



Navigating between analytical rigor and inclusiveness in participatory systems modeling

Birgit Kopainsky

Professor, System Dynamics Group, University of Bergen

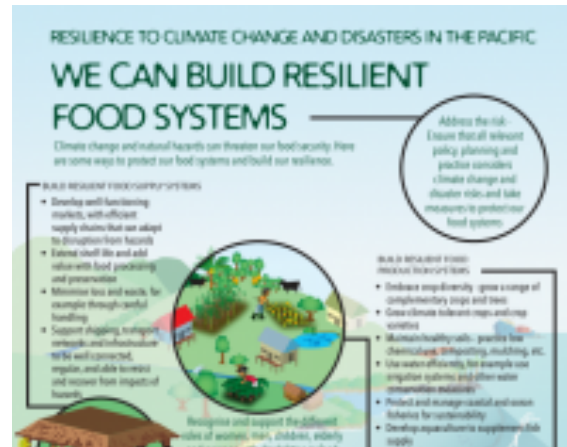
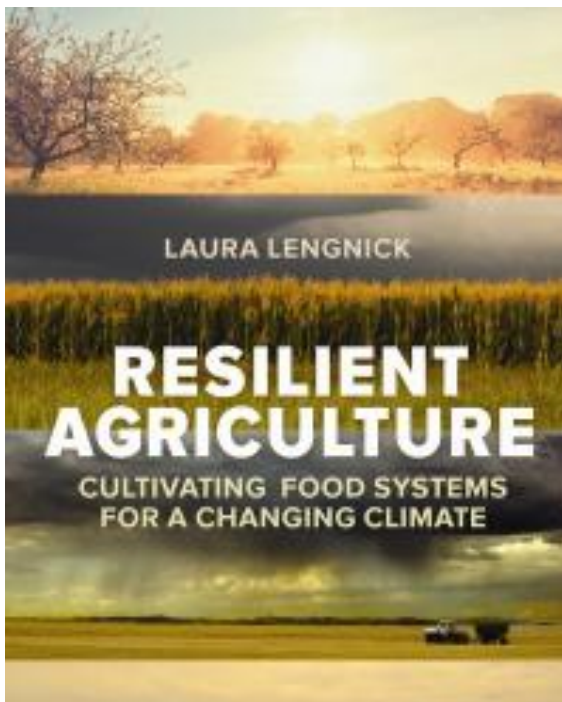
04.12.2019





Who I am





GLOBAL FUTURES & Strategic Foresight



Investing to build sustainable and resilient food systems under climate change

ETH zürich



Keith Wiebe
 International Food Policy Research Institute

Food Security and Climate Change: How to build Sustainable and Resilient Food Systems
 OCP side event to COP22
 Marrakech, Morocco
 14 November 2016



Transformation in governance towards resilient food systems

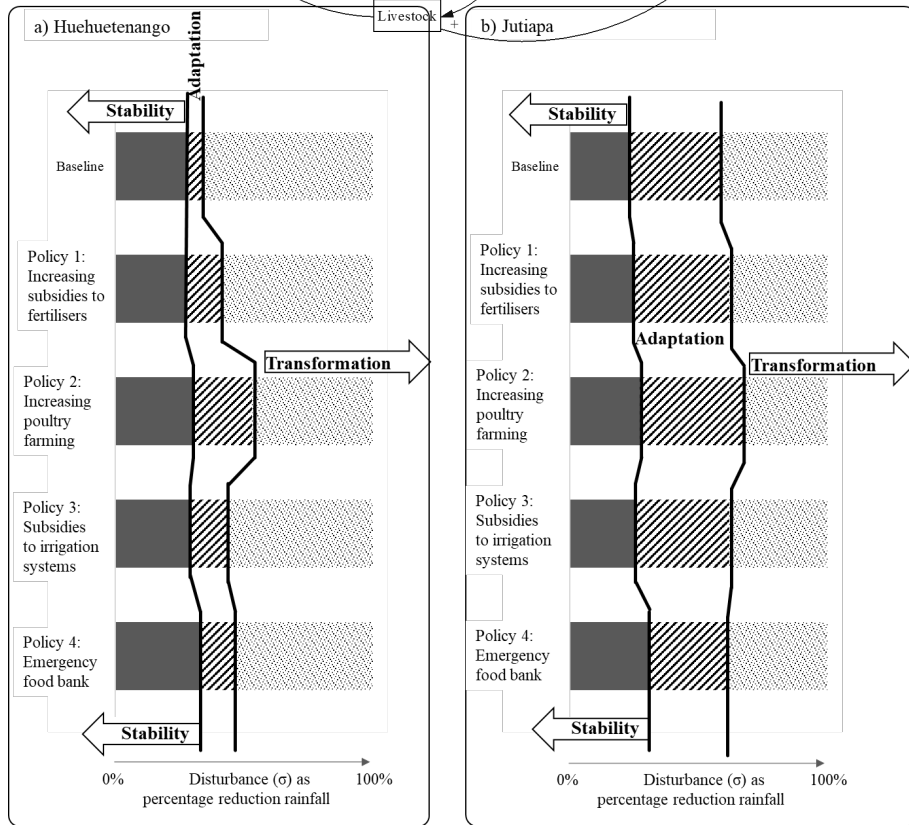
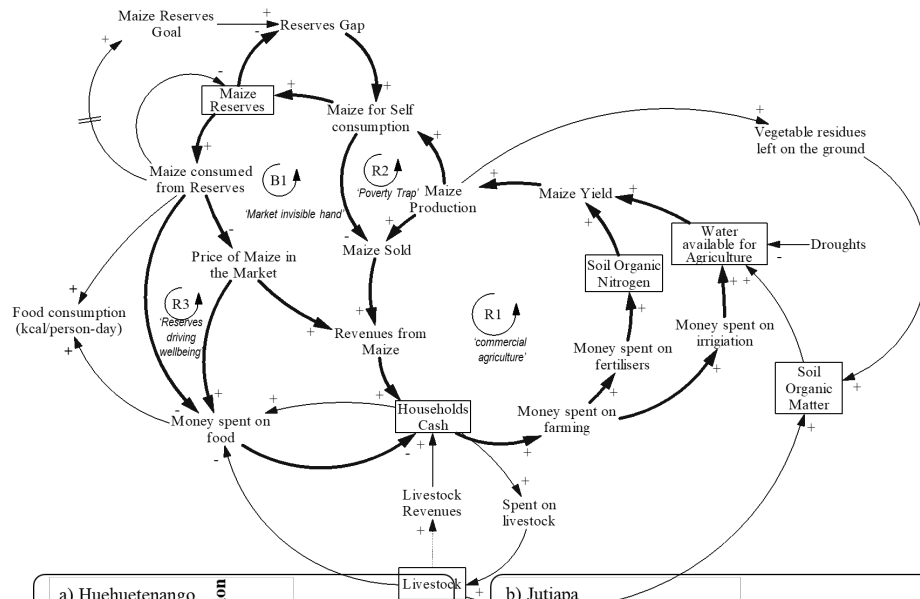
Working Paper No. 190
 CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
 Caroline van Biers, Claudia Pahl-Wostl, Hallie Eakin, Polly Ericksen, Lutgart Lenaerts, Wiebke Förch, Kaisa Korhonen-Kurki, Nadine Methner, Lindsey Jones, Ioannis Vasileiou, Siri Eriksen

WFSC Flagship Research Project

Enhancing Resilience in Food Systems

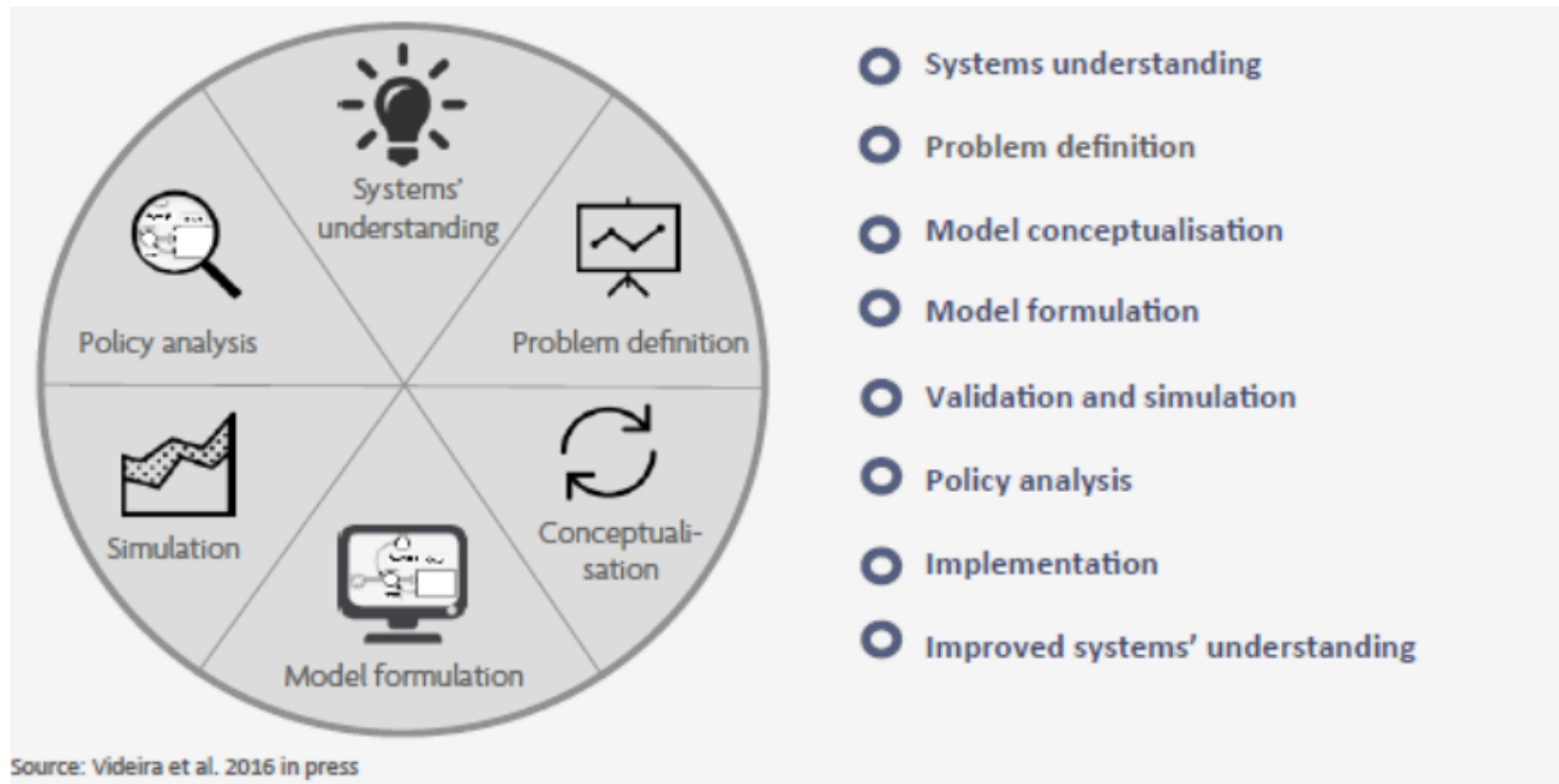


Working Paper





System dynamics modeling process





Participatory system dynamics

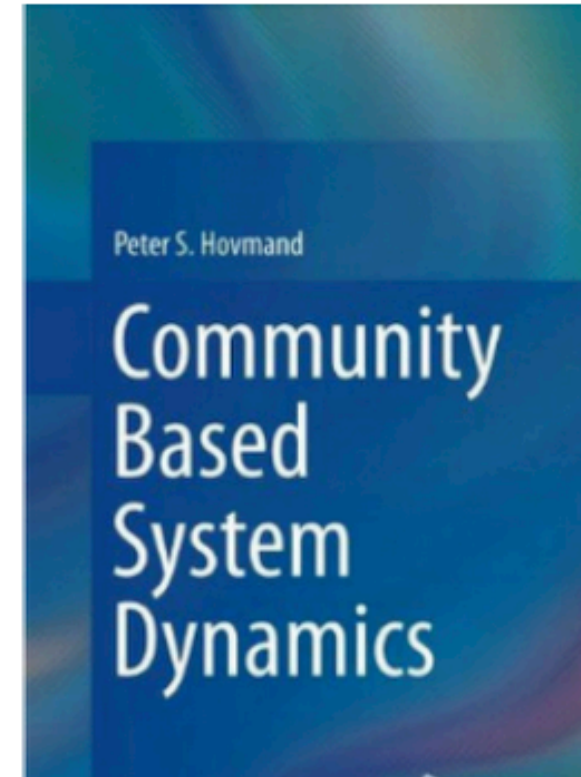
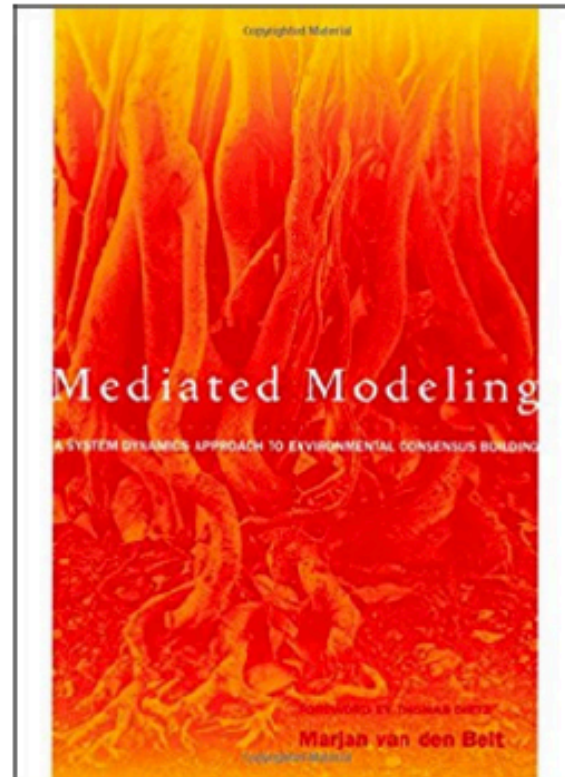
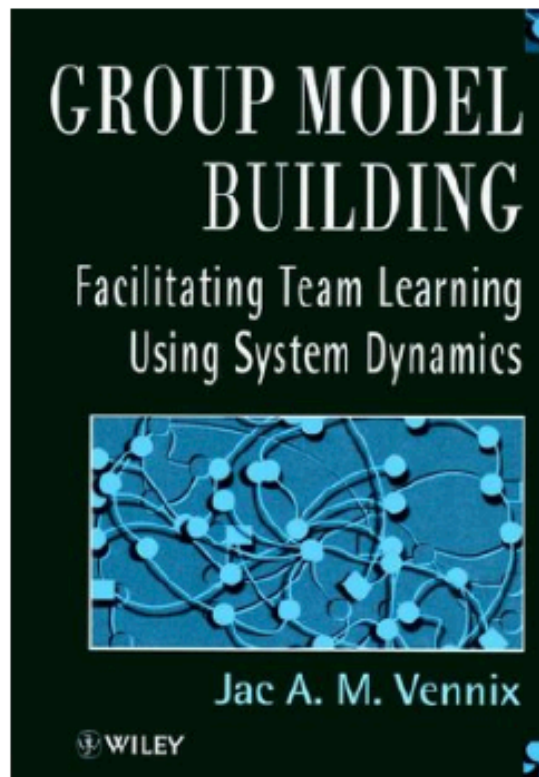


