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Spatial Distribution of Abattoirs in Kano State, Nigeria

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ABSTRACT

The average meat production is on going up approximately by 2%annually. The aim of this study was to examine spatial distribution of abattoirs in Kano state, Nigeria. Two-Mixed approach of quantitative and qualitative was employed. Two sampling technique was used to sample 44abattoirs and 44traditional head of butchers (Sarakunan-Pawa) and chairperson of butchers' association. This research used statistical tools, frequency count analysis for data analysis and presentation. Findings of this research revealed that there are 50 abattoirs distributed in 34. The spatial distribution of these abattoirs is unevenly and located closed to geographical factors. The main factors of spatial distribution of these abattoirs are population and demand, road accessibility, direction flow of wind and so on. This research concluded that large abattoirs are located in metropolitan local government areas while small abattoirs are situated in non-metropolitan local government areas. It is recommended that abattoir should compliance with urban and regional planning as well as other environmental agencies' laws and policies through fine and/or imprisonment on those contravene setting abattoirs not in appropriate location.

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INTRODUCTION

Livestock is part of agriculture and occupies almost 38.4% as of 2017's GDP in Nigeria (National Bureau Statistics [NBS], 2017).Meat becomes part of the people's live as they cannot survive without it especially in urban areas depending upon the culture, economic status, medically aware and other factors. Moreover, Nigeria is among the world top countries that produce goat meat. It was ranked third in the world that produces goat meat in 2011 after China (58%), India (18%), Nigeria and Pakistan 9% each and Bangladesh with 6% (Central Pollution

Control Board [CPCB], 2017). In terms of cattle production, Nigeria ranked 14th in the world and 4th in Africa in 2015 (Cook, 2019) and occupied 17th position in the world for cattle production. Nigeria is endowed with abundance of animals.

On the other hand, locating abattoirs in urban centre provides numerous benefits to the people therein. Despite the fact that, the impact of abattoir operation poses threat to the environment. Locating abattoir in an area could be of potential benefits though, they are major source of public health and environmental threats if its waste is not properly managed (Twumasi, *et al.,* 2016; FAO, 2010). Abattoir solid wastes are major source of air pollution worldwide (WHO, 2005). They are generally known all over the world to pollute the environment either directly or indirectly from their various processes (Adelagan 2002; Osibanjo & Adie 2007).

Moreover, assigning location for abattoir could assist in managing abattoir solid waste. Environment Protection Agency [EPA] (2002) reported that site selection is the critical environmental issue for abattoirs. Site selection significantly reduces the environmental problems especially solid waste.

Statement of the Research Problem

Abattoirs are important component of the livestock industry in Nigeria, providing domestic meat supplies to over 120 million people and employment opportunities for the teeming population both males and females (Nafarnda *et al.,* 2012). It is one of the facilities that should be located around residential areas; that is not too far from the people due to the perishability nature of its products and for easy accessibility to meat consumers. Furthermore, despite their lot of importance abattoirs provided, they (abattoirs) in the study area are in critical condition about cheap and environmentally accepted location to dispose their waste. On the other hand, for every standard abattoir there shall be a space allocated for every abattoir operation such as stunning, bleeding, flaying, and storage. But in Kano state abattoirs, there is no division in terms of slaughtering process like: stunning, slaughtering, hanging, skinning, evisceration, splitting, deboning, chilling, and freezing as well as transportation, which affects the hygienic nature of meat and environment.

Additionally, locating abattoir close to residential area pollutes water, land and air. It also reduces life expectancy not only in Kano State's abattoirs but in most developing countries especially in Africa (WHO, 2005). On the other hand, most of previous studies (Abdullahi *et al.*, 2015; Bello & Oyedemi, 2009; Roberts, De jager & Blight, 2009; Emeka, Braide, & Chindah, 2009; World Bank, 2009; Nwanta *et al.*, 2010) did not broadly discuss the factors that affect the location of abattoir. Therefore, this study examined the spatial distribution of abattoirs and factors that determine the location of abattoir in Kano State.

LITERATURE REVIEW

For the health of the people and environment in general, abattoirs should be located outside residential area. This is because, abattoir produces huge amount of solid waste and wastewater, emission of gases or fuel (burning), and bad odour, etc which affect the people's health directly or indirectly (DARD, 2009).

Abattoir

Abattoir has root from the French verb *abattre,* which means, "to strike down" or "fell" (Tekki*et*

al., 2012). It is regarded as any building that is approved and registered by the controlling authority in which animals are slaughtered and prepared for human consumption (Alimentarius, 1993; Bello, Kwaga & Raji, 2011). EPA (2001) defines an abattoir or slaughterhouse as a building for butchering. It specifies that an abattoir is a house where animals are slaughtered; dress, cut and inspect meats; refrigerate, and take care of its by-products. This is to provide cleaner and hygienic animal slaughtering services; to ensure proper utilization of animal by-products such as hooves, hide, skin, horns, bones; to establish and control standards, and to generate income for the services rendered; and improve impact on the environment by controlling the waste generation and disposal system.

On the other hand, locating abattoirs in urban centre furnish many advantages to the people therein. Abattoir is one of the facilities that should be located around residential areas; that is not too far from the people. This facility produces organic waste which as a result of non-compliance with abattoir laws, residents around abattoir locality can be at a greater risk (Bello & Oyedemi, 2009).

Negative Effects of Location Abattoir to the Residential Area

Indiscriminate disposal of abattoir solid waste contains many diseases induced organisms. These organisms cause diseases such as headache, asthma, heart burn, dysentery, general body weakness, fever and typhoid fever pneumonia, respiratory and chest diseases, coughing, burning eyes, skin rash or irritation, wool sorter diseases, nausea or vomiting, foot, mouth diseases and dengue (Robert, De jager, Blight, 2009; Wing & Wolf, 2000). Besides, reduces life expectancy in most developing countries especially in Africa it has been associated with inadequate and hazardous waste management, among other factors (WHO, 2005). Similarly, despite animal dung could be served as manure, but it contains viruses, bacteria, microorganisms and salt which could impair quality of water in an environment when washed into river or stream (Adewumi, Babatola & Adejuwon, 2016).

Utilization of Abattoir Waste

The main reasons behind establishing abattoir facility are: to provide cleaner and hygienic animal slaughtering services; to ensure proper utilization of animal by-products including blood, hide, skin, hooves, horns, bones; to establish and control standards, and to generate revenue for the services rendered; and to improve impact on the environment by controlling the waste disposal system. Apart from covering environmental problems by converting abattoir waste to biogas, still it acts as fertilizer, as available nitrogen and other substances remain in the treated slurry (Alvarez & Lide´n, 2008). Biogas production potential can produce 53 m^3 by 100kg of abattoir solid waste; that is 1Kg of abattoir waste can produce 0.053 m^3 of biogas (Sindibu, Solomon, & Ermias, 2018).

