



Effect of bio-economic traits on market value of live goats: A case study of indigenous goat breeds

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ABSTRACT

Small ruminants in developing countries are mainly kept by local pastoralists under low-input production systems. The livelihood of the flock holders can be enhanced by the technical and institutional interventions. In this study, effect of bio-economic traits including age (*Ag*), live body weight (*Bw*), milk production (*Mp*), order of lactation (*Or*), prolificacy (*Pf*), favorable mark (*Fm*) and breed (*Br*) on market value of live goat was investigated. Study revealed that magnitude of difference in various traits of breeds ranged from 200 to 800%. It was observed that extent of variation in bio-economic traits of descript breeds was comparatively lower in case of both categories of dairy and meat goat. Non-descript breeds of the goat animals including dairy and meat goat fetched higher price over the descript breeds. Multiple regression analysis was applied to identify the potential economic traits of the breed. *Mp* and *Bw* had a direct and significant influence on the market value of the dairy goat. Similarly, *Bw* influenced the market value of meat goat positively while *Ag* was found to have adverse influence. Economic traits namely *Mp*, *Fm* and *Bw* of the live goat animals were observed as significant characteristics affecting the market value directly. These characteristics may be important for obtaining price premium. Institutional and technical interventions to enhance the milk productivity and gain in body weight of the live goat animals may be a strategic approach to benefit this sector.

Key words: Body weight, Dairy goat, Meat goat, Milk yield, Multiple regression model

China, India, Nigeria, Pakistan and Bangladesh are top five goat meat producing countries accounting for 65% meat production in the world. India contributes 30.47% of goat milk and 10.24% of goat meat (Chevon) of the world goat production. About 2, 8, 47, 64% cattle, buffaloes, sheep, goats and more than 90% of poultry birds and pigs are slaughtered annually in India (Basic Animal Husbandry & Fisheries Statistics, 2013). The value of meat exported from India has increased from 275 million dollars in 2000-2001 to 4,771 million dollars in 2012-13 primarily due to establishment of integrated modern abattoirs and meat processing plants with Hazard Analysis and Critical Control Points (HACCP) and International Organization for Standardization (ISO) quality control programs (UN COMTRADE Statistics 2014). Local pastoralists under low-input production systems need to be encouraged and facilitated by promoting efficient marketing system (Yogi *et al.* 2009). Thus, coordinated attempts in terms of

managerial practices and infrastructural programs are of crucial importance (Kosgey and Okeyo 2007). Intensive goat rearing practice is a strategic approach for making goat farming remunerative for flock holders (Singh *et al.* 2008). Small animal like goats to be called Shock Absorbing Animal (SAA) are appropriate animal for marginal ecological environments (Kearl 1982). Knowledge of bio-economic traits of a population and its relationship with pricing of live goat is the main pre requisite for designing an efficient pricing policy (Pati and Rao 2006).

MATERIALS AND METHODS

Sampling design and data collection: In India, Rajasthan state ranked first in goat population (19th Livestock Census 2012) and it was selected purposively. The arid and semi arid climatic conditions of the state favor goat rearing and facilitate the comparative advantage in milk and meat production. The multi-stage random sampling design was adopted for selection of eight villages spread over four blocks in three districts. The identified area endowed with about 16.8 million goat animals. Sampled flock holders possessed 6,381 goat animals and they were connected with 99 functional marketing agencies for selling of live goats. About 0.5 million live goats were disposed through these goat marketing agencies, annually. The identified area was

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spread over different agro climatic zones including arid and semiarid plains (NARP 1998). A total of four major marketing channels including consumer, butcher/slaughter house, small and big traders directly linked with the 100 identified flock holders were considered for further investigation. Information on economic traits of 130 goats across various categories of flock holders was collected by personal interview method on pre-tested and structured schedules during 2009-10. To study the effect of the various factors on the economic value of the dairy and meat goat, a total of 71 dairy goats and 59 meat goats were taken into account during the survey and detailed information regarding different factors influencing the value of dairy and meat goat were collected. The specific data about quantitative and qualitative details of bio-economic traits and market value of live goat animals were recorded. A standard weighing machine was used for arriving at actual live weight.

