**Hedonic Price Analysis of Beef Cattle Attributes in Maiduguri, Borno State, Nigeria**

**Abstract**

The study examined the effects of beef cattle attributes on its price in Maiduguri, Borno State, Nigeria. Primary data collected from a sample of 100 cattle buyers, chosen through convenience sampling, were utilized for the study. . Frequencies, percentages and hedonic pricing model were used to analyze the data. The most preferred cattle attributes were good body conformation (91%), young adult age (87%), bull (82%), big body size (72%), large faced cattle (68%) and brown skin colour (59%).Cattle buyers would willingly pay over ₦30,000 for attributes such as big body size (₦63,270),medium body size (₦42,180), brown skin colour (₦33,393), and would discount over ₦30,000 for attributes such as *Mbororo* breed (₦40,423) and calf age (₦40,423). The study concludes that cattle buyers would willingly pay the highest premium price for big body size and discount the largest amount for *Mbororo* breed. It was recommended for producers and breeders to promote attributes that consumers show preference for and that influence willingness to pay which would improve cattle demand and increase sales.

**Key words:** Hedonic analysis, Attributes, Price effects, Cattle, Maiduguri

**Introduction**

The cattle enterprise is important to Nigeria’s economy as it provides employment and income generating activities to many Nigerians. It is a source of livelihood to millions of people through cattle production, marketing and processing. Cattle provide animal protein (milk, beef and beef by-products), manure, draught power, raw materials for industries such as hooves, horns, skins, blood and bones. Cattle population in Nigeria comprises about 19.5 million cattle (NBS, 2016a) which are majorly found in the northern parts of the country (World Bank, 2017). They are traded from the supply areas to all parts of the country most especially the low cattle production areas of the southern parts. Different breeds of cattle are traded and consumed in the country. They possess numerous attributes or characteristics that are regarded differently by consumers. However, the attributes or characteristics of goods, rather than the goods themselves, have been postulated to determine the preference structure of individuals (Lancaster, 1996).

Market price, or explicit price, reflects the value of goods as bundles of observable attributes in the market. These prices are derived from the aggregated values of these characteristics (Edmeades, 2005). Since the attributes are not bought and sold differently but embodied in the product, the implicit (marginal) prices of these characteristics determine the market value of the product. For cattle, the attributes embodied within the animal define its price. These attributes are either positively or negatively valued by consumers. Cattle possess multiple attributes which combine to provide utility to consumers, hence consumers demand particular qualities depending on its usage. These demands hold significant implications for cattle production and management requirements. Consumer demands also dictate the type of animal to be raised and managed, the type of by-products to produce and process, and the marketing strategy to adopt in order to meet the demands of consumers. Producers and marketers are interested in attributes which may influence consumer preferences and guide purchase decisions.

Borno State is a major supplier of cattle to the country. The cattle population of the State is estimated to exceed two million (Borno State Ministry of Animal Resources and Fisheries Development, 2011). Cattle trade provides revenue to the State through various forms of taxation and it is a means of income and livelihood for a significant proportion of participants of the value chain (Ghide, Mohammed & Shettima, 2017). Understanding consumer preferences and choices regarding cattle is important for effective supply and delivery in the enterprise. However, the relative importance of attributes used by consumers in their buying decisions, or the quality index used by producers or marketers in distinguishing products to promote sales and the extent to which consumers are willing to pay for such attributes is not known. To achieve these, this study measured consumer preferences for cattle attributes and willingness to pay for each attribute.Information on product attributes can be used by breeders to enhance trade by promoting desired attributes. This information can also assist producers and traders in improving their production and marketing decisions to meet consumer expectations, thereby improving their competitiveness. The information generated through this survey is useful to policy makers as a guide wherein appropriate policies to support cattle production and trade can be made.

