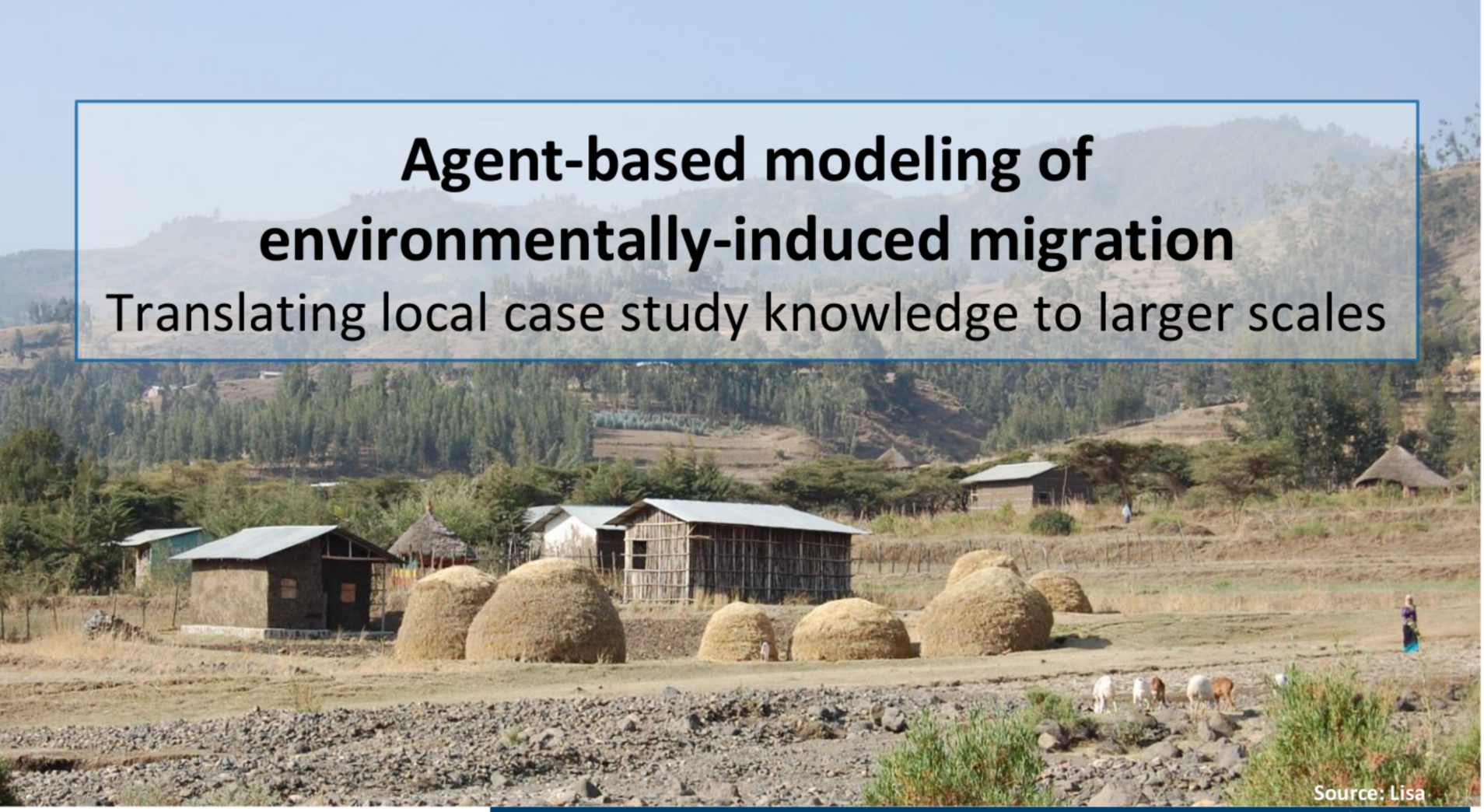
# Agent-based modeling of environmentally-induced migration

## Translating local case study knowledge to larger scales

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**Workshop M4:** Opportunities and challenges for transferability methods in the field of climate-migration studies

