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# Hedonic pricing of goat characteristics at the market level: the case of Pakistan

## RESEARCH ARTICLE

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## Abstract

This study carries out hedonic price analysis of goat's characteristics in five major markets of Pakistan. Data were collected about the various characteristics of each traded animal during the year 2016 through a structured questionnaire by using a personal interview method. A log-linear model was fitted to a sample of 500 observations in order to examine the determinants of observed goat prices. The results of the study showed that live weight, age, and sex were goat characteristics preferred by buyers and had significant positive effects on the prices of goats. Further, significant premiums were associated with the purpose of buying and marketplace. This study indicates that goat producers can improve their profitability when they target goat sales based on weight, marketing place, age, sex and time of sale, especially at the Muslim festival, Eid-ul-Azha.

**Keywords:** goat characteristics, hedonic model, heteroscedastic consistent covariance, traders, buyer preferences
**JEL code:** Q110, Q130, C100

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## 1. Introduction

Global demand for livestock products is growing rapidly and projected to increase 70-80% by 2050 (Steinfeld, 2012). The demand is expected to increase mainly due to growing population, rising disposable income and progressive urbanization. Livestock subsector needs special attention of governments of various countries, especially of developing countries due to the fact that globally its producers are the largest user of agricultural land and world food economy is shifting towards animal-based products (FAO, 2015). Further, livestock is a key livelihood and risk mitigation strategy for small and marginal farmers as well as for poor landless households in the developing countries.

Livestock is the most important constituent of the integrated crop-livestock farming system in many developing countries like Pakistan and India. It provides high-quality food in the form of milk and meat, manure for crop production and cash income to livestock producers. Within the agriculture sector and national economy, it is gaining more importance over time in many developing economies. For example, in Pakistan, livestock shared 30% of agriculture value and 7% of national gross domestic product during 1990-91 (Government of Pakistan, 1991) while the respective shares were 58.3% and 11.4% during 2016-17 (Government of Pakistan, 2017).

Livestock is marketed at villages as well as at special places called livestock markets in Pakistan. These livestock markets are organized at various levels on daily, weekly, fortnightly and monthly basis (Sharif *et al.*, 2003). Sellers and buyers are well informed about the market days. However, some special markets are also organized for two to three weeks before the eve of a religious festival i.e. Eid-ul-Azha. Generally, large and small ruminants are traded in the same markets. Sometimes there are separate markets for small ruminants called 'Bakker-mandies'. Farmers, animal traders and Beoparies (village level dealers) bring animals to these markets for sale. Most of the livestock markets lack basic facilities like boundary walls, electricity, loading-unloading facilities, animal shelters, animal watering, weighing, etc.

Within the livestock subsector, small ruminants are relatively easy to keep and can be produced quickly. These ruminants can spread risks resulting from uncertainties inherent in weather, pests infestations, diseases and other factors affecting the production within the agriculture sector (Ehui *et al.*, 2003). Goats can withstand heat stress, survive under prolonged water deprivation, can use poor quality forages more efficiently, are more prolific and need a small amount of capital (Peacock, 2005). Goats occupy a special position in the agribusiness of Asia, Africa and the Middle East. However, the current contribution of goats is dismal and is not matching to its potential capacity. Due to inadequate government policy support overtime, the potential capacity is constrained by inefficient and inappropriate production systems, inefficient use of important breeds, poor strategies for the management of natural resources, weak marketing systems and inadequate resource use (Devendra, 2001). In many developing countries, goat marketing is dominated by the private sector and it is the most important segment of this business. Goat marketing is generally very haphazard, variable and poorly studied despite the fact that research in this area is of great significance. The poorly organized collection, transportation and marketing of goats result in reduced income to the producers (Devendra, 2001). In goats, pricing mechanism depends on the location and type of the market. At the village level, the price is negotiated between the goat trader and the producer. The producer estimates the reservation price on the basis of his past experiences, village level information obtained from other producers and various attributes of the animal like age, sex, live weight, etc. The goat trader guesses the price of the animal based on the expected price of the animal in the intended market where the animal will be sold, transport costs, distance, various taxes and fees, personal costs involved and the profits he wants to make (Mustafa *et al.*, 1995). The final price between the producer and goat trader also depends on the seasonality and social or religious event. In the goat market, market players consider age, live weight, sex, etc. in calculating the price of the animal. Prices offered by butchers to sellers are determined by back calculation from the prevailing/ retail meat price fixed by the government of Pakistan. The deals are finalized either through one-to-one negotiations or through brokers. One-to-one negotiation is open while the deals are secret when brokers are involved. There is no open auction, classification or grading system of livestock in Pakistan. The goat

producers and the other market actors involved in the goat value chain have an interest in learning about the impact of goat characteristics on their prices. This understanding helps producer to formulate better strategies for production and marketing of goats. The information that market transactions reveal about preferences for goat characteristics has not been empirically estimated especially with reference to Pakistan. Hence in this paper, hedonic price function for goats was estimated in order to understand the marginal values of goat characteristics in the Punjab province of Pakistan.

The prices that emerge through negotiations in goat markets can be considered as hedonic prices. The price of an individual goat depends on its breed, sex, age, etc. Hedonic pricing analysis started with the pioneering work by Waugh (1928). He studied the influence of various quality factors (i.e. color, size, uniformity etc.) on vegetable prices. His methodology has been applied in many ways to a wide range of food products. A brief review of some of the studies conducted on small ruminants will be given in the next part of this section.