**Materials and Methods**

**The Study Area**

The study was carried out in Maiduguri Metropolis, Borno State, Nigeria. The area, also referred to as Maiduguri Urban, lies between latitudes 130 06I and 130 14I E and longitudes 110 46I and 110 54I N (GEONETcast Unimaid, 2015). It has a population of 732,696 people (National Population Commission, 2006) projected to 1,340,438 in 2020 at an annual growth rate of 3.2 percent. Maiduguri Metropolis experiences a hot climate, with a mean temperature of 37oC, and a mean rainfall of 647mm per annum (Lake Chad Research Institute, 2019).

Maiduguri Metropolis comprises parts of four adjoining Local Government Areas (LGA), which include Maiduguri Metropolitan Council (MMC), Jere, Konduga and to a lesser extent parts of Mafa LGA (Kawka, 2002). Major occupations of the people include civil service, farming and trading. Major crops cultivated include cowpea, groundnut, maize, millet, and vegetables such as onions, pepper, tomatoes and amaranths. Livestock reared include cattle, sheep, goat and poultry. Livestock and livestock products such as hide and skin are majorly traded in the Metropolis. Cattle fattening is a major practice in the area. Maiduguri is a major supplier of cattle to the country and has a large livestock market popularly known as *Kasuwan shanu*, where livestock, especially cattle are traded as well as fattened. It also has a large abattoir situated opposite the cattle market which is capable of handling 200 cattle a day as well as hundreds of sheep and goats (Maiduguri Central Abattoir [MCA], 2020).

**Sources of Data**

The study utilised primary data which was sourced using structured questionnaire administered to cattle buyers through interview by trained enumerators. The questionnaire includes information on buyer’s socio-economic characteristics and preference rating of cattle attributes.

**Sampling Procedure**

For the study, five cattle buyers were selected weekly by convenience sampling for a period of 20 weeks (December 2021 to April 2022) to make a total of 100 cattle buyers. Convenience sampling was employed due to the large size of the population and the absence of a sampling frame.. The cattle buyers were obtained from Maiduguri cattle market as it was the major selling point of cattle in the study area. To determine which attributes to consider for selection, a rapid appraisal with three veterinary staff of the cattle market, two cattle traders and three buyers of cattle was carried out. Their opinions were solicited on the criteria and indicators that buyers normally use in buying cattle and those traders use in making decisions on price. These attributes were then considered for the study.

**Analytical Techniques**

For analysis of data, frequencies, percentages, Likert scale ranking and Hedonic Pricing Model were used to achieve the objectives of the study. Likert ranking scale was used to rank consumer preference for cattle attributes. The ranking was considered under 5 points ordering as 5 = Most preferred, 4 = Preferred, 3 = Least preferred, 2 = Not preferred, 1 = Indifferent.

**Hedonic pricing model**

The hedonic pricing model derived from Lancaster (1966) and Rosen (1974) was used to estimate the effects of attributes on price of cattle. Products’ attributes have been postulated to determine the preference structure of individuals, thereby an item can be valued as the sum of the individual prices of its characteristics. Following Ojogho et al. (2013) and Lawal, Mohammed and Musa (2016), the implicit form of the hedonic pricing model is as follows:

………………………………………………(i)

Where:

= unit price paid for cattle by the buyer

= characteristics of cattle by the buyer

error term

with implicit prices,

…………………………………………(ii)

Where k = 1,………….n number of attributes

Different functional forms were fitted but the log transformation was selected as it provided a better fit, with most of the coefficients having signs that were consistent with theoretical expectations. The empirical model estimated was specified as:

ln p + ε ………………. (iii)

With hedonic prices = p …………...…… (iv)

Where:

P = Average price of cattle (₦)

= Intercept

= estimated parameters (= 1-25)

X1 = *Ambala* breed

X2 = *Kuri*

X3 = *Bokoloji*

X4 = *Mbororo*

X5 = *Wadara*

X6 = Female

X7 = Male

X8 = Calf

X9 = Young adult

X10 = Old

X11 = Good conformation

X12 = Average

X13 = Poor

X14 = Small body size

X15 = Medium

X16 = Big

X17 = Short horn

X18 = Long horn

X19 = Fat tail

X20 = Thin tail

X21 = Colour brown

X22 = Black

X23 = White

X24 = Large face

X25 = Thin face

Error term

***A priori* expectation**

The expected signs of the variables used in the hedonic model are presented in Table 1. Positive coefficients signify premium and negative coefficients signify discount.