The abattoir industry is an important component of livestock industry in Nigeria, providing domestic meat supplies to over 150 million people and employment opportunities for the teaming population both males and females (Nafarnda *et al.,* 2012). Some researchers specifically conducted their studies on utilization of abattoir solid waste such as Adhikari, Chae, & Bressler (2018).

Central Place Theory

This theory was developed by Walter Christaller around 1933 in order to explain how hierarchical distribution of settlements can grow. Christaller attempted to design a model that would demonstrate how and where central places in the urban hierarchy would be spatially and functionally distributed. His theory is based on some assumptions which include:

An isotropic surface (flat surface and no physical barriers). That central goods are gotten from the nearest central place. There is existence of equally distributed resources - similar purchasing power of all consumers. All trade areas must be served by a central place. That no excess profit may be made by any central place. There is an evenly distributed population.

Central Place theory explains urban hierarchy, which is based on the functions available in a city and is related to population as well as functions and services. Central Place is a settlement, which offers one or more services for the population living around it. They compete with each other to provide goods and services. Specialized services such as hospitals, higher institution, and so on, are said to be of high order while simple basic services (e.g. foodstuff, grocery stores, among others) are said to be of low order. Having a high order service entails that there are low order services around it, but not vice versa. More so, larger settlement tends be farther away from its kind and provides higher order services for its surrounding. As he stated that, the larger the settlements, the fewer will be their number.Christaller also glued his theory with the following elements as:

Economic reach is a measure of centrality which every city has
Centrality: it is fundamental to the development of urban places and their service areas
Threshold population: this is the minimum effective population that is required to support or sustain a business.
Range: it is the maximum distance over which people would be willing to travel in order to purchase a good or derive a service offered at a central place. The range increases as the population increases.
Complementary regions: They are the regions served by a central place. Those central places serving large areas are called High Order Centres and those serving small areas are known as Low Order Centres. The service limit of each centre was described: by the outer limit of the range of the commodity in which it dealt.
Hinterland: it refers to the area surrounding a service from which consumers are drawn. He applied the above assumptions and came up with the following conclusion that: The model explained that City is the first order centre which serves the complementary regions includes the region of the village, hamlet and town and provides additional goods and services. It is regarded as high order centre, which has large range. The second order in this model is town, which provides village and hamlet with additional goods and services. It has lower population; but many in number compare to the high order centre. Village includes the region of the hamlet and furnishes some additional goods and services to hamlet. Hamlet is the lowest order, which has the fewest goods and services available to serve the hinterland (Figure 1).

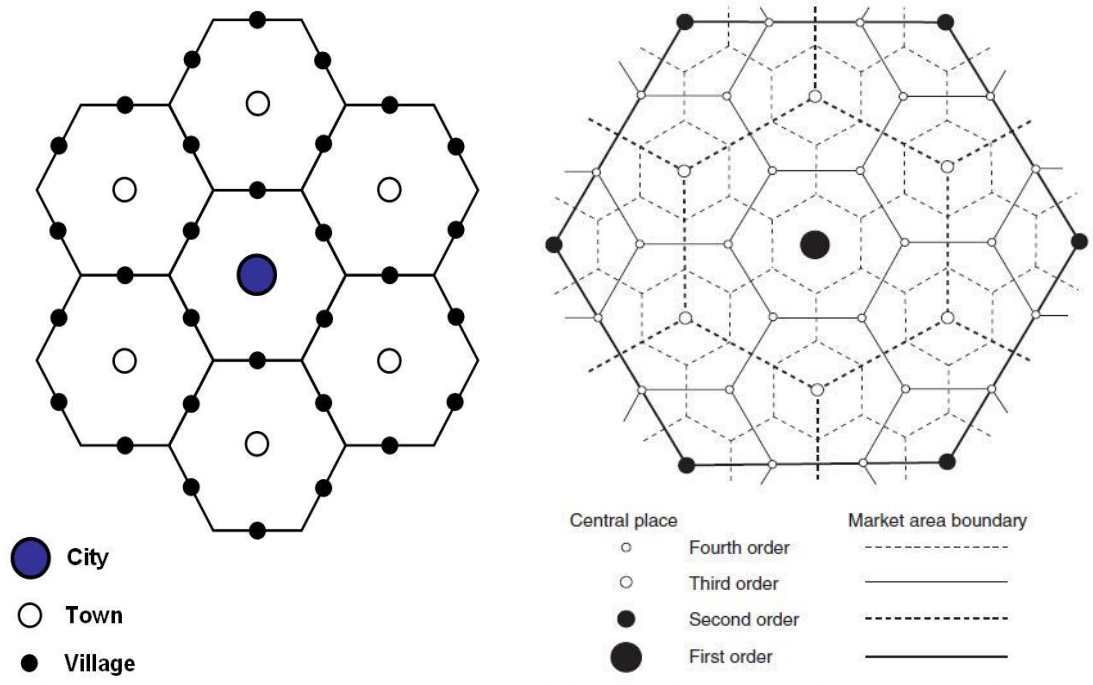


Figure 1: *Hierarchy of spatial agreement of central place theory*

Source: Christaller, 1933

Additionally, the system of central places and complimentary regions entails that central places are Towns that serve as central for regional communities by providing them with central goods and services. High order centres stock a wide variety of goods and services as well as serve large areas. Lower order centres stock smaller range of goods and services with lower coverage area. So, this study would testify the applicability of Christaller's model for abattoir hierarchy and location distribution.

MATERIALS AND METHODS

TYPES AND SOURCES OF DATA

Types of data

Two types of data were used; that is the primary and the secondary data. The primary data include the coordinates of abattoirs locations and factors that determine the location of abattoirs. On the other hand, the secondary data includes the following:

Number of abattoirs in Kano State and their locations

Number of traditional head of butchers (Sarkin-pawa) and chairman of butchers' association.

Sources of data

Primary source of data was sourced from traditional head of butchers and chairpersons of butchers' association in the sampled abattoirs. The quantitative sources of data are: GPS and GIS

techniques. For the qualitative source of data, in-depth interview was used. On the other hand, the secondary data were sourced from the following institutions:

Kano State Butchers Multipurpose Enterprise (2019): number of abattoirs and their locations

Kano State Ministry of environment (2019): name and phone number of each traditional head of butchers and chairman of butchers' association

Methods of Quantitative Data Collection

Based on primary source of data, the coordinates of each abattoir within Kano state were recorded in the field. This data was used in producing map of spatial distribution of abattoirs in Kano state. More so, regarding secondary data, the number of abattoirs was collected from Kano State Butchers Multipurpose Enterprise (2019) register. The summary of the register contains local government area and town where abattoir is located. Name of chairman of butchers' association of each abattoir in Kano state with his phone number is recorded on the register.Additionally, name and phone number of each traditional head of butchers and chairman of butchers' association was collected from Ministry of environment situated at Kofar Mazugal abattoir.

