Governance and the Capacity of Small-Scale Social-Ecological Systems to Adapt to Global Change

J. Marty Anderies[1,2]

[1]School of Human Evolution and Social Change
Arizona State University

[2]School of Sustainability, Arizona State University

NAS Symposium: Science, Innovation, and Partnerships for Sustainability Solutions, May 16, 2012

Small-Scale SESs are Facing Change

The Kham Film Project (http://khamfilmproject.org/SummerPasture.php)

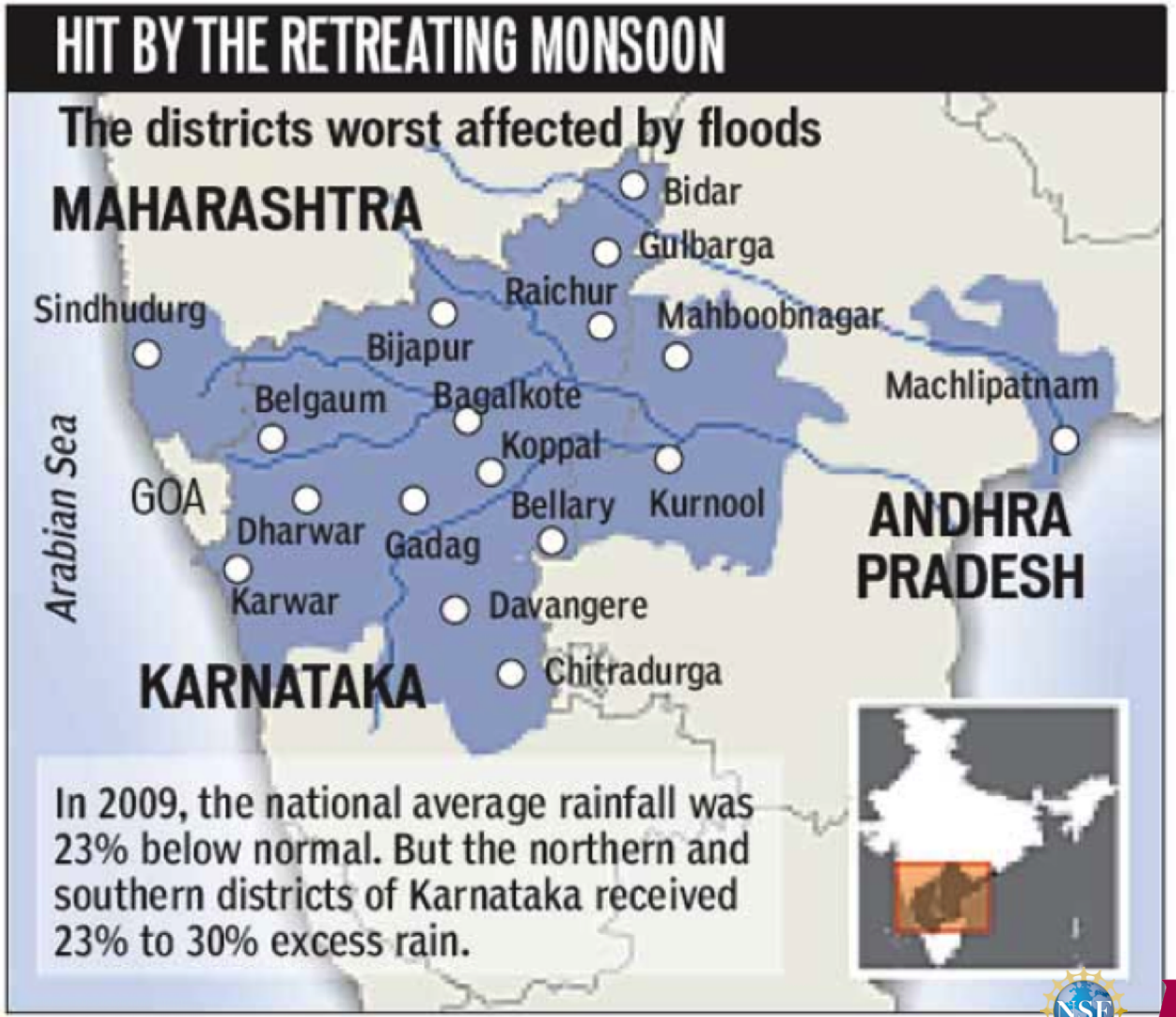
Small-Scale SESs are Facing Change

Irrigated Agriculture:

- Consumes 70% of global developed water supplies
- Produces 40% of global agricultural commodities from 17% of the global cropped area
- 90% of farms worldwide are less than 2 hectares and support the majority of the world's poorest people (> 1 billion)

Image source: Netra Chhetri, School of Geographical Sciences and Urban Planning, ASU.