**Table 1: Expected Signs for Hedonic Variables**

|  |  |
| --- | --- |
| **Cattle attributes** | **Expected signs** |
| Ambala, Kuri, Bokoloji, Mbororo, Wadara, calf, short horn, long horn, colour brown, black, white | +/- |
| Male, young adult, good conformation, average conf., medium size, big size, fat tail, large face | + |
| Female, old, poor conformation, small body size, thin tail, thin face | - |

Source: Author’s Illustration

**RESULTS AND DISCUSSION**

**Socio-economic Characteristics of Cattle Buyers**

The socio-economic characteristics studied include sex, age, marital status, educational qualification, household size, income and occupation. The results showed that majority of the cattle buyers were male (99.0%), within the age range of 41-50 years (66%) and were all married and had some form of formal education (western education) as only 19% had no formal education (Table 2). The majority cattle buyers (61%) had large household sizes ranging from 11-15 persons, with about 49% having modal income class ranging from ₦50,000 to ₦100,000 and are majorly (82%) non-civil servants (Table 2).

**Table 2: Socio-economic Characteristics of Cattle Buyers in Maiduguri**

|  |  |
| --- | --- |
| **Socio-economic variables** | **Cattle buyers (n=100)** |
| **Sex** | **%** |
| Male | 99.0 |
| Female | 1.0 |
| **Age (Years)** |  |
| 21-30 | 0.0 |
| 31-40 | 11.0 |
| 41-50 | 66.0 |
| >50 | 23.0 |
| **Marital status** |  |
| Single | 0.0 |
| Married | 100.0 |
| **Educational qualification** |  |
| Primary | 9.0 |
| Secondary | 48.0 |
| Tertiary | 24.0 |
| Non-formal | 19.0 |
| **Household size** |  |
| 1-5 | 0.0 |
| 6-10 | 28.0 |
| 11-15 | 61.0 |
| 16 and above | 11.0 |
| **Income** |  |
| <50,000 | 18.0 |
| 50,000-100,000 | 49.0 |
| 100,001-150,000 | 20.0 |
| 150,001-200,000 | 4.0 |
| >200,000 | 9.0 |
| **Primary Occupation** |  |
| Civil servant | 18.0 |
| Non-civil servant | 82.0 |

**Source: Field survey, 2022**

The findings of the study revealed cattle in Maiduguri, Borno State were majorly bought by married male who are in an active age range who may be capable of participating in income generating activities to cater for their responsibilities. These consumers can be regarded as fairly educated as they had mostly undergone a minimum of primary education. Household sizes of cattle buyers in Maiduguri was considered large when compared with the Nigerian average household size of 4.9 in urban areas (NBS, 2016b). The income group of the buyers also suggests they had a fairly decent income and are majorly engaged in the private sector.

**Consumer Preference for Cattle Attributes**

Major cattle breeds traded in Maiduguri cattle market include *Ambala*, *Kuri*, *Bokoloji*, *Mbororo* and *Wadara* (MCA, 2020). Distribution for the preference response showed *Ambala* as the choice breed (Table 3). The respondents mostly preferred *Ambala* (43%) to the other breeds and 19% showed indifference to animal breed. The choice of breed is usually considered by fatteners, traders and butchers. Those buying for home consumption generally do not emphasize the breed as choice criteria. Fatteners generally perceive *Ambala* as the breed with the highest feed conversion rate than the others. Its relatively larger size compared to the other breeds also endeares it to cattle traders.