Rodriguez *et al.* (1995) analyzed the price expectations for small ruminants based on various characteristics of goat and sheep, producers and intermediaries. Results of the study depicted that farmers and traders expected higher prices in certain months and on religious occasions. Season and different characteristics, such as age, sex, breed, weight and body condition of goat had a significant impact on the price. Jabbar (1998a) examined the effect of various characteristics that influence the purchase price of goat and sheep. Results of the hedonic model indicated that age and live weight had the significant impact on the price but their magnitude varied in purpose specific models. Goats and sheep buyers on festivals paid premium prices as compared to other periods. There was a significant difference in prices among different periods and markets. Knights *et al.* (2005) conducted a study to determine preferences for specific animal attributes by buyers of live lambs and goats. Results of the hedonic model showed a significant positive relationship between weight classes and lamb prices. Prices for goats in lighter weights were significantly higher than that of goats in heavier weights. The impact of the market location variable on price was significant for both goat and lamb models. Orden *et al.* (2005) determined the preferences for goat characteristics by using a hedonic price model. Various characteristics like breed, sex, age, size and meatiness had a positive and significant effect on the price of goat. Ayele *et al.* (2006) studied the effect of seasons, markets and different attributes of animals on the prices of sheep and goat. Results of the hedonic model indicated that height, heart girth and age of the animal had a significant effect on the prices for both sheep and goats. They found that price per animal was significantly lower for female goats as compared to male goats. In case of goat, color and breed had no significant effect on price but for both goats and sheep, seasons and markets had a significant effect on price. Dossa *et al.* (2008) studied the effect of different quantitative as well as qualitative traits of goats on their prices. The results show that live weight and sex had a positive significant effect on goat prices. Other variables such as coat color and breed did not influence the goat prices significantly. Teklewold *et al.* (2009) identified the factors that affect the market prices of sheep, goat and cattle starting from pastoral markets to export abattoirs and live animal exporters. The hedonic model identified the occasion, season, age group, body condition, buyer and seller type as important determinants of livestock price formation. Afzal *et al.* (2011) estimated the seasonal price variation by considering the effect of different attributes of small ruminants like live weight, age, gender and time of sale. Results of the hedonic model indicated that live weight and body score indicating better body condition had a significant positive effect on the price of small ruminants. Further, price per animal was significantly lower for females as compared to males while the influence of age on price per head was negative and significant. Eid-ul-Azha and Ramzan seasons had positive significant impact on the price per head over the normal season. Naanep *et al.* (2012) investigated the effect of goat's physical attributes on its price. Results depicted that meatiness, sex, breed, age and live weight were the main attributes considered by both Muslim and non-Muslim buyers. Animal's meatiness and live weight have the highest positive effect on price while sex of the goat has the lowest effect on animal price. Srinivas *et al.* (2013) evaluated the effect of various factors which influence the price expectations of goat producers. The hedonic model identified goat sex, live weight, market place, marketing day and access to a marketing network as significant variables influencing the goat producer's price expectation. Terfa *et al.* (2013) estimated the implicit prices of indigenous sheep attributes on the basis of the revealed preference method. They used the hedonic model to determine the influence of different variables on sheep prices.

Results of the hedonic model showed that sheep price is determined by various traits of sheep (i.e. body size, color, age and tail condition), buyer type, market place and season. According to existing literature, the area of research with respect to hedonic price analysis of goat focused on phenotypic characteristics of animals (weight, age, breed of goat, sex, nature of teeth, color of goat, etc.) and buyer's demographics. However, the hedonic analysis of goat prices is an ignored area of research in Punjab, Pakistan, despite the fact that goat meat is not only three to five times more expensive but also considered to be superior in consumption to poultry and other meats due to less fat, more iron and low in cholesterol (Solaiman, 2007). In the present hedonic analysis of goat prices, an important issue, i.e. how goat characteristics induce systematic variation in the price of goat in Punjab, has been addressed. Therefore, attributes were selected that commonly appear in previous hedonic price models. These attributes were employed to a group of goat markets under the conditions of Pakistan in order to determine the effect of various variables on goat prices.

## 2. Analytical framework

The analysis of the present study is based on the theoretical approach developed by Lancaster (1966) and mathematical formation of Rosen (1974). This approach imputes prices to attributes based on the relationship between the observed prices of differentiated products and attributes associated with these products. In the hedonic model, the increment in price due to increase in any characteristic shows the buyer's marginal value for the character as well as the marginal cost of producing that characteristics for sellers. In fact, marginal value to the consumers and the marginal cost to producers are equal to the marginal hedonic price. Hedonic price model decomposes the price of a product into separate components. There are many studies that estimated the impact of attributes of product, buyer, and market on product's observed price (Parker and Zilberman, 1993; Ayele *et al.*, 2006). Therefore, in this study market price of a goat is determined on the basis of buyers willingness to pay for different goat attributes along with the characteristics of buyers and markets. Hence for differentiated goats in the presence of heterogeneous buyers and markets, the hedonic pricing model of the goat can be given as:

$$P_i = F\ (Q_i, M_i, C_i) \tag{1}$$

Where F is the function that relates goat price ($P_i$) to its attributes ($Q_i$), market in which animal is traded ($M_i$) and buyer's characteristics ($C_i$).

The implicit or marginal price of an attribute/characteristic can be obtained by taking the partial derivative of the price function (1) with respect to that attribute/characteristic. The marginal price of an attribute shows the price at which an attribute can be purchased and supplied. The estimation of the hedonic price function has been widely discussed in the literature. An appropriate functional form is very critical in building an accurate and consistent econometric model (Brown and Ethridge, 1995). The use of an inappropriate form of hedonic price function may lead to biased estimates and thus mislead about the implicit prices of the characteristics. This is particularly true for hedonic price function estimations as the functional form of the hedonic price function is unknown. However, when one is concerned with the valuation of product attributes, then there is a need to use a hedonic price function that estimates the marginal attribute prices most accurately. Cropper *et al.* (1988) reported that when all attributes are observed by the researcher the linear and quadratic Box-Cox functions provide the most accurate marginal price estimates of the attributes. Although, various versions of Box-Cox are possible as pointed out by Box and Cox (1964), and Spitzer (1982), this is not possible to apply in the present study as many of the covariates are categorical so precluding most of the transformations. Haab and McConnell (2002) have pointed out that the problem of collinearity should be considered while selecting a functional form and a set of variables. Further, high collinearity makes the choice of a very flexible function less useful as the interactive terms of a flexible functional form lead to great collinearity. Given these considerations and following Cropper *et al.* (1988), and Haab and McConnell (2002), this study used the log-linear functional form of the econometric model for hedonic analysis of goat prices:

$$\ln(PG_i) = X_i'\beta + \varepsilon_i \tag{2}$$

Where $\ln(PG_i)$ is the natural log of the price of goat; $X_i'$ is the vector of independent variables and $\beta$ is a vector of parameters to be estimated and $\varepsilon_i$ is the error term. The conditional distribution of the errors given the matrix of explanatory variables have zero mean [$E(\varepsilon_i/X_i)=0$], constant variance [$V(\varepsilon_i)=\sigma^2$] and zero covariance [$E(\varepsilon_i X_i)=0$] (Gujarati and Sangeetha, 2007).

It may be noted that the major focused traits of traded goats were sex, age, breed, body weight. Under competitive market conditions, implicit prices are estimated for the product attributes without considering producer or buyer attributes. Since livestock markets in Pakistan are not competitive because of non-existence of grading, standardization, and favorable external environment (i.e. inadequate competitive infrastructure: physical transport, communication and information structure; the framework of laws and regulations and so on), socioeconomic variables were considered apart from the attributes of goat in our model (Abdulai, 2000; Kassie *et al.*, 2011; Terfa *et al.*, 2013). Conceptually, the goat characteristics that are perceived as relevant for a buyer, and the values assigned to them depend on demand shift variables, i.e. education, experience and buying purpose of a buyer (Lenz *et al.*, 1991). Inclusion of independent variables in this study is based on previous research and information obtained from buyers at the stage of pretesting the questionnaire.

