Livestock Science 178 (2015) 27–34

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Breeding programs for dairy goats generate profits in Brazil

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ARTICLE INFO

Article history:
Received 11 September 2014
Received in revised form
28 April 2015
Accepted 29 May 2015

Keywords:
Economic evaluation
Genetic gain and profit
Net present value
Progeny test

ABSTRACT

This work aims to evaluate the economic feasibility of a breeding program for dairy goats in developing countries. A traditional scheme was compared with a scheme using a progeny test. In the traditional scheme, farm records are used and the selection of bucks is based on reproduction and milk yield of their dams, while the selection of does is based on their own performance and on their dam's performance. Analyses were performed using the ZPLAN software, which uses a deterministic approach to estimate genetic and economic gains in breeding programs. The traditional selection scheme showed no economic viability and did not cover the costs for maintenance of the breeding program. The scheme using progeny tests of young bucks was viable, with considerable genetic profits for the objectives of selection and individual traits. The economic returns of this program exceeded its costs, with a return on investment of approximately 3%. In this scheme, somatic cell count was the trait with the largest economic impact, followed by milk yield. The intensity of use of young bucks in progeny testing should not exceed 10%. Above this value, no substantial monetary gains were obtained for the objective of selection, besides the reduction of the net present value of the breeding program.

1. Introduction

Breeding programs are essential for the efficiency of animal production systems because they promote positive changes in the traits of economic interest. However, running a breeding program has costs. According to Lôbo et al. (2000), a breeding program's efficiency is measured in terms of the profits it provides, and furthermore, it is essential to combine economic and genetic evaluations for rational and cost effective results. Thus, it is necessary to assess whether the genetic changes in selected traits and the subsequent increased productivity of the production system outweigh the costs of running it, making the investment feasible.

According to Prakash (2009), in countries with large herd sizes, progeny test stations are much more expensive than using farms records. However, in countries with small herds, progeny test stations or special nucleus recording herds may be the only effective means of male selection. Most genetic evaluations of dairy animals in the world use the progeny test. However, in developing countries, there are many financial and logistical difficulties in running a progeny test for goats, such as the lack of specific public policies, the lack of companies for semen collection and distribution, a reduced number of flocks with milk control, and a low efficiency of the insemination technique. These issues are especially true in regions with territorial dimensions such as Brazil. In this country, there are a significant number of goat herds, and traditional selection in which bucks are selected based only on their dam's phenotypic information prevails. Recently, the country began implementing a progeny test for flocks in the Southeast region. However, the relative efficiency of adopting one scheme or another in developing countries is not clear. Thus, it is necessary to assess whether progeny testing young bucks (based on database information, with subsequent collection and distribution of semen among the breeders) or simply using farm records as in traditional selection is more viable and whether running a breeding program generates enough profit to justify its implementation. It is important to question whether the costs involved in a breeding program, anywhere in the world, are viable and promote return on investment. Therefore, the aim of this study was to evaluate the economic feasibility of a breeding program using two selection

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http://dx.doi.org/10.1016/j.livsci.2015.05.032
1871-1413/

schemes to provide a reference for optimizing the choice of future strategies for dairy goats in developing countries.

2. Materials and methods

2.1. Panel of experts from Embrapa Goats and Sheep/Embrapa Dairy Cattle

A panel of experts was proposed, due to the relative lack of publications in Brazil regarding dairy goats. The aim was to discuss issues related to the dairy goat industry in Brazil, and researchers, technicians, farmers and producers, covering information on population structure, market, production systems and selection were gathered. The discussions served to support the analyses pertaining to this study, which will be highlighted throughout the text. The meeting was realized on 03/30/2011 by video conference, with the participation of two research units of the Embrapa Sheep and Goats, located in Sobral-CE, and the Dairy Cattle, located in Juiz de Fora-MG.

2.2. ZPLAN

Economic and genetic evaluations of the selection schemes were performed using the software ZPLAN 2008 (Willam et al., 2008). ZPLAN is designed to optimize selection strategies in livestock breeding. The program requires the population structure, the transmission matrix of gene flow, and other technical and biological parameters in order to calculate results such as the annual genetic gain for the breeding objective, genetic gain for single traits and return on investment adjusted for costs. The total profit for the population is estimated as the sum of the genetic profit per animal of each selection group, with costs subtracted. The program is based on a pure deterministic approach, using the theory of selection indices and methodology of discounted gene flow (Hill, 1974; McClintock and Cunningham, 1974).