**Table 3: Preference Rating for Cattle Attributes (n=100)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attributes** | **Most preferred** | **Preferred** | **Least preferred** | **Not preferred** | **Indifferent** |
|  | **(%)** | **(%)** | **(%)** | **(%)** | **(%)** |
| **Breed** |  |  |  |  |  |
| *Ambala* | 43.0 | 38.0 | 0.0 | 0.0 | 19.0 |
| *Kuri* | 0.0 | 60.0 | 15.0 | 6.0 | 19.0 |
| *Bokoloji* | 26.0 | 34.0 | 21.0 | 0.0 | 19.0 |
| *Mbororo* | 19.0 | 47.0 | 0.0 | 15.0 | 19.0 |
| *Wadara/Yan kasa* | 28.0 | 17.0 | 14.0 | 22.0 | 19.0 |
| **Sex** |  |  |  |  |  |
| Male | 82.0 | 0.0 | 0.0 | 0.0 | 18.0 |
| Female | 0.0 | 36.0 | 13.0 | 33.0 | 18.0 |
| **Age** |  |  |  |  |  |
| Calf | 13.0 | 18.0 | 30.0 | 39.0 | 0.0 |
| Young adult | 87.0 | 13.0 | 0.0 | 0.0 | 0.0 |
| Old | 0.0 | 0.0 | 39.0 | 52.0 | 9.0 |
| **Body conformation** |  |  |  |  |  |
| Good | 91.0 | 0.0 | 9.0 | 0.0 | 0.0 |
| Average | 18.0 | 71.0 | 11.0 | 0.0 | 0.0 |
| Poor | 0.0 | 9.0 | 9.0 | 82.0 | 0.0 |
| **Body size** |  |  |  |  |  |
| Small | 0.0 | 22.0 | 22.0 | 56.0 | 0.0 |
| Medium | 9.0 | 80.0 | 11.0 | 0.0 | 0.0 |
| Big | 72.0 | 13.0 | 6.0 | 9.0 | 0.0 |
| **Type of horn** |  |  |  |  |  |
| Short | 0.0 | 20.0 | 11.0 | 13.0 | 56.0 |
| Long | 10.0 | 21.0 | 0.0 | 13.0 | 56.0 |
| **Tail type** |  |  |  |  |  |
| Fat tailed | 49.0 | 10.0 | 0.0 | 13.0 | 28.0 |
| Thin tailed | 0.0 | 39.0 | 11.0 | 22.0 | 28.0 |
| **Colour of skin** |  |  |  |  |  |
| Brown/red | 59.0 | 9.0 | 0.0 | 0.0 | 32.0 |
| Black | 0.0 | 22.0 | 31.0 | 15.0 | 32.0 |
| White | 1.0 | 52.0 | 15.0 | 0.0 | 32.0 |
| **Face type** |  |  |  |  |  |
| Large face | 68.0 | 13.0 | 0.0 | 0.0 | 19.0 |
| Thin face | 0.0 | 33.0 | 20.0 | 15.0 | 32.0 |

Source: Field survey, 2022

Preference response for sex of the animal revealed male cattle (bulls) were most preferred by the respondents (80%). Bulls are usually used for fattening and for draft. When used for fattening, the respondents perceive higher yields from bulls than female cattle. A healthy cow is usually kept for breeding and milking. When pregnant or suckling, their feed conversion rate declines which makes them less attractive to fatteners and traders alike. Kinkpe et al. (2019) have also reported highest preference for bulls among cattle buyers in Benin Republic.

The age of cattle is estimated from their dentition (MCA, 2020). Very young animals also called yearlings or calves are usually less than a year old. Young adults range from 18 months to five years, while old animals range from above five years. In Maiduguri, yearlings were not popular for consumption, with 30% of respondents indicating they least preferred them and 39% stating they did not prefer them at all. This indicates that the majority of respondents would rather not purchase calves for beef. Majority (87%) of the respondents mostly preferred young adult cattle. Beef from young adults is tender with a good appearance. This could make consumers prefer them to other age category. On the other hand, majority (52%) of cattle buyers did not prefer old animals. This could be attributed to their meat quality which is usually tough with less flavour.

