

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



Universität für Bodenkultur Wien  
Department für Nachhaltige  
Agrarsysteme

K. T. Gebre, M. Wurzinger, S. Gizaw, A. Haile, B. Rischkowsky, J. Sölkner



# 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



Source: Gebre K.T. (2008)

# 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)

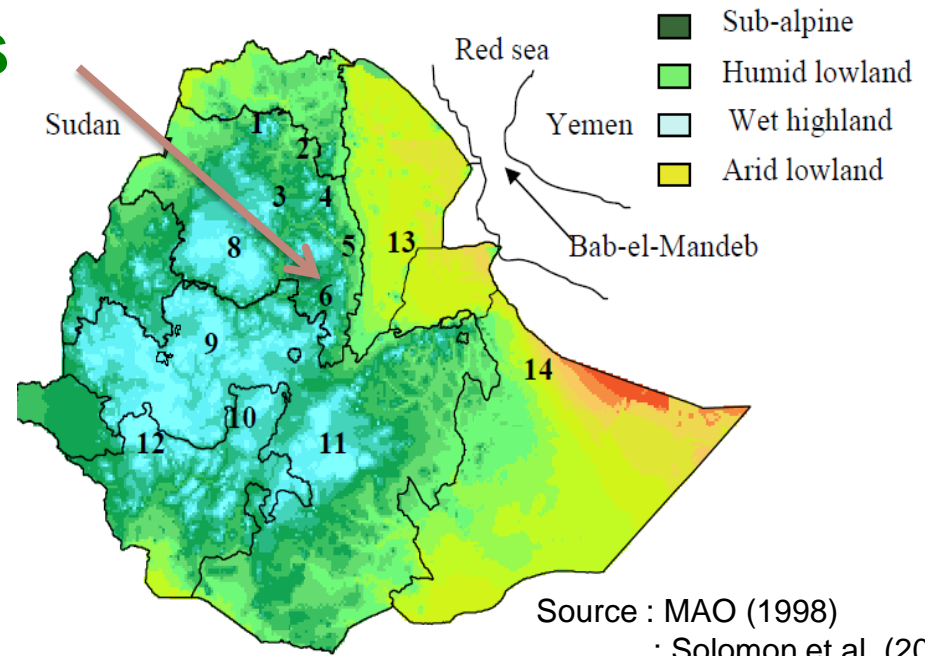
# Materials and Methods

## 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

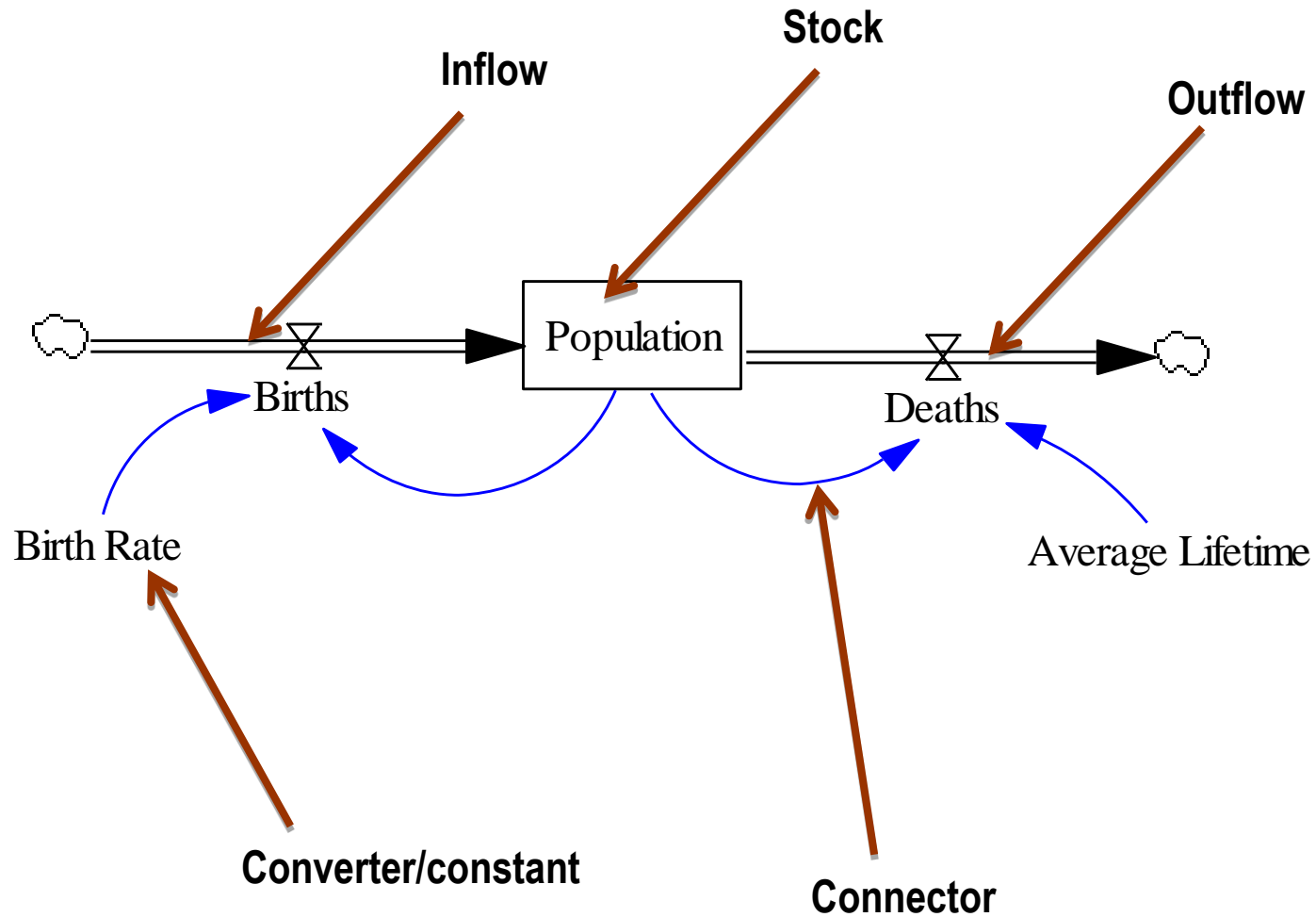


Source: Getachew T. (2008)