## 3. Model specification

To establish the relationship between the price and goat attributes along buyers' characteristics, the following hedonic price model was developed:

$$\ln(GPR_i) = \beta_0 + \alpha_1 LWT_i + \sum_{j=1}^{4}\beta_j MKT_{ij} + \sum_{j=1}^{3}\delta_j BUY_{ij} + \sum_{j=1}^{3}\phi_j EDU_{ij} + \sum_{j=1}^{3}\varphi_j EXP_{ij} + \sum_{j=1}^{3}\gamma_j DENT_{ij} + \sum_{j=1}^{3}\lambda_j BRD_{ij} + \theta_1 SEX_{i1} + \varepsilon_i \quad (3)$$

Table 1 describes different variables used in the model. LWT is the live weight in kg. Dummy variables were used for location of market (MKT), buyer type (BUY), level of education of buyer (EDU), experience of buyer (EXP), dentition type (DENT), breed (BRD) and sex (SEX). The estimated model included all the variables as indicated in Table 1 except the variables for benchmark categories i.e. $MKT_5$, $BUY_4$, $EDU_4$, $EXP_4$, $DENT_4$, $BRD_4$ and $SEX_2$. The constant term includes the joint effect of the categories not included in the model. The semi-logarithmic specification of hedonic price model assumes homotheticity of the utility function and hence homogeneity of degree zero of demand for goat characteristics. Further, each marginal implicit price is a nonlinear function in terms of the entire set of characteristics. The interpretation of regression coefficient of a continuous regressor is straightforward and shows the percentage change in dependent variable for a unit change in regressor. However, there is a common error in the interpretation of the coefficients of dummy variables in semi-logarithmic equations. Some studies discuss only the significance of coefficient while in other studies, the coefficient of a dummy variable is multiplied by 100 in order to show the percentage effect of that variable on the dependent variable. However, Halvorsen and Palmquist (1980) indicated that this interpretation is incorrect, specifically for dummy variables and can result in substantial errors in interpreting of results. Assuming a normal error in Equation 3, Kennedy (1981) proposed the following consistent estimator 'g', which provides the appropriate interpretation of the coefficient of a dummy variable on the dependent variable.

$$g = \exp\left(\hat{\beta} - \frac{1}{2}\mathrm{var}\left(\hat{\beta}\right)\right) - 1 \quad (4)$$

### *3.1. Study area*

The study is confined to the Punjab Province of Pakistan. It is the main province of the country and shares about 37% of the total goat population. Marketing of live animals takes place here in primary, secondary, tertiary and terminal markets. Primary or small livestock markets are present in rural areas, while secondary

**Table 1.** Definitions of variables and their statistics.

| Variable | Description | Mean | Standard Deviation |
|---|---|---|---|
| GPR | Price per head of goat (US $) | 159.15 | 103.66 |
| LWT | Live weight (kg) | 39.28 | 16.40 |
| MKT | Marketplace | | |
| $MKT_1$ | 1 if Faisalabad, 0 otherwise | 0.20 | 0.40 |
| $MKT_2$ | 1 if Lahore, 0 otherwise | 0.20 | 0.40 |
| $MKT_3$ | 1 if Multan, 0 otherwise | 0.20 | 0.40 |
| $MKT_4$ | 1 if Attock, 0 otherwise | 0.20 | 0.40 |
| $MKT_5$ | 1 if Dera Ghazi Khan, 0 otherwise | 0.20 | 0.40 |
| BUY | Buying purpose of goat | | |
| $BUY_1$ | 1 if purchased for resale, 0 otherwise | 0.18 | 0.38 |
| $BUY_2$ | 1 if purchased for butchering, 0 otherwise | 0.22 | 0.42 |
| $BUY_3$ | 1 if purchased for slaughtering on Eid-ul-Azha or sacrifice, 0 otherwise | 0.52 | 0.50 |
| $BUY_4$ | 1 if purchased for rearing, 0 otherwise | 0.08 | 0.27 |
| EDU | Educational level of buyer | | |
| $EDU_1$ | 1 if illiterate, 0 otherwise | 0.29 | 0.45 |
| $EDU_2$ | 1 if education up to primary, 0 otherwise | 0.38 | 0.48 |
| $EDU_3$ | 1 if education level is primary to high school, 0 otherwise | 0.16 | 0.37 |
| $EDU_4$ | 1 if education level is above high school, 0 otherwise | 0.17 | 0.38 |
| EXP | Experience of buyer | | |
| $EXP_1$ | 1 if no experience, 0 otherwise | 0.50 | 0.50 |
| $EXP_2$ | 1 if 1 to 5 years' experience, 0 otherwise | 0.07 | 0.25 |
| $EXP_3$ | 1 if 5 to 10 years' experience, 0 otherwise | 0.17 | 0.37 |
| $EXP_4$ | 1 if the experience is more than 10 years, 0 otherwise | 0.26 | 0.44 |
| DENT | Dentition type | | |
| $DENT_1$ | 1 if goat with milk teeth, i.e. Kheera, 0 otherwise | 0.26 | 0.44 |
| $DENT_2$ | 1 if goat with one pair of adult incisive, i.e. Donda, 0 otherwise | 0.62 | 0.49 |
| $DENT_3$ | 1 if goat with two pairs of adult incisive, i.e. Chougha, 0 otherwise | 0.07 | 0.25 |
| $DENT_4$ | 1 if goat with three pairs of adult incisive, i.e. Chigha, 0 otherwise | 0.05 | 0.22 |
| BRD | Breed type | | |
| $BRD_1$ | 1 if Beetal, 0 otherwise | 0.26 | 0.44 |
| $BRD_2$ | 1 if Teddy, 0 otherwise | 0.15 | 0.36 |
| $BRD_3$ | 1 if Crossbred, 0 otherwise | 0.33 | 0.47 |
| $BRD_4$ | 1 if the breed is other than Beetal, Teddy and Cross, 0 otherwise | 0.26 | 0.44 |
| SEX | Sex of goat | | |
| $SEX_1$ | 1 if the goat traded is male, 0 otherwise | 0.77 | 0.42 |
| $SEX_2$ | 1 if the goat traded is female, 0 otherwise | 0.23 | 0.42 |

or large markets are organized in the urban areas. Generally large and small ruminants are traded in the same markets. However, at some places, cattle, buffaloes, goats and sheep are also traded in separate markets. In primary markets, sellers bring their animals on foot, motorcycle or rickshaw because of short distance. Once the animal is purchased from a primary market, it is carried to secondary markets using various transport means like mini trucks, trucks, vans and trollies. The roads leading to primary markets are generally poor compared to those leading to secondary and tertiary markets. The quality of vehicles used for the transportation of animals is very poor because they are primarily built for the transportation of goods rather than animals. Five major secondary goat markets established in big cities of the Punjab province were purposively selected as they represent various cropping systems, climatic conditions and socio-economic conditions of people in this study. The included markets are: Faisalabad from mix cropping system, Lahore from wheat-rice system,