Analytical framework: There are various factors that affect the market value of live goat. Based upon the economic logic and statistical criteria, relevant economic traits were selected and units of the measurement of these quantitative and qualitative variables were specified accordingly. There were two qualitative characters like breed and mark which influence the market value of the live goat animal and to take care of these aspects dummy variables were introduced in both the models (Gujarati 2007). The value of dairy goats between age groups of first kidding to fifth kidding period was considered as dependent variable for analysis. The following functional form was used for dairy goat:

$$Y_d = f(Agd, Bwd, Mpd, Ord, Pfd, Brd)$$

where, dependent variable Y_d is market value of dairy goat in rupees. Agd , Bwd , Mpd , Ord , Pfd and Brd are explanatory variables for age in months (Agd), actual body weight in kilograms (Bwd), milk productivity in litres per day (Mpd), order of lactation in numbers (Ord), prolificacy in numbers (Pfd) and breed (Brd) of dairy goat, respectively. Similarly, the market value of meat goats was considered as dependent variable for analysis. Breed and favorable mark of meat goat was introduced as dummy variable in the model. The following functional form was used for meat goat:

$$Y_m = f(Agm, Bwm, Brm, Fmm)$$

where, dependent variable Y_m is market value of meat goat in rupees for the given equation. Agm , Bwm , Brm and Fmm are explanatory variables for age in months (Agm), body weight in kilograms (Bwm), breed (Brm) and favorable mark (Fmm) of the meat goat, respectively.

Descriptive statistics was computed and magnitude of variation giving maximum and minimum value was obtained across both the breed groups.

In order to estimate parameters affecting value of live goat animals, the models namely Multiple Linear Regression Model (MLRM) and Multiple Log-Lin Regression Models (MLLRM) were fitted whose functional forms are given below:

Multiple Linear Regression Model (MLRM)

$$Y_j = \beta_0 + \sum \beta_i X_{ij} + u_j \quad (1)$$

Multiple Log-Linear Regression Model (MLLRM)

$$Y_j = \beta_0 X_{ij}^{\beta_i} e^{u_j} \quad (2)$$

MLRM (1) was finally chosen on the basis of economic and statistical criteria. Subscript i ranged from 1,2,3.... k (where; $k=6$ for dairy goat and $k=4$ for meat goat) and subscript j varied from 1,2,3,.... n (where, $n=71$ for dairy goat and $n=59$ for meat goat).

RESULTS AND DISCUSSION

Economic trait based market price mechanism may be strategic action for live goat market and infrastructural development programs. A prior information revealed that the age and body weight of live goat influenced its market value (Shukla *et al.* 1996) and male sex, maturity (age) and good healthy appearance commanded a price premium (Kumar and Singh 1999). The country has a vast genetic resource with 20 breeds of goat (Acharya *et al.* 1982, Tandia *et al.* 2000). Selection of the best animals for genetic gain and more emphasis on the improvement of economic traits will enable for price premium and livelihood support for poor small and marginal flock holders.

Variation in economic traits across the breed groups of dairy and meat goat: Descriptive statistics of specified economic traits about the two breed groups of dairy goat are presented in Table 1.

Table 1. Descriptive statistics of descript and non-descript breeds of dairy goat

Traits ^a	Descript			Non-descript			Overall		
	Average	Max	Min	Average	Max	Min	Average	Max	Min
Y_d (₹)	1997	2500	1300	2037	3000	1200	2028	3000	1200
Agd (months)	25.63	35.00	18.00	30.85	45.00	15.00	29.68	45.00	15.00
Bwd (kg.)	20.69	35.00	15.00	26.49	38.00	14.00	25.18	38.00	14.00
Mpd (lit.)	0.88	1.50	0.50	0.85	2.00	0.25	0.86	2.00	0.25
Ord (no.)	2.00	4.00	1.00	3.11	5.00	1.00	2.86	5.00	1.00
Pfd (no.)	1.06	2.00	1.00	1.22	3.00	1.00	1.18	3.00	1.00

^a Y_d : Value of live dairy goat (₹); Agd : age of dairy goat; Bwd : body weight of live dairy goat; Mpd : milk productivity; Ord : order of lactation; Pfd : prolificacy.

Table 2. Descriptive statistics of descript and non-descript breeds of meat goat

Traits ^a	Descript			Non-descript			Overall		
	Average	Max	Min	Average	Max	Min	Average	Max	Min
<i>Ym</i> (₹)	3483	4500	2200	2256	5000	900	2383	5000	900
<i>Agm</i> (months)	28.2	35.0	20.0	23.4	54.0	12.0	23.8	54.0	12.0
<i>Bwm</i> (kg)	30.8	40.0	20.0	21.5	40.0	10.0	22.5	40.0	10.0

^a*Ym*: Value of live meat goat (₹); *Agm*: age of meat goat; *Bwm*: body weight of live meat goat.

