


north
south



From modeling a theory back to practice
Reflections on a system dynamics journey for sustainable water resources Management

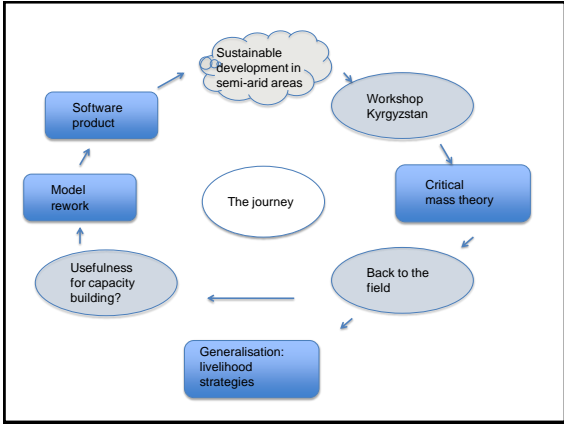
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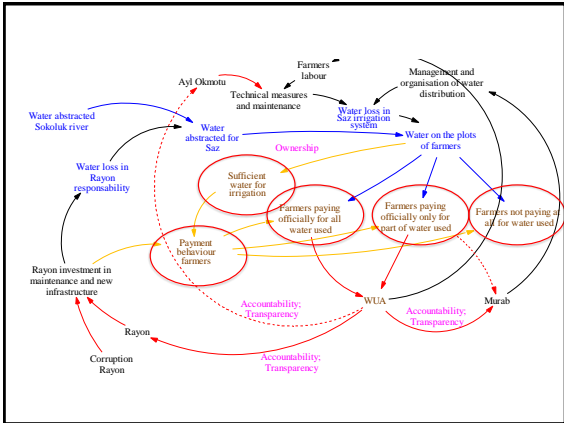
Content

- Introduction
- The journey
- Reflections: lessons learnt

Introduction

- NCCR North-South
 - Sustainable development with a focus on methodology
 - System dynamics: an instrument for (comparative) transdisciplinary research?
 - Pathways towards sustainable development
- Case studies
 - Kyrgyzstan
 - Kenya





A theory of collective action

Granovetter: Threshold model of collective action (1978)

- People have different thresholds to enter collective action
- Distribution of thresholds matters

Schelling: Critical mass model of collective action (1978)

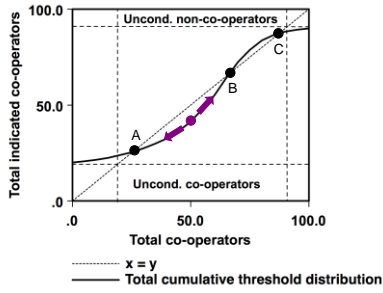
- Three categories of co-operators:
 - unconditional co-operators
 - conditional co-operators
 - unconditional non-co-operators

Game theory: Assurance game - not prisoner's dilemma

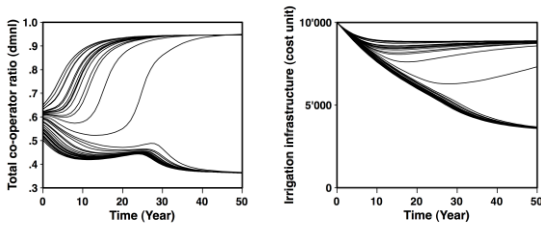
- Co-operation can emerge, if enough people feel sufficiently assured that others will also co-operate.

(Axelrod 1981, Baland and Platteau 1996)

Fundamental dynamic structure of a critical mass model

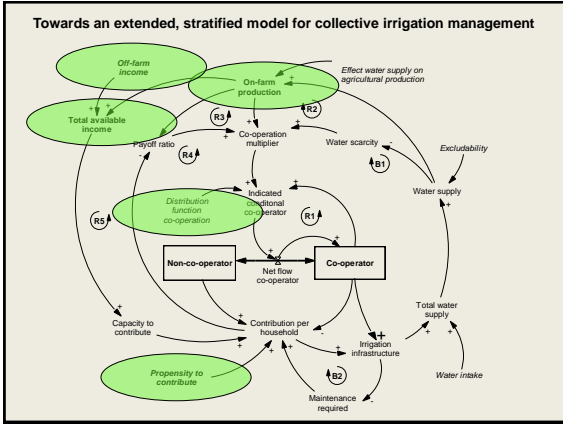


Variation of initial co-operation



Main problems

	Kyrgyzstan (Sokoluk river, Saz)	Kenya (Burguret river)
Insufficient payment, maintenance	+++	+
Deterioration of infrastructure	+++	+
Illegal abstraction upstream	++	+++
Conflicts	+	+++
Rapid population growth	+	+++
Variation of water flow	+ (low)	+++ (high)
Water availability (intake) per household in dry season	1 l/s per household	0.05 l/s per household
Problem pressure	+ (low)	+++ (high)
Dependence on irrigation	+++ (cash crop, livestock)	+++ (domestic use, livestock, cash crop)



- Back to practice: usefulness for capacity building and decision making?**
- Problem focus
 - Applicable to Kenya?
 - Rely on hypotheses for modeling
 - Find mix of agricultural practice (rain fed, irrigated, livestock) to optimize river water productivity
 - Theoretical framework
 - Plant water requirements
 - Model structure
 - Simple, (quasi)linear structure, 'physical' model (water flow)
 - Output
 - prototype

The Situation: Socioeconomic dynamics

- Very high dynamics
- Very high diversity
- Great disparities
- Immense pressure on land and water

Implications: Pressure on Water Resources

The river dried up for a stretch of 60- 90 km upstream of Buffalo Springs in 1984, 1986, 1991, 1994, 1997, 2000, 2002, 2003, 2004, 2005



What is the Problem?

- Population development and land use change dynamics
- Conflicts between upstream and downstream users
- Potentials and limitations of collective irrigation management
- Limited access of smallholders to financial credits
- Agricultural practices to optimize river water productivity
- ...

Reflection: lessons learnt

- Problem focus
 - (Collective) irrigation management
- Rely on hypotheses for modeling
 - Systems behaviour (possible solution, reference modes)
 - Underlying mechanisms (structure)
- Theoretical framework
 - Transparent modeling
 - relate to (disciplinary) scientific discourse
 - Applicable to other areas? Clarify preconditions

Reflection: lessons learnt

- Small models offer numerous options for extensions
- Manage complexity
 - (small) models → large number of scenarios (policies)
 - Assist user to explore and to manage this large variety
- Software product (not system dynamics model)
 - Usability
 - Graphical user interface (drag and drop)

System dynamics for transdisciplinary research

- Potentials
 - Integrate different pieces of disciplinary as well as of local knowledge
 - Offer a consistent and testable theory
 - Provide quantitative, dynamic simulations.
- Challenges
 - involvement of and communication with local stakeholders
 - validation procedures
 - comparison/combination with other modelling methods (e.g. agent-based or object-oriented modelling approaches)
 - how to take into consideration uncertain and unknown future developments.