Attock from rainfed area, Multan and Dera Ghazi Khan from cotton-wheat system. Cotton-wheat is the largest system in terms of area and sharing goat population. These markets are poorly linked and the price information is mainly limited to personal interaction between market actors due to poor market intelligence systems (Rodriguez *et al.*, 1995). All these markets operate for two designated days except Multan market. Faisalabad, Lahore and Dera Ghazi Khan Markets operate on Wednesday and Saturday. Attock market operates on Wednesday and Friday, while Multan market operates only on Wednesday. The market infrastructure of these markets is very poor and there is no shed and feed provision. There is no grading and standardization and transactions take place through one to one bargaining between seller and buyer on per head basis. The price finally settled depends on how well the buyer and seller can bargain. Under such circumstances, the price paid by the buyer reflects his preference for various goat traits. The identification and analysis of such traits that influence the actual prices paid by buyer form the basis for effective production and marketing development interventions.

### *3.2. Data*

No records of livestock transactions including goats are kept by Livestock Department or any other Department in markets. Consequently, it is not possible to quantify the annual sale volumes in any market. Generally, annual sales business is higher in markets located in big cities than the ones situated in small cities because of difference in the population/number of consumers. As there is no list of registered buyers, sampling units were not randomly chosen. Buyers were interviewed using a pretested questionnaire after the purchase of goats on a market day using convenience sampling method. The data were collected by a trained enumerator under the supervision of the researcher. Data about 500 traded goats and its buyer attributes were collected from five main markets. The large sample size increases the data reliability and validity of the research results. The major focused traits of traded goats were sex, age, breed, body weight. Two survey rounds were done for the purpose of the study. The first round was done during the months when there was no important religious festival, such as Eid-ul-Azha, while the second round was done up to three weeks before the Eid-ul-Azha. Data was collected from 100 respondents from each market by interviewing 50 buyers in each round.

## 4. Results and discussion

This section discusses the descriptive statistics of variables and results of the econometric model.

### *4.1. Descriptive statistics*

The descriptive statistics related to mean and standard errors are reported in Table 1. The average live weight of traded goat was 39.28 kg. In all the markets, goats are sold alive and the animals are not weighted. Actual weighing of animals is not practiced in livestock markets and transactions are done by visual appraisal. Market traders targeting animals make good guesses about weight and on that basis they make a good bargain (Jabbar, 1998a; Naanep *et al.*, 2012). However, in this study we calculated the weight of a purchased animal by using a formula[1]. The buyers were traders, butchers, rearers and consumers. Consumers were the major buyers and they purchased 52% of the traded goats. They mainly buy goat animals in order to sacrifice the animals on religious festivals, i.e. Eid-ul-Azha, and for other purposes like Hakika (animal slaughtered for the birth of a child), marriage, Sadqa (animal slaughtered for voluntary charity especially on the occasion when a member of the family is seriously sick), funeral and Christmas. Of the remaining traded goats, 22% was purchased by butchers for butchering, 18% by traders for resale and 8% by goat producers for rearing purposes. Grouping of respondents according to buyer type by round showed that in the first round dominant buyers were butchers (44%), followed by traders (24%), consumers and goat rearers (16% each). In the second round, consumers were the major buyers (88%) and the remaining 12% were traders. It is important to mention here that the major proportion of goats is slaughtered on Eid-ul-Azha in the Punjab province

[1] To calculate the weight of an animal, heart girth and body length were measured in inches and used the following formula (Moaeen-ud-Din *et al.*, 2006): Animal weight (in pounds) = [(heart girth)$^2$x(body length)]/300. The weight estimated was converted to kg.

(Government of Pakistan, 2006). A major portion of goat buyers (50%) had no experience in purchasing goats. This was mainly due to the fact that many buyers purchase goat only on the occasion of Eid-ul-Azha. About 26 and 17% had goat buying experience of ten years and above, and 5-10 years, respectively. These are mostly the butchers who are in business over a longer period. The age of the goat was approximated from its dentition. The animals were categorized on the basis of pairs of adult incisive. It was observed that 26% of the traded goats were Kheera (animal had milk teeth and they were less than one year old) and these animals do not fulfill the conditions of sacrifice for Eid-ul-Azha. However, animals of at least one year old fulfill this condition. About 62% of transacted goats were Donda (animal had one pair of adult incisive) and were one to two years old. 7% of transacted goats were Chougha (animals had two pairs of adult incisive) and were two to three years old. The last category of goats, Chigha had three pairs of adult incisive and was at least three years old. They accounted for only 5% of the total traded goats.

There were many breeds of goats that were purchased by buyers. Beetal and Teddy breeds were the most commonly purchased breeds. Out of 500 goats in the sample, Crossbred, Beetal and Teddy goats accounted for 33, 26 and 15%, respectively. Other breeds include Nachi, Rajanpur, Dera Din Panah, Dehrki, etc. collectively accounted for 26% of all goat animal purchased. In all five markets, 77% of the traded goats were male. It shows that male goats were the commonly marketed animals and female goats were kept by the producers for reproduction.

### *4.2. Results of econometric hedonic price model*

There are many functional forms (i.e. linear, semi-log and double log) that have been used by researchers. The many binary variables in our dataset limits the choice of a functional form to linear or log linear specification. These two functional forms were estimated to select the best form. A quadratic form of live weight, coat color and health variable were also included in these forms besides the variables considered in Equation 3. The health variable was excluded from the models as there were only a few observations. Each functional form with different number of variables was tested using the Ramsey's Regression Equation Specification Error Test (RESET). When coat color alone, coat color and weight square, and weight square alone variable were added in the model, the value of Ramsey RESET test was significant in linear and semi log models and indicated the specification bias. However, Ramsey RESET did not indicate the specification bias for the model of which results are presented and discussed in this paper. Vuong's (1989) test was used as a complementary test for the selection of appropriate functional form between the estimated linear and log linear hedonic price models. The value of Vuong statistics was almost zero (5.71986E-08) and indicated that there was no difference between the log linear and linear models. Hence, the smaller sum of residual squares established the superiority of log linear model (Gujarati and Sangeetha, 2007). In the selected model, the variance inflation factor (VIF) was calculated to test the presence of multicollinearity and for various coefficients, its value ranged from 1.36 to 8.71 with a mean value of 3.10. Since these values were less than 10, the rule of thumb maximum value (Gujarati and Sangeetha, 2007), multicollinearity was not a problem in the estimated model. To check heteroscedasticity, the Breush-Pagan/Cook-Weisberg test was used. In this test, $\chi^2$ was 8.50 and was significant at a 1% level of significance. Hence, we rejected the null hypothesis of constant variance at the 1% level of significance and concluded that the assumption of homoscedasticity is violated. We used alternative ways for heteroscedastic correction and used heteroscedasticity consistent standard errors (White, 1980), and estimated results with the covariance matrix of the error term of ordinary least squares, $HC_0$ (heteroscedasticity consistent -0), $HC_2$ (heteroscedasticity consistent -2) and $HC_3$ (heteroscedasticity consistent -3). But Long and Ervin (2000) indicated that $HC_3$ is a superior test for coefficients that are most affected with heteroscedasticity. Therefore, we considered $HC_3$ for testing coefficients of the hedonic model.