- **Stakeholder analysis and interviews**
Identify, select and invite participants
Conduct preliminary interviews
Define team roles and scripts
- **Workshops**
Problem definition, reference modes
Sequence of workshops and format of working groups
Systems mapping and dynamic hypothesis
Model formulation and simulation
Work behind-the-scenes and validation
Define scenarios and analyse policies
- **Evaluation and follow-up**
Evaluate modelling outputs and outcomes of participatory process
Prepare for further iteration and implementation



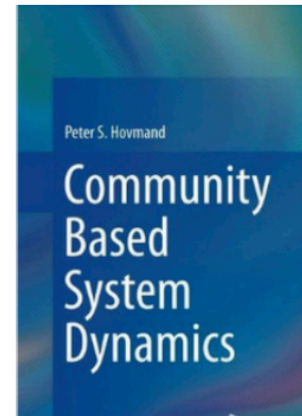
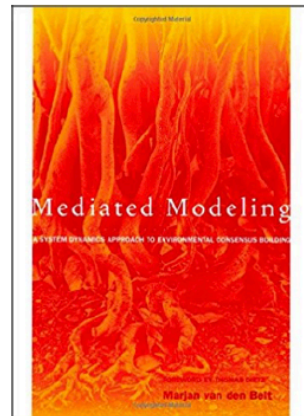
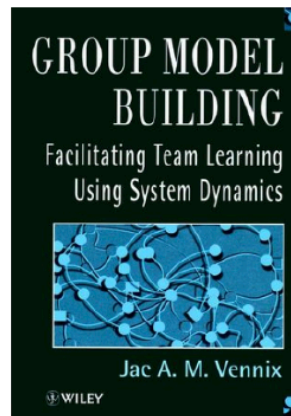


Participatory system dynamics

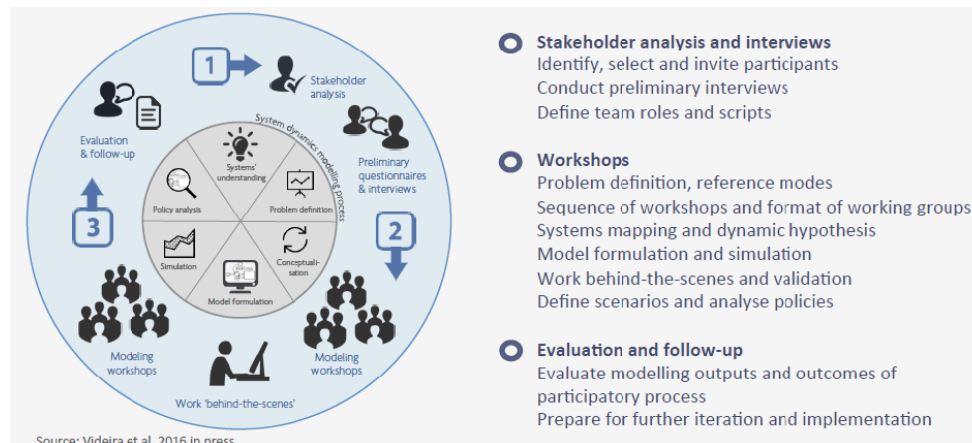




Plan for today



- Effectiveness?
- Inclusiveness?

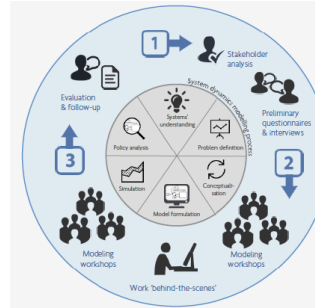
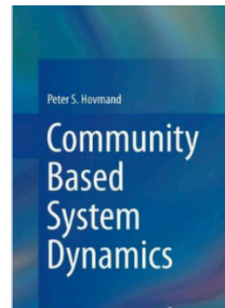
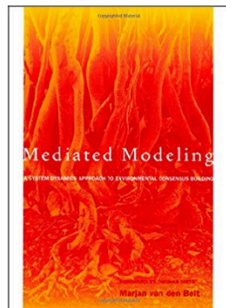
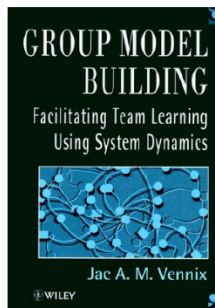


- **Stakeholder analysis and interviews**
Identify, select and invite participants
Conduct preliminary interviews
Define team roles and scripts
- **Workshops**
Problem definition, reference modes
Sequence of workshops and format of working groups
Systems mapping and dynamic hypothesis
Model formulation and simulation
Work behind-the-scenes and validation
Define scenarios and analyse policies
- **Evaluation and follow-up**
Evaluate modelling outputs and outcomes of participatory process
Prepare for further iteration and implementation





Plan for today

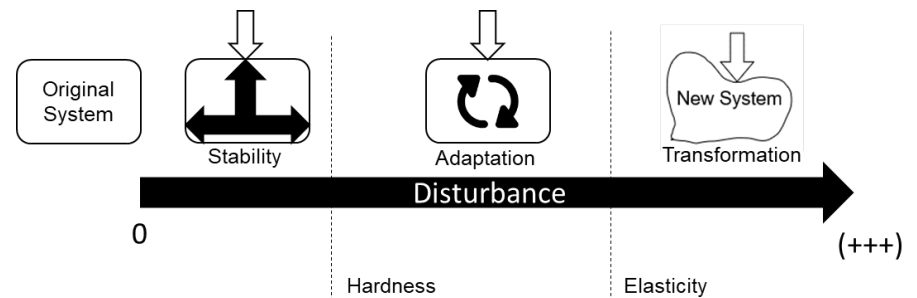


- 1 Stakeholder analysis and interviews**
 Identify, select and invite participants
 Conduct preliminary interviews
 Define team roles and scripts
- 2 Workshops**
 Problem definition, reference modes
 Systems mapping and dynamic hypothesis
 Model formulation and simulation
 Work behind-the-scenes and validation
 Define scenarios and analyse policies
- 3 Evaluation and follow-up**
 Evaluate modelling outputs and outcomes of participatory process
 Prepare for further iteration and implementation

Source: Videira et al. 2016 in press

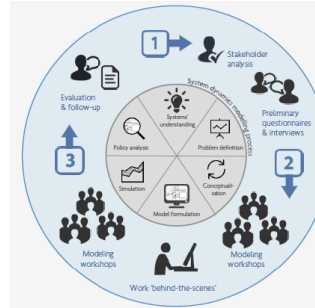
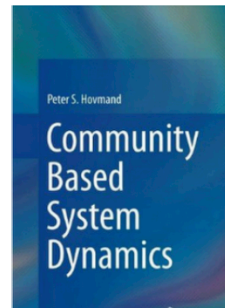
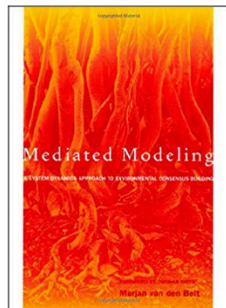
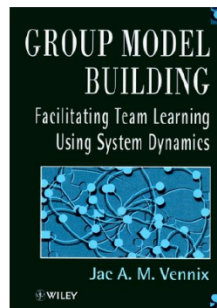


Inclusiveness





Plan for today



- **Stakeholder analysis and interviews**
Identify, select and invite participants
Conduct preliminary interviews
Define team roles and scripts
- **Workshops**
Problem definition, reference modes
Systems mapping and dynamic hypothesis
Model formulation and simulation
Work behind-the-scenes and validation
Define scenarios and analyse policies
- **Evaluation and follow-up**
Evaluate modelling outputs and outcomes of participatory process
Prepare for further iteration and implementation

Source: Videira et al. 2016 in press

To what extent do you agree or disagree with the following statements?
Please tick appropriate box.

3.1. The purposes of the workshop were clear

Strongly Agree Agree Neutral Disagree Strongly Disagree N/A

3.2. What was expected from me during the workshop was not clear

Strongly Agree Agree Neutral Disagree Strongly Disagree N/A

3.3. There was too much talk

Strongly Agree Agree Neutral Disagree Strongly Disagree N/A

3.4. Workshop discussions were free and open

Strongly Agree Agree Neutral Disagree Strongly Disagree N/A

Effectiveness



Pre-test

Workshop

Post-test



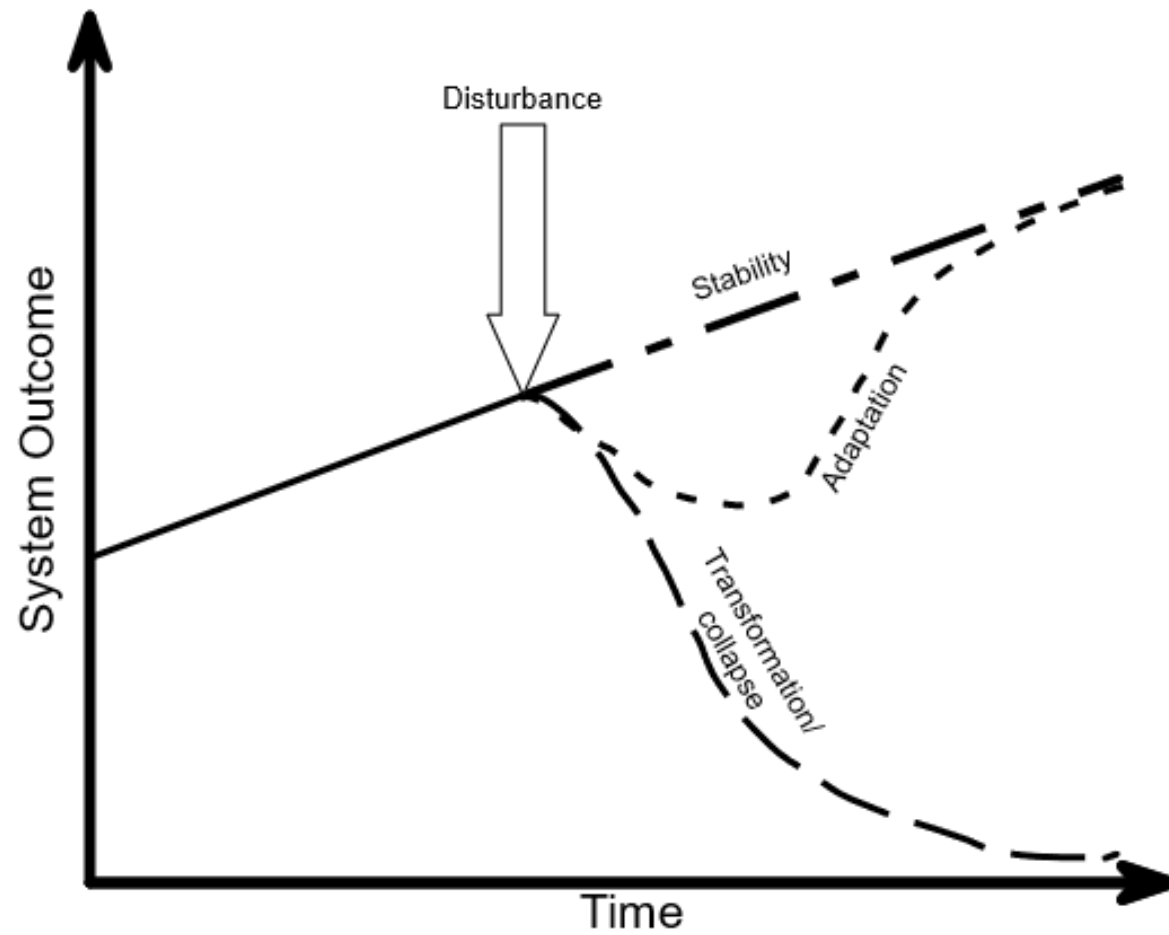


Inclusiveness, part 1: simple measures for complex concepts

Herrera H., Kopainsky B. Do you bend or break? The dynamic feature of resilience. System Dynamics Review (forthcoming).