Methods of Qualitative Data Collection

Regarding factors that determine abattoir location of ASWM were collected from traditional head of butchers and chairperson of butchers' association.

Sample and Sampling Population

There are fifty (50) abattoirs in the whole Kano State distributed in both metropolitan and non-metropolitan local government areas. Based on Krejcie and Morgan (1970), 44 abattoirs were selected using stratified sampling technique. The reason for adopting stratified sampling techniques is that abattoirs are different in terms of handling capacity, types of animals slaughtered, day(s) of operation and even the size of the abattoirs. The abattoirs were divided into 3 stratums: stratum 1 is small abattoirs and 35 abattoirs were selected. Stratum 2 is medium abattoirs which contain 5 abattoirs; census sampling technique was employed here. The last stratum contains large abattoirs based on handling capacity. Here, census-sampling technique was used also.

On the other hand, total population of the respondents include: traditional heads of butchers and chairmen of butchers' association with total number of 44 each. Similarly, purposive sampling technique was employed, since there are different categories of operation specialization at abattoir. This purposive sampling technique was used for interview; where all Sarkin-Pawa and chairman of butchers' association were selected purposely for their unique knowledge they have about abattoir. However, disproportionate sample was used for interview.

INSTRUMENTS FOR DATA COLLECTION

Instruments used for Qualitative Data Collection

In-depth interview: in-depth interview was used in collecting data from abattoirs' traditional head of butchers (Sarkin-Pawa) and Chairmen of butchers' association regarding factors influencing location of abattoir.

Instruments used for quantitative data collection

Global Positioning System (GPS) device Garmin cx76 model was used for taking coordinates of all abattoirs under study area so as to map their spatial distribution in a Geographical Information System (GIS) software environment (Arc GIS 10.3 Model). This was used in identifying spatial distribution of abattoirs situated within the study area.

Methods for Data Analysis and Presentation

Data collected using GPS and in-depth interview were analysed through the following methods:

For spatial distribution of abattoirs in Kano State, GIS analysis was performed using ArcGIS 10.3 software. Coordinates were recorded in an excel file, which was then exported into ArcGIS environment for analysis. The file contains therein all the corresponding coordinates of all the abattoirs and relative coordinates. The exported file was then converted into ArcGIS format shape-file, to allow use for GIS analysis, and together with Kano state shape-file (Kano State Local Government and State Boundary map and roads) same georeference format was set to World Geographic System 1984 (WGS 84). The data presentation employed the use of maps.

Nearest Neighbour Analysis was performed to identify how abattoirs in the study area are distributed; are they cluster, scattered or random? On the other hand, factors that determine abattoir location were analyzed using frequency table.

RESULT AND DISCUSSION

Inventory, Location and Spatial Distribution of Abattoirs in Kano State

Inventory of Abattoirs in Kano State

Based on the result of inventory, fifty (50) abattoirs were identified which were distributed within 34 local government areas (Appendix I). The availability and concentration of abattoirs in Kano state varied with respects to the 34 local governments areas studied. There is no name for abattoirs by the local people but rather, the people call each abattoir with the ward it is located. People in Kano state use two most common names for abattoir: '*kwata',* or *'mayanka'* except for Kofar Mazugal abattoir which is called '*abbatuwa'.*

On the other hand, there are 10 local government areas without abattoirs (Albasu, Ajingi, Bagwai, Fagge, Gwale, KMC, Makoda, Rogo, Tofa and Warawa) in both metropolitan and non-metropolitan local government areas. The possible reasons for not having abattoir in non-metropolitan local government areas are: all local government areas in non-metropolitan are subsumed by larger local government area. For example, Albasu and Ajingi depend mostly on Gaya and Wudil for most of their infrastructural facilities. While Bagwai depends upon Bichi for its most social amenities; Makoda gets most of its social facilities from Danbatta and Bichi. Tofa is situated in one corridor which makes it to depend on Dawakin Tofa and Rimin gado. Warawa local government area derives most of its infrastructural facilities from Dawakin kudu and Gezawa, while Rogo derives some of its social amenities from Kiru local government area. Additionally, transportation network is another factor to be considered for not having abattoirs in these local government areas. Most of them are not on high way or on roads that link that local government to big town or city. For example, Albasu, Bagwai, Makoda, Rogo, Tofa and Warawa are not on high way, nor on interstate road network; but rather on a nook.

Unlike some local government areas such as: Dawakin Kudu, Dawakin Tofa, Garko, Kabo, Kibiya, Madobi, Minjibir, Takai, Tudun wada and Wudil which have 2 abattoirs each. As it was observed that, most of these local government areas have more than one town and each is independent which creates competition among them. For example, Madobi and Kwankwaso, Dawakin Tofa and Dawanau, Kabo and Garo, Takai and Kachako, Wudil and Darki, just mentioned a few.

On the other hand, 3 local government areas that do not have abattoir in Kano metropolitan are: Fagge, Gwale and Kano Municipal (KMC). Due to urbanization, it is impossible to differentiate between one local government area to another, as some have gutter or road line as borderline and mostly there is no sign of demarcation written boldly. So, there is symbiosis relationship among these local government areas. Therefore, they depend on Kofar Mazugal abattoir which is situated in Dala local government area for meat. Another reason is that there is no enough space in metropolitan local government which an abattoir can be erected due to the nature of its operation and space consuming (such as place for slaughtering, skinning, evisceration, splitting, deboning, storage, waste dumping site, etc).

Classification of Abattoirs in Kano State

Based on the finding of this result, it is indicated that abattoirs in Kano State could be classified based on types of animals slaughtered, handling capacity, day of operation and processes for slaughtering animals. This classification identified from qualitative and quantitative data derived from interview and observation checklist respectively. These classifications are based on:

Types of animal slaughtered

Abattoirs in Kano state were divided into small (goats and sheep) and large (cattle and camels) animals slaughtered. Among abattoirs within Kano metropolitan, only Sauna abattoir is specialized in slaughtering single type of animal (goats and/or sheep). Apart from Sauna, there is no single abattoir specialized in slaughtering either small or large animals. On the other hand, 6 abattoirs in non-metropolitan local government areas specialize in slaughtering single (goats/sheep) type of animal. These abattoirs are: Danzabuwa, Dumbulin, Kunya, Madobi, Shuwaki, and Zakirai. However, no single abattoir in both metropolitan and non-metropolitan local government areas specializes in either slaughtering cattle or camels (Table 1).