Body conformation was considered under three categories; good, average and poor. This intrinsic attribute can be determined by visual inspection of the animal. Animals with good body conformation were the most endeared (mostly preferred by 91%). Cattle with big body size were preferred by 72% of buyers, followed by cattle with medium body size which were preferred by 80% of the buyers. Just as for good body conformation, buyers would prefer to buy animals with big body size unless they are not financially capable. Fatteners in particular would prefer animals with big body size as they usually show feed conversion faster than those with small body size. Those buying for home consumption or for occasions may not emphasise on body size as criteria for selection.

The length of the horn was not regarded as important by the majority of respondents, with 56% being indifferent to whether the horn was short or long. Understandably, since horn is not directly consumed by the respondents they may not be interested in its nature. A few of the buyers however, rated long horn as mostly preferred (10%) and preferred (21%) attributes. These respondents could be traders and fatteners as size of horn is distinctive to some breeds. Those interested in certain breeds may be interested in the type of horns.

More than half of the respondents revealed their liking for fat tailed cattle as shown by the responses of 49% and 10% as most preferred and preferred, respectively. About 28% were indifferent to the nature of the animal’s tail. Generally, size of tail is one of the attributes used by traders to distinguish body condition and size. Just as tail type, the type of face whether large or thin can also be used in distinguishing animal size and body condition. Majority of the respondents mostly preferred large face in cattle and none of the respondents mostly preferred thin face. This showed that buyers would prefer to buy animals with large faces.

Three skin/coat colours were majorly marketed at the Maiduguri cattle market; brown/red, black and white. Brown/red was mostly preferred by the respondents, with 59% indicating this preference.. Black coat colour was the least preferred. On observation at the cattle market, there were fewer black coloured cattle spotted than the other colours. Respondents revealed not liking the colour black as it was not attractive. The results also revealed 32% of the respondents were indifferent to the colour of the cattle purchased. Those buying for household consumption and butchers may not be interested in the coat colour, focusing solely on the beef. Traders and fatteners would consider coat colour since it may influence future sales.

**Effects of cattle attributes on its price**

Average price of cattle bought by the cattle buyers estimated was ₦175,750 per head. The coefficient estimates represent the percentage share of the cattle attributes to the average cattle price as presented in Table 4. The R-squared value was 0.89 suggesting goodness of fit of the model, which indicates that 89% of the variability in the cattle price in Maiduguri was explained by the variables (cattle attributes) used in the model.

**Table 4: Hedonic Estimates for Cattle Attributes**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Parameter estimate** | **Willingness-to-pay price (₦)** |
| Intercept | 14.0892\*\*\* | - |
| **Breed**  *Ambala* | 0.1708\*\* | 29,878 |
| *Kuri* | 0.0655NS | - |
| *Bokoloji* | -0.0921\*\* | -15,818 |
| *Mbororo* | -0.2322\*\*\* | -40,423 |
| *Wadara* | -0.0078NS | - |
| **Sex**  Male | 0.1159\*\* | 21,090 |
| Female | -0.0221NS | - |
| **Age**  Calf | -0.2298\*\*\* | -40,423 |
| Young adult | -0.0205NS | - |
| Old | -0.0296NS | - |
| **Body Conformation**  Good | 0.1588\*\* | 28,120 |
| Average | 0.0169NS | - |
| Poor | -0.0615NS | - |
| **Body size**  Small | -0.1407\*\*\* | -24,605 |
| Medium | 0.2396\*\*\* | 42,180 |
| Big | 0.3557\*\*\* | 63,270 |
| **Horn**  Short | 0.1662\*\*\* | 29,878 |
| Long | -0.1525NS | - |
| **Tail**  Fat | 0.1570\*\* | 28,120 |
| Thin | -0.0609NS | - |
| **Coat colour**  Brown | 0.1920\*\*\* | 33,393 |
| Black | -0.1032\*\* | -17,575 |
| White | 0.1070\*\*\* | 19,333 |
| **Face**  Large | 0.1096\*\*\* | 19,333 |
| Thin | -0.1003\*\*\* | -17,575 |
| R2 = 0.89 |  |  |
| Mean cattle price = ₦175,750 |  |  |