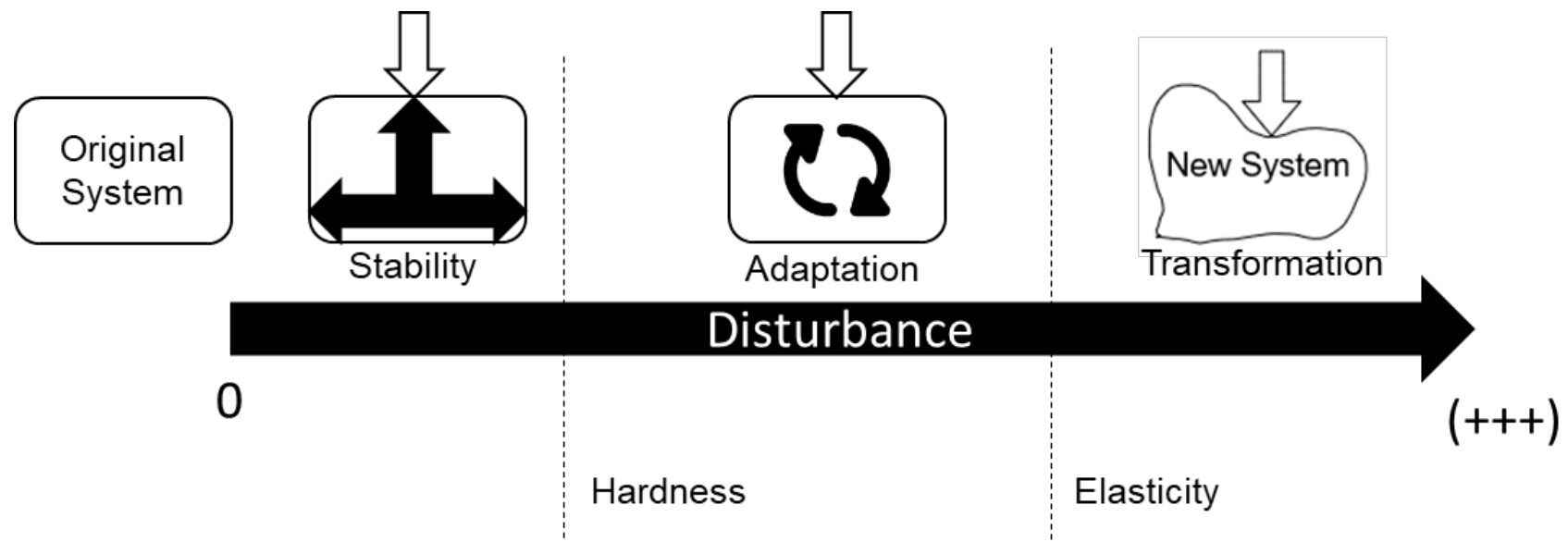


Resilience





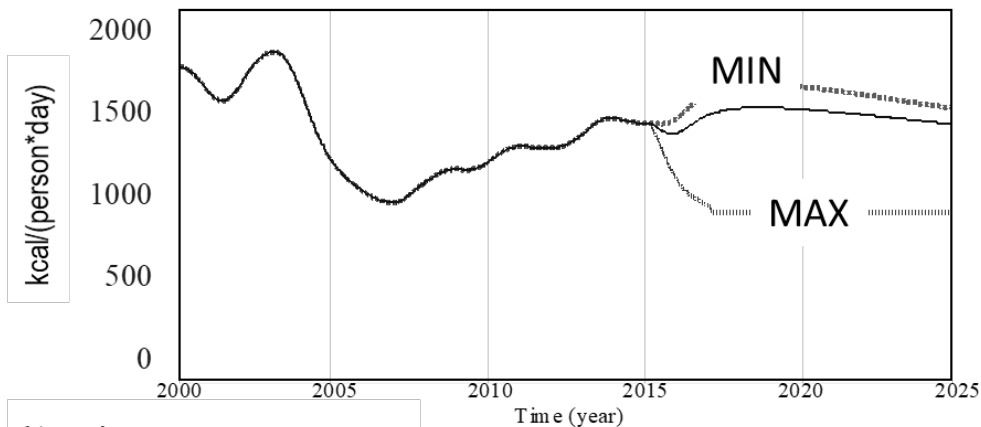
Quantitative assessment of resilience



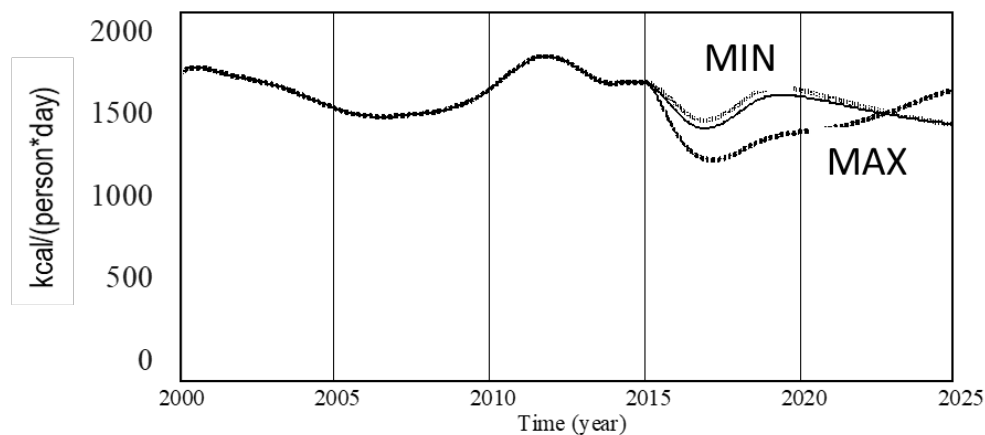


Quantitative assessment of resilience

a) Huehuetenango



b) Jutiapa



- $\sigma = M * d$
 - σ : drought
 - M : magnitude of the drought (rainfall reduction as a % of the average rainfall expected for that period)
 - d : duration (months)





Case study

Maize in Guatemala



25% of GDP depends on agriculture

70% of malnutrition among indigenous population

70% of basic grain consumption is maize

One of the 10 countries most affected by Climate Change

Resilience of What to What?