Table 1: *Types of animals slaughtered*

	Name of Abattoir	**LGA**	**Ward**	**Status of Abattoir**
S/N	**Specialize in slaughtering Camel, Cattle and Goat/Sheep**			
1	Kofar Mazugal abattoir	Dala	Kofar Mazugal	Sampled
2	Unguwa uku abattoir	Tarauni	Unguwa Uku	Sampled
3	Bachirawa abattoir	Ungoggo	Bachirawa	Sampled
4	Takai abattoir	Takai	Takai	Sampled
5	Makole abattoir	Dawakin kudu	Lahadin Makole	Sampled

S/N	Specialize in slaughtering Cattle and Goat/Sheep			
1	Danbatta abattoir	Danbatta	Danbatta	Sampled
2	Kumbotso abattoir	Kumbotso	Unguwa Uku	Sampled
3	Dangawan abattoir	Dawakin Tofa	Dawanau	Sampled
4	Rano abattoir	Rano	Rano	Sampled
5	Tudun Wada abattoir	Nassarawa	Tudun Murtala	Sampled
6	Wudil abattoir	Wudil	Wudil	Sampled
7	Bichi abattoir	Bichi	Bichi	Not sampled
8	Bunkure abattoir	Bunkure	Bunkure	Sampled
9	Bebeji abattoir	Bebeji	Bebeji	Sampled
10	Dawakin tofa abattoir	Dawakin Tofa	Dawakin Tofa	Not sampled
11	Dawakin kudu abattoir	Dawakin kudu	Dawakin kudu	Not sampled
12	Doguwa abattoir	Doguwa	Sabon gari	Sampled
13	Garin Malam abattoir	Garin Malam	Garin Malam	Sampled
14	Dal abattoir	Garko	Dal	Not sampled
15	Garko abattoir	Garko	Garko	Sampled
16	Gaya abattoir	Gaya	Gaya	Sampled
17	Gwarzo abattoir	Gwarzo	Gwarzo	Sampled
18	Gezawa abattoir	Gezawa	Gezawa	Sampled
19	Getso abattoir	Gwarzo	Getso	Sampled
20	Kabo abattoir	Kabo	Kabo	Sampled
21	Garo abattoir	Kabo	Garo	Not sampled
22	Karaye abattoir	Karaye	Karaye	Sampled
23	Kibiya abattoir	Kibiya	Kibiya	Sampled
24	Saya-saya abattoir	Kibiya	Sayasaya	Sampled
25	Kiru abattoir	Kiru	Kiru	Sampled
26	Yako abattoir	Kiru	Yako	Sampled
27	Kwanar Dangora abattoir	Kiru	Yelwa	Sampled
28	Kura abattoir	Kura	Kura	Sampled

29	Kwankwaso abattoir	Madobi	Kwankwaso	Sampled
30	Minjibir abattoir	Minjibir	Minjibir	Sampled
31	Rimin gado abattoir	Rimin gado	Rimin gado	Sampled
32	Shanono abattoir	Shanono	Shanono	Sampled
33	Sumaila abattoir	Sumaila	Sumaila	Not sampled
34	Kachako abattoir	Takai	Kachako	Sampled
35	Dalawa abattoir	Tudun wada	Dalawa	Sampled
36	Tudun Wada abattoir	Tudun wada	Tudun wada	Sampled
37	Darki abattoir	Wudil	Darki	Sampled
S/N	**Specialize in slaughtering Goat/Sheep**			
1	Danzabuwa abattoir	Bichi	Danzabuwa	Sampled
2	Badume abattoir	Bichi	Badume	Sampled
3	Shuwaki abattoir	Kunchi	Shuwaki	Sampled
4	Kunya abattoir	Minjibir	Kunya	Sampled
5	Dumbulin abattoir	Tsanyawa	Dumbulin	Sampled
6	Zakirai abattoir	Gabasawa	Zakirai	Sampled
7	Sauna abattoir	Nassarawa	Sauna	Sampled
8	Madobi abattoir	Madobi	Madobi	Sampled

Source: Field survey, 2020

Handling Capacity

Abattoirs in Kano State were divided into three stratums based on handling capacity: large, medium and small. Dala, Ungoggo, Tarauni and Kumbotso local government areas have high order capacity or class A (large) abattoirs (table 1). Danbatta, Rano, Dawakin Tofa, Wudil and Nassarawa local government areas have medium abattoirs while other 41 abattoirs are considered as small abattoirs or slaughterhouses. The divisions of these abattoirs in Kano state into 3 stratums are:

Stratum 1 Small: less than 100 small animals (goats and/or sheep) per operation or less than 10 large animals (camels and/or cattle) per abattoir market day. Additionally, in this stratum, 41 abattoirs were identified (table 2). As stated by some Sarakunan-pawa that Darki is the largest goats/sheep market for the whole Kano state and fall under this category in terms of slaughter handling capacity.

Stratum 2 Medium: 100-299 goats/sheep or 10-49 camels and/or cattle. Therefore, there are 5 abattoirs in this category. Additionally, Danbatta and Wudil abattoirs which are the major domestic livestock markets in Kano State fall under this category. Wudil market is the largest

market for cattle in Nigeria and probably the largest in West Africa due to large volume of cattle brought to the market every Friday. Danbatta market is among the largest cattle markets in Kano state which operates every Sunday (Gambo, 2020). Though, both abattoirs fall under medium abattoirs; they are the largest markets, but not the largest abattoirs in terms of handling capacity in the state. For the whole Kano state, there is no market for camels. In terms of slaughtering camels, Kofar Mazugal abattoir is the largest in Nigeria.

Table 2: Types of animals and handling capacity

			Types of animals		
S/N	**LGA**	**Ward**	**Goat**	**Cattle**	**Camel**
		Large abattoir based on handling capacity			
1	Dala	Kofar Mazugal	1500	300	120
2	Kumbotso	Unguwa Uku	200	10	
3	Tarauni	Unguwa Uku	600	15	4
4	Ungoggo	Bachirawa	800	50	5
	Total		**3100**	**375**	**129**
		Medium abattoir based on handling capacity			
1	Danbatta	Danbatta	570	85	
2	Dawakin Tofa	Dawanau	50	15	
3	Rano	Rano	530	116	
4	Nassarawa	Tudun Murtala	50	3	
5	Wudil	Wudil	205	93	
	Total		**835**	**227**	**0**
		Small abattoir based on handling capacity			
1	Bichi	Badume	100		
2	Bichi	Bichi	6	1	
3	Bichi	Danzabuwa	105		
4	Bunkure	Bunkure	39	2	
5	Bebeji	Bebeji	15	4	
6	Dawakin Tofa	Dawakin Tofa	60	3	
7	Dawakin kudu	Dawakin kudu	250	15	
8	Dawakin kudu	Lahadin Makole	110	20	2