Among all the identified dairy goats the highest market value was observed for the non-descript breed. Live body weight and prolificacy were observed to be higher for non-descript breed in comparison to descript breed. Consequently, non-descript breed got a price premium over the descript breed. Average age of marketing of dairy goats of non-descript breeds was higher than descript breeds. It was observed that there was a vast variation in the terms of various bio-economic parameters. The magnitude of variation for non-descript breeds was 250, 300, 271, 800, 500 and 300% in value of live dairy goat (*Yd*), age (*Agd*), live body weight (*Bwd*), milk production (*Mpd*), order of lactation (*Ord*) and prolificacy (*Pfd*), respectively. Extent of percent variation in *Yd*, *Agd*, *Bwd*, *Mpd*, *Ord* and *Pfd* for descript breeds was found to be 192, 194, 233, 300, 400 and 200, respectively. Magnitude of divergence was comparatively higher in the group of non-descript breeds. It was highest for the most important economic trait *Mpd* in the group of non-descript breeds. *Mpd* was reported one of the most critical economic trait governing market value of the dairy goat by Kumar and Meganathan (2005).

Descriptive statistics of specified economic traits for meat goat are provided in Table 2. Similar to dairy goat, extent of variation in the economic traits for meat goat was comparatively lower for descript breeds. There was a favorable mark on the body of non-descript breeds that made it more valuable in the market due to consumers' preference during festive or ritual occasion (Kumar and Upadhyay 2006). Average age of marketing of meat goats of non-descript breeds was lower than descript breeds. Consequently, non-descript breed of meat goat got the price premium over the descript breed. The finding supports the fact that huge population of non-descript goat animals have greater variability in comparison to descript breeds in the population and thus, becomes an important means of conserving genetic variability (Lavania and Singh 2008). Overall, magnitude of percent variation in traits of meat goat ranged from 200 to 500, in *Ym*, *Agm*, *Bwm* for descript and non-descript breeds, respectively which were in conformity with the findings made by Deoghare (2001) and Kumar *et al* (2010). *Agm* and *Bwm* were reported as more critical economic traits governing market value of the meat goat.

On the whole, relatively more variation across various economic traits of the live goats was observed in case of non-descript breeds as compared to descript breeds based on the selected sample observations.

Table 3. Determinants of market value of dairy goat (*Yd*^a)

Explanatory variables ^b	Co-efficient	p-value ^c
Constant	998.45	0.00029*
<i>Agd</i> (in months)	-7.49	0.62006***
<i>Bwd</i> (kg)	19.80	0.00183*
<i>Mpd</i> (per day)	720.17	2.19E-1*
<i>Ord</i> (numbers)	27.92	0.74083***
<i>Pfd</i> (number of kids / kidding)	35.54	0.60756***
<i>Brd</i>	57.09	0.43810**
<i>R</i> ²	0.71	-
<i>F</i> -statistics	-	1.78E-1*

The variables acronyms are as follows: ^a*Yd* is dependent variable stands for market value of live dairy goat (in ₹). ^b*Agd*: age; *Bwd*: body weight of live dairy goat; *Mpd*: milk productivity; *Ord*: order of lactation; *Pfd*: prolificacy; *Brd*: breed; ^c*, coefficient significant at 1% level of significance; **, coefficient significant at 5% level of significance; ***, coefficient significant at 10% level of significance.

Estimation of parameters affecting market value of dairy goat: Large size breeds of north-western region in India such as *Jamunapari*, *Beetle Jakhara* and *Sirohi* produces fairly good amount of milk. The milk yield varies from 0.5 to 5.0 litres per day with an average butter fat content of about 4.5% (Rai *et al.* 2005). The average per day milk yield of a dairy goat varied from 0.35 to 0.58 litres at state and the national level, respectively.