Globalization Challenges for Irrigation SESs

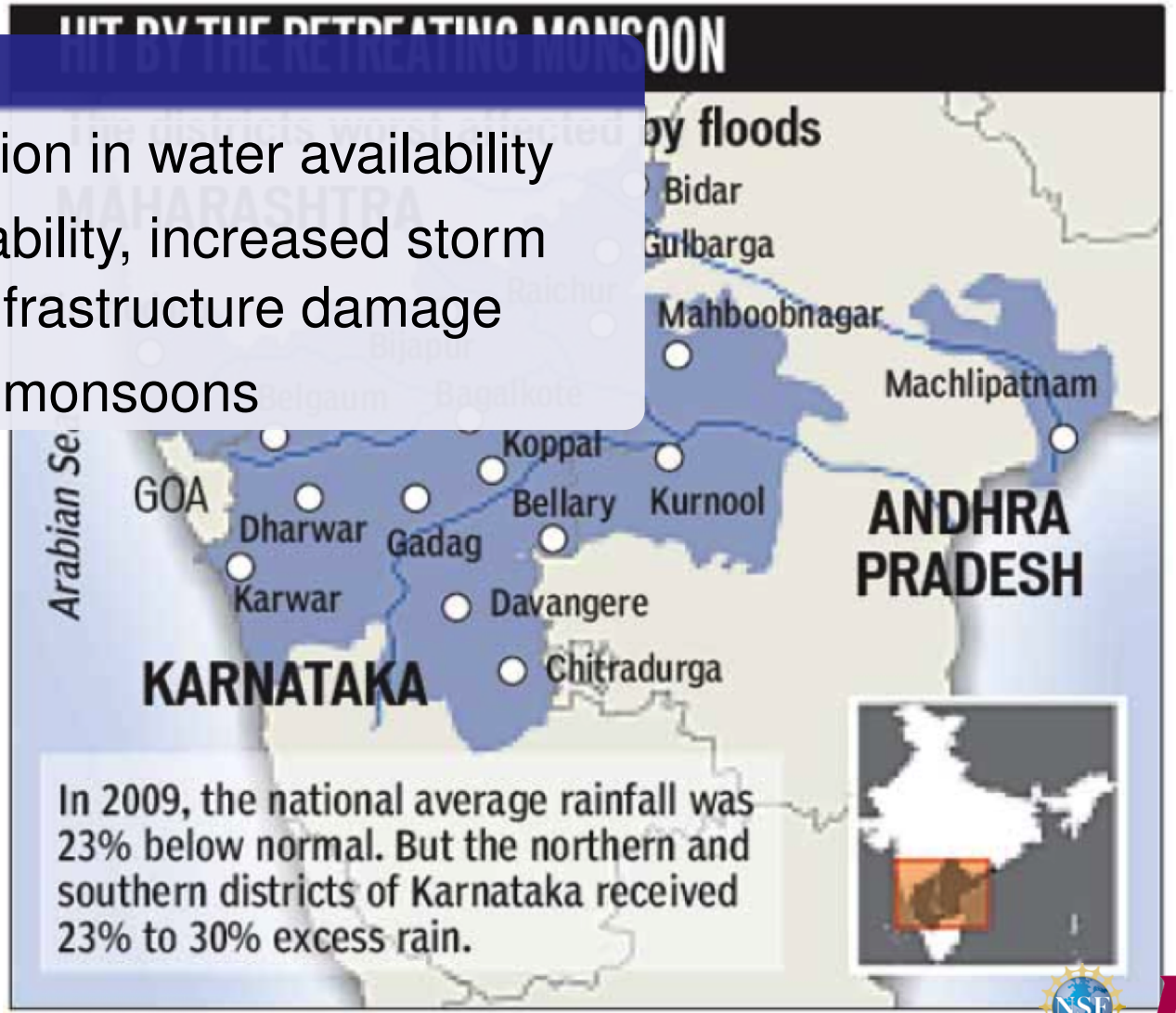


(Source: Hindustan Times)

Globalization Challenges for Irrigation SESs

Climate

- General reduction in water availability
- Increased variability, increased storm intensity and infrastructure damage
- Later arrival of monsoons



(Source: Hindustan Times)

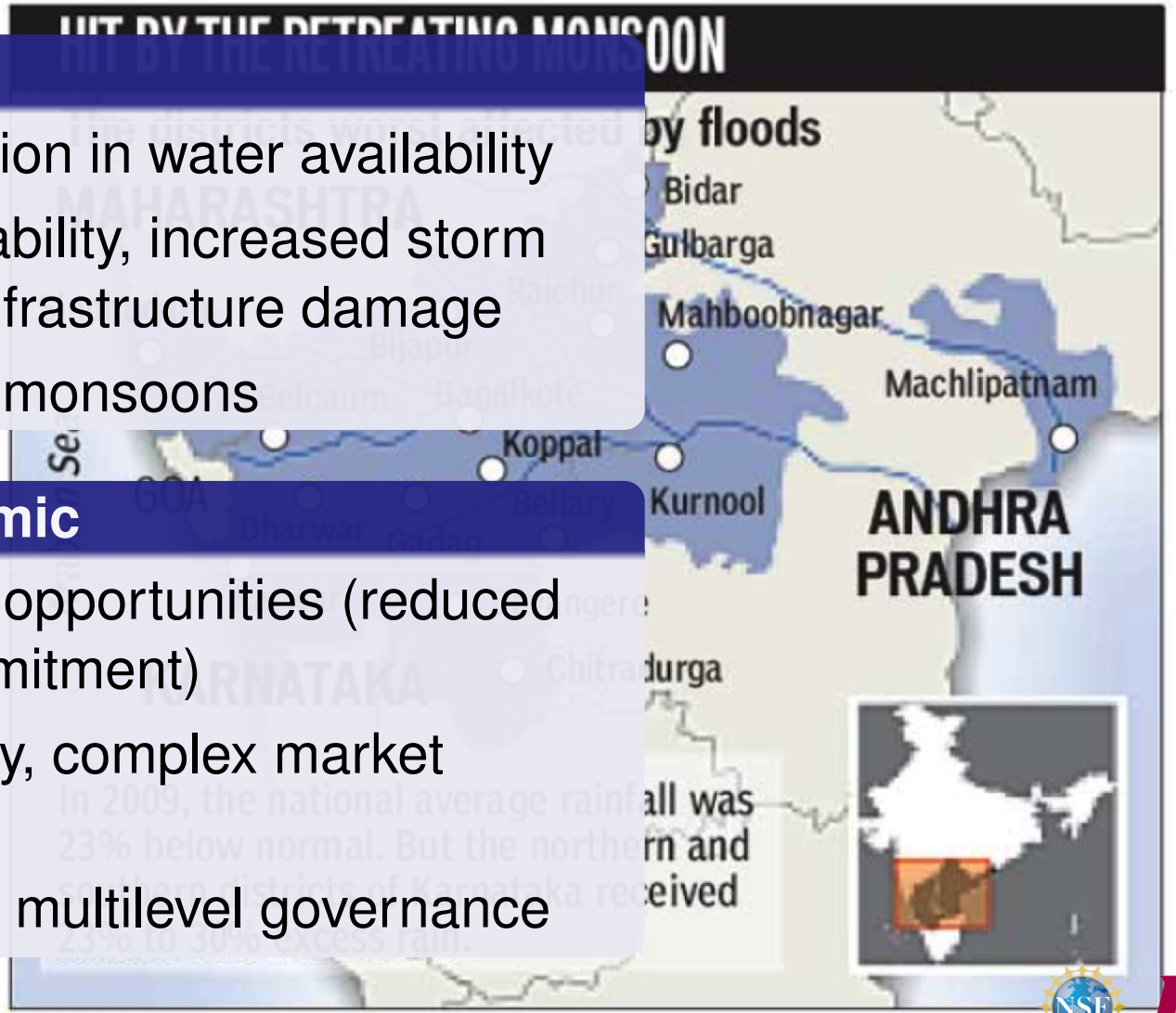
Globalization Challenges for Irrigation SESs

Climate

- General reduction in water availability
- Increased variability, increased storm intensity and infrastructure damage
- Later arrival of monsoons