9	Doguwa	Sabon gari	18	5	
10	Gabasawa	Zakirai	15		
11	Garin Malam	Garin Malam	20	8	
12	Garko	Dal	100	30	
13	Garko	Garko	40	10	
14	Gaya	Gaya	18	15	
15	Gwarzo	Gwarzo	180	34	
16	Gezawa	Gezawa	174	6	
17	Gwarzo	Getso	162	47	
18	Kabo	Kabo	205	7	
19	Kabo	Garo	60	10	
20	Karaye	Karaye	140	35	
21	Kibiya	Kibiya	28	9	
22	Kibiya	Sayasaya	10	1	
23	Kiru	Kiru	90	17	
24	Kiru	Yako	20	8	
25	Kiru	Yelwa	45	4	
26	Kunchi	Shuwaki	115		
27	Kura	Kura	120	16	
28	Madobi	Kwankwaso	50	2	
29	Madobi	Madobi	10		
30	Minjibir	Kunya	50		
31	Minjibir	Minjibir	125	4	
32	Nassarawa	Sauna	15		
33	Rimin gado	Rimin gado	100	10	
34	Shanono	Shanono	142	8	
35	Sumaila	Sumaila	15	10	
36	Takai	Takai	100	30	7
37	Takai	Kachako	91	12	

38	Tsanyawa	Dumbulin	50		
39	Tudun wada	Dalawa	50	10	
40	Tudun wada	Tudun wada	60	12	
41	Wudil	Darki	100	2	
	Total		**3203**	**407**	**9**

Source: Field survey, 2020

Stratum 3 Large: 300 goats or sheep to above per market-day or 50 camels or cattle to above per market-day. These abattoirs are source of meat not to other metropolitan local government areas, but to many states within the nation and other countries such as Saudi Arabia as stated by Sakin-pawa of Kofar Mazugal and Bachirawa abattoirs during interview conducted. This is among the possible reasons that there is no abattoir in Fagge, Gwale and Kano Municipal local government areas due to the huge meat produce by these 3 abattoirs.

Day(s) of operation per week

This study identified abattoirs that operate on daily basis are 8 in number in Kano state (Figure 2). All these abattoirs are within Kano metropolitan local government areas except Dawanau and Bichi abattoirs. However, abattoirs that operate weekly are 18. Seven abattoirs out of 18 (38.9%) operate on Friday; 4 operate on Tuesday. Abattoirs that operate on Wednesday are 3; with two abattoirs operate on Thursday and Sunday each. No abattoir in Kano State operates on either Saturday or Monday.

On the other hand, 15 abattoirs operate on daily/weekly basis. These abattoirs slaughter daily in small quantity, but on market day the number of animals slaughtered is high. Out of 15 abattoirs, 7 (46.70%) operate on daily and Friday. The possible reason for having the largest percentage of Friday as a market-day might be related to religious activities (since Friday is considered as Sacred day among the Muslim). Two abattoirs each operate daily and on Sunday (market day); daily and on Wednesday; daily and Monday. The remaining 2 abattoirs operate daily and on Tuesday as well as daily and on Thursday. There is no abattoir that operates on Saturday in this category (Figure 2).

Additionally, 4 abattoirs operate twice in a week. Abattoir in Kwankwaso, Madobi and Yako town operate on Monday and Friday while Garo abattoir operates on Saturday and Tuesday. On the other hand, the remaining 5 abattoirs: Gaya, Gezawa and Tudun wada abattoir operate on one day-off. While Garin malam and Shanono abattoirs operate daily and twice in a week (Monday & Friday).

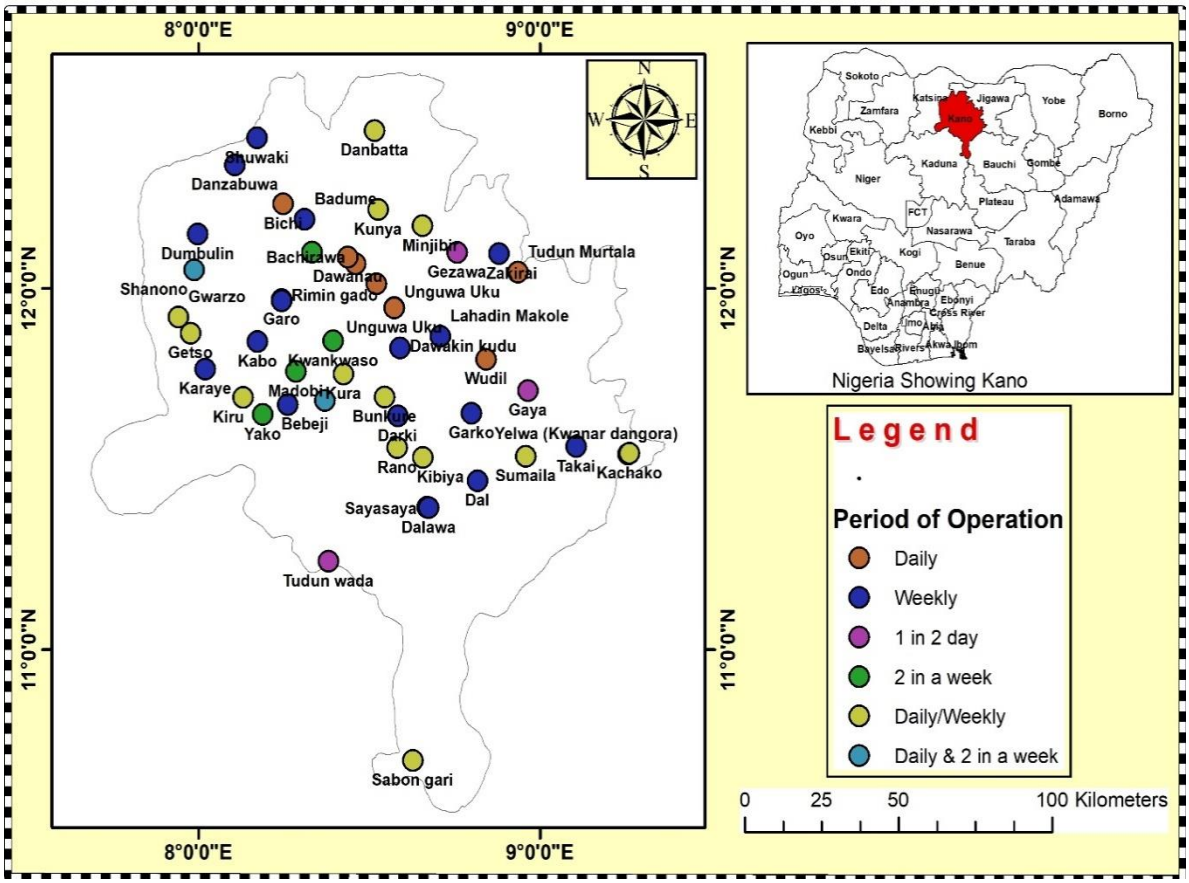
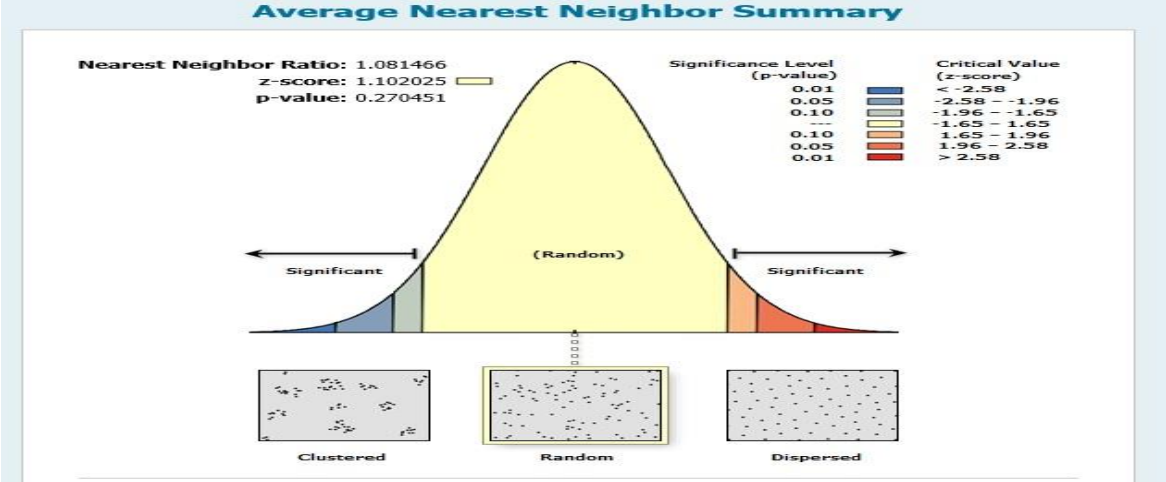


