and management of animal wastes and the bio-physical and socio-economic environment of Ikara.

A questionnaire was administered to 380 respondents across the ten (10) wards in the study area which are Ikara, Saulawa, Auchan, Kurmin/Kogi, Janfalan, Pala, Saya-Saya, Kuya, Rumi and Paki using the Krejcie and Morgan (1970) method of determination of sample size. The questionnaire was administered using convenient sampling technique whereby allocating questionnaire to respondents was based on population size per ward.

Table 1: Estimated Population of Wards and Number of Questionnaires Administered

Wards	Ward Headquarter	Population of Selected Locality as at 1991	Estimated Population of locality (2013)	No. of Questionnaires Administered
Ikara	Ikara	14,563	25,521	160
Saulawa	Saulawa	2,696	4,725	30
Auchan	Auchan	3,589	6,289	40
Kurmin Kogi	Kurmin Kogi	1,309	2,294	14
Janfalan	Janfalan	808	1,416	9
Pala	Pala	552	967	6
Saya-Saya	Saya-Saya	523	917	6
Kuya	Gangarida	927	1,624	10
Rumi	Rumi	862	1,511	10
Paki	Paki	9,012	15,793	100
Total		34,841	61,057	385

Source: Computed by Author from Ikara Headquarter Data, 2009 and Nigerian Population Census Data 1991

On-site animal waste separation and measurements was selectively done at farmyards across the wards in the study area. This involved sorting and weighing all animal wastes from the farmyards during the period of harvesting, when on farm agricultural waste generation is at its greatest. Depending on the nature of the animal waste generated, empty sacks, plastic bin and weighing scale were used to collect and measure the waste. Farmyard work suit and nose and face mask were used during the sorting and measurement for data collection with the help of some field assistants.

A total of 385 copies of questionnaire were taken to the field for data collection. However only 380 were returned and valid for analysis. Data entry, coding, cleaning and test for normality was made following standardized procedures. Quantitative and qualitative statistical methods were employed to analyze the information collected from the field. The descriptive and qualitative statistical technique was used to summarize the results gotten from the field. Characterization of animal waste was done by identifying the types, composition and other properties of animal waste which was then tabulated to reveal the percentage distribution. Simple descriptive statistics was used to present the sources of these animal droppings using the pie chart. Tables were then used to present the management techniques adopted in managing the animal waste while the reuse value of these wastes was determined by the use of bar charts. In order to examine the factors militating against efficient waste management in the area, content analysis of response obtained from farmers was undertaken which were later subjected to descriptive statistics such as tabulation. All statistical analysis was carried out using SPSS 17. Statistical test for significance was carried out at 5% level of significance.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Farmers

The socio-economic characteristics of the respondents include the sex, age, occupation of farmers other than farming and educational qualification of farmers. Table 2 shows that the farmers at Ikara local government area are predominantly male as attested by 96% of the farmers. This is basically as a result of the cultural and religious setting limiting the involvement of female farmers in most rural areas in the Hausa dominated Muslim communities in northern Nigeria as deduced from the responses of the 4% females.

Table 2: Socio-economic Characteristics of Respondents in the study area

A. Sex	Frequency	Percentage (%)
Male	364	96
Female	16	04
Total	380	100
B. Age	Frequency	Percentage (%)
20-30	116	31
31-40	77	20
41 and above	187	49
Total	380	100
C. Occupation of Farmers other than Farming	Frequency	Percentage (%)
Civil Servant	74	20
Business	104	27
Student	36	09
Others	06	02
None	160	42
Total	380	100
D. Educational Qualification	Frequency	Percentage (%)
No formal education	74	19
Quranic school	106	28
Primary	122	32
Secondary	63	17
Tertiary	15	04
Total	380	100
E. Type of Farmer	Frequency	Percentage (%)
Subsistence	364	96
Commercial	16	04
F. Farm Size in Acres	Frequency	Percentage (%)
1-5 Acre	329	87
6-10 Acre	46	12
11-15 Acre	05	01

Source: Authors Fieldwork, 2014

It was also observed that 49% of the farmers in the study area are above 40 years old, 20% are within the age bracket of 31-40, while 31% fall within age bracket of 21-31, which indicates that most of the farmers are old and apart from 20% and 27% that engage in civil service and business enterprises other than farming, 42% are solely farmers. Indeed as revealed by Table 2D, 19% of the respondents have no formal education, 28% have Quranic education, 32% have attained first school certificate, 17% have attained SSCE while 4% have acquired tertiary qualifications. The farmers with tertiary certificates are all located in the local government headquarter and are predominantly subsistence based.