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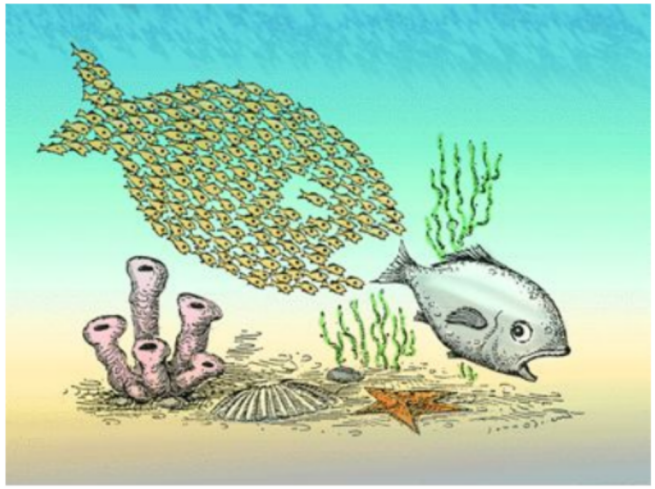
# What is agent-based modelling?

Agent-based models (ABMs) are simulation models that help us to understand…

*"…how macro phenomena are emerging from micro level behaviour among a heterogeneous set of interacting agents."* (Holland 1992)



www.OpenABM.org

**Micro-level:**

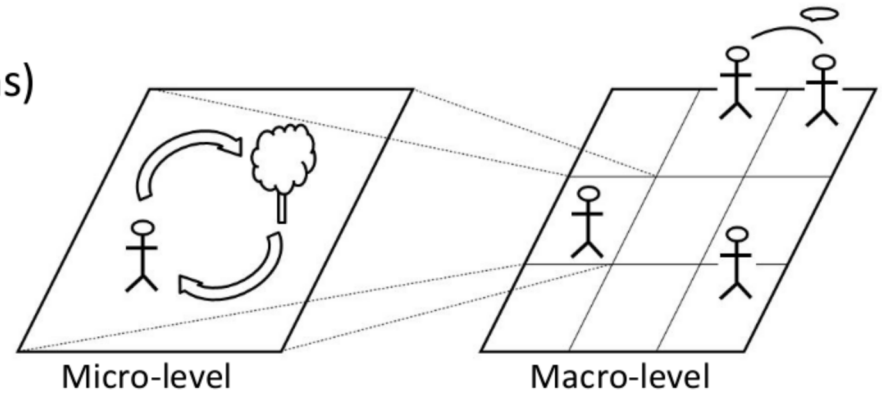
- Agents (e.g. individuals, households) follow decision rules
- Characteristics: heterogeneity, interaction, learning

**Macro-level:**

- Emergence of patterns (e.g. land use patterns)

**Model purposes:**

- System understanding, decision support, prediction



# Potential of ABMs for studying social-ecological systems

**Strengths of ABMs:**

- Feedbacks between social & ecological systems
- Temporal dynamics -> Comparison of potential future scenarios
- Spatial heterogeneity

**Use as virtual laboratory (Dibble 2006):**

- Mechanistic understanding of processes
- Learning without consequences that enables the evaluation of policies
- Generic or adjustable model rules enable insights into more than one study region

**Applications:**

- Land use/land cover change (Groeneveld et al. 2017)
- Ecosystem and environmental management (Le Page et al. 2013)
- Migration (e.g. urban-urban by Buchmann et al. 2016, environmentally-induced rural migration by Kniveton et al. 2011)

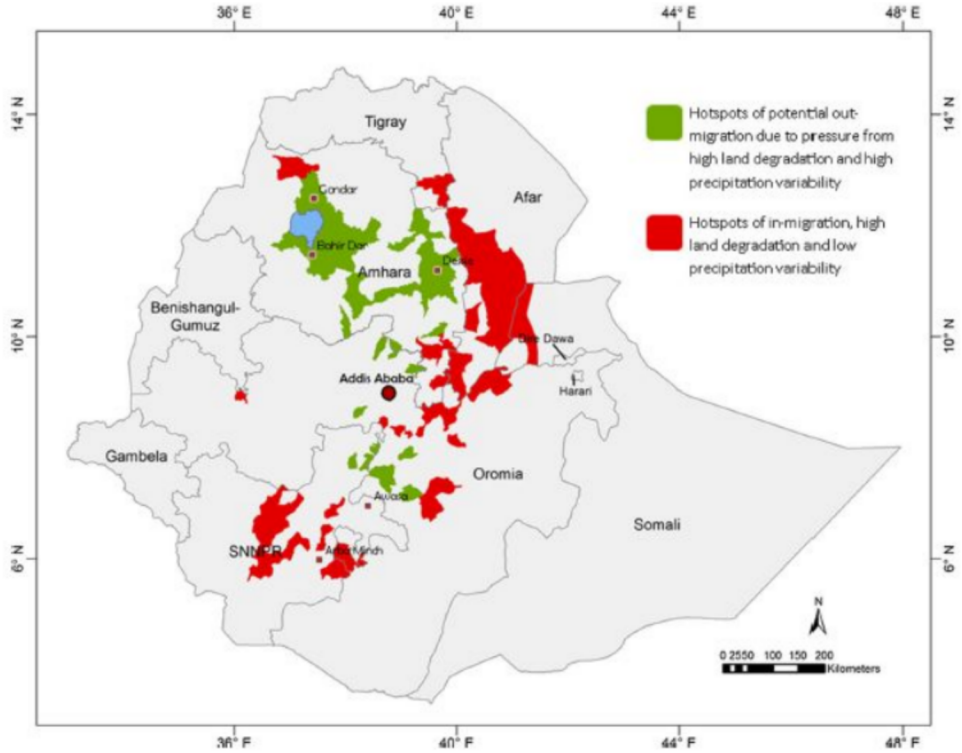
# An ABM of environmentally-induced migration