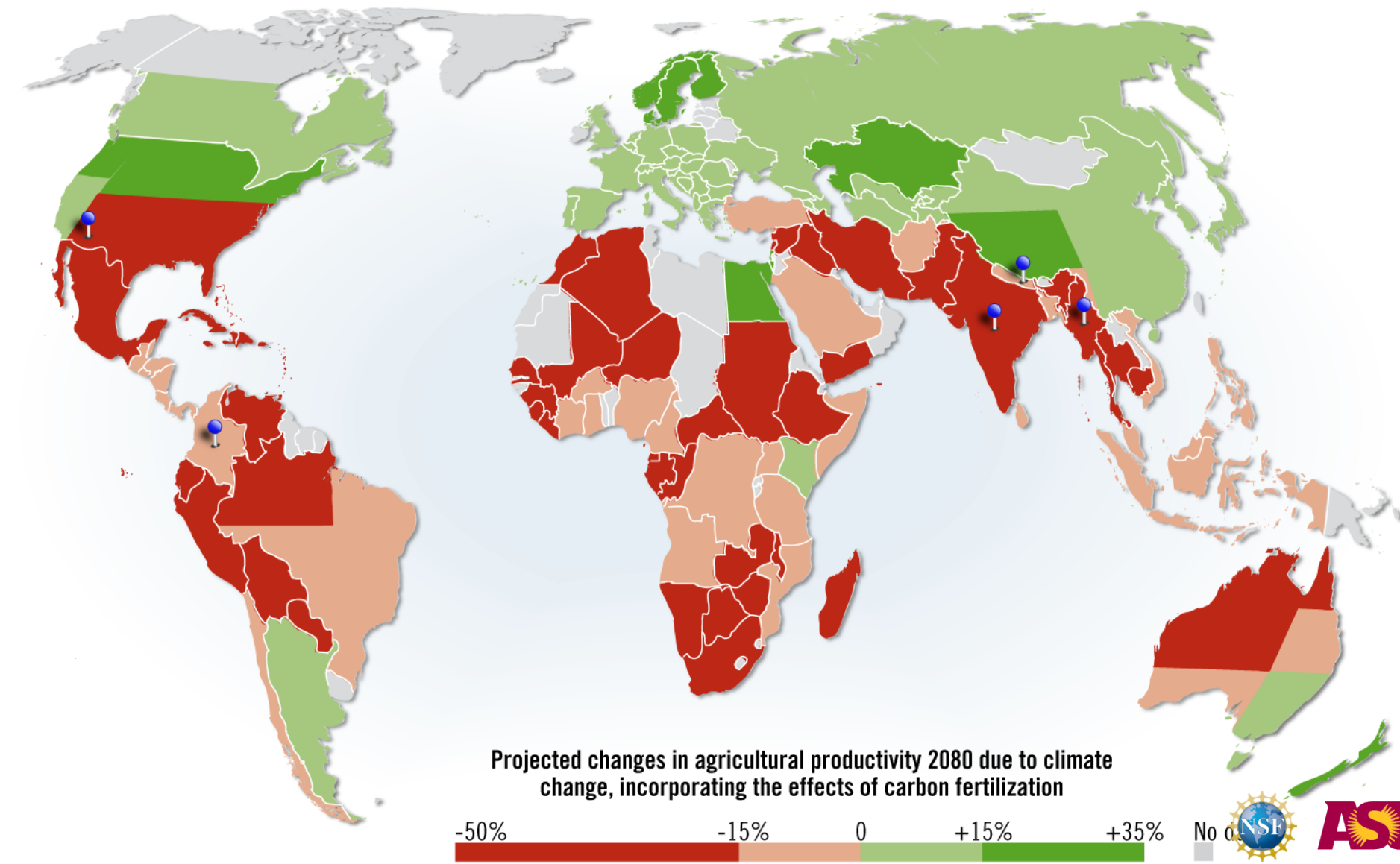
Social and Economic

- New livelihood opportunities (reduced labor and commitment)
- New technology, complex market interactions
- National/local - multilevel governance



(Source: Hindustan Times)

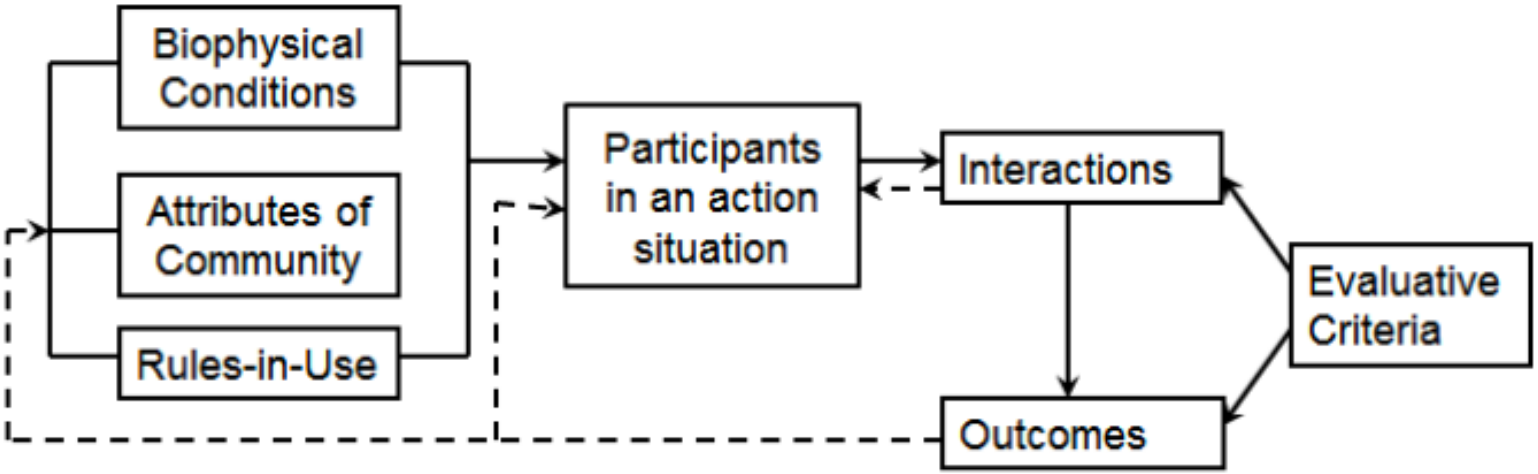
Scale of Change



Research: Organizing Principles

- Adaptive capacity of small-scale SESs is important for sustainable food production,
- Important to link local governance systems into multilevel governance structures,
- Governance must address robustness-fragility trade-offs inherent in these systems.