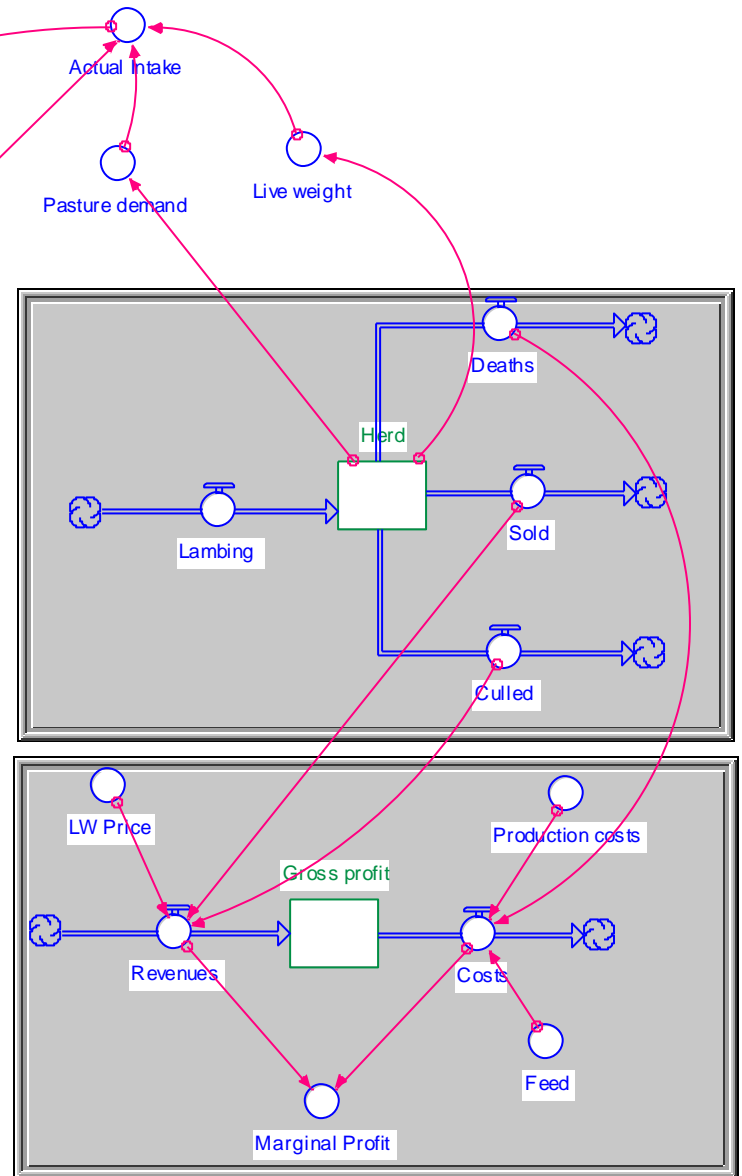
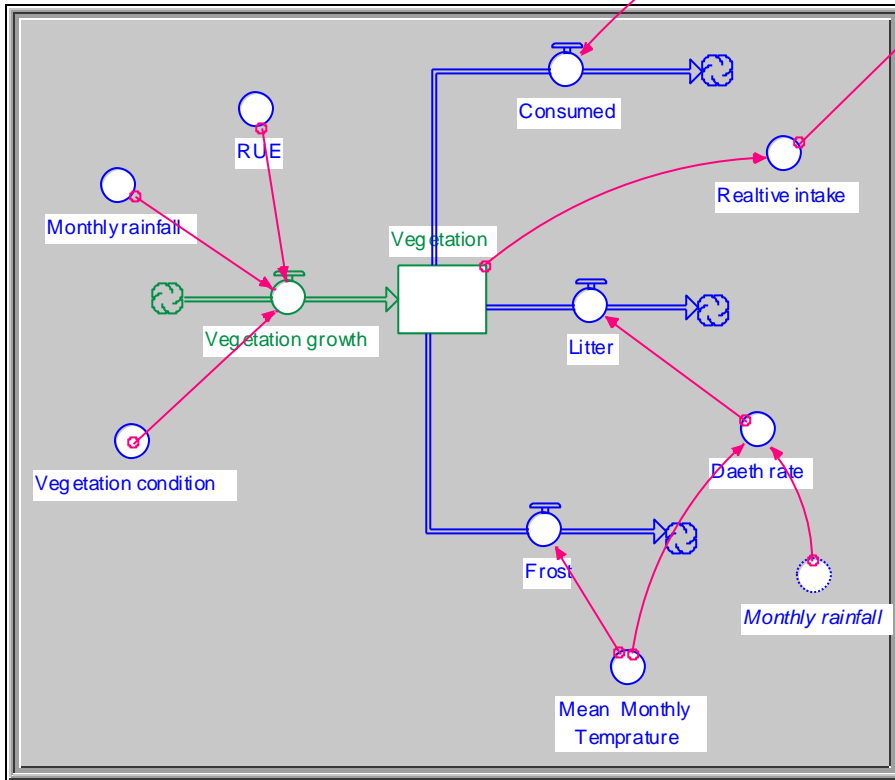
Source: Gebre K.T. (2008)