The subroutine NBILD was written to specify relationships among the parameters used in the simulations.

2.3. Population structure

Information that allowed specification of the population structure is shown in Table 1. The total population was estimated as 600,000 animals specialized for milk yield. However, the population structure of dairy goats in Brazil consists only of the breeding nucleus and commercial flocks without a clear definition of the multiplier flocks.

The breeding nucleus consisted of purebred and controlled pedigree animals. Because approximately 10,000 young animals are registered in the Brazilian Goat Breeders Association per year, half of which are male, and the average herd life of a doe is eight years, the total number of animals in the breeding nucleus was estimated to be 40,000 (10,000*8/2). Thus, the remainder (560,000) composed the commercial stratum (no registered purebred, crossbred and unknown breed animals) in this study.

Table 1
Population structure of dairy goats in Brazil.

Parameters	Number	Source
Kidding interval in breeding nucleus	350.4 days	Vieira et al. (2009)
Kidding interval in commercial flocks	292 days	Sarmento et al. (2003)
Does registered in the association/ year in the breeding nucleus	10,000	Panel of experts (see item 2.1 in text)
Average for parity rate	1.15	Vieira et al. (2009), Sarmento et al. (2003)
Total number of does	600,000	Panel of experts (see item 2.1 in text)
Does in breeding nucleus	40,000	
Does in commercial flocks	560,000	
Does per buck	40	

2.4. Breeding objective

The following traits were considered: milk yield in kg (MY), lactation length (LL), age at first kidding in days (AFK), kidding interval in days (KI), somatic cell count (SCC/ml) and total solids in g/100 g (TS). These parameters were proposed by Lopes et al. (2012).

2.5. Selection schemes

Two selection schemes were evaluated: the traditional selection (I), which sought to portray the current reality of the general system of goat production in Brazil, and the progeny test (II), as proposed by the Dairy Goats Breeding Program (CAPRAGENE; Lôbo et al., 2010; Facó et al., 2011). CAPRAGENE started in 2005 with the support of the Embrapa Goats and Sheep and was implemented specifically in the Southeast region of Brazil. In this program, each year, a group of young bucks has semen collected, codified and distributed among breeder participants, with herds located in three states of this region (Minas Gerais, Rio de Janeiro, São Paulo and Espírito Santo).

The comparison aims to contrast the reality of the two schemes, which are running independently in Brazil. They are the same in breeding structure (two-tiered schemes with nucleus and commercial flocks), but differ in selection criteria and source of information (scheme 2 uses information of grandparents and progeny) and in buck use (scheme 2 uses AI and both young and proven bucks). More details are given below.

2.5.1. Scheme of traditional selection (I)

In this traditional scheme, 10 groups of selection were considered, corresponding to gene-flow between the different groups of bucks and does in the two strata of the population (Fig. 1). Only the use of natural mating was considered, without the adoption of artificial insemination. In the breeding nucleus, the gene-flow occurred between and within four groups of selection (1–4). The direct gene-flow from nucleus does to commercial stratum was not considered.

The traits milk yield in kg, lactation length in days, age at first kidding in days and kidding interval in days were considered as selection criteria. In all steps, the selection was carried out based on the best index for the criteria considered. The number of relatives with records in the various groups of selection was based on population parameters such as kidding and survival rates, among others. Two indices have been proposed: (i) Index 1-Selection of bucks from the breeding nucleus (groups 1, 3, 5 and 6; Fig. 1) and (ii) Index 2-Selection of does from the breeding nucleus (groups 2 and 4; Fig. 1). The information used in Index 1 was one record of the dam of the buck for each one of the traits MY, LL, AFK and KI. One record of the dam of the doe for each one of these same traits was used in Index 2.

During the assessment of genetic and economic gains for a breeding program, only the selection practiced in the breeding strata, the nucleus in this case, is considered. This is because the benefits are shared by all strata. The selection practiced in commercial flocks does not spread to the entire population, unless it is an open system, where animals from commercial flocks can be incorporated into the breeding nucleus, which is not the case analyzed in this study. Thus, the selection practiced in the commercial stratum for groups 7, 8, 9 and 10 would not influence the impacts of selection. For these groups, a selection index