Effect of genetic improvement of body weight on herd dynamics and profitability of Ethiopian meat sheep: a dynamic simulation model

Introduction

System Dynamics

- Behavior of complex systems over time
- Understanding structural causes of a system’s behavior - test for different policies

Population dynamics

- Growth and decline of a population
- Periodic variation on animal performance & livestock population.
- Carrying capacity (TLU/ha) & pasture resources - consider seasonal variation

Our case – Sheep in Ethiopia

- Insufficient rainfall, frost, recurrent drought, severe overgrazing and degradation
- Combination of these driving forces - negative effect on smallholders livelihood

Source: Gebre K.T. (2011)
Objective of the study

- To develop a simulation model adopting system dynamics modelling approach to analyze the effect of genetic improvement of body weight on herd dynamics and profitability.

Source: Gebre K.T. (2011)
Materials and Methods

Study area
- Menz district, Altitude of 3000 m.a.s.l
- Low vegetation, ~900 mm rainfall
- Max 22.1 °C and Min 7.6 °C

Breed
- Menz sheep, Short-fat-tailed
- Used for meat and wool production

Source: Getachew T. (2008)
Source: MAO (1998)
Source: Solomon et al. (2007)
Materials and Methods Cont..

- Data sources (herd-book and questionnaire)
- STELLA® 9.0.2 (High Performance Systems Inc., Hanover, New Hampshire) software and time horizon (240 months)
- **Baseline scenario**: the first 120 months with breeding ram fattening (no genetic improvement)
- **Scenario I**: the last 120 months (genetic improvement + breeding ram fattening)
- **Scenario II**: the last 120 months (genetic improvement + lamb fattening)
- The results are means of 100 simulation runs
Conceptual Model
Herd structure

Scenario II

Scenario I
Results and Discussion

- Periodic variation in sheep population and body weight
- Genetic improvement – sheep population decrease
- Genetic improvement – higher profit
- Goal seeking behavior - “feed control on sheep herd”

Source: Gebre K.T. (2011)
Herd behavior from month 1 to 240
Sheep population in months of the year

Herd

Sheep population

Months of the year

150 165 180 195 210 225 240

1 2 3 4 5 6 7 8 9 10 11 12
six month weight before and after genetic improvement
## Marginal profit and financial efficiency

<table>
<thead>
<tr>
<th></th>
<th>Baseline scenario</th>
<th>Scenario I (Ram fattening)</th>
<th>Scenario II (Lamb fattening)</th>
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</thead>
<tbody>
<tr>
<td>Marginal Profit (Euro/Herd/Month)</td>
<td>143±98</td>
<td>168±98</td>
<td>183±69</td>
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<td>Financial efficiency</td>
<td>2.81±1.30</td>
<td>3.20±1.40</td>
<td>3.33±0.99</td>
</tr>
</tbody>
</table>

Source: Gebre K.T. (2011)
Conclusions

- Periodic variation on sheep population and body weight very well captured by the model
- Simulation demonstrated the fattening with genetic improvement was considerably more profitable
  - Lamb fattening is better than ram fattening
- Need to validate the model using results from field data
  - Ongoing community based breeding program
References