## 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

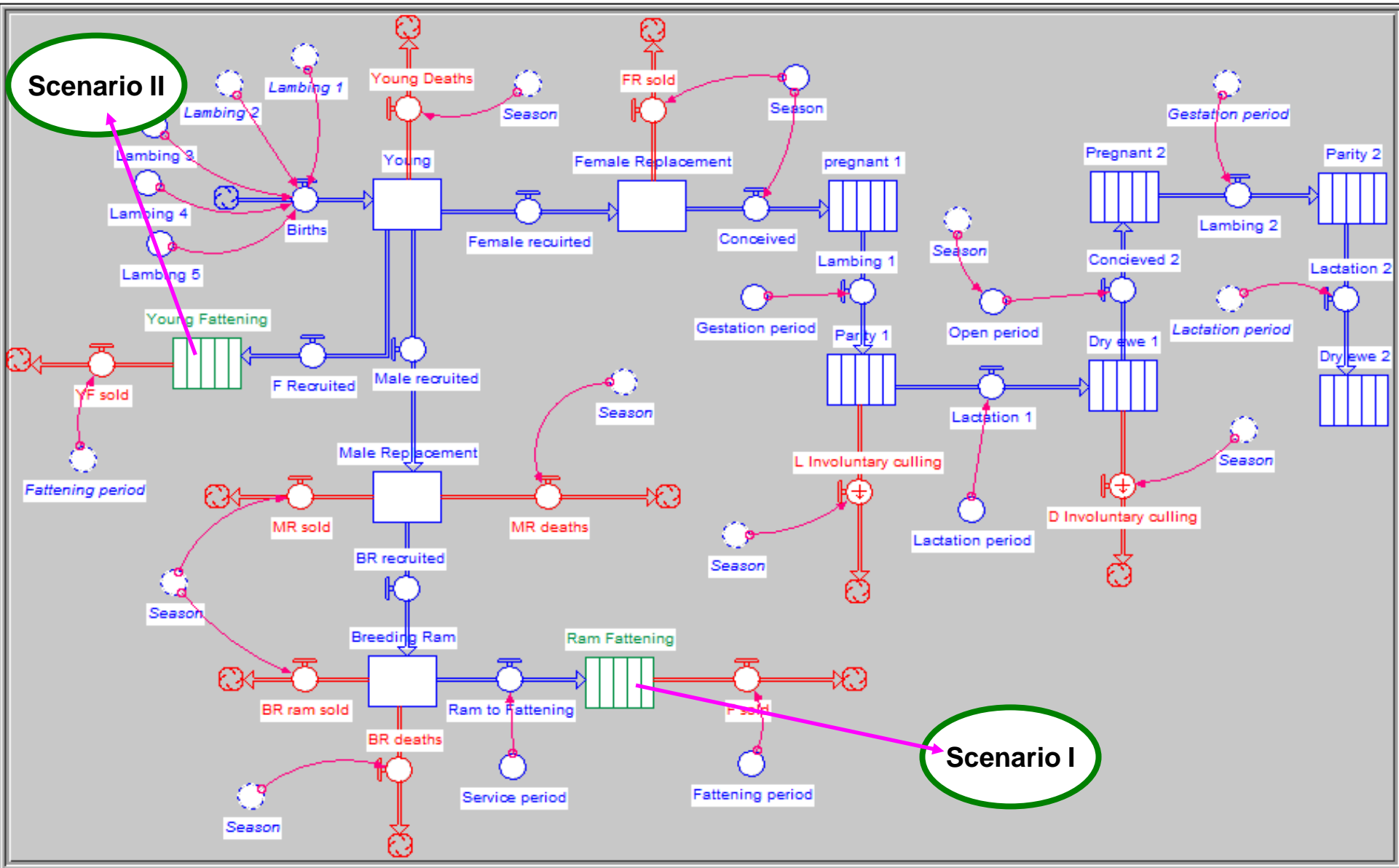


# Conceptual Model





# Herd