Climate
Change

Droughts

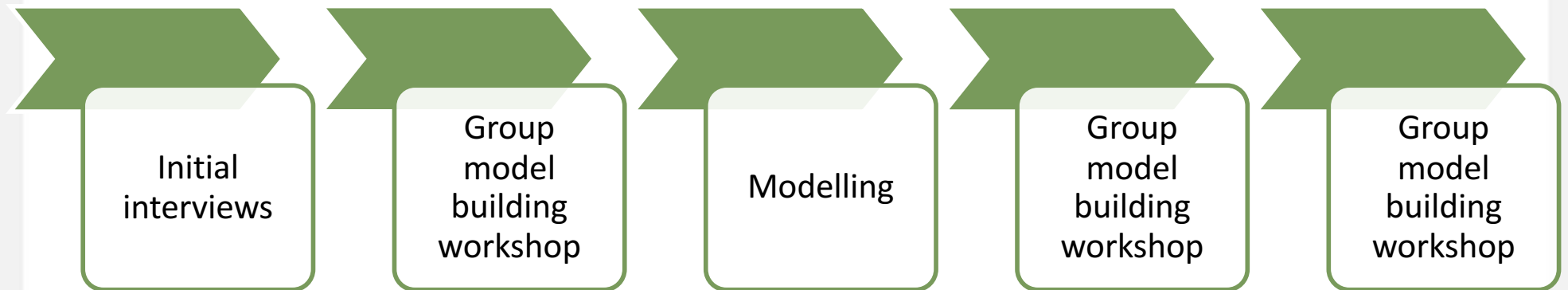
Agriculture
Systems

Food Affordability





Method



Maize Market

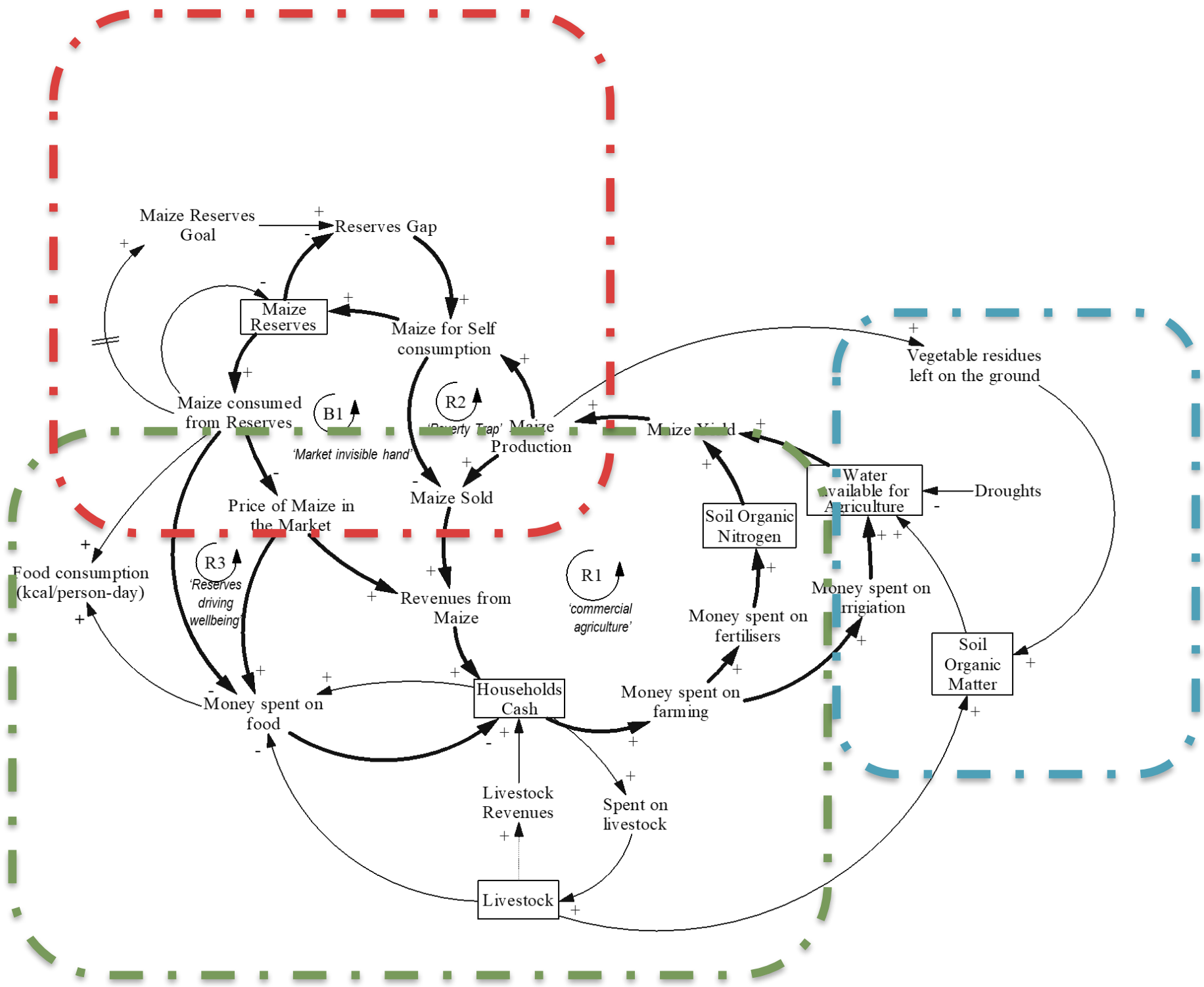


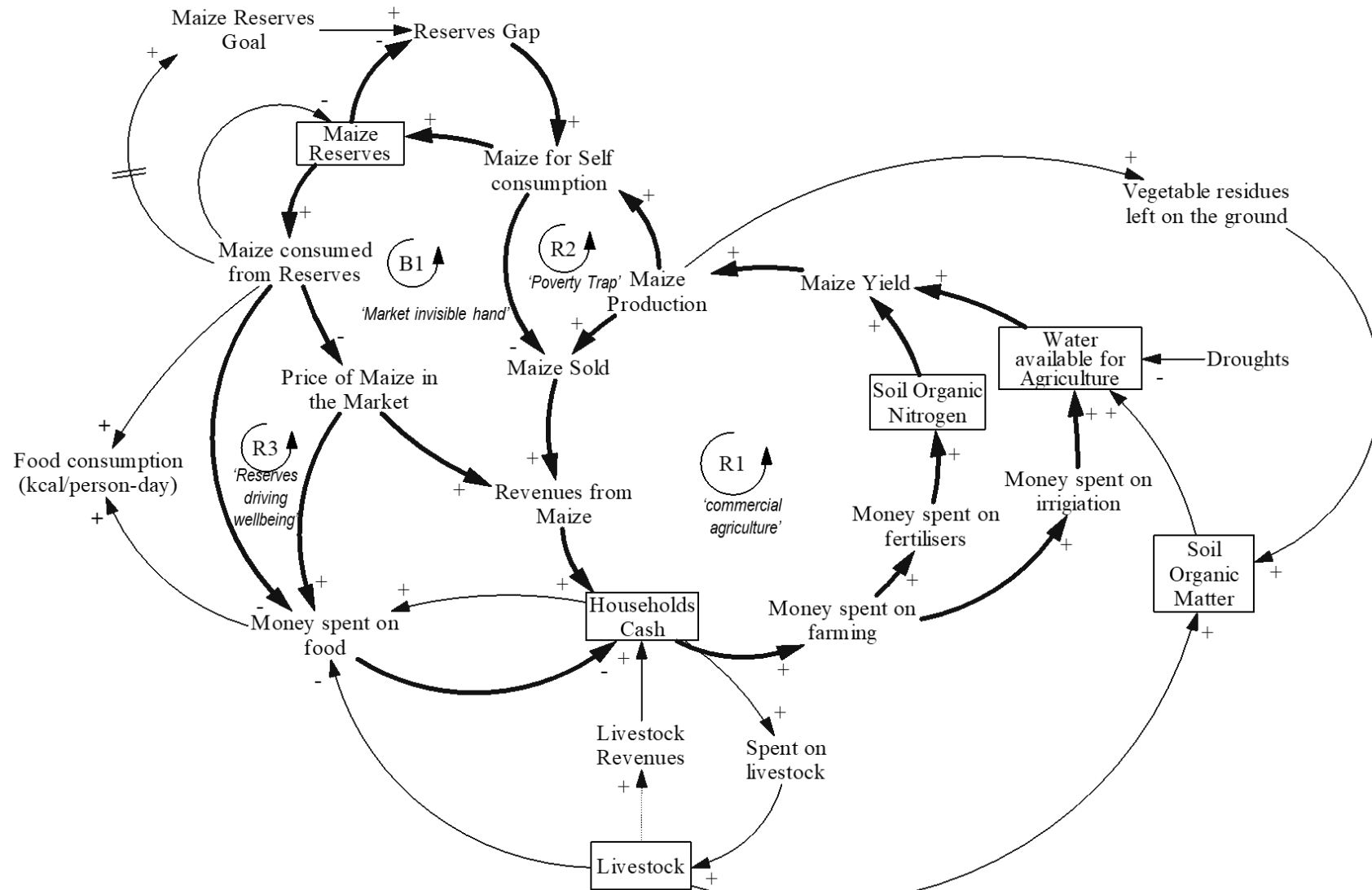
Natural System



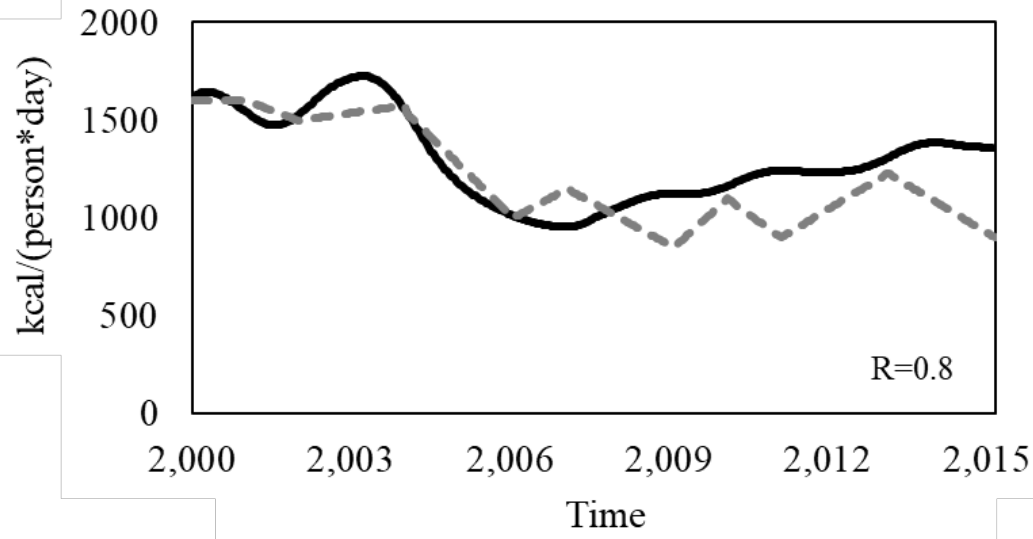
Households



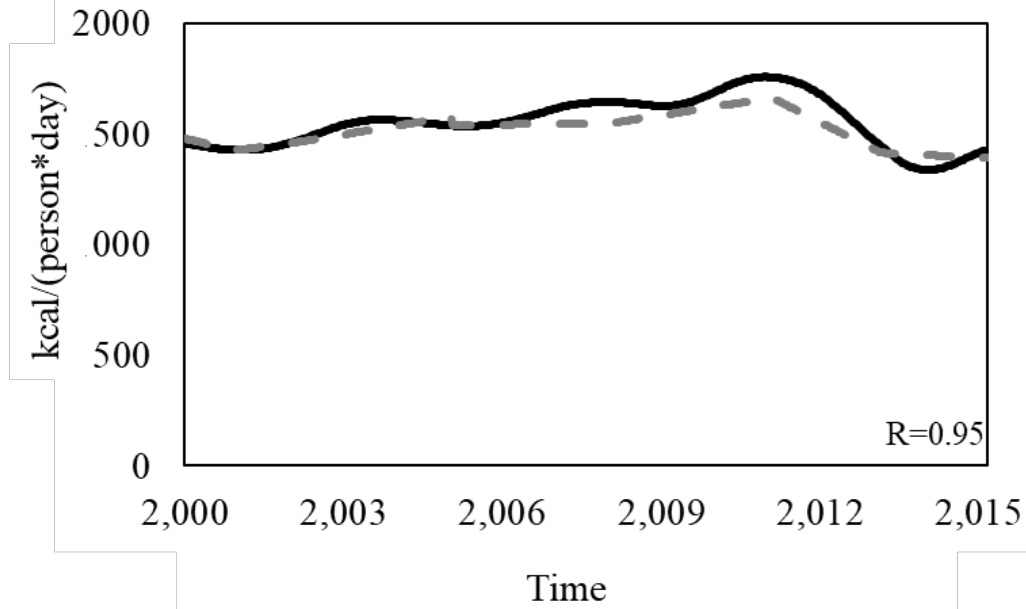




a) Huehuetenango



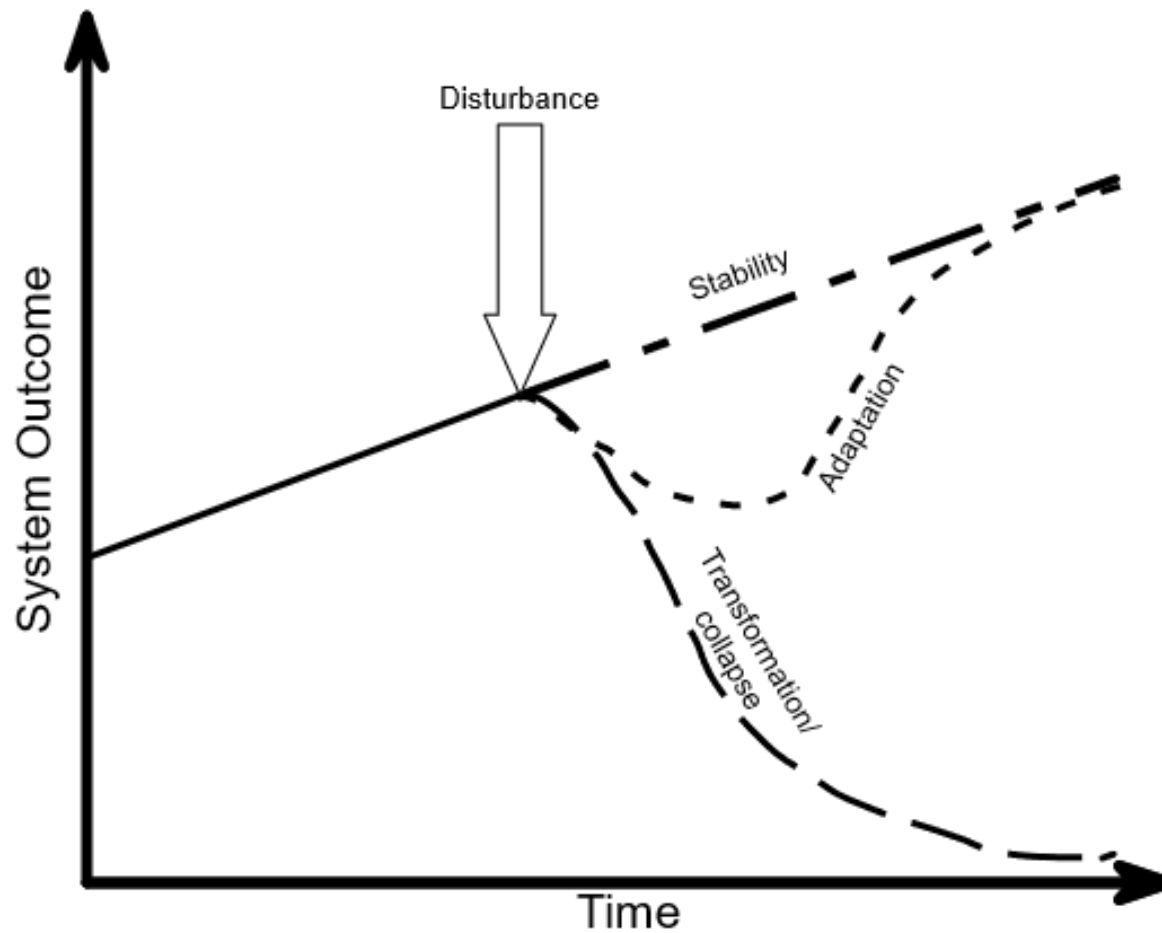
b) Jutiapa



Simulated Behaviour kcal consumed per day ———
Historical kcal consumed per day - - -



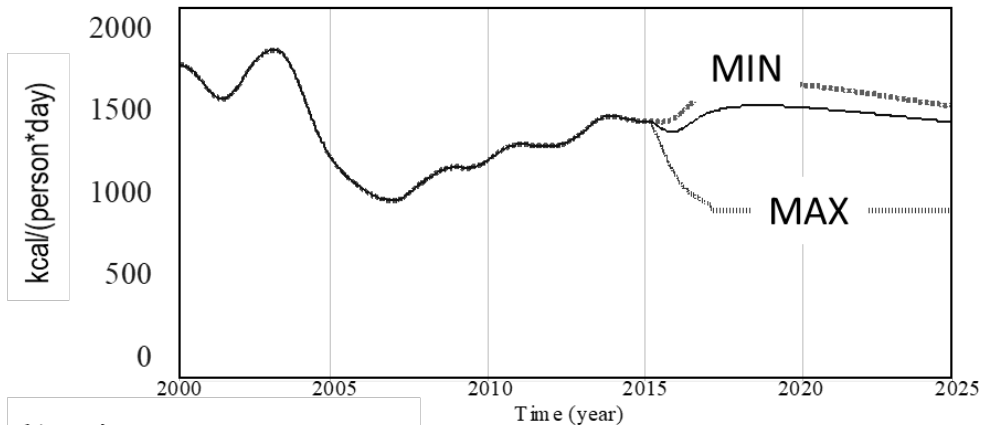
Resilience to climate change



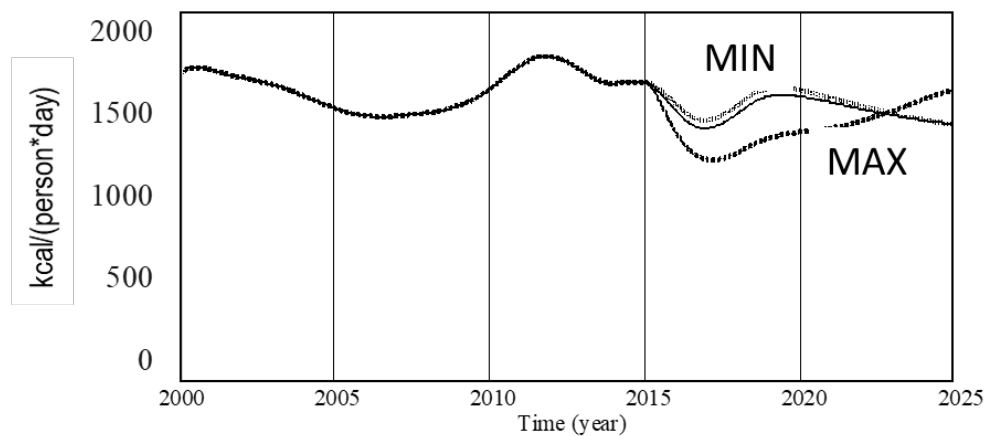


Resilience to climate change

a) Huehuetenango



b) Jutiapa

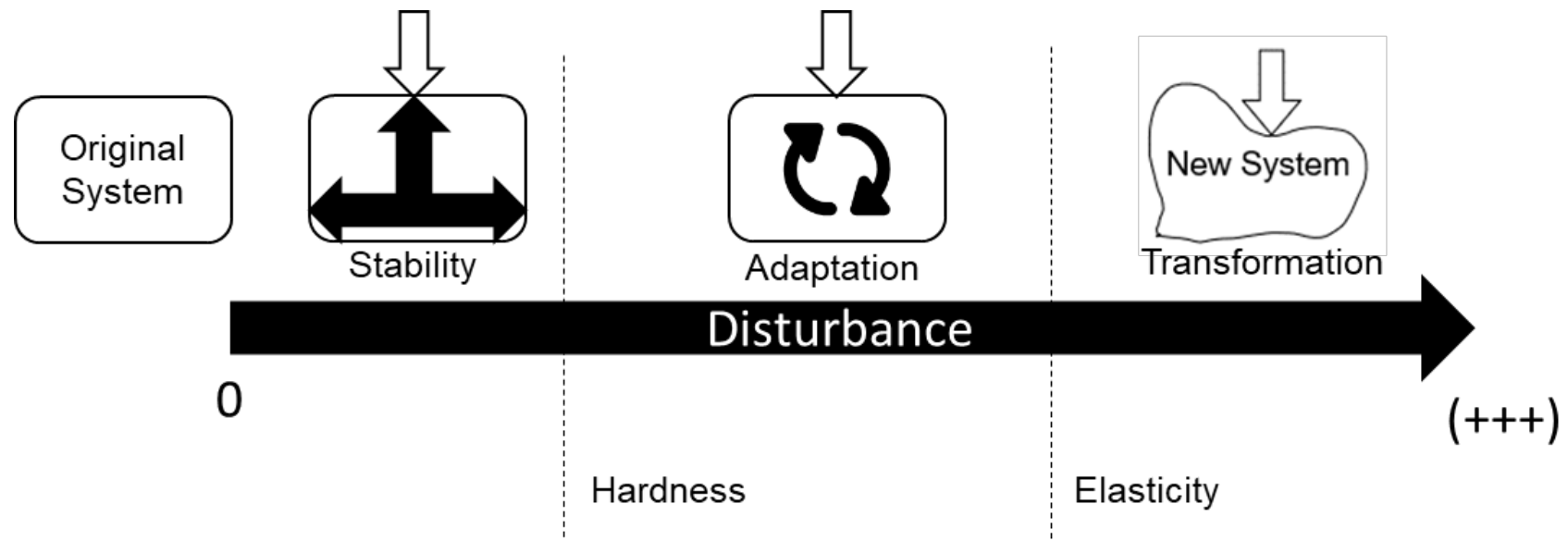


- $\sigma = M * d$
 - σ : drought
 - M : magnitude of the drought (rainfall reduction as a % of the average rainfall expected for that period)
 - d : duration (months)