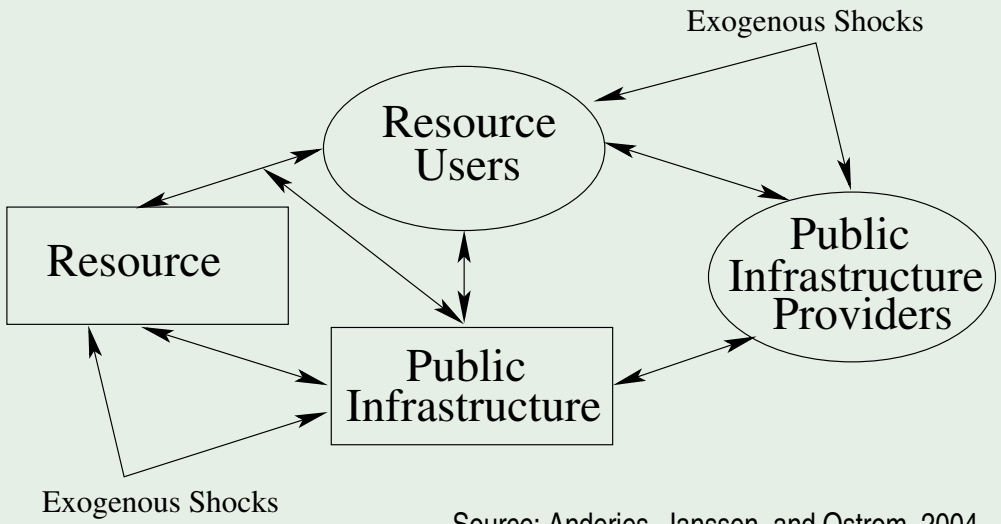
Extension of the IAD Framework



Static analysis: Constellation of factors that promote successful collective action and self-organizing governance.

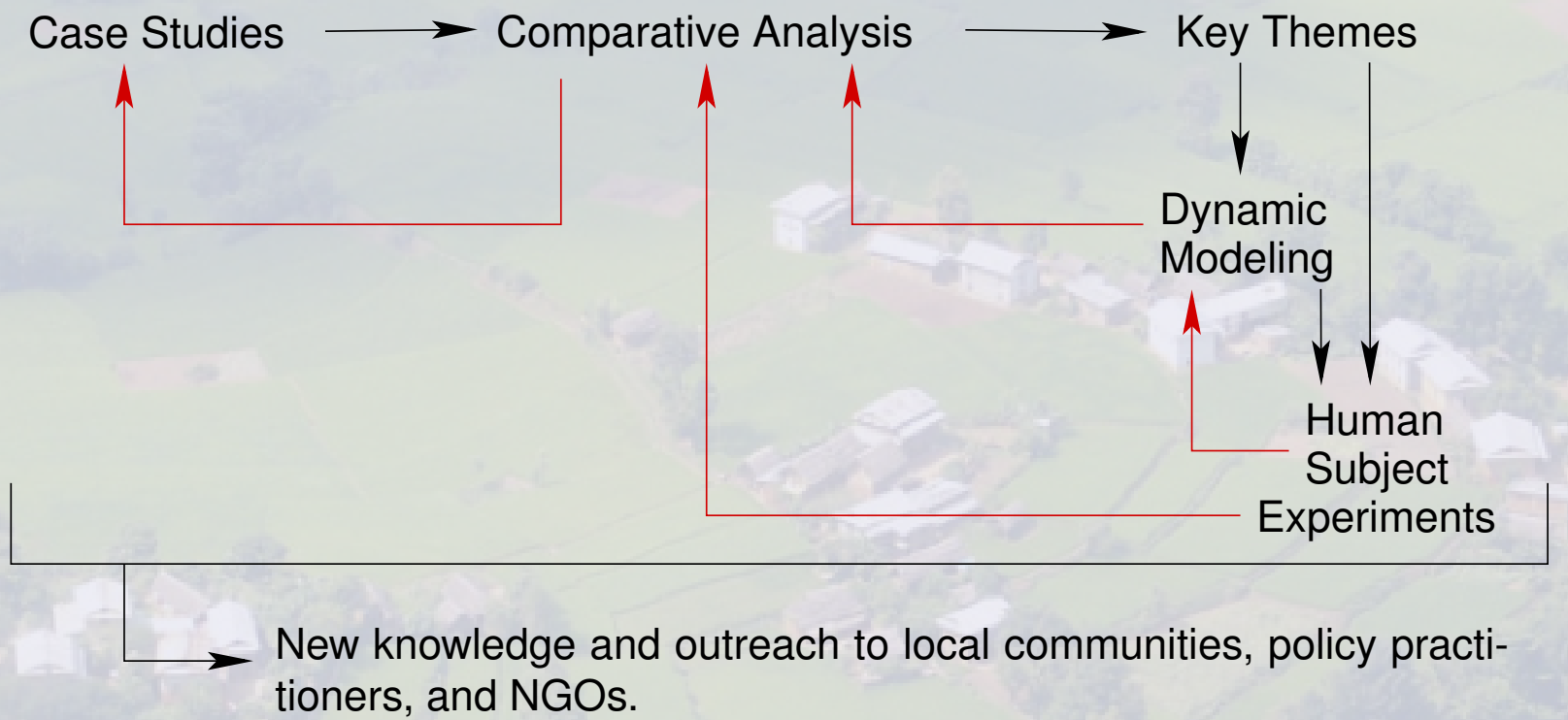
Extension of the IAD Framework

Dynamic analysis: Constellation of factors that affect social-ecological systems' ability to maintain capacity for collective action, adapt their governance structures, and continue to function in the face of change.



Source: Anderies, Janssen, and Ostrom, 2004

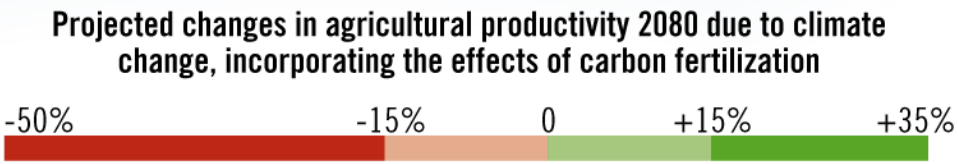
Research Methods: An Iterative, Multimethod Process