Table 2E shows the responses of farmers with respect to the type of agriculture practiced. From the responses, it was clearly observed that 96% of the farmers in the study area are predominantly subsistence, while 4% are commercial. However, it was also observed that most subsistent farmers also sell some of their products, although on a very small scale. On the other hand, 4% of the respondents are commercial farmers and they make use of large area of land and are usually involved in both crop farming and animal rearing for commercial purposes. Table 2F shows the acres of land used by farmers in the study area. It can be clearly seen that because of the small scale nature of farming of the farming households, most of the farmers in the study area use 1-5 acres of land as attested by 87% of the respondents.

In the socio economic characteristics of the respondents, it can be clearly seen that Ikara LGA depicts the true characteristics of a rural settlement, characterized by low educational qualification. It however, contradicts other characteristics of rural areas as portrayed by Uyanga (1980) that rural areas are where the youths have migrated or classify rural areas as zones of high propensity for out migration because in the study area over 51% of the respondents are youths actively involved in agriculture, although they combine it with trading and schools.

Types of Animal Waste in the Study Area

Animal wastes (or manure) are mainly the droppings of livestock animals (Solano *et al.*, 2001). Animal dung is by far the highest contributor to animal waste in the study area as shown by Table 3. Other animal waste generated include sloughed feathers and fur or skin as observed in some poultry and goat farm in Kurmin Kogi and Ikara wards. The animal wastes generated are of economic benefit to the farming households because they serve as sources of manure for crop farming and in some cases are gathered in sacks and sold in the market for money.

Table 3: Type of Animal waste generated in the study area

Type of Animal Waste	Frequency	Percentage (%)
Animal dung	282	74.2
Others (feathers and fur)	51	13.4
No Animal Waste	32	8.4
No Response	15	4.0
Total	380	100

Source: Authors Fieldwork, 2014

Volume of Animal Waste in the Study Area

The volume of animal waste is the total quantity of crop and animal waste generated in a study area (Kwaghe *et al.*, 2011). Table 4 presents the estimated quantity (Kilograms) of animal waste generated in the study area. *Zaria Geographer Vol. 22, No. 1, 2015*

waste generated in the study area by the farming households. The total volume of animal waste generated in 2014 is 143,230 kg. From Table 4 it can also be clearly seen that farmers in Kurmin Kogi generate the highest volume of animal waste (33,400kg) equivalent to 23.32% of the total. This is because most farming households are either sedentary livestock farmers or nomads responsible for producing goats, cattle and poultry sold and consumed in the study area and marketed at nearby urban centres like Makarfi, Kubau and Kaduna metropolis (the state capital). The animal waste from Paki and Saulawa wards are 26,750kg and 20,000kg respectively thereby ranking 2nd and 3rd. It can also be observed that despite the population of farming households considered in Ikara, its percentage contribution in relation to other wards is 14.87%. This is because Ikara ward is the most urbanized part of the LGA, hence other land uses such as educational and industrial affect land for farming.

Table 4: Volume of crop waste generated in the study area

Wards	Estimated Volume of Animal Waste (Kg)	Percentage in Relation to Other wards (%)
Ikara	17,350	12.11
Saulawa	20,000	13.96
Auchan	6,450	4.50
KurminKogi	33,400	23.32
Janfalan	9,500	6.64
Pala	2,350	1.64
Saya-Saya	17,350	12.11
Kuya	1,780	1.24
Rumi	8,300	5.80
Paki	26,750	18.68
Total	143,230	100

Source: Authors Fieldwork, 2014

The work of Kwaghe *et al* (2011) revealed that the estimated quantity/tonnage of animal waste for farming households in Jere Local Government area of Borno State is 161,000kg of waste. This shares close similarities with the quantity of animal waste generated in Ikara local government area. Although Jere LGA has higher generation of animal waste which may be attributed to the difference in ecological zone (Ikara is in the north central while Jere is in the north east) and also because cattle rearing constitute the main business of the Shuwa Arab people one of the major tribes in the study area and also the regional cattle market is situated in the area.

Sources of Animal Waste in the Study Area

In Ikara LGA, animal waste comes from various sources. Figure 2 shows that goats accounted for 46% of the total animal waste generated in the study area, cattle accounted for 29% while poultry accounted for 15%. Majority of the farming households in Kurmin Kogi were of the opinion that cattle produce the highest animal waste in the area. This is because cattle rearing constitute the main occupation of the Fulani who are one of the major tribes in the study area. Other farm animals such as donkeys and mule contribute 10% to the total waste generated in

the study area. The farming households in Paki ward uses the mule which is a beast of burden in transporting farm inputs to the farm during the farming season.