Parameters estimate for Equation 3 are reported in Table 2. These estimates explain the variation in log goat prices. The overall goodness of fit of the estimated model with the entire data set indicated that the independent variables included in the model explained 89% of goat price variations. In the market specific models, the explanatory power ranged from 83% for the Dera Ghazi Khan market to 96% for the Faisalabad market (Supplementary Table S1). The results of the four estimators (OLS, $HC_0$, $HC_2$, $HC_3$) in the overall

**Table 2.** Results of the ordinary least squares and heteroscedastic consistent hedonic model.[1,2,3,4]

| Ln price | Coefficient | *P*-value | $HC_3$ SE | OLS SE | $HC_0$ SE | $HC_2$ SE | Relative Impact | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | % | US $ |
| Constant | 8.010*** | 0.000 | 0.087 | 0.082 | 0.084 | 0.084 | | |
| LWT | 0.024*** | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | | |
| MKT1 | 0.117*** | 0.002 | 0.037 | 0.034 | 0.036 | 0.036 | 12.29 | 19.56 |
| MKT2 | 0.136*** | 0.000 | 0.035 | 0.035 | 0.034 | 0.034 | 14.48 | 23.04 |
| MKT3 | 0.116*** | 0.005 | 0.041 | 0.034 | 0.040 | 0.040 | 12.16 | 19.36 |
| MKT4 | 0.120*** | 0.001 | 0.034 | 0.036 | 0.033 | 0.034 | 12.70 | 20.21 |
| MKT5 | 0.000 | | | | | | | |
| BUY1 | 0.139** | 0.047 | 0.070 | 0.050 | 0.066 | 0.067 | 14.64 | 23.30 |
| BUY2 | -0.098 | 0.146 | 0.068 | 0.051 | 0.064 | 0.065 | -9.56 | -15.22 |
| BUY3 | 0.136* | 0.055 | 0.071 | 0.055 | 0.067 | 0.068 | 14.30 | 22.76 |
| BUY4 | 0.000 | | | | | | | |
| EDU1 | 0.000 | | | | | | | |
| EDU2 | 0.060* | 0.061 | 0.032 | 0.028 | 0.031 | 0.031 | 6.13 | 9.76 |
| EDU3 | 0.111*** | 0.001 | 0.034 | 0.034 | 0.033 | 0.033 | 11.68 | 18.59 |
| EDU4 | 0.035 | 0.357 | 0.037 | 0.036 | 0.036 | 0.036 | 3.44 | 5.47 |
| EXP1 | 0.040 | 0.287 | 0.038 | 0.041 | 0.036 | 0.036 | 4.03 | 6.41 |
| EXP2 | -0.080 | 0.112 | 0.050 | 0.047 | 0.047 | 0.048 | -7.76 | -12.35 |
| EXP3 | -0.076** | 0.049 | 0.039 | 0.036 | 0.037 | 0.037 | -7.39 | -11.76 |
| EXP4 | 0.000 | | | | | | | |
| DENT1 | 0.033 | 0.683 | 0.082 | 0.062 | 0.077 | 0.079 | 3.06 | 4.87 |
| DENT2 | 0.221** | 0.010 | 0.085 | 0.061 | 0.080 | 0.082 | 24.33 | 38.73 |
| DENT3 | 0.162** | 0.073 | 0.090 | 0.067 | 0.084 | 0.086 | 17.10 | 27.22 |
| DENT4 | 0.000 | | | | | | | |
| BRD1 | 0.024 | 0.431 | 0.030 | 0.030 | 0.029 | 0.029 | 2.36 | 3.75 |
| BRD2 | -0.150*** | 0.000 | 0.039 | 0.039 | 0.038 | 0.038 | -13.99 | -22.26 |
| BRD3 | -0.031 | 0.284 | 0.029 | 0.030 | 0.029 | 0.029 | -3.13 | -4.99 |
| BRD4 | 0.000 | | | | | | | |
| SEX1 | 0.322*** | 0.000 | 0.037 | 0.029 | 0.036 | 0.036 | 37.85 | 60.24 |
| SEX2 | 0.000 | | | | | | | |

| | |
|---|---|
| $R^2$=0.8932 | Ramsey RESET Test F(2, 476) =2.16 *P*-value = 0.1165 |
| Mean VIF=3.10 | Breusch-Pagan / Cook-Weisberg test for heteroskedasticity: |
| F(21, 478) = 177.77 | $\chi^{2(1)}$=8.50*** *P*-value = 0.0036 |
| *P*-value = 0.0000 | |

[1] OLS = Ordinary Least Square, SE = Standard Error; $HC_0$ = Heteroscedasticity consistent -0; $HC_2$ = Heteroscedasticity consistent -2; $HC_3$ = Heteroscedasticity consistent -3.

[2] Abbreviations explained in Table 1.

[3] Significance levels at 1%***, 5%** and 10*, based on $HC_3$ SE.

[4] The relative impact measures the individual attribute coefficient estimate's percentage/price impact on the goat price evaluated at the sample mean. Calculations are based on Equation (4).

model show that goat price is determined by market locations, purpose of purchase, level of buyer education, experience of buyer and goat traits (such as age, sex, breed and live weight). In the market specific models, live weight and male goat have a significant positive relationship with price but the magnitude varies. These positive effects indicate that a premium price is paid for heavier and male goats in various markets. Further, the effects of most other variables were not consistent and significant across markets. Therefore, we discuss the results of the model based on the entire sample.

