

RESEARCH PROPOSAL -AGRICULTURAL COMMISSION - WITFOR

Computerised decision support for rural goat production systems

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Abstract

The aim of this project was to develop a computerised decision support system to assist extension officers and farmers in optimising goat production in rural areas of southern Africa. According to Bembridge & Tapson (1993), collective improved livestock management should accompany the implementation of grazing schemes and breeding programmes on an integrated package basis. "Unlike crop production, commercial or high technology has equal application with commercial and small-scale stock owners in communal land." (Bembridge & Tapson, 1993).

Computerised management and decision support systems in animal production appear to be accurate and realistic methods to assess with confidence the consequences of current and alternative management strategies (Webb et al, 1997). Such models were developed for pigs (Moughan & Smith, 1984; Whittemore, 1986; Black *et al.*, 1987; Whittemore & Morgan, 1990; Pomar *et al.*, 1991; Black *et al.*, 1993), poultry (Emmans, 1981; Kleyn & Gouws, 1988; Talpaz *et al.*, 1991) and ruminants (Black, 1984; Blackburn & Cartwright, 1987; France *et al.*, 1987; Loewer *et al.*, 1987; Dowle *et al.*, 1988; Gillard & Monypenny, 1988; Korver *et al.*, 1988; Bowman *et al.*, 1989; Di Marco & Baldwin, 1989; Oldham & Emmans, 1989; Azzam *et al.*, 1990; Blackburn *et al.*, 1991; Werth *et al.*, 1991).

Many modern electronic technologies are now utilised by the industry to assist in the continuous recording of animal performance. Examples of these include the electronic weighing of animals, devices that record milk production and composition, probes for backfat thickness measurements and electronic weather recording equipment (Black & Vickery, 1986). The industry now accepts the importance of electronic and computer technologies and therefore it is sensible to study and develop a computerised decision support system in order to improve goat production in southern Africa, without adversely affecting the environment.

Goat production in perspective

It is estimated that more than 80% of southern Africa consists of barren land. In terms of agriculture, herbivores are the only animals that can be kept economically in these areas. Unfortunately, livestock production currently contributes little to the cash economy in southern Africa (Webb, 1998). Goats have an important enterprise function and provide an ideal opportunity for rural development. Goats are often used for home consumption, ceremonial slaughters and lobola (to pay for a wife), but they also serve as a source of income or investment. The potential of goat farming in southern Africa is tremendous.

Goats are reported to be better adapted to harsh extensive conditions compared to either sheep or cattle (Van Niekerk & Schoeman, 1993). These browsers are more heat tolerant, can withstand dehydration and survive on deplorable low planes of nutrition i.e. coarse, fibrous feeds. They often utilise desert shrubs and coarse roughage. In addition, goats are fairly selective and tend to walk long distances in search of feed.

“The question is not whether there will continue to be a viable role for the goat. There will be. The question and the continuing challenge is to define the roles for the goat and to find the most productive ways that goats can fill these roles to improve the environment and provide food and fibre and contribute to the social well-being of people” (International Goat Association).

In recent studies (Mamabolo & Webb, 1996; Mamabolo & Webb, 1997) the fertility and production of indigenous goats were studied extensively (seasonal, management, environmental and social factors). A research project was also recently initiated to quantify the effects of land tenure systems on animal production. Results suggest a deplorable low reproductive rate in indigenous goats, mainly due to poor management. The results suggest that inbreeding in indigenous goats is a common phenomenon (estimated from DNA-analysis and microsatellite markers), which also explains the poor reproduction efficiency. In addition, the current stocking densities often result in over-grazing and significant veld deterioration. Evidently the feasibility / sustainability of an enterprise is dependent on the interaction of many factors and it is almost impossible for an individual to predict with confidence the consequences of different production strategies on the efficiency and profitability of an enterprise.

To summarize:

- * A limited amount of information is currently available on the effects of the various environmental and social factors that influence the productivity and sustainability / profitability of livestock production in the different production systems in rural areas.
- * Extension officers and farmers struggle to improve rural animal production, mainly due to the number of complex factors and their interaction that may influence the system.
- It is almost impossible for an individual to predict with confidence the consequences of different production strategies on the efficiency and profitability of an enterprise.