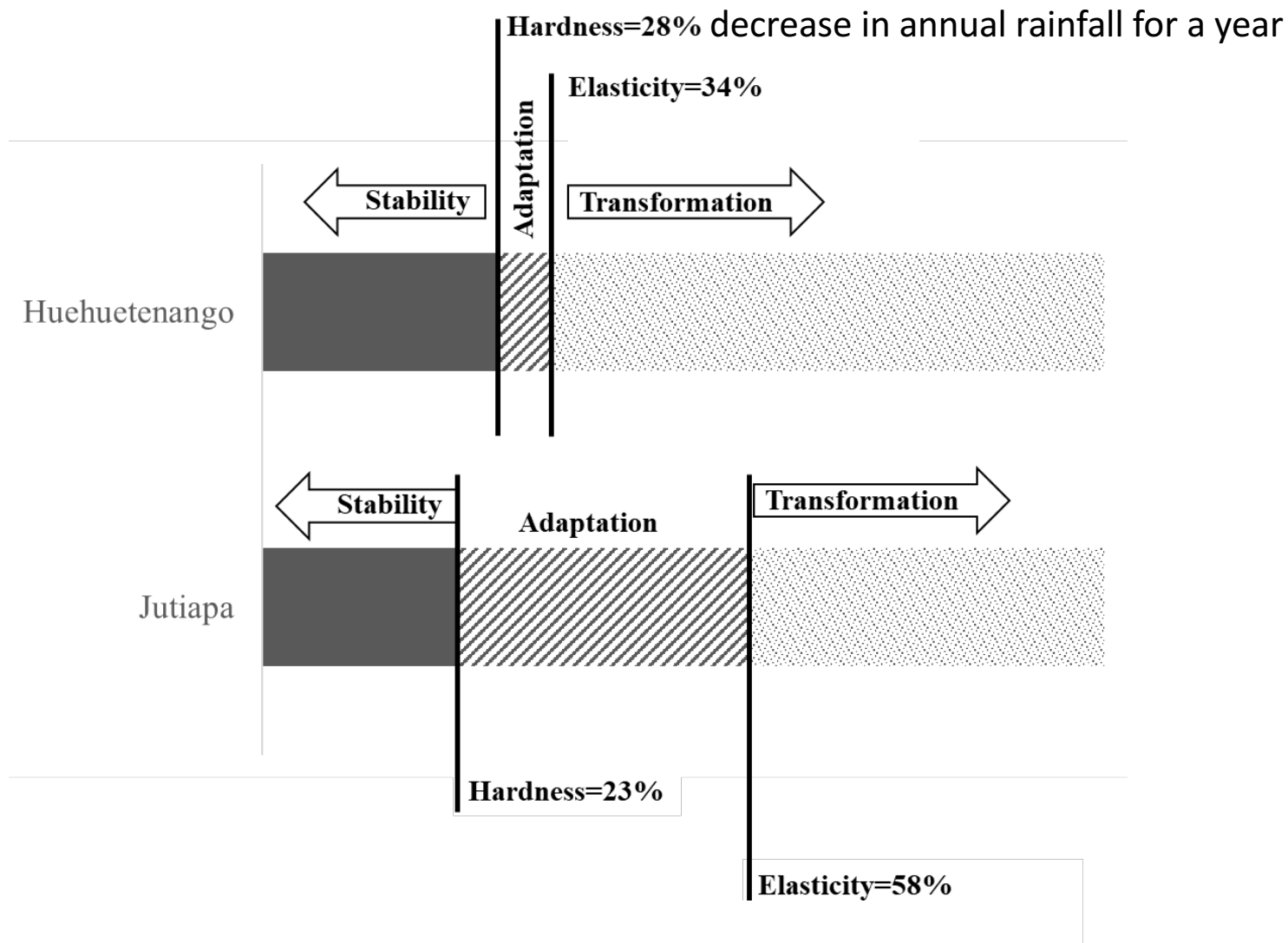


Quantitative assessment of resilience



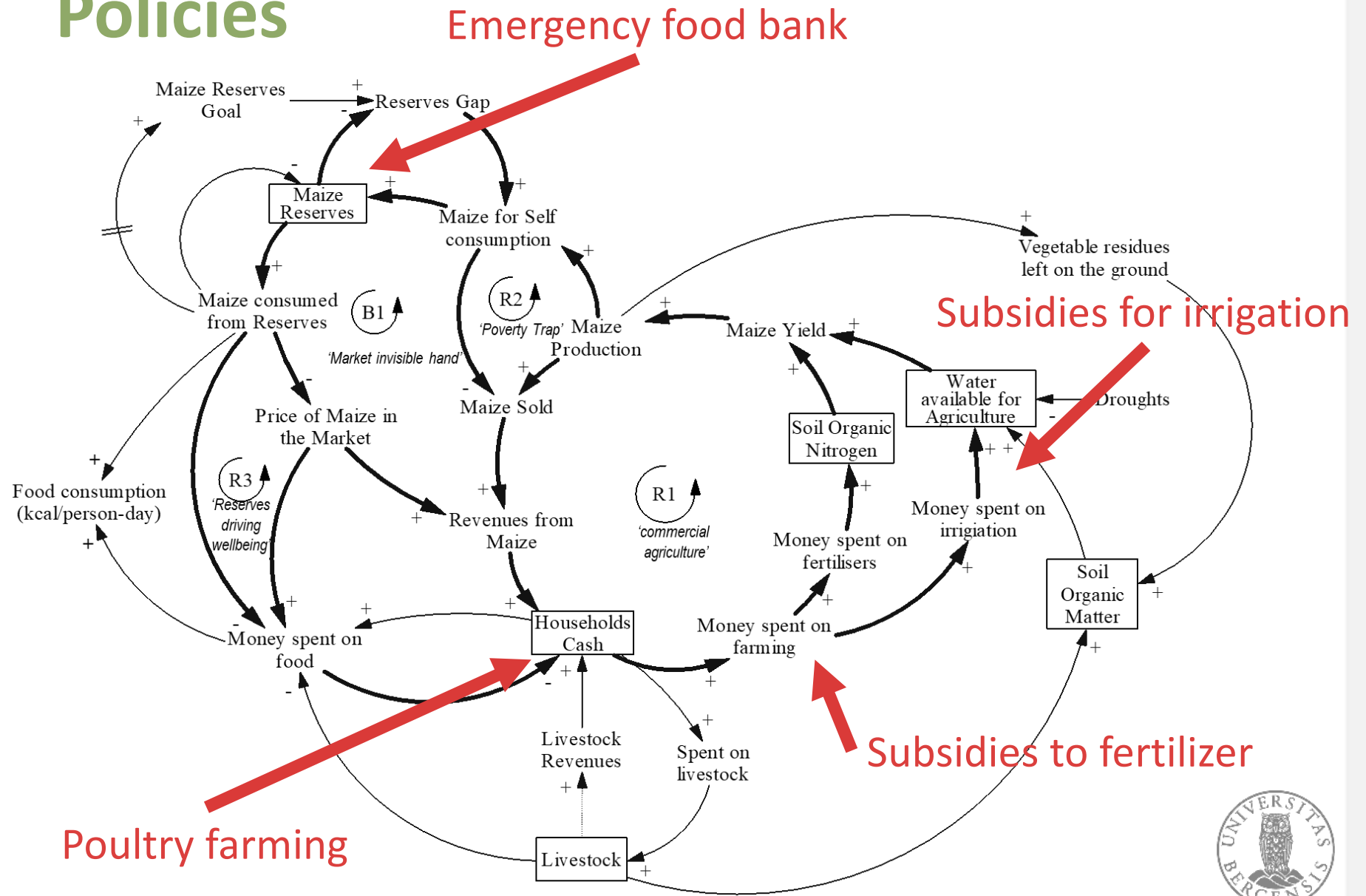


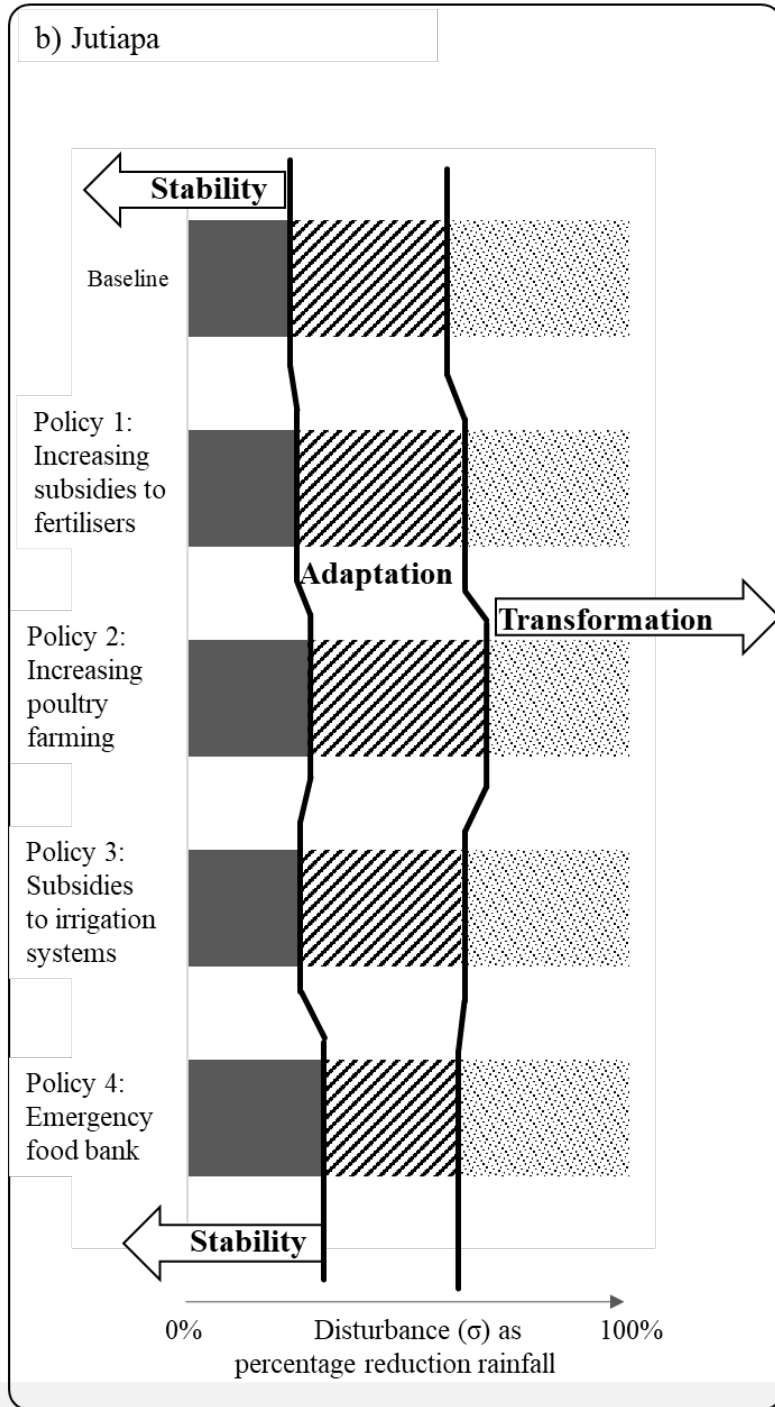
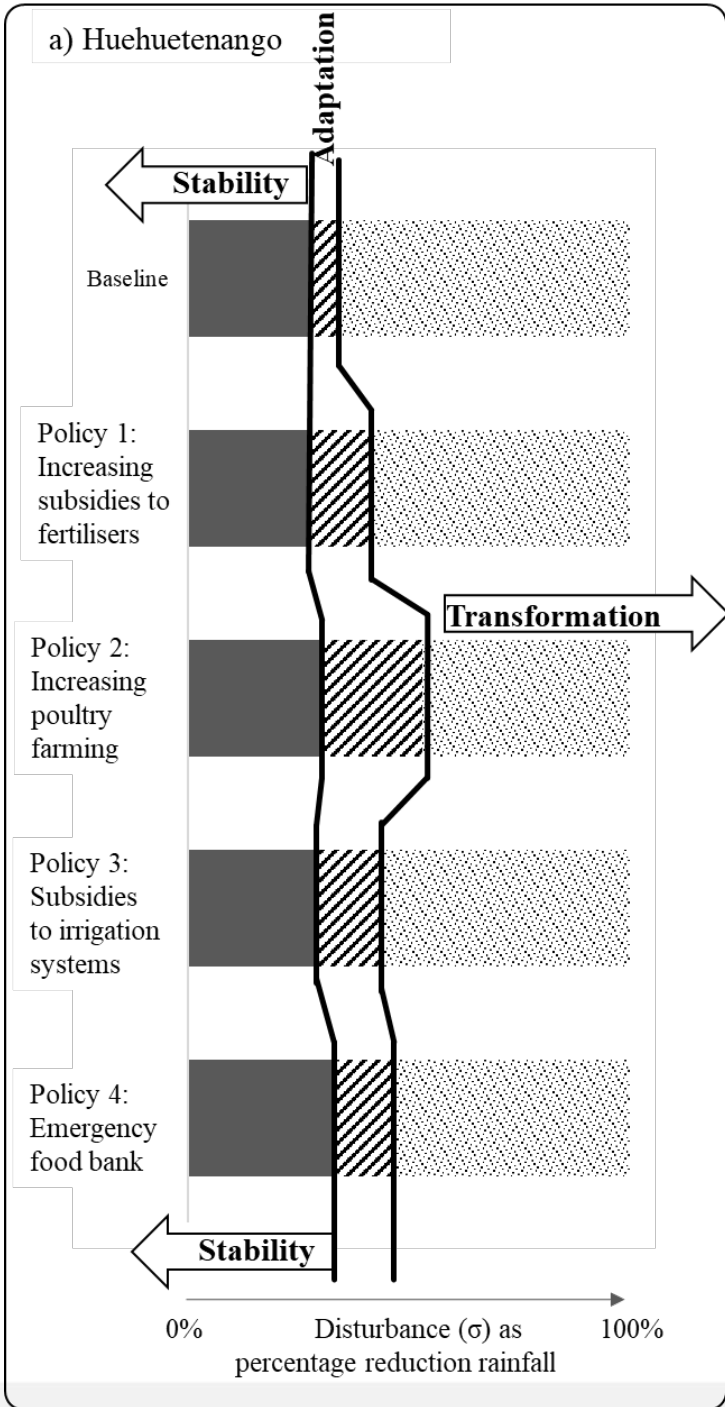
Quantitative assessment of resilience