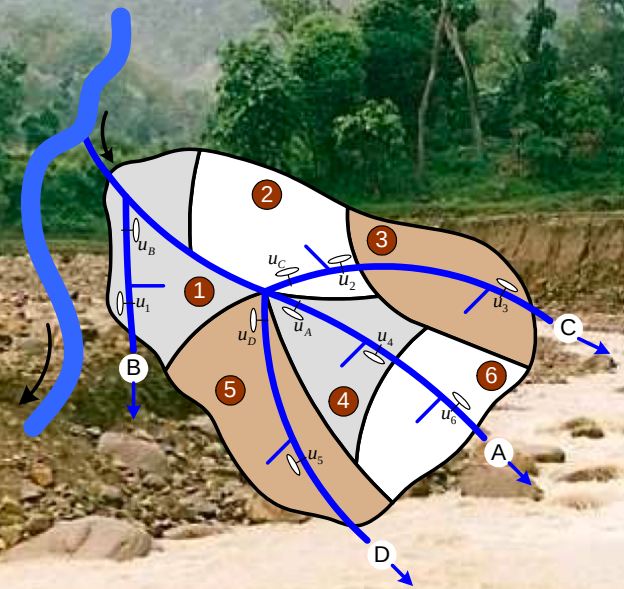
Examples

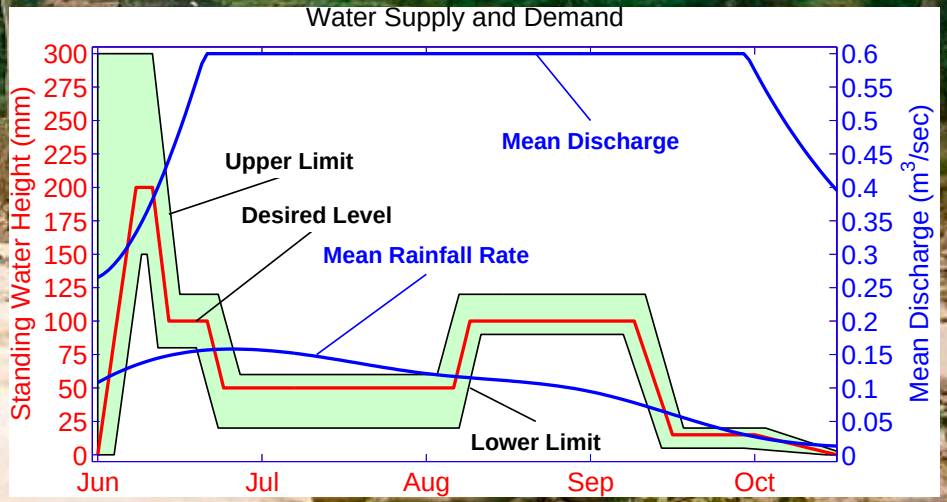
Specific Examples-NSF Sponsored Projects

- Dynamical systems/robustness analysis of the Pumpa irrigation system in Nepal.
- Human subject experiments of collective action in commons dilemmas.



Irrigation System Management and Robustness



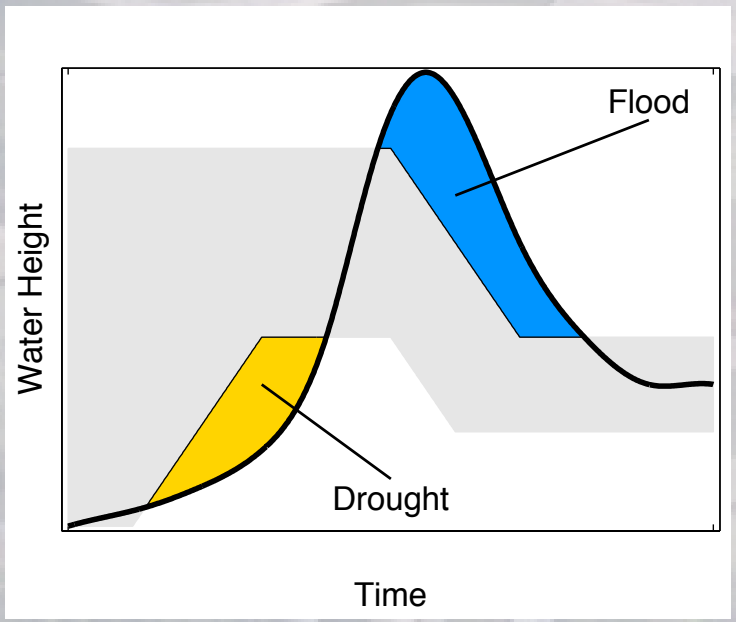


System Characteristics

- 120 Households, 6 regions with priorities
- Crop: Rice paddy. Water demand is greatest in the first 2 weeks.
- Headgate constraint