Figure 2: abattoir frequency of operation

Source: Fieldwork, 2020

Spatial Distribution of Abattoirs in Kano State

Abattoirs in Kano state are distributed unevenly which occurred as a result of some geographical factors such as population density, commercial activities, transportation network and space available. So, the pattern of the distribution of abattoir in Kano State is random as it can be seen in Figure 3.



Average Nearest Neighbor Summary

Observed Mean Distance:	10865.1836 Meters
Expected Mean Distance:	10046.7193 Meters
Nearest Neighbor Ratio:	1.081466
z-score:	1.102025
p-value:	0.270451

Figure 3: *Nearest Neighbour Analysis in the Study Area*

Source: Fieldwork, 2020

From Figure 3, it was calculated the Nearest Neighbour Index (NNI) is greater than 1 and Z score is also greater than 1. This means that the pattern of abattoirs in Kano State is random. This is because the abattoirs are distributed or built randomly in different commercial hubs, road transportation site and high population concentration local government areas.

Location of large abattoirs in Kano State

Based on handling capacity, 4 abattoirs were identified as large. These abattoirs are concentrated in Kano metropolitan local government areas. These 4 abattoirs (Kofar Mazugal, Bachirawa, Unguwa uku Tarauni and Unguwa uku Kumbotso)produce more than half of all what other abattoirs produce in Kano state in terms of meat and waste (table 2). Their spatial pattern of distribution is mostly clustered (Fig. 4). All are located close to motor parks except Bachirawa. On the other hand, KofarMazugal abattoir is amidst of multi-billionaire markets in Kano State which are Akija, Kantin kwari, Kofar Wambai, Kurmi, Sabon gari, Singer, Wapa (Maigari, 2014).