**Case study: Ethiopia**

Photo: Lisa Garbe

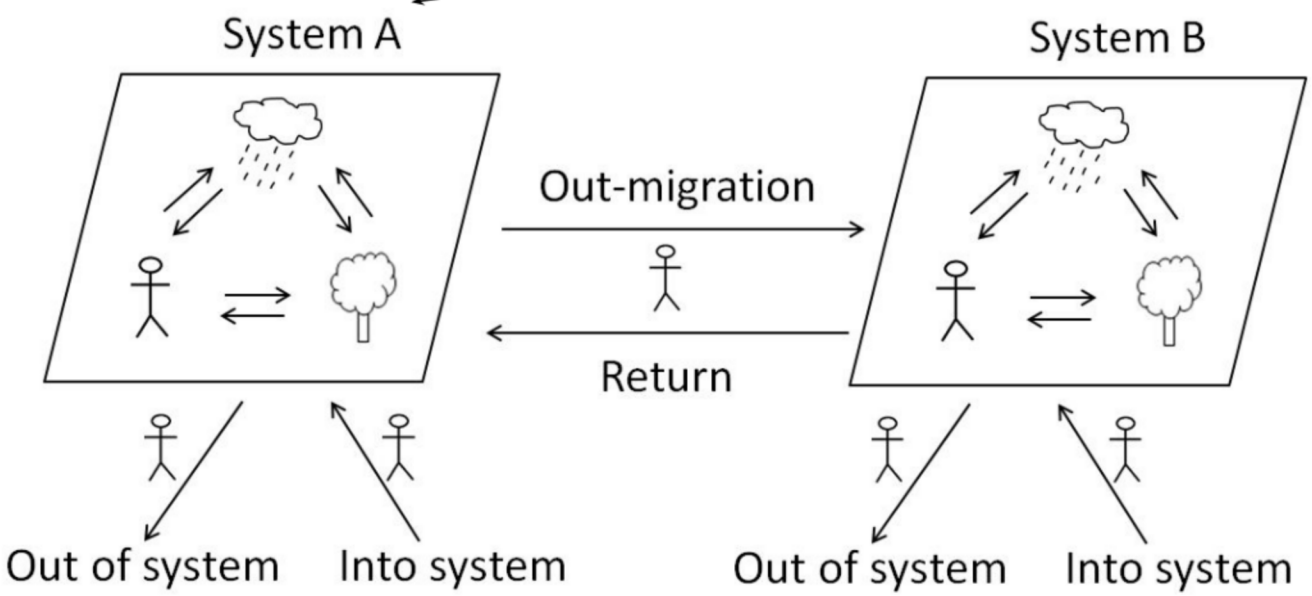
- Precipitation decreases
- Intensity of droughts increases
- Land degradation
- Population increases

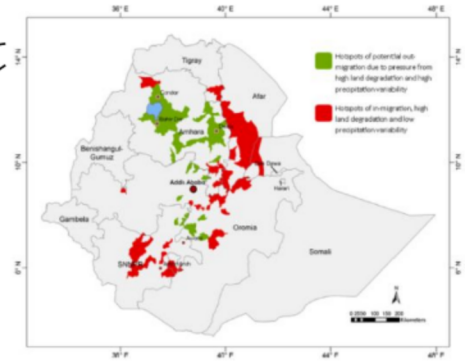
→ **Food insecurity & human migration**




Source: Hermans-Neumann et al. (2017)