In the model, it was observed that the relationship between live weight and goat price is positive and highly significant. An increase in live weight of goat by one kg increases the goat price by 2.4%. Thus, an increase in live weight of goat by one kg is expected to increase the price of a goat by US$3.82. Studies conducted elsewhere also reported a significant effect of live weight on prices. For example, Rodriguez *et al.* (1995) found the strongest effect of live weight on producers and intermediaries expected prices. Dossa *et al.* (2008) indicated that live weight is the most important variable affecting the price of goats. Maxa *et al.* (2009) reported the high influence of the live weight of an animal on auction price of ram. Afzal *et al.* (2011) indicated the relationship of live weight to price was significant at a 5% level of significance. Naanep *et al.* (2012) indicated that live weight of goats had a significant contribution in influencing price variation. An increase in live weight by 1% increases the price by 0.46%. However, Knights *et al.* (2005) reported that price received for low weight categories of goats was significantly higher than the high weight category indicating preferences for lighter weights.

Among market locations, Dera Ghazi Khan is the farthest from the main consuming centers. Goat prices were significantly higher in Faisalabad, Lahore, Attock and Multan markets as compared to prices in the base category, i.e. Dera Ghazi Khan. Goats received the premium of 12.29, 14.48, 12.16 and 12.70% in Faisalabad, Lahore, Multan and Attock markets, respectively, in comparison to the Dera Ghazi Khan market. The prices were expected to be more due to marketing and transaction cost between Dera Ghazi Khan and each of the other markets. Another source of price variation among markets could be the people who are served by that market. People served by the Dera Ghazi Khan market in general, have a lower income than people of other markets. Differences in goat and sheep prices among markets have also been reported by Jabbar (1998a), Knights *et al.* (2005) and Srinivas *et al.* (2013).

The purpose of buying is considered as an important determinant of price paid by the buyer. Other things being equal, buyers paid significantly higher prices when buying goats for slaughtering on Eid-ul-Azha or sacrifice and resale compared to the base category i.e. rearing. Goats purchased on Eid-ul-Azha or sacrifice and for resale received premium of 14.30 and 14.64%, respectively, compared to the rearing purpose. The goats purchased for the purpose of butchering received a discount but the effect was not significant. Ayele *et al.* (2006), Jabbar (1998a), Jabbar *et al.* (1998b), Naanep *et al.* (2012) and Teklewold *et al.* (2009) also reported that animals prices were significantly higher at festival time of Muslims (i.e. Eid-ul-Azha, Fasting month) and Christians (i.e. Christmas, Easter, New Year) as compared to other periods. Andargachew and Brokken (1993), Jabbar (1998a) and Teklewold *et al.* (2009) also found that animal prices paid vary significantly among various type of buyers.

The coefficients of buyers whose education level was primary, primary to high school and above high school were positive as compared to those who were illiterate. However, these coefficients were significant only for primary and primary to high school education levels. The coefficient for above high school education level was insignificant. The former is most probably related to consumers who buy goats for religious festivals and the latter are likely to be traders. These findings are in line with the research work of Kassie *et al.* (2011).

Experienced buyers are expected to pay low prices for goats as they might have a better understanding of goat trading than inexperienced buyers. Results of the study show that buyers with no or one to five years trading experience have an insignificant effect on goat prices. However, buyers with trading experience of five to ten years have a negative significant effect on goat prices and they pay a discount of 7.39% compared to the base category, i.e. buyers with 10 years and above experience. This is probably due to higher proportion of goats purchased for rearing (27%) by goat producers with trading experience of five to ten years compared to the base category (4%). Goats purchased for rearing have less weight (i.e. 30.96 kg) compared to goats purchased for Eid-ul-Azha (46.98 kg) and resale (38.82 kg). Another possible reason is that they purchased a higher number of Kheera goats (64%) compared to buyers with ten years and above experience (46%). These animals have relatively less demand as they do not qualify for slaughtering on Eid-ul-Azha due to religious restrictions.

Age was approximated by the type and number of teeth. The results show that Donda and Chougha have significant positive effect on the prices of goat as compared to base category, i.e. Chigha. These animals received a premium of 24.33 and 17.10% respectively compared to Chigha. This shows that animal price increased with dentition (i.e. age) and declined for older or over matured animals (Chigha). This is likely due to the fact that Chigha are mostly old and culled animals especially the female goats, and the quality of meat of these animals is poor. Another possible explanation could be that Donda and Chougha goats are preferred by the buyers on a religious festival like Eid-ul-Azha and for sacrifice than the older animals. The coefficient for Kheera goats is positive but insignificant compared to base Chigha category. It can partly be explained by the fact that Kheera goats cannot be slaughtered on the occasion of Eid-ul-Azha and for sacrifice due to religious restrictions. Previous studies though employed various techniques for measuring the age of animals but they showed a mixed effect of age on the animal prices. Ayele *et al.* (2006), Jabbar (1998a) and Naanep *et al.* (2012) reported that age significantly influences the price of a goat. In these studies, animal's price increased with age but declined for over matured or older animals. Orden *et al.* (2005) concluded that age of the goat was positively related to the goat price as the age indicates tenderness and meatiness. Afzal *et al.* (2011) reported an inverse relationship between the price and age of goat, and indicated consumer preferences for young animal's meat. However, Teklewold *et al.* (2009) reported higher price for matured animals than the immature and young animals because of an increase in their live weight.

There are about 37 breeds of goats in Pakistan. In several cases, it is difficult to identify a specific breed. Therefore, in this study, main breeds of goats found in the market were identified as Beetal, Teddy, Crossbred and other breeds. In the estimated model, Teddy goat prices were significantly lower than the base category, i.e. other breeds. Teddy goat received a discount of 13.99% as compared to other breeds. The regression coefficient of the Beetal goat was positive while that of Crossbred negative but both were insignificant. In previous studies for example, Jabbar *et al.* (1998b), Naanep *et al.* (2012) and Rodriguez *et al.* (1995) reported significant differences in the prices of various breeds. However, Ayele *et al.* (2006), Dossa *et al.* (2008), Jabbar (1998a) and Srinivas *et al.* (2013) indicated insignificant effect of breed on price.

Sex plays an important role in the determination of goat price. Keeping other things constant, the price of a male goat was significantly higher than that of a female goat. For male goats buyers pay a 37.85% higher premium than for female goats. This is probably due to the fact that meat of male goats has greater flavor, juiciness, quality and general acceptability than the meat from female goats (Rodrigues and Teixeira, 2009). Another possible reason is that marketed female goats are mostly old culled animals. The quality of meat of such animals is poor and it requires much longer time for cooking. Therefore, people have preference for male goat meat over the female goat meat. Further, on religious occasion like Eid-ul-Azha, people generally prefer to buy male goats than female goats. Rodriguez *et al.* (1995), Jabbar *et al.* (1998b), Jabbar (1998a), Ayele *et al.* (2006), Afzal *et al.* (2011), Naanep *et al.* (2012) and Srinivas *et al.* (2013) also reported that prices of male animals were significantly higher than female animals.