The results of the regression analysis for dairy goat are shown in Table 3. All the explanatory variables except the *Agd* were found to be influence positively the market value of dairy goat. In case of regression analysis ascertaining for combined influence of meat and dairy goat (without segregating the population into dairy/meat goat), it was found that age of dairy goat positively influenced the market value (Shukla *et al.* 1996). However, an examination of regression result based upon statistical criteria revealed that the *Agd*, *Ord*, *Pfd* and *Brd* did not influence significantly the market value of the dairy goat. *Mpd* and *Bwd* were found to be significantly and positively influence the market value of the dairy goat. Overall, taking all the variables together, the regression model explained about 71% of total variation in market value of dairy goat. Kumar and Singh (1999) in a study on live goat marketing in the tribal area observed that sex (male), live body weight, age, maturity and healthy appearance commanded a price premium. It was reported that every per kilogram of additional gain in the body weight

Table 4. Determinants of market value of meat goat (Ym^a)

Explanatory variables ^b	Co-efficient	p-value ^C
Constant	544.02	0.038450*
<i>Agm</i> (months)	-31.10	0.054590**
<i>Bwm</i> (Kg)	108.32	1.54E-07*
<i>Brm</i>	59.54	0.845540***
<i>Fmm</i>	499.16	0.018550*
R^2	0.66	-
<i>F-statistics</i>	-	3.72E-12*

The variables acronyms are as follows: ^a Ym is dependent variable stands for market value of live meat goat (in ₹). ^b Agm : age; Bwm : body weight of live meat goat; Brm : breed; Fmm : favorable mark/sign; ^C*, coefficient significant at 1% level of significance; ^C**, coefficient significant at 5% level of significance; ^C***, coefficient significant at 10% level of significance.

of goat fetched additional revenue of ₹9.16 to flock holders. It was concluded that positive effect of economic traits on market value of live goat were larger than the negative effect of age of goat animals.

Estimation of parameters affecting the market value of meat goat: Meat production is other important source of the income from the goat rearing which is popularly known as chevon. At present, demand of the goat meat is in excess of supply, which in turn, is associated with higher market values of goat meat. The results of the regression analysis for meat goat are shown in Table 4. In the model, all the probable variables that could have influenced the value of meat goat had been taken based on a priori information. All the explanatory variables except the age of the meat goat were found to have positive influence on the market value of the meat goat. An examination of the estimate of parameters revealed that *Agm*, *Bwm* and *Fmm* were found to be significant explanatory variables explaining 66% of total variation in the market value of the meat goat. The influence of *Brm* on market value of the meat goat was not significant. The regression estimates showed that meat goat with favorable mark (sign of 'moon eclipse' or sketch of mysterious figure '786' on the body of meat goat which is preferred by Muslim community particularly on the occasion of festivals like *Bakra Eid*) on its body may fetch a price premium over the other animals. Further, it was found that the unit increase in body weight influenced the market value of meat goat positively while market value of the meat goat decreased with the increase in age of the meat goat. Magnitude of the negative effect of the age was comparatively higher in case of meat goat. This may be due to the decreasing influence of tenderness or taste of the chevon over the average age of about 24 months (Singh and Hussain 1996). Kumar and Upadhyay (2006) reported that more than 60% flock holders were selling live goat at farm itself because of urgent cash needs, higher transportation cost, lack of awareness about market information and current market prices. Shukla *et al.* (1996) reported that age and body weight of goat influenced the

market value of goat positively and significantly. It was further concluded that descript breed (*Ajmeri*) of goat was valued higher than other breeds of goats. General appearance, body capacity and other characteristics had significant impact on the market price of live animals across various annual animal fairs in Rajasthan (Das and Jain 2013).

Non-descript breeds of dairy and meat goat fetched price premium over the descript breeds. An unfavorable phenomenon called inbreeding depression may be avoided if the observed vast phenotypic variation across the non-descript breeds is used for the breed improvement. There is potential for genetic improvement of economically important traits from the 570 documented breed populations that represent most global goat genetic resources (Shrestha and Fahmy 2007). Due to the lack of awareness and unregulated market system, flock holders sell the animals without giving much importance to key economic traits like age, order of lactation, prolificacy and breed. Multiple linear regression models revealed that the milk yield and body weight was found to positively influence the market value of dairy goat. Favorable mark/sign and body weight of the meat goat influenced the market value of meat goat positively while age of the meat goat was found to have an adverse effect. Similarity in the direction of relationship between age and market value of both types of goat animals was observed. Economic traits namely milk yield, favorable mark and body weight of the live goat animals were observed to be significant characteristics affecting the market value directly. Institutional and technical interventions may be initiated to enhance the milk productivity and gain in body weight of the goat animals. The findings have direct policy implications in the context of liberalized economic policies and recent World Trade Organization (WTO) interventions in international market. All the factors influencing the market value of live goat across various countries can be documented with the application of appropriate modeling. Subsequently, a more synchronized pricing framework may be designed at common global platform for live goat animals to benefit the poor flock holders.

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