structure



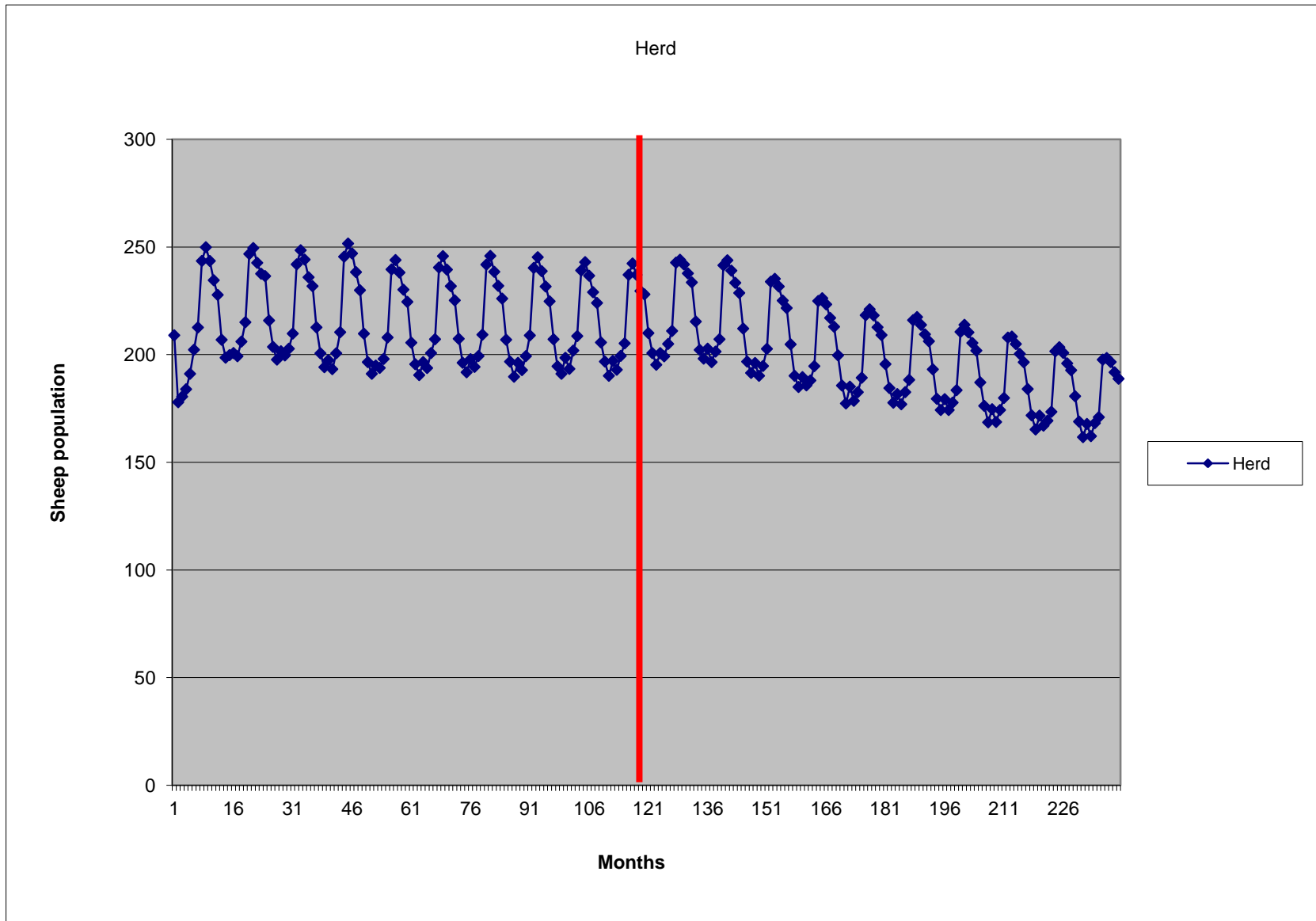
# Results and Discussion

- 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”