\*\*\*, \*\*, NS significant (p<0.01), (p<0.05) and Not Significant respectively

Source: Computed from Field Data, 2022

The results showed among the five different breeds of cattle studied, *Mbororo*, *Ambala* and *Bokoloji* were statistically significant (p<0.01, p<0.05, p<0.05 respectively) in determining the price of cattle. The coefficient for *Ambala* (0.1708) was positive, which showed cattle buyers were willing to pay a premium price of up to 17% for *Ambala* which translates to about ₦29,878. *Bokoloji* (-0.0921) and *Mbororo* (-0.2322) attracted discount of 9% and 23% respectively as shown by their negative coefficients. This showed buyers would buy these breeds at a lower price than *Ambala*.

Bulls were significant (p<0.05) in determining cattle price. Buyers would be willing to pay a premium of up to 12% for a bull. Bulls are usually bigger than cows of the same age and also have higher feed conversion rate. This may make buyers with slaughter motive prefer bulls to cows. The coefficients for age of cattle showed calf was highly significant (p<0.01). Although significant, yearlings garnered discount of about 23% the price of cattle. In contrast to this study, Mitchell and Peel (2016) in Oklahoma auctions, discovered that bred cows sold as one-year-olds had the greatest positive impact on price while those that were older than three had a negative effect on price. Contrary to expectation, young adults were negative and not significant in determining cattle price in Maiduguri.

As expected, coefficient for good body conformation was positive (0.1588) and significant (p<0.05) in determining price of cattle. Buyers would pay a premium price of up to 16% when buying such animals. This is understandable as beef from such animals usually have good appearance and high flavour hence would be most preferred. Beef cattle buyers in Ethiopia also paid premium for cattle with good body condition (Teklewold, Legese, Alemu & Negasa, 2009).

Cattle with big body size attracted premium of about 36%, those with medium size received premiums of about 24% while small body size received discount of about 14%. This was rather expected as big and medium sized animals yield more beef than small sized animals. A similar situation was observed in a study of Ngelzarma cattle market in Yobe State, Nigeria, where big sized cattle were found to be significant (p<0.01) with positive coefficient and small sized cattle also significant (p<0.01) but with negative coefficients (Mohammed, Lawal & Musa, 2015).

Short horn was significant (p<0.01) in determining cattle price. The coefficient for short horn (0.1662) showed buyers would willingly pay ₦29,878 more for short horned cattle. *Ambala* was the cattle of choice in the study area (Table 3) and attracted more price. This breed of cattle usually has short horns. Breeds like *kuri* have long horns and were not as preferred as *Ambala* and were not significant in determining price. Short horns in cattle were also found to significantly attract premiums in Ngalda cattle market in Yobe State, Nigeria (Lawal et al., 2016).

Fat tail was significant (p<0.05) with a positive coefficient (0.1570). This means fat tail attribute will attract a premium of about 16% in the purchase of cattle. Fat tailed cattle are usually big in size with good body condition. Such animals are expected to have higher values than smaller animals. Coat colours were important determinants of cattle prices as all the coat colours were significant. Brown/red and white were positive and significant (p<0.01), black was negative and significant (p<0.05). Premium prices were paid for brown and white cattle. This result is expected as brown/red colour was the most preferred colour in the study area closely followed by white (Table 3). Black coloured cattle garnered discount of about 10%. This was also expected as it was least preferred by buyers. On the contrary, in Oklahoma, USA, black bred cows bring a price 6.74% higher than nonblack cows and producers purchasing cows that will be placed into herds prefer black cows to any other colour (Mitchell & Peel, 2016).

Large face was highly significant (p<0.01) and positively influenced cattle price by 11%. Large face is an attribute of animal with big body size and good condition. Such animals usually have high value. The coefficient (-0.1003) for thin face was significant (p<0.05) but negative. This showed thin face was an attribute that yield discount of about 10% in cattle price in Maiduguri. The lower price offered for cattle with thin face is mainly because this attribute indicates the animal has small body size and probably with poor body condition.