Adaptive Governance and Performance

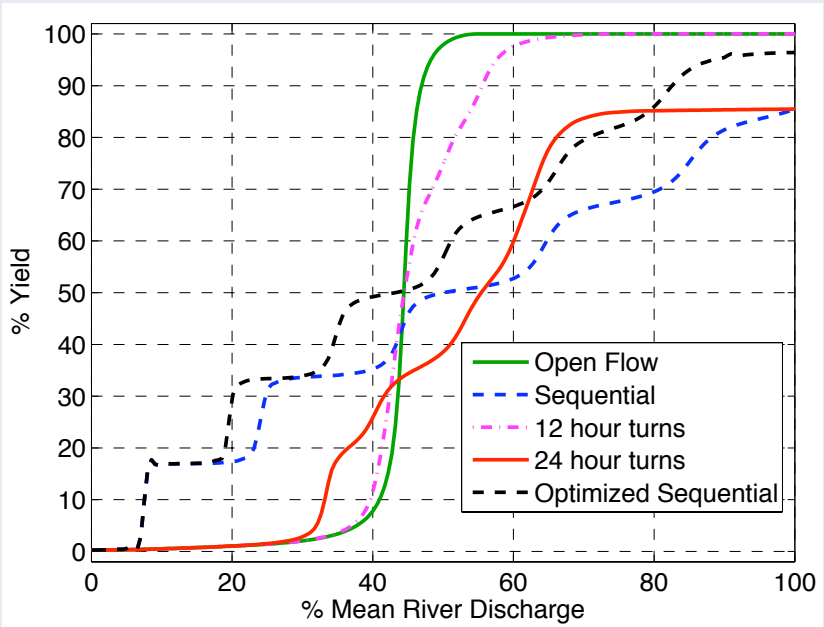
Performance

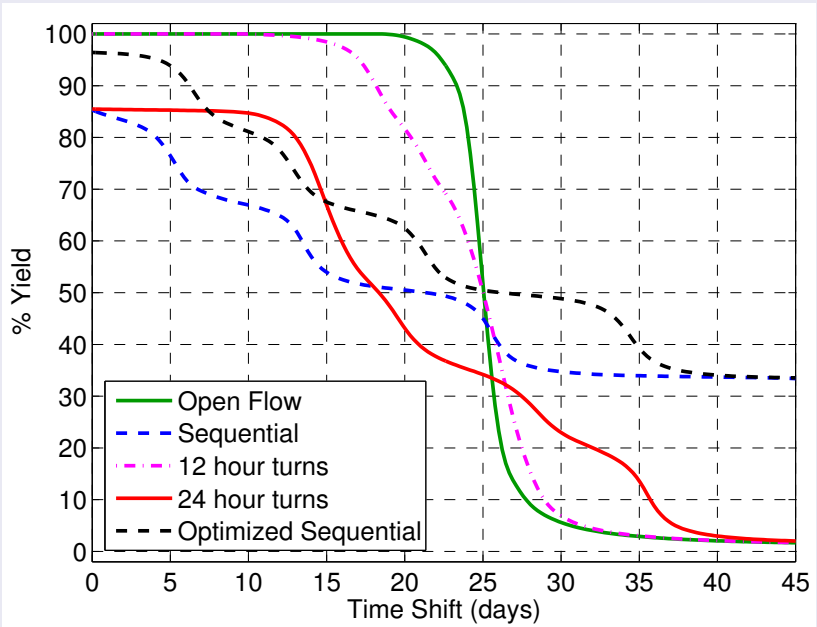


Governance

- Water delivery coordination: Open Flow, Sequential rotations, 12 and 24hr clock rotations.
- Upstream-downstream asymmetry
- Mobilize labor for canal maintenance and repair

Performance: Open Flow Versus Sequential





Performance: 12 and 24 hour rotations?

Formal Modeling-Case Study interaction

- Model predictions for 12 and 24 hour rotations forced a revisit of case study data.
- Follow up with irrigators: only use 12 and 24 hour rotations under extremely low water conditions (headgate washout).
- Headgate washout scenarios: 12 hour most equitable and highest performance, 24 hour maximum fairness in very bad situations.

What have we learned?

Adaptive Governance:

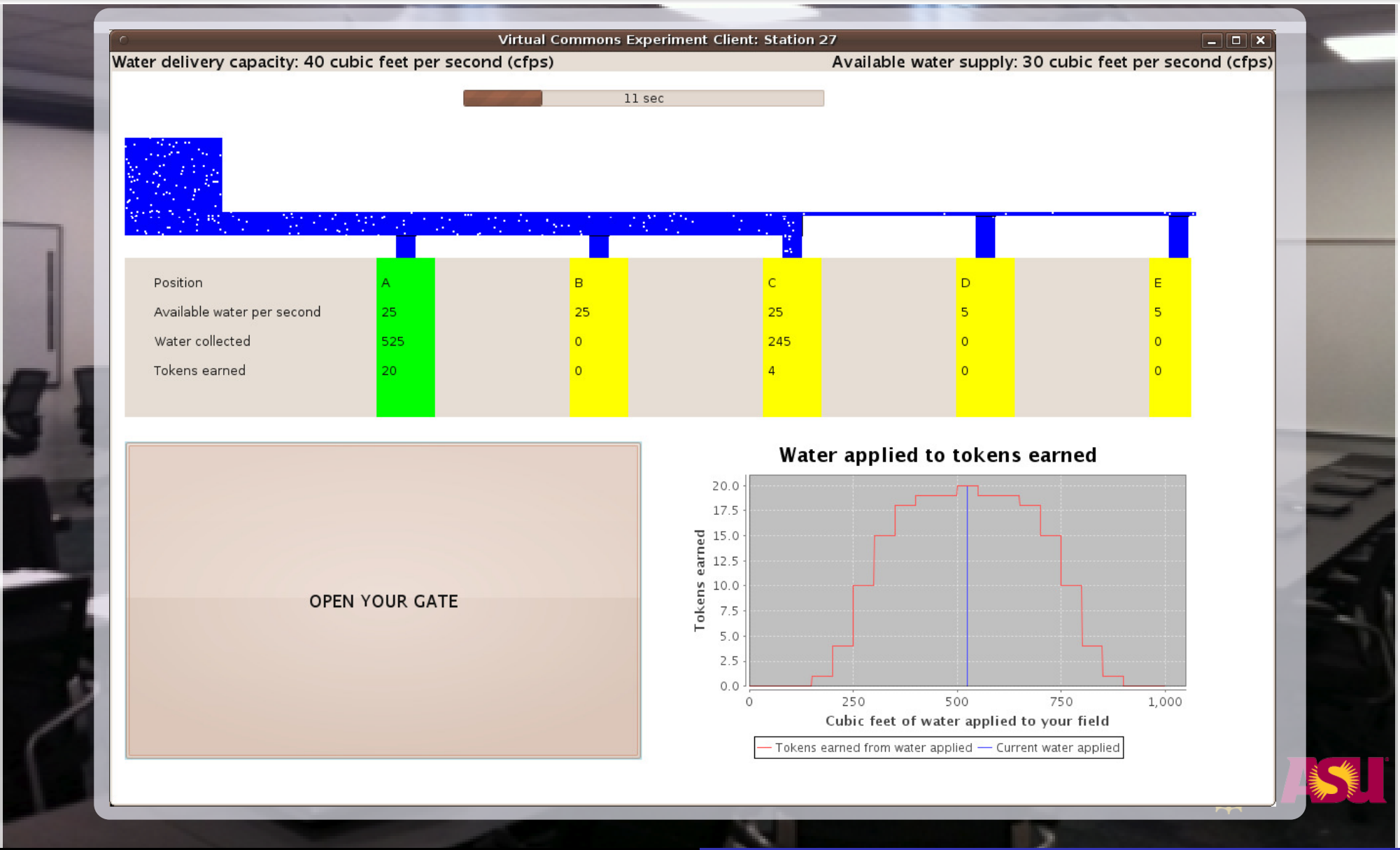
- Can effectively coordinate water delivery, manage conflict (balance equity, fairness, performance) and increase the robustness of the system up to a point
- **BUT** has become well-tuned to local biophysical context and
- Assumes effective collective action (strongly aided by biophysical context).

What about collective action?