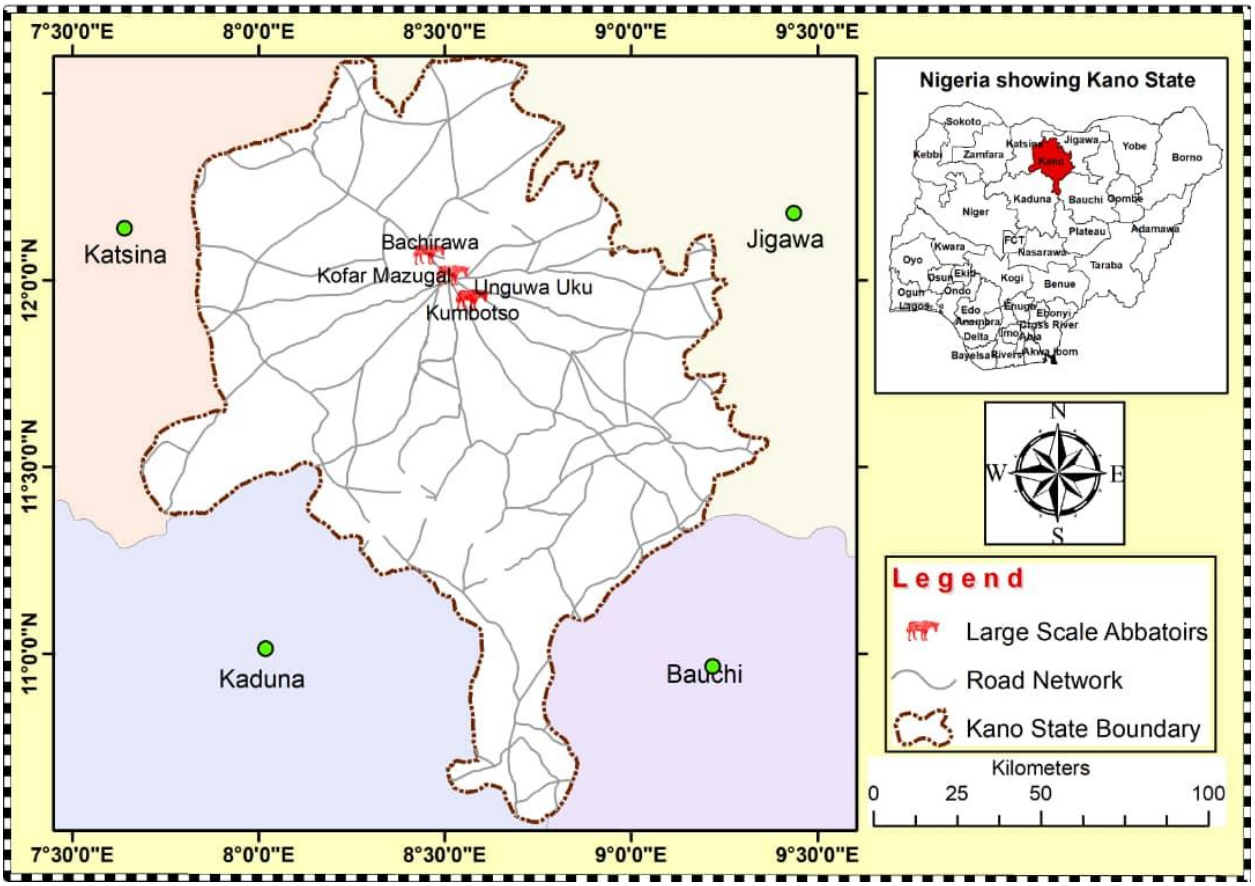
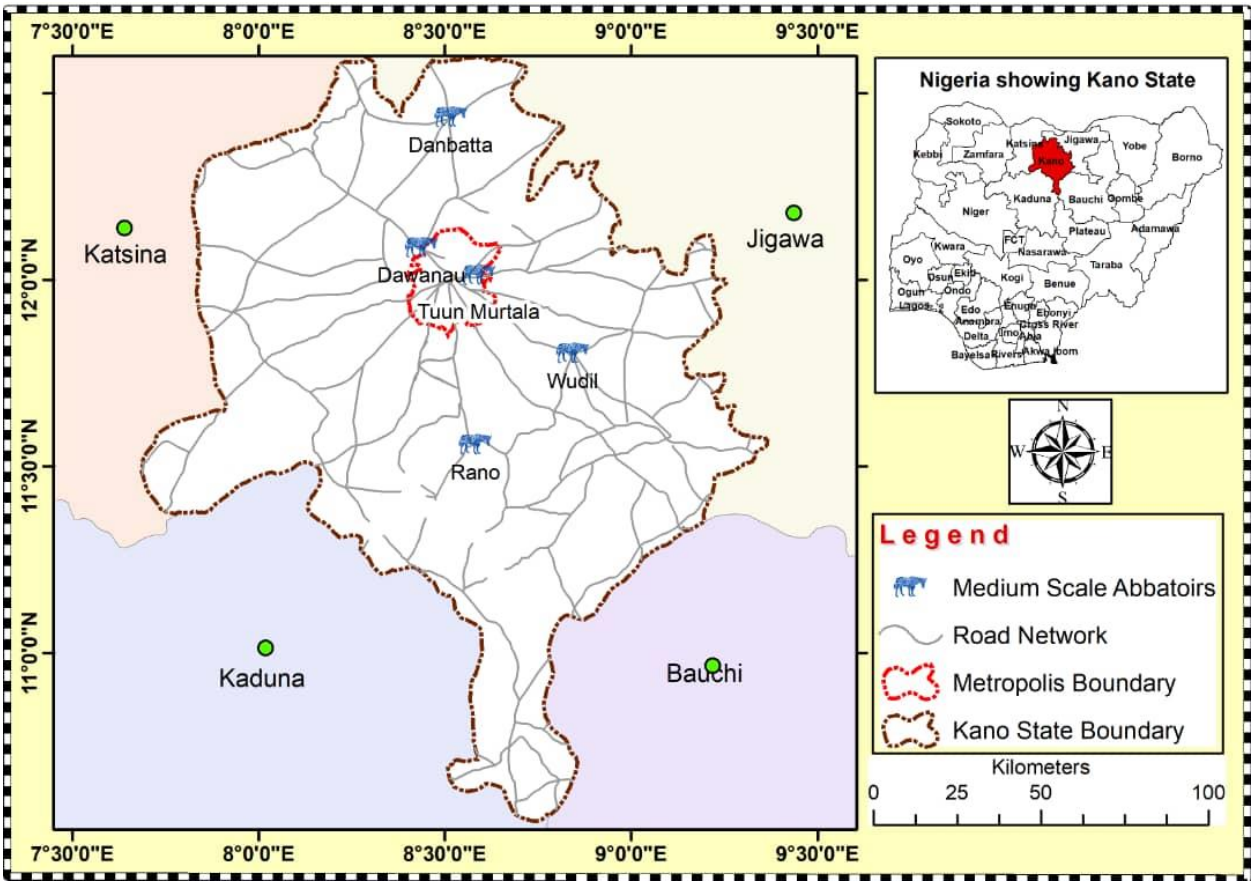


Fig. 4: *Spatial Pattern of Medium abattoirs in Kano State*
Source: Fieldwork, 2020

Location of Medium abattoirs in Kano State

Medium abattoirs are 5; with only one (Tudun Murtala) is in Kano metropolitan. Spatially, their pattern of distribution is random (Fig. 5). These abattoirs are concentrated mostly in Kano north and south (relatively) longitudinally. Wudil is found in eastern part of Kano state, but there is no category of medium abattoir in western region. Furthermore, all are located close to road and within the market, except Tudun Murtala which is close to the road and other industries. They all serve other smaller communities with meat and other services. Theoretically, this finding supports the Christaller'sCentral Place Theory (1966). In terms of animals slaughtered, they do not slaughter camel in their regular activities, except by accident.

