**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 were used for the study which were obtained from 100 cattle buyers selected using convenience sampling. Frequencies, percentages and hedonic pricing model were used to analyze the data. The most preferred cattle attributes were bull (82%), young adult age (87%), good body conformation (91%), big body size (72%), brown skin colour (59%) and large faced cattle (68%). Cattle buyers would willingly pay over ₦30,000 for attributes such as medium body size (₦42,180), big body size (₦63,270) and 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 is 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 for 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. The 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 prices (explicit price) reflect the value of goods as bundles of attributes that are observable in the market and are composed of 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 have multiple attributes that combine to provide utility to consumers hence, consumers demand particular qualities depending on its usage. These demands are very important as they have implications for cattle production and management requirements. It dictates the type of animal to be raised and its management, 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 these attributes which may influence consumer preferences and guide purchase decisions.

Borno State is a major supplier of cattle to the country. Available statistics on the cattle population is estimated above 2 million (Borno State Ministry of Animal Resources and Fisheries Development, 2011). The 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 in 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 can also be useful to policymakers 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 13° 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 [NPC], 2006) projected to be 1,340,438 in 2020 at an annual growth rate of 3.2 percent. It has a hot climate with a mean temperature of 37°C and mean rainfall of 647mm per annum (Lake Chad Research Institute, 2019).

Maiduguri Metropolis comprises parts of 4 adjoining Local Government Areas (LGA) which include Maiduguri Metropolitan Council (MMC), Jere, and Konduga and to a lesser extent parts of Mafa LGA (Kawka, 2002). Major occupations of the people include civil service, farming as well as trading. Major crops cultivated include cowpea, groundnut, maize, millet, and vegetables such as onions, pepper, tomatoes and amaranths. Livestock reared includes cattle, sheep, goat and poultry. Livestock and livestock products such as hides and skins 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 most 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 a structured questionnaire administered to cattle buyers through interviews by trained enumerators. The questionnaire includes information on the 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 used to select the sample as the population was large and there was no 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 method 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. The Likert ranking scale was used to rank consumer preference for cattle attributes. The ranking was considered under 5 points ordered 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 the 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 are presented in Table 1. It showed the 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. Most of them (61%) had large household sizes ranging from 11-15 persons, with about 49% having middle class income ranging from ₦50,000 to ₦100,000 and are majorly (82%) non-civil servants.

**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 was majorly bought by the married male who are in an active age range and 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 were 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). In Table 3, distribution for the preference response showed *Ambala* as the choice breed. The respondents mostly preferred *Ambala* (43%) to the other breeds as 19% showed indifference to animal breeds. The choice of breed is usually considered by fatteners, traders, and butchers. Those buying for home consumption generally do not emphasize breed as a choice criterion. Fatteners generally perceive *Ambala* as the breed with the highest feed conversion rate than the others. It i relatively larger in size compared to the other breeds; also endeared 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 more preferred by the respondents (80%). Bulls are usually used for fattening and draft. When used for fattening, the respondents perceive higher yields from bulls than female cattle (cows). 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, Rodrigue, Cokou, Jacob and Luc (2019) have also reported the highest preference for bulls among cattle buyers in Benin Republic.

 The age of cattle is estimated with the help of dentition (MCA, 2020). Very young animals also called yearlings or calves are usually less than a year old. Young adults ranged from 18 months to five years while old animals ranged from above five years. Yearlings were not popular for consumption in Maiduguri as 30% and 39% least preferred and not preferred it respectively. This showed majority of the respondents did not like to buy 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 categories. On the other hand, the 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 is 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 mostly preferred by 72% of buyers, then 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 smaller body size. Those buying for home consumption or for occasions may not emphasise on body size as criteria for selection.

 Rating for length of horn was not regarded by majority of the respondents, 56% were indifferent to whether the horn was short or long. Understandably, since the horn is not directly consumed by the respondents therefore, they may not be interested in its nature. A few of the buyers, however, rated longhorn 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. 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. The majority of the respondents mostly preferred large faced cattle and none of the respondents 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. Cattle usually come as entirely or majorly one of the colours. Brown/red was mostly preferred (59%) by the respondents. 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 black as was unattractive colour.. 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 but only the beef. Traders and fatteners would consider coat colour since it may influence future sales.

**Effects of cattle attributes on its price**

 The 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 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 a 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 prices in Maiduguri.

 As expected, the coefficient for good body conformation was positive (0.1588) and significant (p<0.05) in determining the 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 has good appearance and a good flavour.. Beef cattle buyers in Ethiopia also paid premium for cattle with good body condition (Teklewold, Legese, Alemu & Negasa, 2009).

 Cattle with bigger body sizes attracted premiums of about 36%, the medium sized cattle received premiums of about 24% while small body sized 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 the Ngelzarma cattle market in Yobe State, Nigeria, where big-sized cattle were found to be significant (p<0.01) with a 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 to enable the availability of desired breeds.

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