From the data obtained, it can be deduced that the major farm animal in the study area is goat. This directly contradicts the work of Kwaghe *et al* (2011) in Jere LGA of Borno State, Nigeria, where cattle were the dominant farm animal in the area because cattle rearing constitute the main business of the Shuwa Arab people one of the major tribe in the study area and also the regional cattle market is situated in the area. However, it conforms to the work of Elijah (2010) in Minna, Niger state, Nigeria, where goats were the major farm animals kept by the farmers because of the ease of purchase and the ease of rearing.

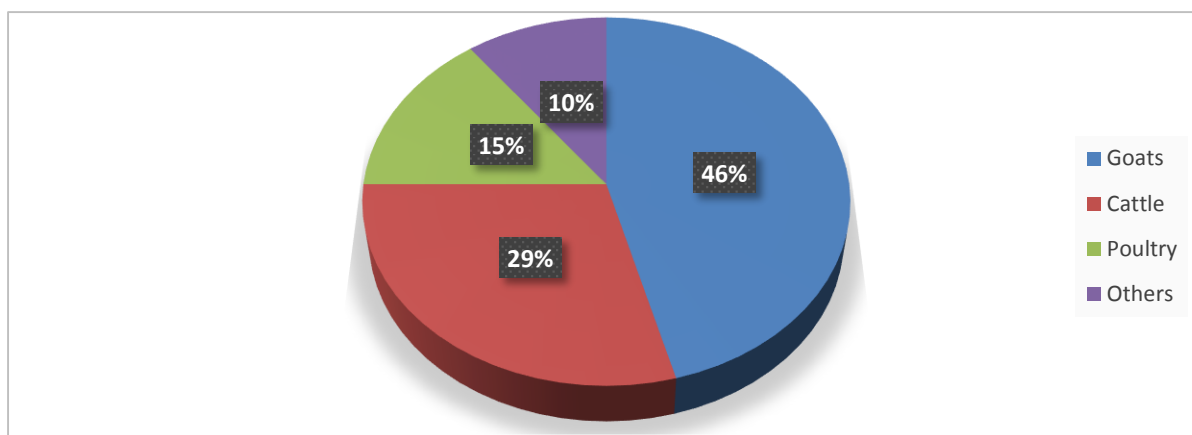


Fig. 2: Sources of Animal Waste in the Study area

Source: Author's Fieldwork, 2014

Animal Waste Management

Agricultural biomass waste converted to energy can substantially displace fossil fuel, reduce emissions of greenhouse gases and provide renewable energy to people in Ikara LGA. There are several methods that have been developed for the better exploitation of agricultural wastes. Agricultural residue (grass, dry leaves, sugarcane trash, animal dung etc.) which are produced in huge quantities in the study area is put to little use. The animal waste management options is shown in Table 5.

Table 5: Disposal Methods adopted by Respondents in Managing Animal waste

Disposal Methods	Frequency	Percentage (%)
Composting	56	14.74
Burning	62	16.31
Burying	116	30.53
Reuse	108	28.42
Others	38	10.00
Total	380	100

Source: Author's Fieldwork, 2014

Burying is the predominant animal waste management option as shown by 30.53% of the respondents. Composting and burning accounted for 14.74% and 16.31% respectively. However, 28.42% reuse their animal waste and 10% indicated other animal waste management options such as usage for fodder and playing tools. The disposal methods adopted in managing animal waste in the study area contradicts the work of Fafioye and John-Dewole (2012) where open dumping and burning is the predominant disposal technique. However it shares close similarities with the work of Kwaghe *et al* (2011) in Jere LGA of Borno State, Nigeria where burying and dumping is the most practiced disposal method by farmers.

Figure 3 on the other hand shows the response of those farmers that reuse animal waste. About 88 utilize their animal waste as organic fertilizers while 17 sell their waste. Other uses of animal waste as indicated by respondents include animal feed, broken egg shells are used for making detergents etc.