Policies







Inclusiveness, part 2

Ecological Modelling 362 (2017) 101–110

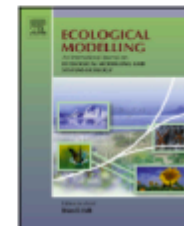


ELSEVIER

Contents lists available at [ScienceDirect](#)

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel



Research paper

Transforming food systems at local levels: Using participatory system dynamics in an interactive manner to refine small-scale farmers' mental models



Birgit Kopainsky^{a,*}, Gerid Hager^a, Hugo Herrera^{a,b}, Progress H. Nyanga^c

^a System Dynamics Group, Department of Geography, University of Bergen, P.O. Box 7800, 5020 Bergen, Norway

^b Department of European Studies, University of Palermo, Via Ugo Antonio Amico 3, 90100 Palermo, Italy

^c Geography and Environmental Studies Department, School of Natural Sciences, University of Zambia, P.O. Box 32379, Lusaka, 10101, Zambia

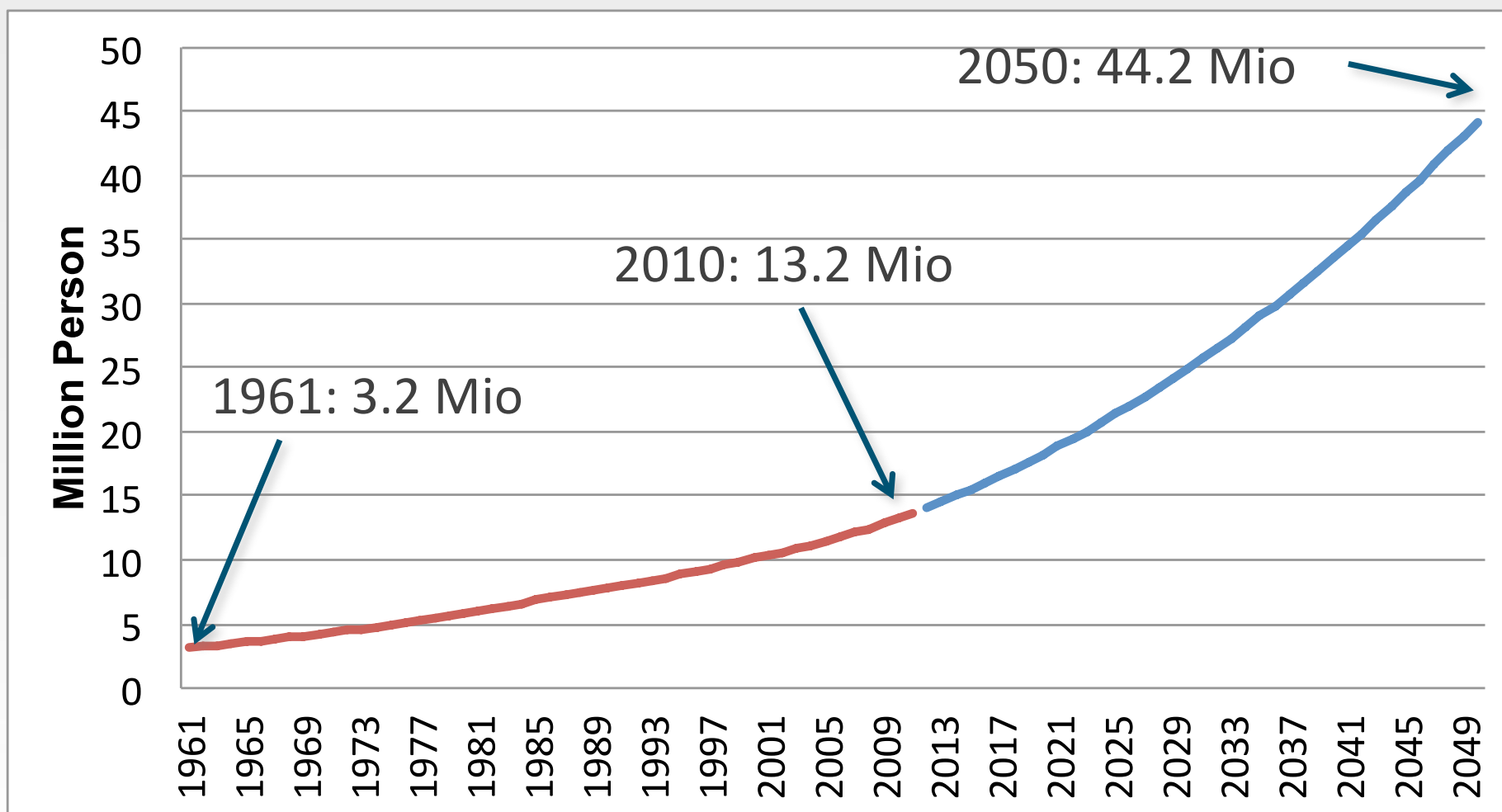


Republic of Zambia





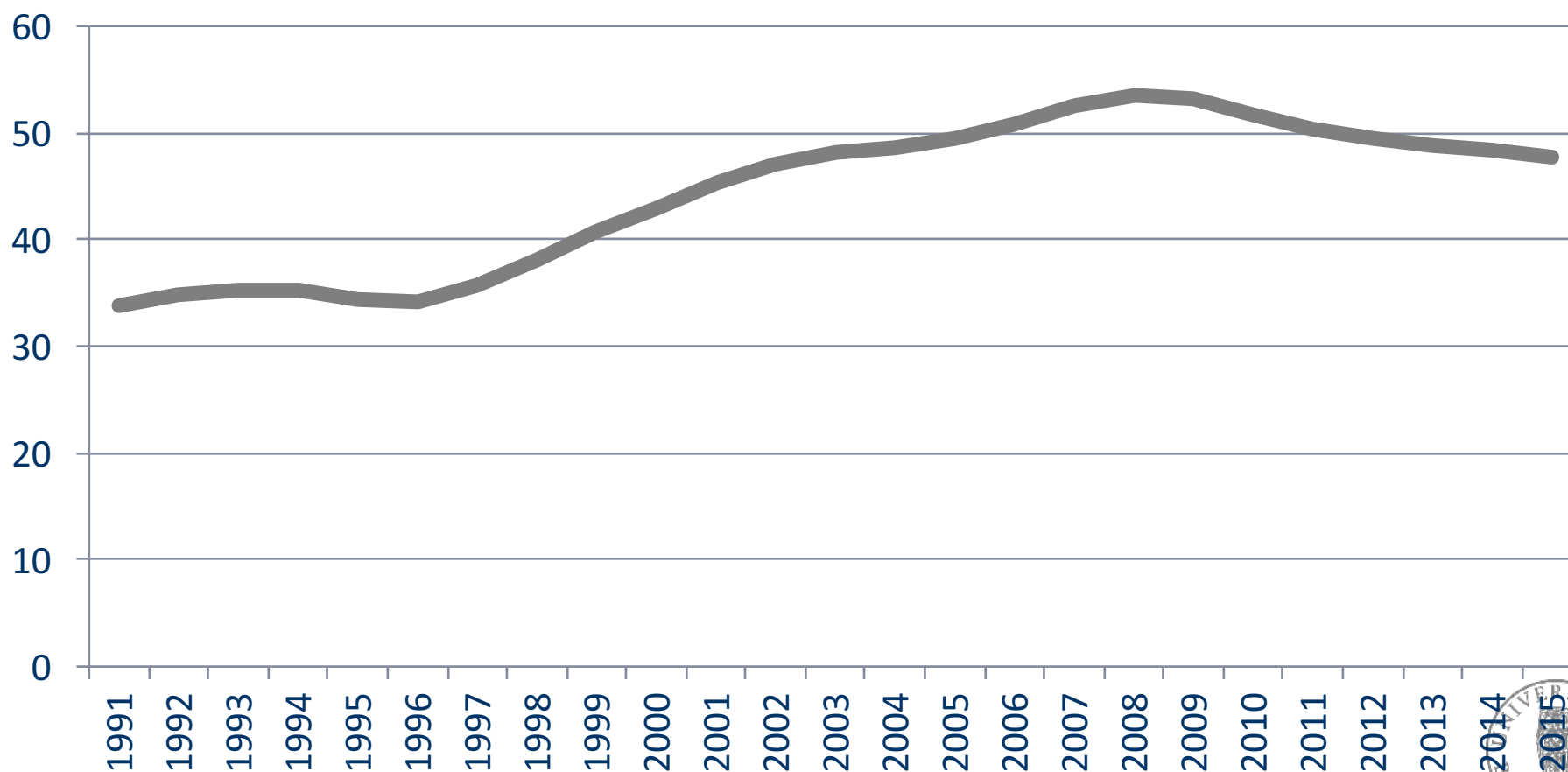
Population Zambia





Food security Zambia

Prevalence of undernourishment (% of population)



Data source: World Bank Open Data







Motivating questions

- **How to move system dynamics from board room settings to groups at the community level with low or no formal educational background?**
- **How to assess its effectiveness?**



Berkeley

Peder Sather Center
for Advanced Study

Project “Knowledge analysis in coupled social-ecological systems. A pilot study in smallholder farmer communities in Zambia”

LEARNING ABOUT SYSTEMS THROUGH INTERACTION: A CASE STUDY WITH SMALLHOLDER FARMERS IN ZAMBIA

Gerid Maria Hager

Thesis submitted in partial fulfillment of the requirements for the degree of European Master in System Dynamics (Universitetet i Bergen, Universidade NOVA de Lisboa) and Master of Science in Business Administration (Radboud Universiteit Nijmegen)

Supervisor: Dr. Birgit Kopainsky
Co-supervisor: Dr. Progress H. Nyanga
Second reader: Prof. Dr. Etiënne Rouwette

System Dynamics Group
Department of Geography, University of Bergen, Norway
July 2015

















Effectiveness, part 1

Ecological Modelling 362 (2017) 101–110



ELSEVIER

Contents lists available at [ScienceDirect](#)

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel



Research paper

Transforming food systems at local levels: Using participatory system dynamics in an interactive manner to refine small-scale farmers' mental models



Birgit Kopainsky^{a,*}, Gerid Hager^a, Hugo Herrera^{a,b}, Progress H. Nyanga^c

^a System Dynamics Group, Department of Geography, University of Bergen, P.O. Box 7800, 5020 Bergen, Norway

^b Department of European Studies, University of Palermo, Via Ugo Antonio Amico 3, 90100 Palermo, Italy

^c Geography and Environmental Studies Department, School of Natural Sciences, University of Zambia, P.O. Box 32379, Lusaka, 10101, Zambia