Expected Benefits

- * The research results, condensed in a computerised decision support system, will contribute to better management, breeding and production of livestock.
- * In the medium to long run, this information will benefit the rural or small-scale farmer to ensure sustainable animal production and food security.

Benefits of computerised management and decision support systems include (from Webb et al, 1997):

1. Provide a better understanding of the various components and their interactions in biological systems.
2. Identification of research areas where scientific information is lacking, particularly within the growth process.
3. Provide a method to predict in a logical way the performance of animals in a given environment.
4. Predict the physiological consequences of genetic improvement or alternative inputs.
5. Predict the economic implications of alternative dietary, feeding or housing conditions and improve the management of the production system.
6. Make comparisons between actual and potential production in order to identify limitations or constraints in a production system.
7. To aid in the design and interpretation of nutrition experiments.
8. To demonstrate the principles of nutrient utilisation and animal growth in the teaching of nutrition.

RESEARCH METHODOLOGY

An alternative approach is required to improved the current knowledge and subsequent decision support in order to improve livestock production in rural areas.

1. Three post-graduate students completed research on the fertility and production of indigenous goats in southern Africa. A number of trials and surveys were conducted on the current fertility status (semen quality, peak sexual activity, age and weight at puberty, gestation periods, mortality and weaning percentages, fecundity, survival rate, ratio of males to females) and production (stocking rates; growth; size vs. environment, age and sex; meat, milk and fibre production and use of goat products) of indigenous goats in ten randomly allocated areas in Mpumalanga and the Northern province.
2. More trials and surveys will be conducted to quantify the effects of the various environmental and social factors on the production of goats in different production systems in southern Africa, as well as the interactions with other livestock and wild animals grazing in the same areas.
3. Quantify the effect of land tenure systems on animal production.
4. Develop a computerised decision support system to assist extension officers and farmers in optimising goat production in rural areas of southern Africa, based on the beta-demonstration version of the proposed computer programme (see Appendix B for the installation of the beta-demonstration version of the computer programme (disk 1, In Windows 95 RUN "A:\SETUP").

The steps in compiling the computerised decision support programme will be as follows:

Step 1: The scope and goal of the model are defined and by means of logical deduction from *a priori* knowledge (background understanding of the system), a **frame** is developed. The frame contains only the relevant input and output variables, the time base and subsystems.

Step 2: A **structure** is designed which defines the various mathematical relationships in the model. The mathematical representation consists of two parts (see Appendix B for beta-demonstration version of the proposed computer programme) namely (1) define the mathematical equation to be used to describe each component in the system and (2) establish values for each of the constants in the equations (parameterization of the equation).

Step 3: The **values of the constants** (known as parameters) have to be estimated from experimental data. The parameters may have a biological meaning, but this will depend on the type of model (i.e. empirical or mechanistic models). This step may have to be repeated many times until accurate scientific information is available to describe the system.

Step 4: **Validation** of the model. This may occur on a (1) replicative level, (2) predictive level or (3) structural level.

1. validation in deduction
2. validation in induction
3. validation in purpose.

EXPECTED OUTPUTS

- * Computerised decision support system to assist extension officers and farmers in optimising goat production in rural areas of southern Africa.
- * PhD thesis: MJ Mamabolo
Masters thesis: L Sithulimela
Masters thesis: B Monakghotla
- * Scientific papers in peer reviewed local and international journals.
- * Paper presentations at National Animal Science Conference
- * Popular scientific papers in Farmers Weekly and Effective Farming.

DISSEMINATION STRATEGY

A computerised decision support system (interactive computer program) will be provided to extension officers at the regional offices of the Department of Agriculture, the National Department of Agriculture, the ARC and small-scale farmers. A good working relation has already been established with community leaders and extension officers. Support from the community leaders is vital for successful implementation of the decision support system. The program will be demonstrated to users and the Animal Science departments at the University of Pretoria and University of Venda will provide a backup support system. The Computerised Decision Support System for Goats will also be propagated through the International Goat Association, particularly since various other countries have similar problems with goat production and management.