# An ABM of environmentally-induced migration



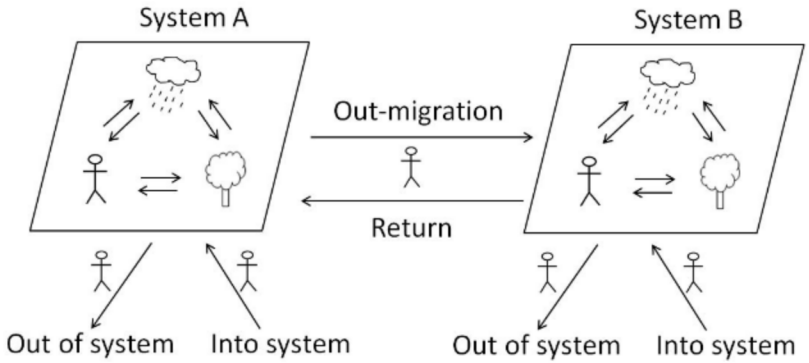
Hermans-Neumann et al. (2017)

**Aim of the model:**

- based on project results from meta-analysis & empirical fieldwork
- study interplay of multiple migration drivers
- study social-ecological impacts of environmentally-induced migration

# THANK YOU FOR YOUR ATTENTION!

Photo: Lisa Garbe




This study has been conducted in the frame of the BMBF- and UFZ-funded junior research group MigSoKo (https://www.ufz.de/index.php?en=41462).

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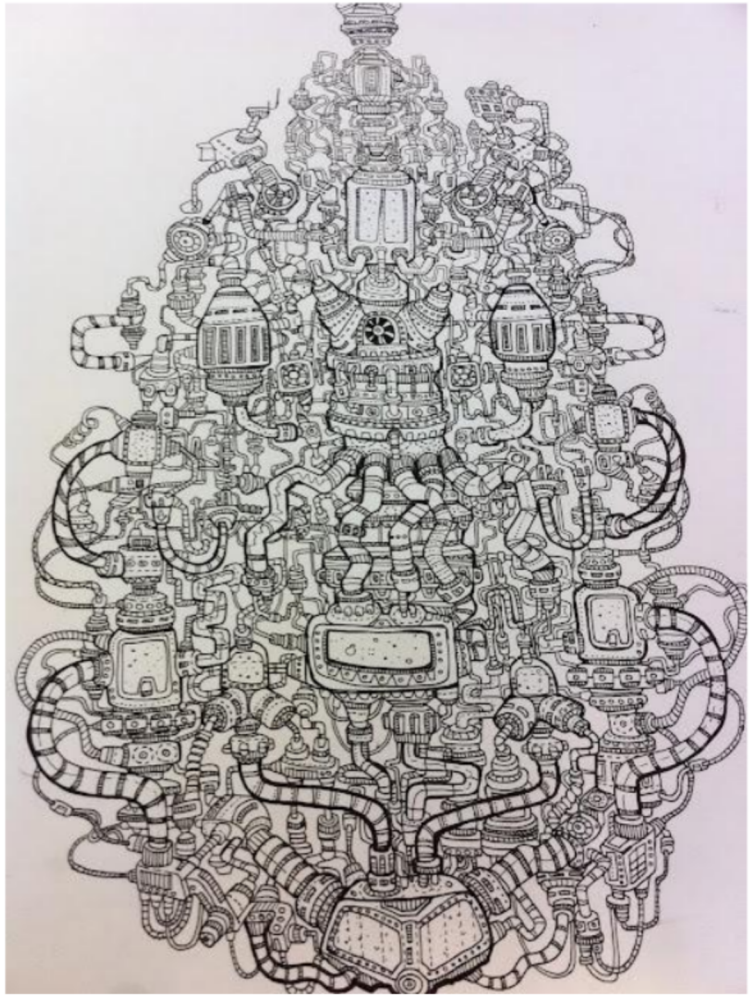
# Limits and challenges of ABMs

- **Area of tension: model vs. reality**
  - Strong simplifications are needed
  - Not all important relationships can be formalized
  - Validation, parameterization, analysis of complex models often difficult

- **Models = "black box" → low trust?**
  - Methodological standards partly missing or not used widely
  - Time intensive model analysis needed
  - "You only get out, what you put into the model"

**Very important to communicate the limits and the assumptions of modelling**!



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# Appendix
## *Transferability*