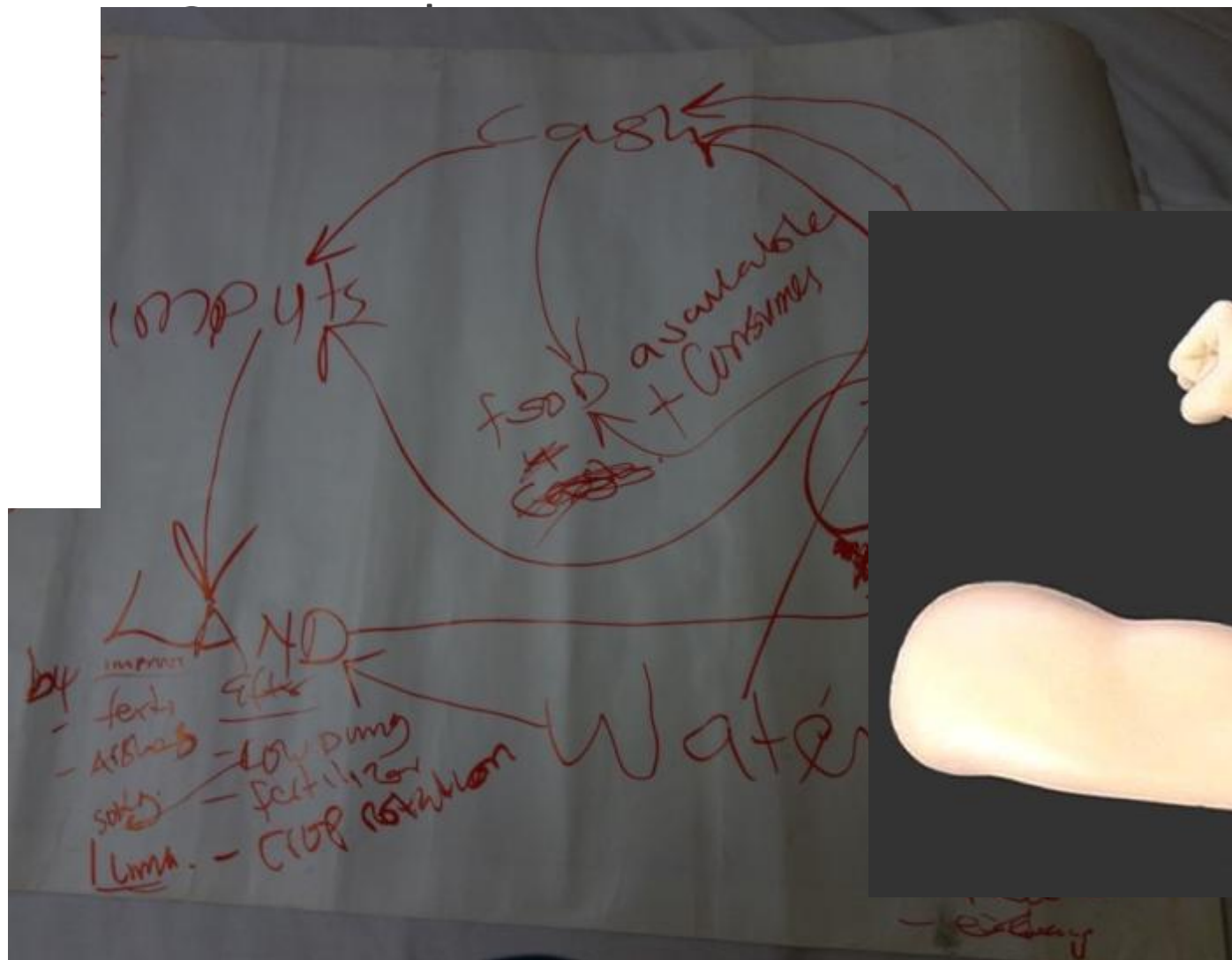
Zambia 2016

- One year later





Zambia 2016





Zambia 2016

- One year later
 - Actions that farmers had undertaken
 - Food budgeting
 - Cash budgeting
 - Teaching fellow farmers
 - Livestock
 - Small business





Zambia 2016

- One year later
 - Actions that farmers had undertaken
 - Food budgeting
 - Cash budgeting
 - Teaching fellow farmers
 - Livestock
 - Small business
 - Considered cutting wood for charcoal





Zambia 2016

- Maybe extend the system boundary...
- Keep refining the process





The LIVES project



In partnership with



Funded by



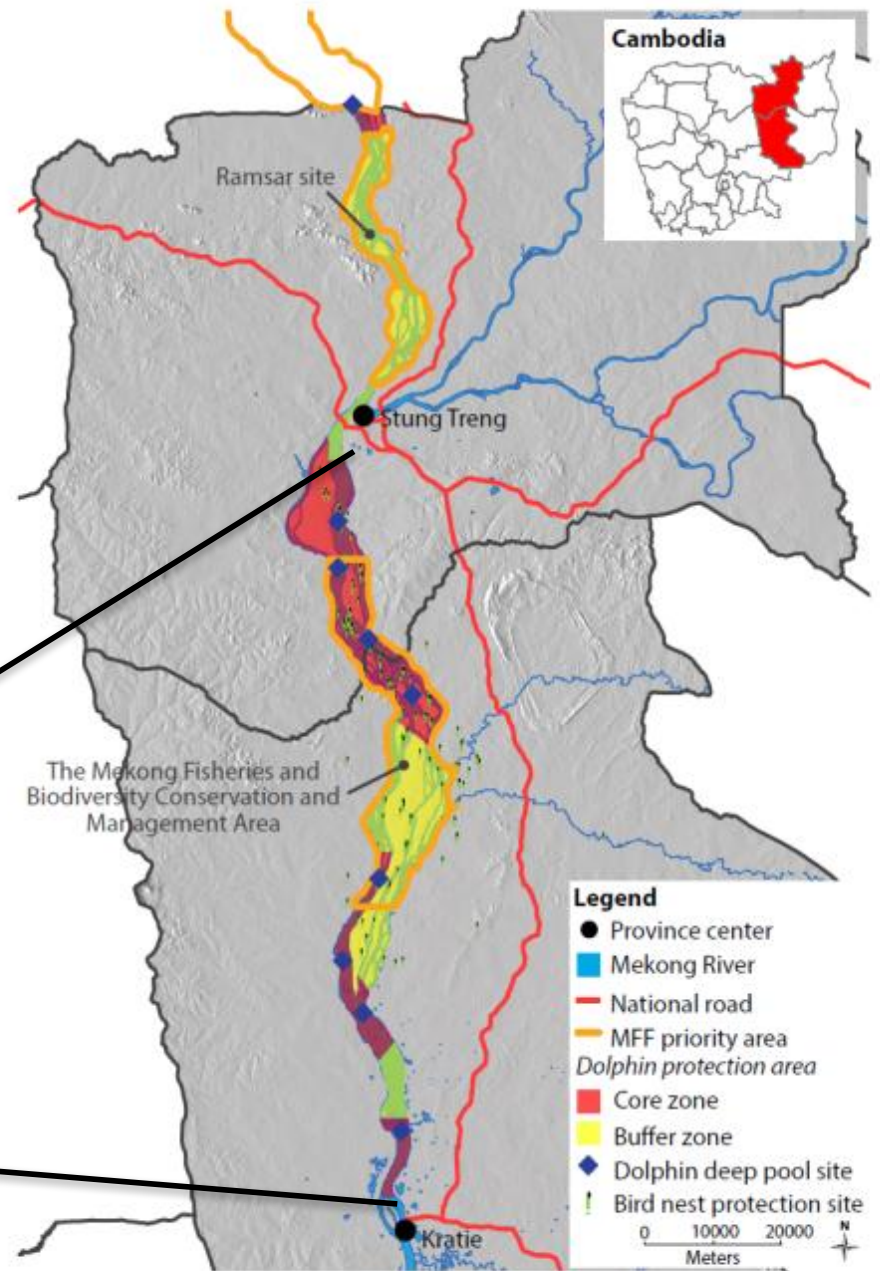


THE MEKONG FLOODED FOREST LANDSCAPE

A critical biodiversity zone in rural Cambodia at the heart of the regional dam development with a challenging political context and limited data

Stung Treng Dam,
commissioning:
2016

Sambor Dam,
commissioning: 2020



The Mekong River Flooded Forest region in Cambodia. Map courtesy of WWF-Cambodia.



Starting question with stakeholders at large

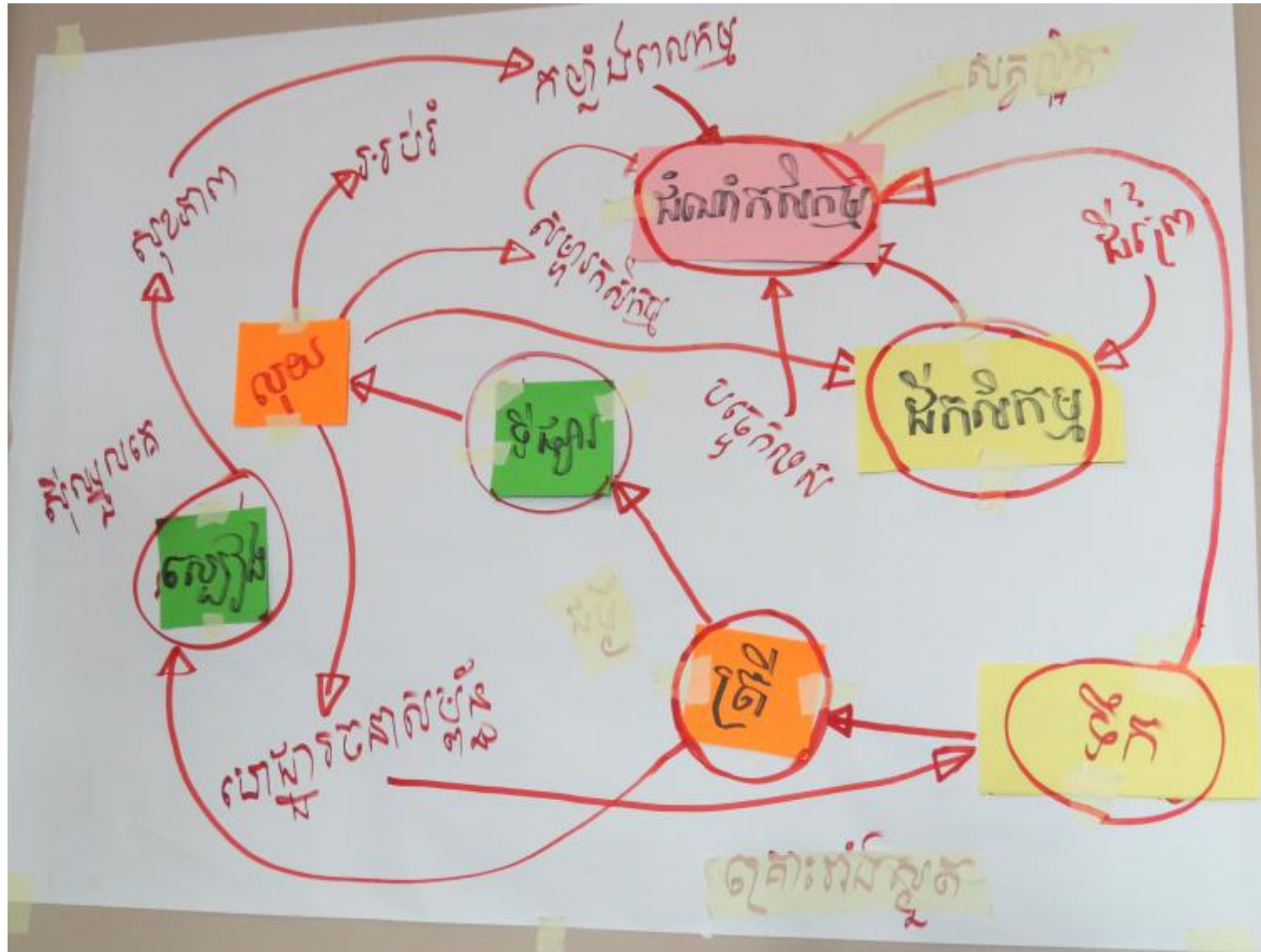


What effects could infrastructure development have on **future economic and social outcomes** in Kratie and Stung Treng Provinces?





Off topic – but isn't this beautiful?!





Cambodia 2018

- Subjective expectations as strong predictors of prospective behavior change
 - Delavande, A., Giné, X., & McKenzie, D. (2011b). Measuring subjective expectations in developing countries: A critical review and new evidence. *Journal of Development Economics*, 94(2), 151–163.
<https://doi.org/10.1016/j.jdevec.2010.01.008>
 - Jensen, R. (2010). The (perceived) returns to education and the demand for schooling. *The Quarterly Journal of Economics*, 125(2), 515–548.
 - Kimmich, C., & Fischbacher, U. (2016). Behavioral determinants of supply chain integration and coexistence. *Journal of Forest Economics*, 25, 55–77.
<https://doi.org/10.1016/j.jfe.2016.08.001>





Cambodia 2018



Pre-test



Workshop



Post-test





Change in expectations

- Expectations (subjective probability) regarding e.g.: future events, crop decisions and yield, fishponds and aquaculture, irrigation and small dams, commune investment planning
- E.g.:

Now I would like to ask you about some other future events:]

3. How likely do you think it will be that a drought (like in 2015/16) might occur..

3a. ..within the next **five** years?

___/10 beans placed in the basket

3b. ..within the next **ten** years?