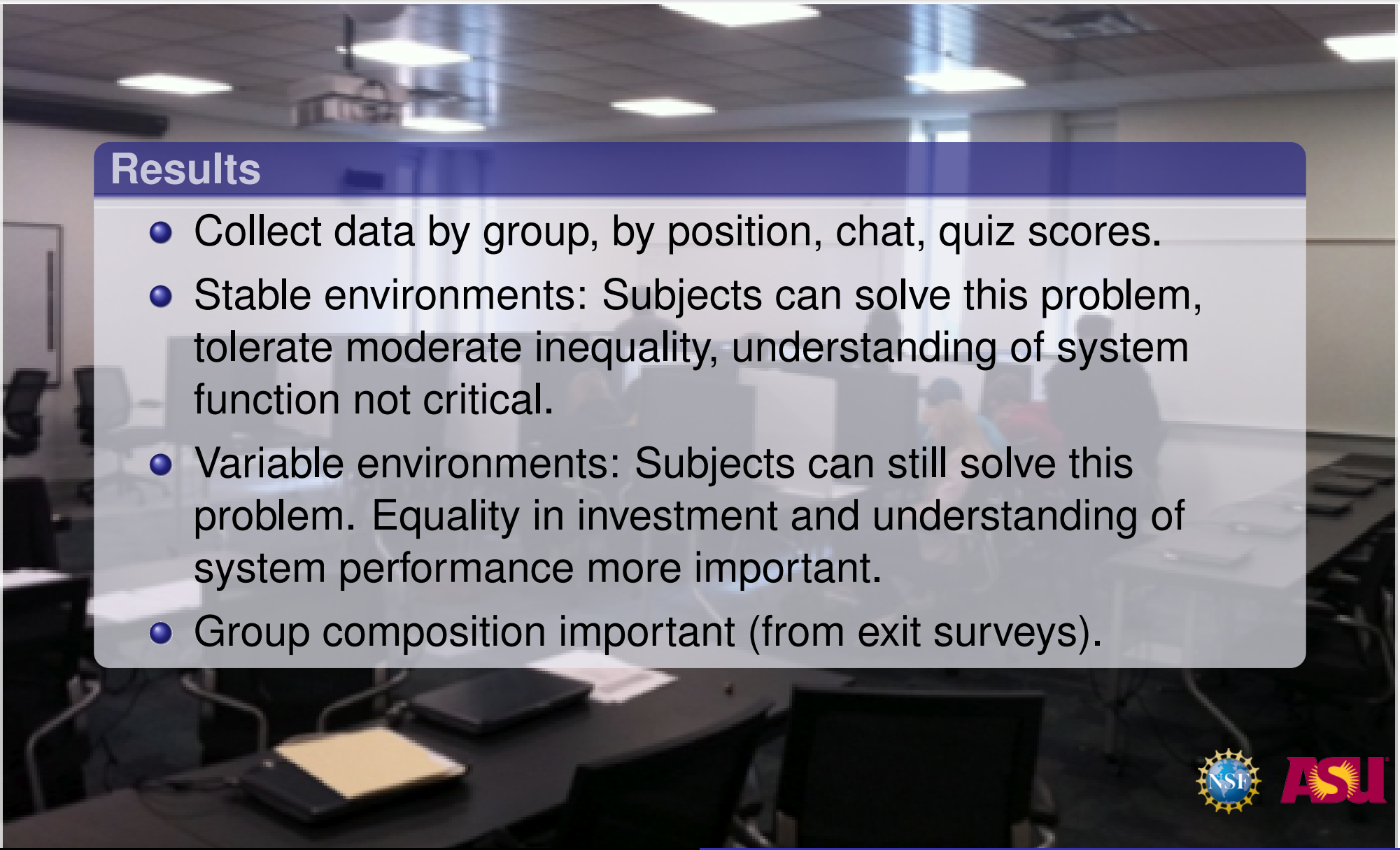
- Changing disturbance regimes and livelihood options
- Experiments to mimic irrigation dilemmas

In the lab

In the lab


Virtual Commons Experiment Client: Station 27
Water delivery capacity: 40 cubic feet per second (cfps)
Available water supply: 30 cubic feet per second (cfps)
11 sec
Position A B C D E
Available water per second 25 25 25 5 5
Water collected 525 0 245 0 0
Tokens earned 20 0 4 0 0
OPEN YOUR GATE
Water applied to tokens earned
Tokens earned
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
250
500
750
1,000
Cubic feet of water applied to your field
Tokens earned from water applied
Current water applied

In the lab

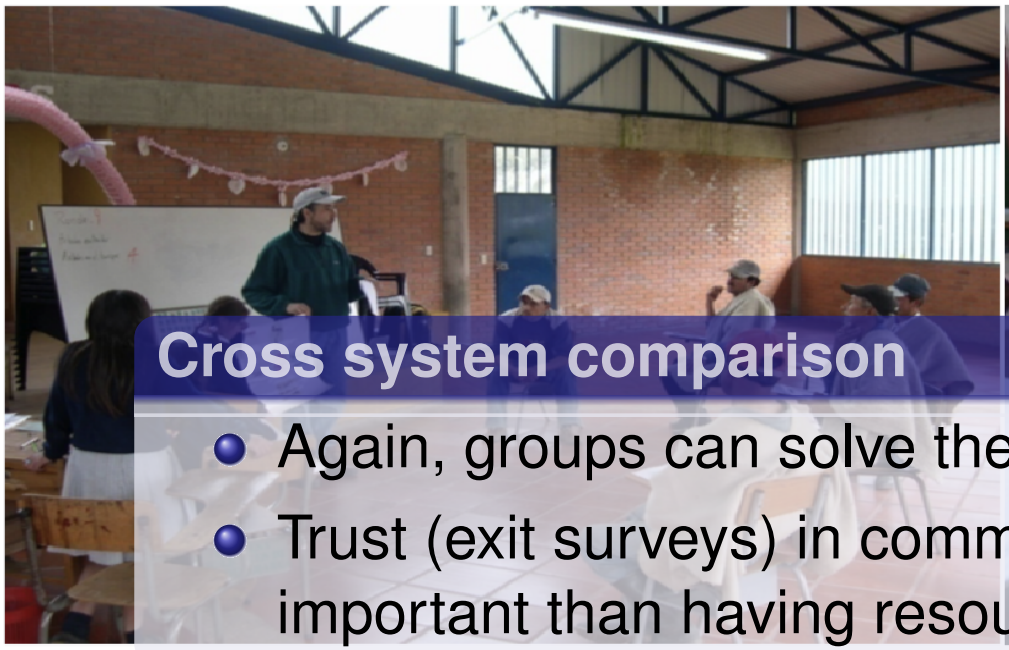


Results

- Collect data by group, by position, chat, quiz scores.
- Stable environments: Subjects can solve this problem, tolerate moderate inequality, understanding of system function not critical.
- Variable environments: Subjects can still solve this problem. Equality in investment and understanding of system performance more important.
- Group composition important (from exit surveys).

In the field - does context matter?

In the field - does context matter?