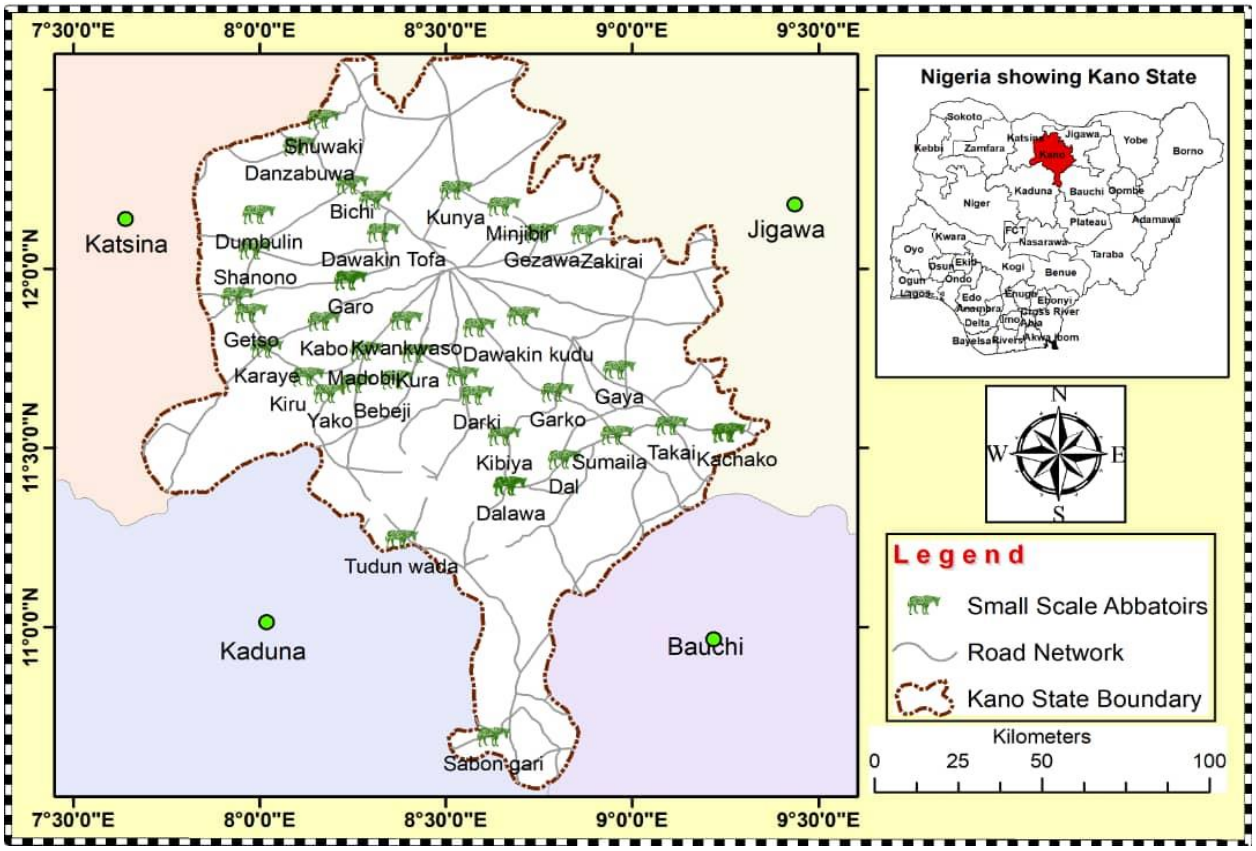


Source: Fieldwork, 2020

Fig. 5: *Spatial pattern of medium abattoirs in Kano State*

Location of Small abattoirs in Kano State

This category has 41 abattoirs. Their spatial distribution is fairly even (Fig. 6). For example, in northern and southern Kano there are small abattoirs in Kunchi and Doguwa local government areas respectively. From eastern part of Kano, there are abattoirs in Gaya, Sumaila and Takai while in western fringe there are abattoirs in Gwarzo, Karaye and Kiru. Centrally, there are abattoirs in Nassarawa, Dawakin Tofa and Madobi. Out of 41 small abattoirs in Kano state, only Sauna abattoir in Nassawara local government area is located in Kano metropolitan but the rest are in non-metropolitan area. However, the small abattoirs are tenth and eighth times of large and medium abattoirs respectively, but produce less than fifth times of their edible and non-edible meat in a week. Theoretically, this finding corroborates Christaller'sCentral Place Theory which states that the lowest order units are higher than the first order unit in hierarchy of settlement.



Source: Fieldwork, 2020

Fig. 6: *Spatial pattern of small abattoirs in Kano State*

Factors that Determine the Locations of Abattoir in the Study Area

The most important factors for this distribution of abattoirs are population, demand for meat, road accessibility, markets, just mentioned a few. Fig. 6 showed that all abattoirs are located close to road transportation or footpath.

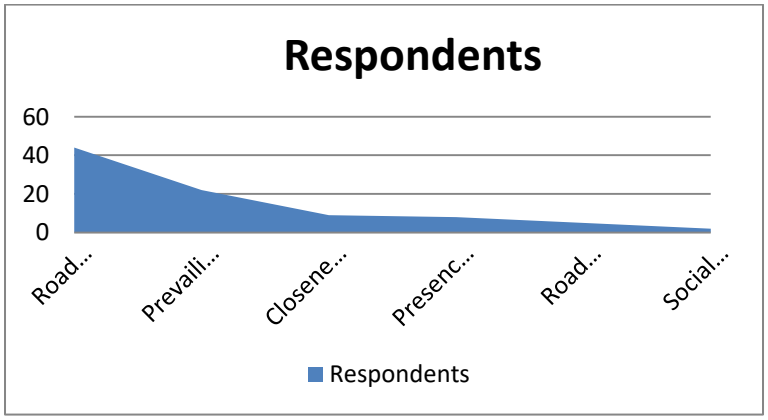


Fig 7: *Factors influencing the location of abattoirs*

Source: Fieldwork, 2020

Looking at the Fig. 7 above, total responses are 158 which supposes to be 132 respondents (44 officers from each local government area under Agriculture Department, 44 Sarakunanpawa and 44 Chairpersons of butchers). Some of the interviewees stated more than one reason for locating abattoir in an area. There is agreement among allSarakunanpawa and Chairpersons of butchers together with few local government officers that road accessibility is the major factor considers for locating abattoir in an area. The road can be foot path, minor road, secondary or main road. Apart from road accessibility, direction of wind takes second position, followed by closeness to settlement. While traditional ceremonies take the last position. In summary, all the factors stated by the respondents could either be physical, social or economic factors.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Abattoirs are not evenly distributed in Kano State as this study discovered. They are more concentrated in highly populated and commercial areas with more concentration of large abattoirs in Kano metropolitan. The abattoirs were erected at 34 local government areas. The pattern of distribution of these abattoirs is random which can affect the immediate environment. However, 10 local government areas without abattoir: 7 and 3 from non-metropolitan and metropolitan local government areas respectively. These 7 local government areas having depending on larger local government neighbouring them for most of their social amenities and transportation network is another factor to be consider for not having abattoirs in these local government areas. On the other hand, there is symbiosis relationship among metropolitan local government areas, so, these 3 local government areas depend on Kofar Mazugal abattoir which is situated in Dala local government area for meat production.

On the other hand, social factors play vital role in determine the location of abattoir in the study area. The most central factors that determine the distribution of abattoirs are population, demand for meat, road accessibility, markets, just mentioned a few. It is showed that all abattoirs are located close to road transportation or footpath.

Recommendations

Based on the findings of this research, the following recommendations are given:

It is recommended that the government should relocate some abattoirs in Kano metropolitan to suburban area so as to reduce the negative effects of abattoirs that might be found. For those local government have more than one abattoir, one of the abattoirs should be relocated to local government area where is no abattoirs and government provide subsidy for newly relocated abattoir such as removing taxation, chief electricity, water, and so on.

It is also recommended that transportation network should be provided to link all local government areas as it is one of the requirements for establishing abattoir in an area for easy convey of live animals and carcass as well as commute people.

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