**Conclusion**

The study analysed the effects of cattle attributes on price of cattle in Maiduguri, Borno State, Nigeria. In cattle trade, it was observed buyers were majorly married male within an active age range who had some form of western education and were mostly employed in the private sector and earned a fair income. Buyers of cattle had high preference for big sized, brown skinned, young adult *Ambala* bull with good body conformation, fat tail and large face. Cattle attributes largely influenced its price. Buyers would willingly pay the highest premium price for big body size and discount the largest amount for *Mbororo* breed. The study recommends producers and breeders to promote cattle attributes that consumer’s show preference for and that influence willingness to pay in order to improve demand and increase sales. Policies should be geared at improving cattle production through provision of facilities and incentives so as to enable availability of desired breeds.

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**REFERENCES**

Borno State Ministry of Animal Resources and Fisheries Development, (2011). Annual Report. Pp 18- 19.

Edmeades, S. (2005). A hedonic perspective to estimating a marginal value function for variety attributes of a subsistence crop. Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27.

GEONETCast (2015). Department of Geography, University of Maiduguri, Borno State.

Ghide, A. A., Mohammed, S. T., & Shettima, B. G. (2017). Analysis of value addition within the cattle value chain in Maiduguri Metropolis, Borno State, Nigeria. *Dutse Journal of Agriculture and Food Security*, 4(1), 1-9.

Kawka, R. (2002). The physiognomic structure of Maiduguri: Interdisciplinary studies on the capital of Borno State, Nigeria. 22-33.

Kinkpe, T. A., Rodrigue, V. C. D., Cokou, P. K., Jacob A. Y., & Luc, H. D. (2019). The role of cattle attributes in buyers’ choices in Benin. *African Journal of Agricultural and Resource Economics*, 14(1), 56-71

Lake Chad Research Institute. (2019). Annual Weather Report. www.lcrimaid.gov.ng

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy, 74*(2), 132-157.

Lawal, A. T., Mohammed, A. B., & Musa, S. A. (2016). Hedonic price analysis of characteristics influencing cattle Prices in Ngalda livestock markets in Yobe State. *Journal of Agriculture and Sustainability, 9*(1), 43-57.

Maiduguri Central Abattoir, MCA (2020). Annual Slaughter Records. Borno State Ministry of Animal Resources and Fisheries Development.

Mitchell, J., & Peel, D. S. (2016). Price determinants of bred cows in Oklahoma auctions. Selected paper prepared for presentation at the Southern Agricultural Economics Association annual meeting, San Antonio, Texas, February, 6‐9.

Mohammed, A. B., Lawal, A. T., & Musa, S. A. (2015). Economics of physical attributes influencing cattle prices in Ngalzarma livestock markets, Yobe State. *Journal of Agriculture and Sustainability*, 7(1), 72-86

National Bureau of Statistics, NBS (2016a). National agricultural sample survey. Public Access Data Set. www.nigeriastat.gov.ng/pages/download/66

National Bureau of Statistics, NBS (2016b). Nigeria - General household survey-panel wave 3 (post planting) 2015-2016, third round.

National Population Commission, NPC (2006). National Population Census. Federal Republic of Nigeria official gazette, 94(24), Lagos, Nigeria: FGN Prints.

Ojogho, O., Erhabor, P., Emokaro, C., & Egware, R. (2013). Hedonic demand analysis for beef in Benin Metropolis, Edo State, Nigeria. *Global Journal of Agricultural Sciences,* 12(1), 91-99.

Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy, 82*(1), 34-55.

Teklewold, H., Legese, G., Alemu, D., & Negasa, A. (2009). Determinants of livestock prices in Ethiopian pastoral livestock markets: Implications for pastoral marketing strategies. Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22.

World Bank (2017). The World Bank Livestock Productivity and Resilience Support Project. Project Information Document/ Integrated Safeguards Data Sheet (PID/ISDS). Retrieved from https//www.worldbank.org.projects on 12/6/23