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“Solidarity in a competing world —
fair use of resources”

The Use of System Dynamics Modelling Methodologies in Sheep Breeding Programs and Management Systems

KAHSA TADEL GEBRE¹, MARIA WURZINGER², SOLOMON GIZAW³, AYNALEM HAILE⁴, BARBARA ANN RISCHKOWSKY⁴, JOHANN SÖLKNER²

¹*Mekelle University, Dept. of Animal, Rangeland and Wildlife Sciences, Ethiopia*

²*University of Natural Resources and Life Sciences (BOKU), Dept. of Sustainable Agricultural Systems, Austria*

³*International Livestock Research Institute, Ethiopia*

⁴*International Center for Agricultural Research in the Dry Areas (ICARDA), Ethiopia*

Abstract

System dynamics modelling approach has been widely used in the agriculture sector to describe livestock production systems, livestock health and natural resource management. However, its application in modelling livestock breeding programs and systems is limited. Therefore, this study explores the utility of system dynamics modelling in evaluation of sheep breeding programs and management systems in the Ethiopian highland. A community-based sheep breeding programme was modeled using STELLA software. A weather and resource driven stochastic herd model was developed to evaluate the effect of genetic improvement and change in management system on herd dynamics and profitability. The baseline model was developed using historical rainfall and temperature data. Performance data was extracted from the herd-book of the breeding programme and additional input data were obtained from various sources. The model accounts for pasture growth, nutrient requirement and seasonal variation in animal performance, physiological status and aging chain of the herd. Economic analysis was also done considering the returns and costs of the system. The baseline model was further expanded to account for genetic selection of body size, fattening strategies and alternative management systems to evaluate their effect on herd dynamics and profitability. Technical evaluation and extensive logic testing during the building phases was conducted. The model results were compared to independent calculations to determine whether the model was matching expectations, and to help clarify the relationships between variables. The model demonstrates that balancing the feed supply and demand is crucial. Genetic selection for large body size has resulted in decrease of herd size and higher income. Fattening of young animals has increased the farm income. Increase feed supply by producing improved forage plants increased herd size and farm income. For more economic benefit genetic improvement programs should be coincide with appropriate fattening strategies and resource availability. Overall, system dynamics modelling tools are useful to describe breeding programs and management systems by building simple, flexible and usage driven simulation models.

Keywords: Breeding programs, Ethiopia, sheep, STELLA, system dynamics