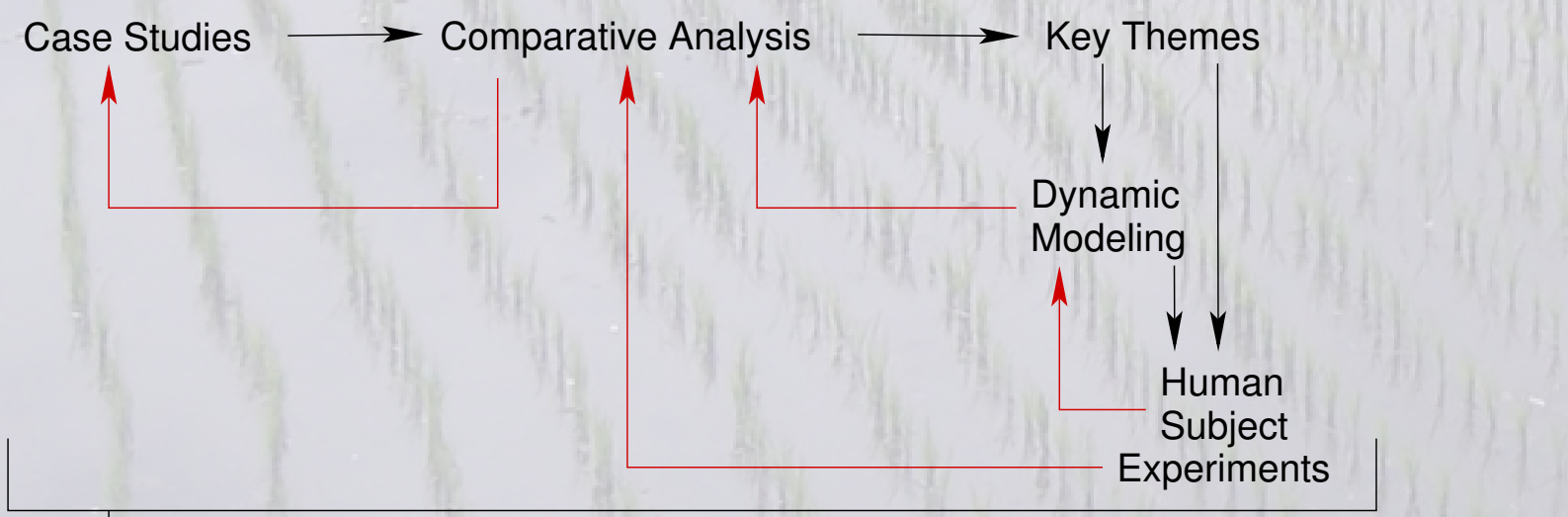


Cross system comparison

- Again, groups can solve the collective action problem.
- Trust (exit surveys) in community members is more important than having resource use experience.

Summary

Iterative, Multimethod Research Process



Institutional design principles to:

- Help link local SESs to multilevel governance structures,
- Enhance existing robustness properties while managing associated robustness-fragility trade-offs,
- Build capacity to cope with global change.

Find out more at csid.asu.edu

ASU SCHOOL OF HUMAN EVOLUTION & SOCIAL CHANGE

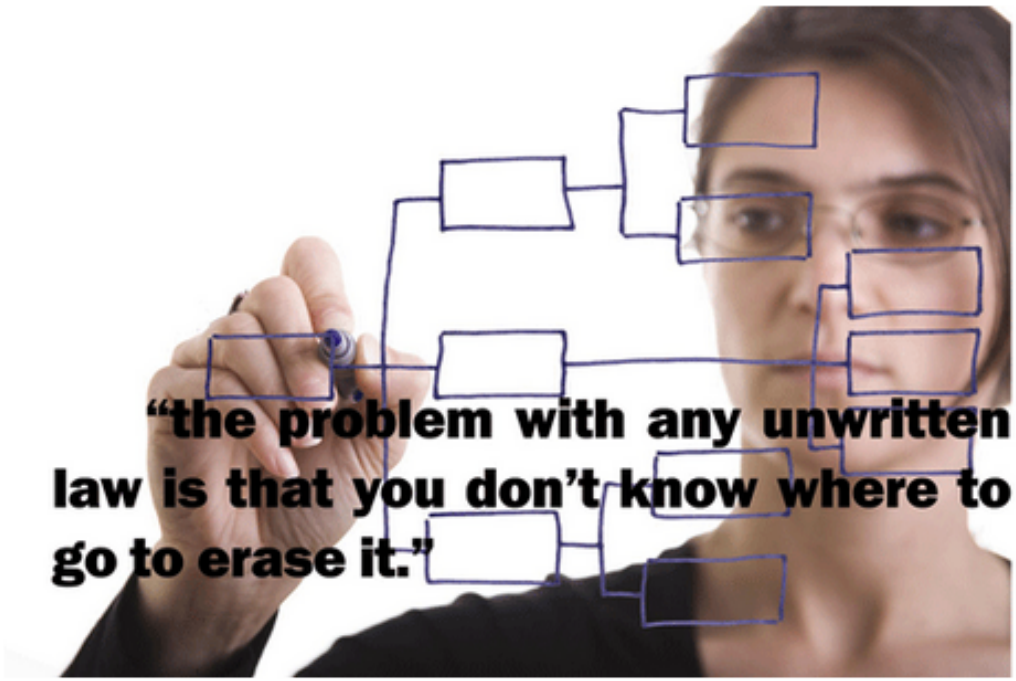
ASU Home | My ASU | Colleges & Schools | A-Z Index | Directory | Map | John SIGN OUT

CLAS ASU Search CLAS Search

CENTER FOR THE STUDY OF INSTITUTIONAL DIVERSITY

- About Us
- My account
- Contact Us
- People
- Research
- SES Library
- News
- Publications
- Working Paper Series
- Events
- Workshops
- Elinor Ostrom Multi-Method Lab
- Education
- Partners and Collaborators
- Resilience 2011
- Email Us
- Helpful Links

Location



In the News

- Hurtado elected to the American Academy for Arts and Sciences
- Ostrom listed in TIME's Top 100 of most influential people
- Ostrom and Janssen at Planet Under Pressure conference
- Museum exhibit of Hruschka's research on ethical dilemmas
- Anderies awarded new NSF grant
- Researchers studying 10,000 Solutions project
- Janssen receives Leopold Leadership Fellowship
- Hill links human uniqueness to hunter-gatherer group structure

Credits

- Collaborators
  - USA, ASU/IU: M. Janssen, A. Lee, O. Cifdaloz, A. Regmi, A. Rodriguez, R Aggarwal, R. Muneepeerakul, E. Ostrom
  - Thailand/Nepal, Asian Institute of Technology: G. Shivakoti, R. Bastakoti
  - Columbia, Universidad de los Andes: J. Camillo-Cardenas
- Financial Support
  - NSF CNH: When Strengths Can Become Weaknesses: Emerging Vulnerabilities in Coupled Natural Human Systems under Globalization and Climate Change (GEO-1115054).
  - NSF HSD: Integrated Analysis of Robustness in Dynamic Social Ecological Systems (BCS-0527744).