## 5. Recommendations

In order to reap the benefits of rising international as well as domestic demand, the government should create a favorable environment and incentive mechanism for encouraging the goat industry to meet the needs of local people, and the export of goat meat and live animals for the benefit of goat producers. The results of the study can help the goat producers to understand buyers' preferences for different characteristics of the animal. Goat producers can target breeding time, feeding practices and place of sale to gain more from existing market opportunities (Ayele *et al.*, 2006). For this purpose, appropriate policies targeting to commercialization of goat production at the grassroots level should be in place. It may require the application of proper goat production technologies, selection of appropriate breeding bucks, identification of occurrence and severity of diseases and parasites, and their solutions for improving the performance of goat animal.

The relationship between live weight and goat price is positive and highly significant. From this, it can be concluded that an increase in live weight of goat increases the price of the animal and it is an important

preferred goat characteristic of buyers. An increase in live weight by 1 kg increases the goat price by US$ 3.82. In order to ensure fair returns to the goat producers, policy makers should ensure that they get the prices of their animals based on kg live weight and grade instead of on traditional bargaining systems. This will also involve a shift from retail meat price policy to the price per kg live weight of animal policy. This will reduce the role of middlemen in the marketing of goats, and empower the goat producers through the provision of information on buyer's preferences, market prices and demand of animals in major markets. This necessitates that weighing machines may be installed for weighing animals at the entry points of the markets. This will provide information to the goat producers about the exact weight of the animal, thus helping them in determining the value of animal and bargaining. Thus goat producers can significantly improve their profitability by receiving higher prices for their animals. In order to achieve greater price efficiency in the long run, the government must move to value-based pricing (i.e. price based on individual animal characteristics). Such pricing of animals will result in proper rewards for goat producers on producing high-quality animals to meet the needs of the consumer.

The marketplace was an important determinant of goat prices. The Dera Ghazi Khan market was the cheapest marketplace while the other markets, i.e. Lahore, Faisalabad, Multan and Attock, were relatively more expensive. Thus, market location/place had a significant influence on the prices of goats. This shows that goat producers can get a significant benefit if they carefully select the marketplace. For this purpose, goat producers should be provided necessary information about markets regarding the high demand for goats in order to improve their returns. Non-availability of market information about goat prices limits producers' marketing decisions and consequently affects their production and sales decisions. Further, inadequate information about prices results in poor integration of spatially dispersed markets (Upton, 2000) and high margins for the intermediaries (Aklilu *et al.*, 2007). Therefore, communication of price information to goat producers can improve their competitiveness and profitability. This will help producers to tune their marketing activities accordingly. Government departments should also work on improving market access for goat producers in order to reduce transaction costs and to maximize their profits by enhancing competitiveness in the market.

Purpose of goat purchasing was observed to be an important determinant of goat prices. About 52% of goats were purchased for the purpose of slaughtering on the occasion of Eid-ul-Azha or sacrifice. Goats purchased for sacrifice on the occasion of Eid-ul-Azha have a price premium and animals purchased for rearing by the goat producers do not. Therefore, the goat producers should design market strategies to exploit this opportunity in order to maximize their income/profit. There is also a strong need for the improvement of marketing infrastructure in the form of auction platforms, weighing scales, feeding pans, water points, sheds according to weather requirements, etc.

The coefficient for Kheera goats is positive but insignificant compared to Chigha. Donda and Chougha have a significant positive effect on the price of goats as compared to Chigha. From this, it can be concluded that animal price increases with dentition and declined for over matured or older animals. It implies that goat producers should sell their animals when they are matured (i.e. Donda or Chougha) but not over matured (i.e. Chigha) in order to get premium prices.

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## Supplementary material

Supplementary material can be found online at https://doi.org/10.22434/IFAMR2018.0037.

**Table S1.** Estimation results of heteroscedastic consistent hedonic model of various markets.

## References


Abdulai, A. 2000. Spatial price transmission and asymmetry in the Ghanaian maize market. *Journal of Development Economics* 63 (2): 327-349.

Afzal, M., S. Ahmad, A.S. Baloch and Q.B. Ahmad. 2011. Seasonal price variation and price characteristics for small ruminants marketing in Balochistan. *Pakistan Journal of Agricultural Research* 24: 86-93.

Aklilu, H., C. Almekinders, H. Udo and A. Van der Zijpp. 2007. Village poultry consumption and marketing in relation to gender, religious festivals and market access. *Tropical Animal Health and Production* 39 (3): 165-177.

Andargachew, K. and R.F. Brokken. 1993. Intra-annual sheep price patterns and factors underlying price variations in the central highlands of Ethiopia. *Agricultural Economics* 8 (2): 125-138.

Ayele, G., M.A. Jabbar, H. Teklewold, E. Mulugeta and G. Kebede. 2006. Seasonal and inter-market differences in prices of small ruminants in Ethiopia. *Journal of Food Products Marketing* 12 (4): 59-77.

Box, G.E.P and D.R. Cox. 1964. An analysis of transformations. *Journal of the Royal Statistical Society. Series B (Methodological)* 26 (2): 211-252.

Brown, J.E., and D.E. Ethridge. 1995. Functional form model specification: An application to hedonic pricing. *Agricultural and Resource Economics Review* 24 (2): 166-173.

Cropper, A.L, L.B. Deck and K.E. McConnell. 1988. On the choice of functional form for hedonic price functions. *The Review of Economics and Statistics* 74 (4): 668-675.

Devendra, C. 2001. Small ruminants: Imperatives for productivity enhancement improved livelihoods and rural growth. A review. *Asian-Australasian Journal of Animal Sciences* 14 (10): 1483-1495.

Dossa, L.H., B. Rischkowsky, R. Birner, and C. Wollny. 2008. Market potential for the local Djallonké goat in Southern Benin: empirical evidence from two rural markets. *Market Research for Rural Development* 20 (5): 1-10.

Ehui, S.K., M.M. Ahmed, B. Gebremedhin, S.E. Benin, A. Nin-Pratt, and M.L. Lapar. 2003. 10 years of livestock policy analysis. Policies for improving productivity, competitiveness and sustainable livelihoods of smallholder livestock producers. ILRI (International Livestock Research Institute), Nairobi, Kenya.

FAO (Food and Agricultural Organization of the United Nations). 2015. FAO Statistical Pocketbook World Food and Agriculture. Available at: http://www.fao.org/3/a-i4691e.pdf.

Government of Pakistan. 1991. Pakistan Economic Survey 1990-1991. Finance Division, Economic Adviser's Wing, Islamabad. Available at: https://tinyurl.com/yxjm9gkj.