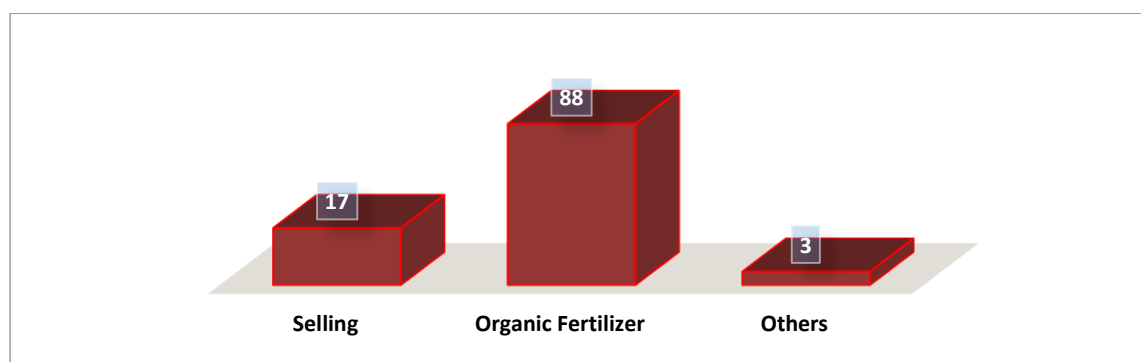


Fig. 3: Reuse options of Animal Waste

Source: Author’s Fieldwork, 2014

Efficiency of Animal Waste Disposal Technique

Table 6 shows the self-assessment of animal waste management methods of farmers in the study area. From the opinion, it shows that the management of animal waste in Ikara is ineffective (poor and very poor) as attested by 52.37% of the respondents. This is because as indicated by Shafiul and Mansoor (2003), agricultural waste forms the potential renewable energy source as biomass. Therefore, putting the huge quantities of biomass resources, mostly in the form of animal droppings which are currently disposed by burning, burying or dumping, to energy production could potentially increase the energy supply.

Table 6: Opinion of Respondents on Assessment of management of Animal Waste

Efficiency of Management Option	Frequency	Percentage
Very Good	105	27.63
Good	76	20.00
Poor	185	48.68
Very Poor	14	3.69
Total	380	100

Source: Author’s Fieldwork, 2014

It also confirms the statement of Jekayinfa and Omisakin (2005) that agricultural wastes in most developing countries, including Nigeria are not properly managed. On the other hand, 47.63% (very good and good) indicated that there was effective management of crop residue.

Factors Militating against Efficient Animal Waste Management

Having established that animal waste management techniques adopted are inefficient, the study also investigated some of the possible factors affecting the proper utilization of animal wastes in the study area. The responses of the farmers are presented in Table 7. The result shows that 31.58% reported that ignorance of the efficient/sustainable management methods and benefits of such management is the major factor as most farmers are not aware of the economic benefits of these residues such as for sale and energy regeneration and as cooking gas. Therefore this ignorance on the benefits of animal waste makes them to subscribe to inefficient management such as burning, burying and open air dumping. Improper planning of farm yards was reported by 31.32% which indicated that some farm yards are not well situated and in some cases are too far from waste management facilities which make management efficiency difficult. On the other hand, 21.31% of the respondents indicated that lack of disposal facilities on the farm yards such as composting pits is a major factor militating against efficient management of animal waste. The remaining 15.79% of the respondents indicated that indiscipline of farmers is a factor affecting effective animal waste management.

Table 7: Factors affecting Animal Management

Factors Affecting Animal Waste Management	Frequency	Percentage
Lack of Disposal Facilities	81	21.31
Improper Planning of Farm yards	119	31.32
Lack of Awareness on Agricultural Disposal Methods	120	31.58
Indiscipline of Farmers	60	15.79
Total	380	100

Source: Authors Fieldwork, 2014

The information above has provided a basis for which animal waste in selected farms can be utilized, the type of animal waste on these farms and various methods adopted by these farmers in the management of these wastes. It is therefore necessary that these wastes are taken care of in view of their increasing magnitude on these farms as the desire for increased agricultural production is achieved through farm mechanization. Animal wastes management can be a valuable resource for improving food security and sustainable environmental management. However, if not treated, kept or disposed properly, these wastes are likely to cause pollution to the environment thereby being source of harm to human health.

CONCLUSION

The management of animal waste in Ikara LGA of Kaduna State appears to be inefficient, given the multiple benefits they could otherwise provide. The current management option is not perfect and the existing framework to ensure adequate management system and the collection facilities is not available. Animal wastes are still collected without separation at the source,

treatment facilities are limited and the collected wastes are mostly dumped haphazardly in open areas or in most cases burnt before the next farming season. Since about 32% of the farmers reported that ignorance of the benefits and strategies of animal waste management is one of the reasons for inefficient utilization of animal waste in the study area, households will benefit more if they are enlightened. Furthermore, reuse of agricultural wastes will minimize cost and ensure a healthy environment for the farming communities. Based on the findings of this study, it shows that animal waste management in the study area can be improved upon.

Hence, it is suggested that intensive mass literacy programmes on the economics of animal waste management be undertaken in the study area. This could be achieved through the extension agents, non-governmental organizations, community based organizations or farmers' cooperative societies. By involving the farmers and other stakeholders, government should come up with appropriate policies and legislative measures to discourage dumping and burning of animal wastes.

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