___/10 beans placed in the basket

4. How likely do you think it will be that somebody from your family will take over your farm and fishing after you?

___/10 beans placed in the basket

5. How likely do you think it will be that your income from...

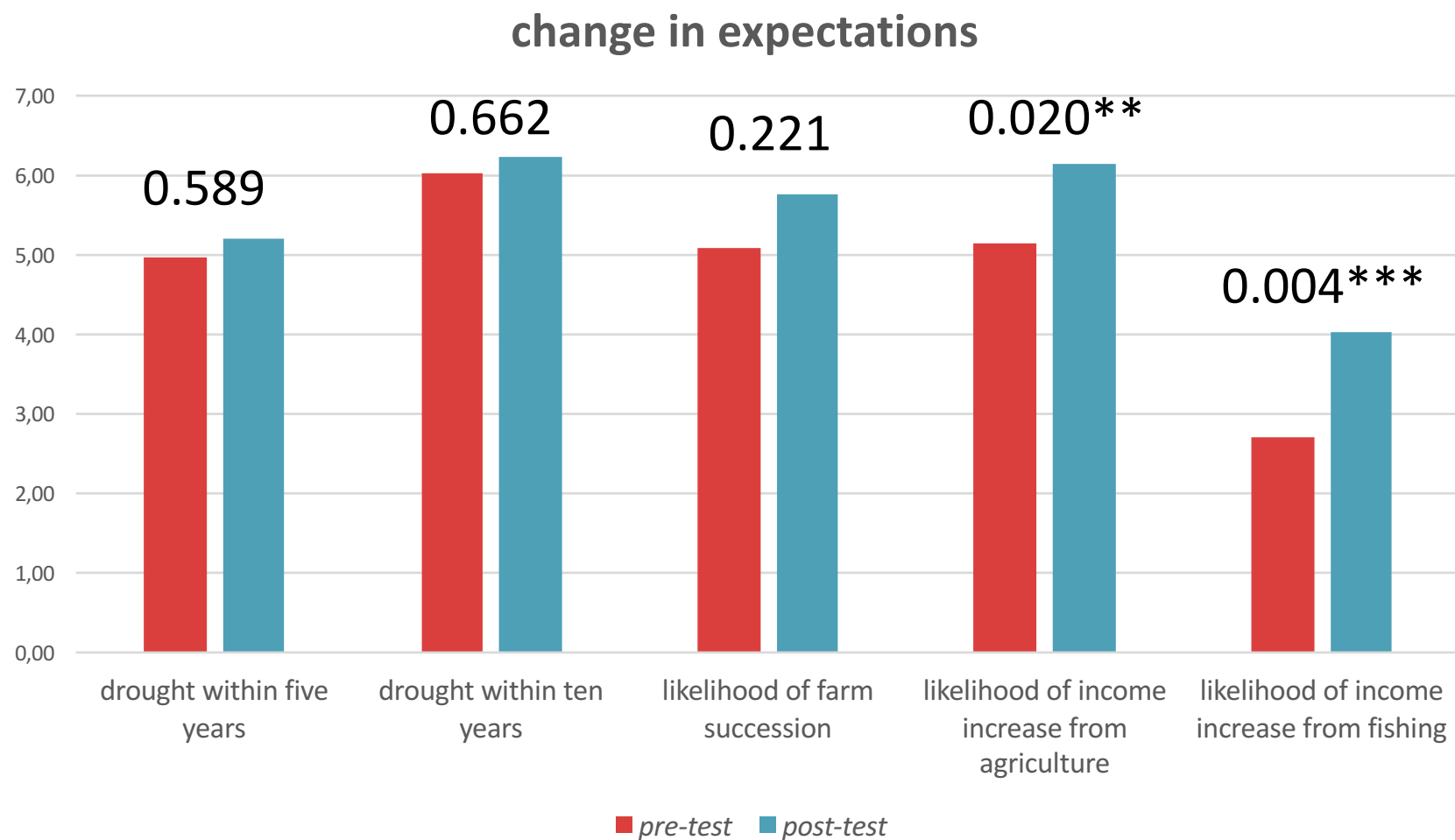
5a. ..agricultural production within the next five years will increase?

___/10 beans placed in the basket





Individual empowerment results





Shared expectations

- Some convergence in expectations
- Participants judged it less likely that they would participate in the commune investment planning process again in their post-test survey
 - Hmmmm...





Additional caveats

- Permanence of change and convergence in expectations?
 - values, power, politics...

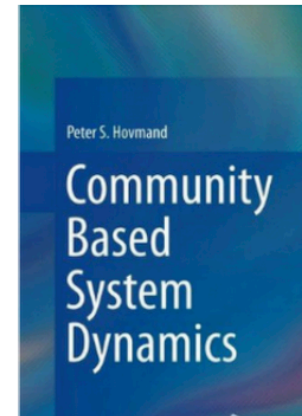
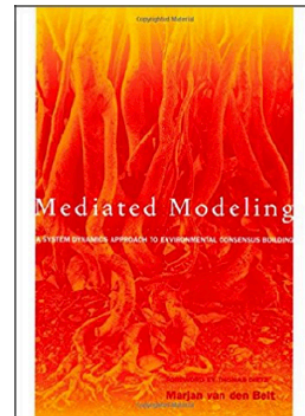
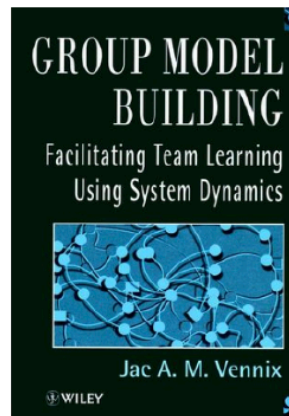




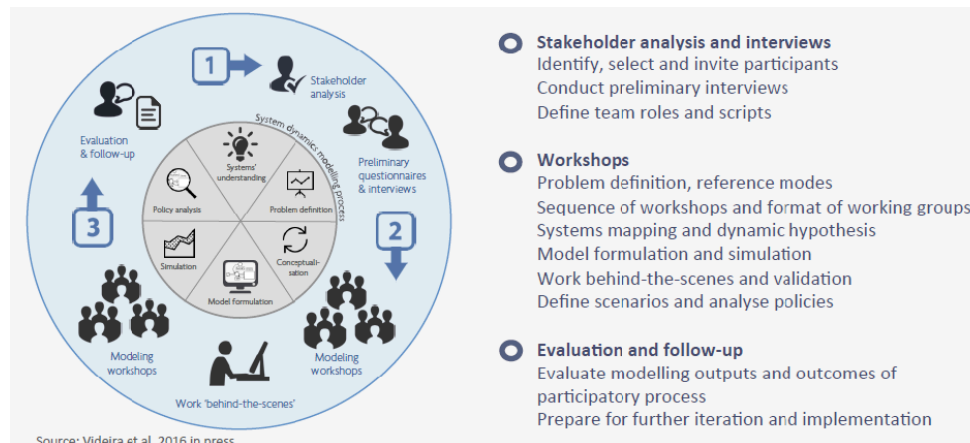
Conclusions



Conclusions



- Effectiveness?
- Inclusiveness?



- **Stakeholder analysis and interviews**
Identify, select and invite participants
Conduct preliminary interviews
Define team roles and scripts
- **Workshops**
Problem definition, reference modes
Sequence of workshops and format of working groups
Systems mapping and dynamic hypothesis
Model formulation and simulation
Work behind-the-scenes and validation
Define scenarios and analyse policies
- **Evaluation and follow-up**
Evaluate modelling outputs and outcomes of participatory process
Prepare for further iteration and implementation



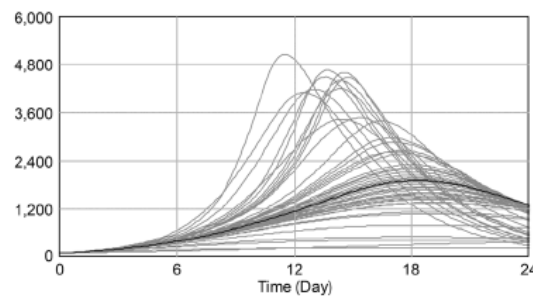


Inclusiveness & effectiveness

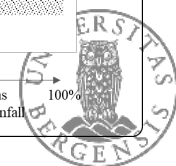
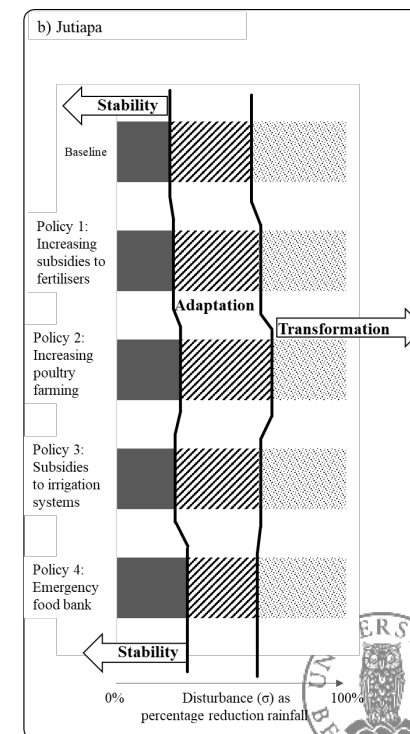
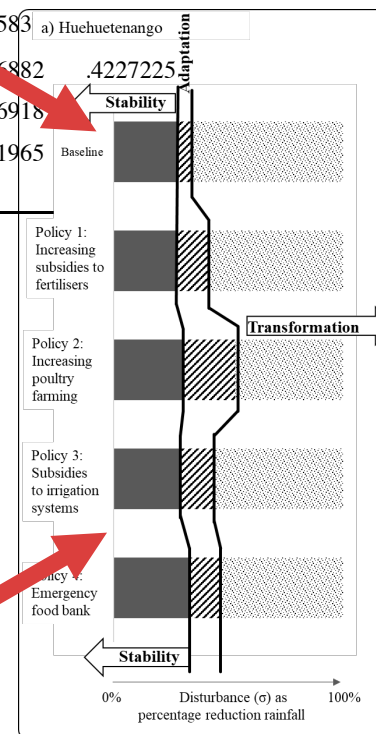
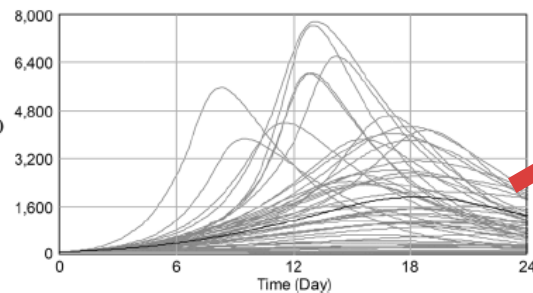
“Sensitivity analysis” and “significant differences” might not seem intuitive to everybody...

CLD_treatment	Coef.	Jknife SEs	z	P>z	[95% Conf. Interval]
drought (5y)	.0623229	.0935694	0.67	0.505	-.1210698 .2457156
drought (10y)	-.0028329	.0790037	-0.04	0.971	-.1576772 .1520115
takeover by child	.1331445	.0738423	1.80	0.071	-.011583 .277872
agr. income (5y)	.2677054	.0790918	3.38	0.001	.1126882 .4227225
fish income (5y)	.3541076	.1022549	3.46	0.001	.1536918 .5545234
food expenditure	-.0524079	.1248944	-0.42	0.675	-.2971965 .1923807

(b)
m: Uniform(-1, 1)
p: Uniform(0, 1)

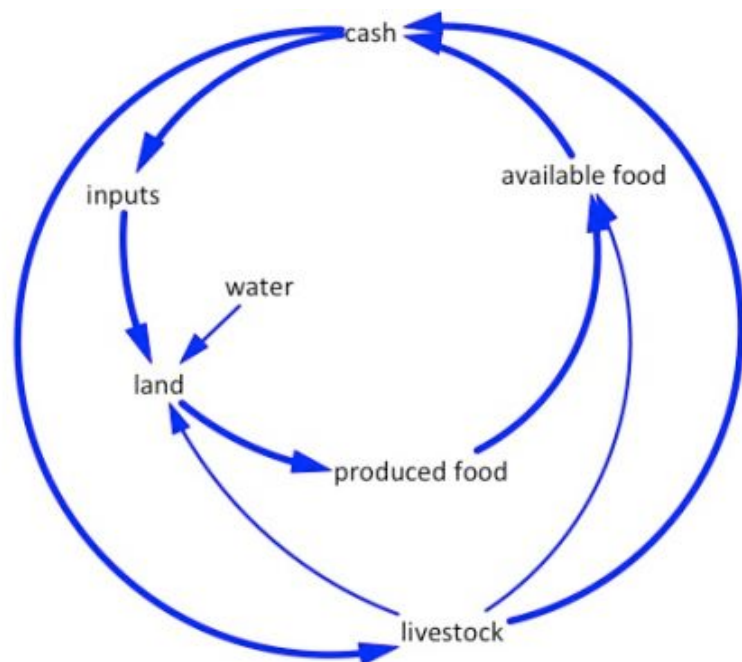


(c)
N: Uniform(5000, 15000)
d: Uniform(2, 6)
m: Uniform(-1, 1)
p: Uniform(0, 1)





Inclusiveness & effectiveness



Model structure

- Fairly generic
- Different emphasis in different locations

Pictures and objects

- Stimulate multiple sensory cues:
 - + visual
 - + haptic
- Facilitate conceptual change:
 - Tension between familiar picture/object and new context





Inclusiveness & effectiveness



Cups for “fake simulation”

- THE metaphor for illustrating behavioral implications
 - “The government prevents us from filling our cups”
 - “We learned that we need to fill our cups”



Diagram and simulation

- Seem to facilitate transfer
- Support reflective system action
- Support future thinking





Silver bullet solution?

what are other
words for
silver bullet?

quick fix, solution, nostrum,
panacea, cure-all, magic bullet,
cure, answer, antidote,
cure for all ills





Silver bullet solution?

- Sorry, no...
- But is sure is incredibly fascinating!