Government of Pakistan. 2006. Pakistan livestock census 2006. Statistics Division, Agriculture Census Organization, Gurumangat Road, Gulberg-III, Lahore, Pakistan. Available at: https://tinyurl.com/yyugcdcl.

Government of Pakistan. 2017. Pakistan Economic Survey 2016-17. Finance Division, Economic Adviser's Wing, Islamabad. Available at: http://www.finance.gov.pk/survey/chapters_17/Pakistan_ES_2016_17_pdf.pdf.

Gujarati, D. and N. Sangeetha. 2007. Basic econometrics. Tata McGraw-Hill Publishing Company Limited, New Delhi, India.

Haab, T.C. and K.E. McConnell. 2002. Valuing environment and natural resources: The econometrics of non-market valuation. Edward Elgar, Cheltenham, UK.

Halvorsen, R and R. Palmquist. 1980. The interpretation of dummy variables in semilogarithmic equations. *American economic review* 70 (3): 474-75.

Jabbar, M.A. 1998a. Buyer preferences for sheep and goats in southern Nigeria: a hedonic price analysis. *Agricultural Economics* 18 (1): 21-30.

Jabbar, M.A, B.M. Swallow, G. d'Iteren and A. Busari. 1998b. Farmer preferences and market values of cattle in West and Central Africa. Journal of Sustainable Agriculture 12 (2-3): 21-47.

Kassie, G.T, A. Abdulai and C. Wollny. 2011. Heteroscedastic hedonic price model for cattle in the rural markets of central Ethiopia. *Applied Economics* 43 (24): 3459–3464.

Kennedy, P.E. 1981. Estimation with correctly interpreted dummy variables in semilogarithemic equations. *American Economic Review* 71 (4): 801.

Knights, D.S, D.K. Smith and M. Knights. 2005. A hedonic analysis of sheep and goat prices in a changing environment: the role of consumers and implication for management. Paper presented at the American Agricultural Economics Association annual meeting, Providence, Rhode Island, July 24-27.

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

Lenz, J.E., R.C. Mittelhammer and J.K. Hillers. 1991. Pricing milk components at retail via hedonic analysis. *Journal of Dairy Science* 74 (6): 1803-1814.

Long, J.S. and L. Ervin. 2000. Using heteroscedasticity-consistent standard errors in the linear regression model. *The American Statistician*, 54 (3): 217-224.

Maxa, J., M. Borchere, H. Thomsen, H. Simianer, M. Gauly and A.R. Sharifi. 2009. Auction orice of Texel, Suffolk and German white-headed mutton rams: a genetic-statistical study. *Small Ruminant Research* 85 (2) :105-110.

Moaeen-ud-Din, M., N. Ahmad, A. Iqbal and M. Abdullah. 2006. Evaluation of different formulas for weight estimation in Beetal, Teddi and Crossbred (Beetal X Teddi) Goat. *Journal of Animal and Plant Science* 16 (3-4): 74-78.

Mustafa, U., K. Mehmood, S.I. Ali, N.A. Shah and M. Afzal. 1995. Marketing of small ruminants in highland Balochistan. Progressive Farming 5(2), Pakistan Agriculture Research Council Islamabad, Pakistan.

Naanep, N.D., N.B. Velasco, C.B. Tayab, F.L. Dacayo, R.C. Jordan, J.M. Maltu and E.C. Villar. 2012. Traders' preferences for halal goat characteristics in selected markets in region xii, Philippines. *Philippine Journal of Veterinary and Animal Sciences* 38 (2): 177-186.

Orden, M.E.M., W.E. Jamandre, E.O. Brown, E.A. Orden, E.M. Cruz, A.M.P. Alo and E.C. Villar. 2005. Traders' Preference for goat characteristics in selected markets of Pangasinan, Philippines. *Animal Science Journal* 76: 179-185.

Parker, D.D. and D. Zilberman. 1993. Hedonic estimation of quality factors affecting the farm-retail margin. *American Journal of Agricultural Economics* 75: 458-466.

Peacock, C.P. 2005. Goats - a pathway out of poverty. *Small Ruminant Research* 60 (1): 179-186.

Rodriguez, A., I. Ali, M. Afzal, N.A. Shah and U. Mustafa. 1995. Price expectations of sheep and goats by producers and intermediaries in Quetta market, Pakistan. *Agricultural Economics* 12 (1): 79-90.

Rodrigues, S. and A. Teixeira. 2009. Effect of sex and carcass weight on sensory quality of goat meat of Cabrito Transmontano. *Journal of Animal Sciences* 87 (2): 711-715.

Rosen, S. 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy* 82 (1): 34-35.

Sharif, M.C., W. Malik, N.I. Hashmi and U. Farooq. 2003. Action plan for livestock marketing systems in Pakistan. Social Sciences Institute, National Agriculture Research Center and Food and Agriculture Organization of the United Nations, Islamabad, Pakistan. Available at: https://agrihunt.com/articles/livestock-industry/action-plan-for-livestock-marketing-systems-in-pakistan/.

Solaiman, S.G. 2007. Assessment of the meat goat industry and future outlook for US small farms, Tuskegee University, Tuskegee. Available at: https://www.tuskegee.edu/Content/Uploads/Tuskegee/files/CAENS/Caprine/US%20Goat%20Industry%20Assessment.pdf.

Spitzer, J.J. 1982. A primer on Box Cox estimation. *The Review of Economics and Statistics* 64 (2): 307-313.

Srinivas, T., A.A. Hassan, B. Rischkowsky, M. Tibbo, J. Rizvi and A.H. Naseri. 2013. Hedonic analysis of price expectations of goat producers in Afghanistan: implications for production and marketing decisions. *Agribusiness* 29 (2): 133-146.

Steinfeld, H. 2012. Livestock and natural resources. In: proceedings of an international policy forum, Bangkok 16-17 August 2012.

Teklewold, H., G. Legese, D. Alemu and A. Negasa. 2009. Determinants of livestock prices in Ethiopian pastoral livestock markets: implications for pastoral marketing strategies. Paper presented at the International Association of Agricultural Economists Conference, Beijing, 16-22 August 2009. Available at: https://tinyurl.com/y448tjtc.

Terfa, Z.G., A. Haile, D. Baker and G.T. Kassie. 2013. Valuation of traits of indigenous sheep using hedonic pricing in Central Ethiopia. *Agricultural and Food Economics* 1 (1): 6-22.

Upton, M. 2000. The livestock revolution-implications for smallholders agriculture: A case study of milk and poultry production in Kenya. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.564.5969&rep=rep1&type=pdf.

Vuong, Q.H. 1989. Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica* 57 (2): 307-333.

Waugh, F. 1928. Quality factors influencing vegetable prices. *Journal of Farm Economics* 10 (2): 185-96.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48 (4): 817-838.