

## Returns and determinants of technical efficiency in small-scale Malabari goat production units in Kerala, India

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**Abstract** A stochastic frontier production function was employed to measure technical efficiency and its determinants in smallholder Malabari goat production units in Kerala, India. Data were obtained from 100 goat farmers in northern Kerala, selected using multistage random sampling. The parameters of the stochastic frontier production function were estimated using the maximum likelihood method. Cost and return analysis showed that the major expenditure was feed and fodder, and veterinary expenses were secondary. The chief returns were the sale of live animals, milk and manure. Individual farm technical efficiency ranged from 0.34 to 0.97 with a mean of 0.88. The study found herd size (number of animal units) and centre (locality of farm) significantly affected technical efficiency, but sex of farmer, education, land size and family size did not. Technical efficiency decreased as herd size increased; half the units with five or more adult animals had technical efficiency below 60 %.

**Keywords** Malabari · Economics · Commercialization · Determinants of technical efficiency · Goat

### Introduction

The world population of goats is about 921 million, of which over 90 % are found in developing countries. Asia is home to

about 60 % of the total world goat population and has the largest goat breed share of 26 % (Devendra 2012). India ranks second in the world goat population with 14.6 % of the population. As per Indian livestock census in 2007, Kerala's share is only 1.23 % in goat population. Yet, goats are a very reliable source of income in rural areas of Kerala.

Goat production in Kerala is mainly centred on its native breed, Malabari (or Tellichery), which is reputable for its high prolificacy, milk yield, excellent growth rate and adaptability to the hot humid conditions prevalent in the state (Alex and Raghavan 2012). It is named after its place of origin, the Malabar region of Kerala state. This breed of goats is a mixed population of Arab Indian goats including Cutch cross and Tellichery. Malabari goats are medium-sized, dual-purpose animals with small, slightly twisted horns and medium-sized ears directed outward and downward (Raghavan et al. 2004). The importance of this valuable genetic resource is largely underestimated, and the extent of its contribution to the livelihood of the poor is inadequately understood. Investment initiatives on research and development to improve the relatively low level of goat productivity often do not match its potential importance. The All India Co-ordinated Research Project (AICRP) on goats (Malabari field unit) in Kerala is one of the government ventures to improve the production potential of Malabari goats in terms of growth, milk production and reproductive traits through selection, and it is working in this regard for the last 12 years.

In Kerala, goats are usually kept in smallholder farming systems. These farming systems are characterized by minimal resources in terms of land and capital, low income, poor food security and informal labour arrangements derived from family members, with some non-agricultural activities to supplement household incomes (Kosgey et al. 2006; de Sherbinin et al. 2008). However, these holdings follow the

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general trend of intensification that has occurred recently in goat systems in many parts of the world (Bouwman et al. 2005; Morand-Fehr and Lebbie 2004; De Rancourt et al. 2006). Little information, however, is available on the economic viability and sustainability of the smallholder system of goat rearing in Kerala. With this background, this paper has explored the economics of goat rearing and its efficiency and identified the determinants of technical efficiency in Malabari goat rearing in Kerala, and thus evaluates the scope of commercialization of goat rearing in the present conditions existing in Kerala.

## Materials and methods

### Study area and data collection

The study was undertaken in three field centres of AICRP in goats (Malabari field unit) viz., Thalassery, Badagara and Tanur, which are located in the northern part of Kerala, which is the breeding tract of Malabari goats. Baseline information was collected through surveys of smallholder farmers participating in three field centres. Farmers were grouped into five categories in terms of animal units, an animal unit being defined as one doe and its kids. From this, a sample of 100 farmers who had been rearing Malabari goats continuously for more than 2 years was selected randomly on the basis of probability proportional to the number of farmers in each category. Data from the selected farmers, recorded monthly over 3 years, 2007 to 2009, by trained field recorders, were analysed and are presented in this paper. The data include production, reproduction, management, population, feeding, disease, mortality and socio-economic costs and returns.

### Analytical tools

#### Model

The efficiency of a production unit may be defined by how effectively it uses variable resources for the purpose of profit maximization, given the best production technology available. Technical efficiency refers to the maximum attainable level of output for a given level of production inputs, considering the alternative technologies available to the producer. This study measures technical efficiency and identifies the factors associated with inefficiency, and thus, it identifies ways to increase output through better use of available resources in goat production.

The stochastic frontier production function analysis was used to estimate the coefficients of the parameters of the production function and also to predict the technical efficiencies of the goat keepers. The production technology of

the farmer was assumed to be specified by the Cobb Douglas frontier production function which is defined by Eq. (1):

$$\ln Y = \beta_0 + \beta_F \ln F + \beta_V \ln V + V_i - U_i \quad (1)$$

where

$Y$  = return per goat per year (Rs/goat)  
 $F$  = cost of fodder and feed per year (Rs/goat)  
 $V$  = cost of veterinary care per year (Rs/goat)  
 and  $\beta$  = the parameters to be estimated

Maximum likelihood estimation (MLE) techniques were used to estimate the equation by using the programme Frontier 4.1 (Coelli 1996).

### Determinants of technical efficiency

After analysing the stochastic frontier production function, the determinants of technical efficiency were identified. The  $V_i$ s are random errors that are assumed to be independent and identically distributed as  $N(0, \sigma_v^2)$ 's random variables. The  $U_i$ s are non-negative technical inefficiency effects associated with the technical efficiency of goat production, and it captures the variation in output due to sex, family size, age, educational status and other socio-economic characteristics that are assumed to be independently distributed among themselves and between the  $V_i$ s such that  $U_i$  is defined by truncation of the  $N(\mu_i, \sigma_u^2)$  distribution where  $\mu_i$  is defined by:

$$\mu_i = \delta_0 + \sum_{j=1}^6 \delta_j Z_{ij} \quad (2)$$

where  $Z_1$  represents the sex of the goat keeper (dummied as 1 for female and 0 otherwise),  $Z_2$  represents the centre of AICRP (Malabari field unit) dummied as 1 for Thalassery and 0 otherwise,  $Z_3$  represents dummy variables for educational status of the farmer,  $Z_4$  represents landholding (cent),  $Z_5$  represents the size of the family (in number) and  $Z_6$  represents animal units (number). The  $Z$ s are included in the model to indicate their possible influence on the technical efficiency of the goat rearers. The estimates of all the parameters of the stochastic frontier production function and inefficiency model were contemporaneously obtained (Battese and Coelli 1995), and these estimate the variance parameters in terms of  $\sigma_u^2 = \sigma^2 + \sigma_v^2$  and  $\gamma = \sigma_u^2 / \sigma_u^2$ . Small livestock rearing is considered to be the primary responsibility of women and children. These animals are cared for and controlled by women and contribute to food security for the family (Deshpande and Sabapara 2010). In the present study, majority of the goat farmers were females. As goat