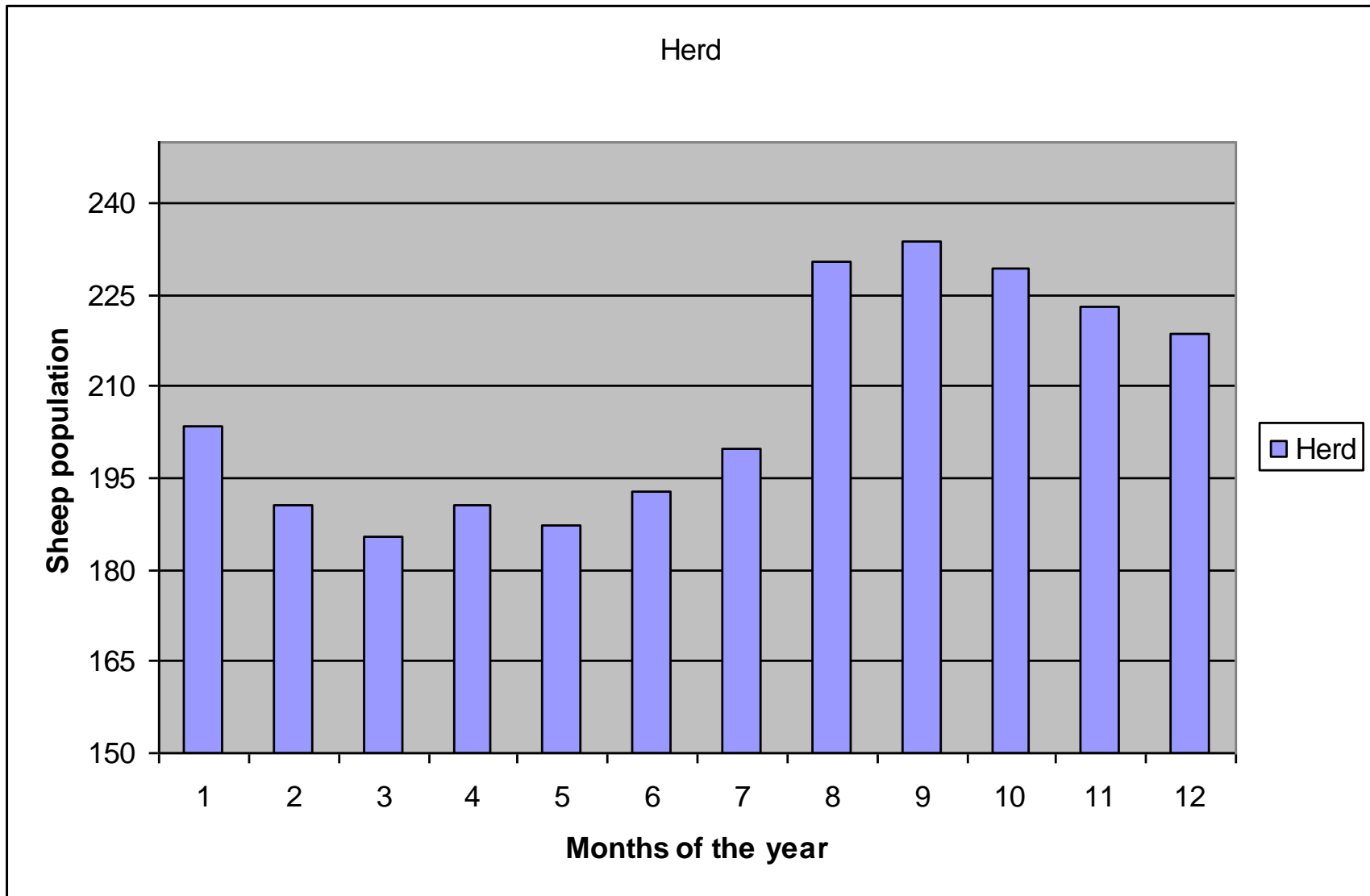


Source: Gebre K.T. (2011)

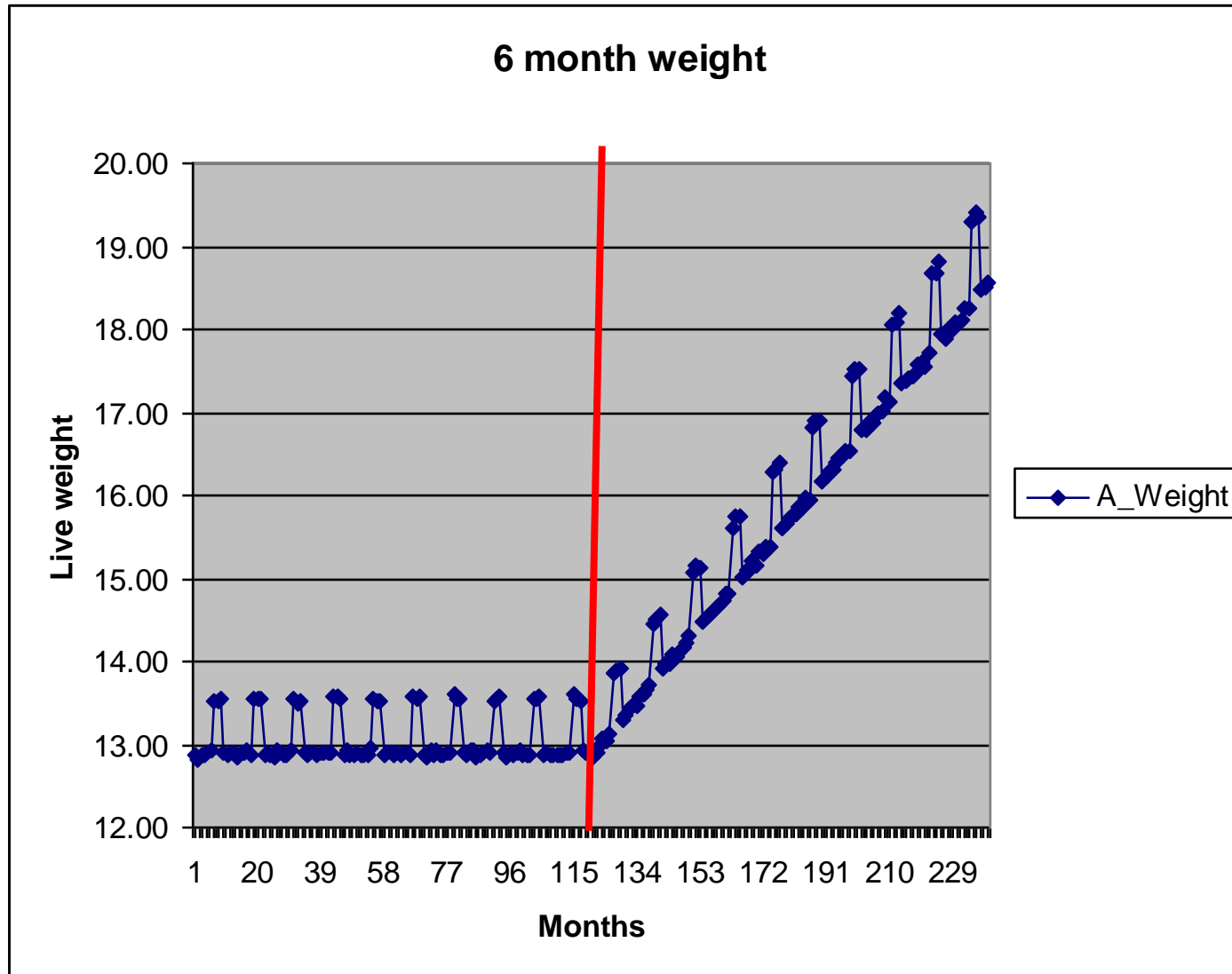
# Herd behavior from month 1 to 240



# Sheep population in months of the year



# six month weight before and after genetic improvement



# Marginal profit and financial efficiency

	Baseline scenario	Scenario I (Ram fattening)	Scenario II (Lamb fattening)
Marginal Profit (Euro/Herd/Month)	143±98	168±98	183±69
Financial efficiency	2.81±1.30	3.20±1.40	3.33±0.99



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

- Diaz-Solis, H., Kothmann, M.M., Hamilton, W.T., Grant, W.E., 2003. A simple ecological sustainability simulator (SESS) for stocking rate management on semi-arid grazing lands. *Agricultural Systems* 76, 655–680.
- Gatenby, R.M., 1986. *Sheep Production in the Tropics and Sub-Tropics*. Longman Inc., New York, 351 pp.
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