Challenges for Achieving Conservation and Development

Elinor Ostrom

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How Do the Social and Ecological Interact to Generate Robust SESs?

- Ecological systems vary immensely
- Social systems also exhibit immense variety
- Both are COMPLEX
- Each SES is unique ð as is each human
- SESs are structured by multiple variables that affect patterns of outcomes over time
- Need to develop our diagnostic skills so we can develop capacity to predict, explain, and improve

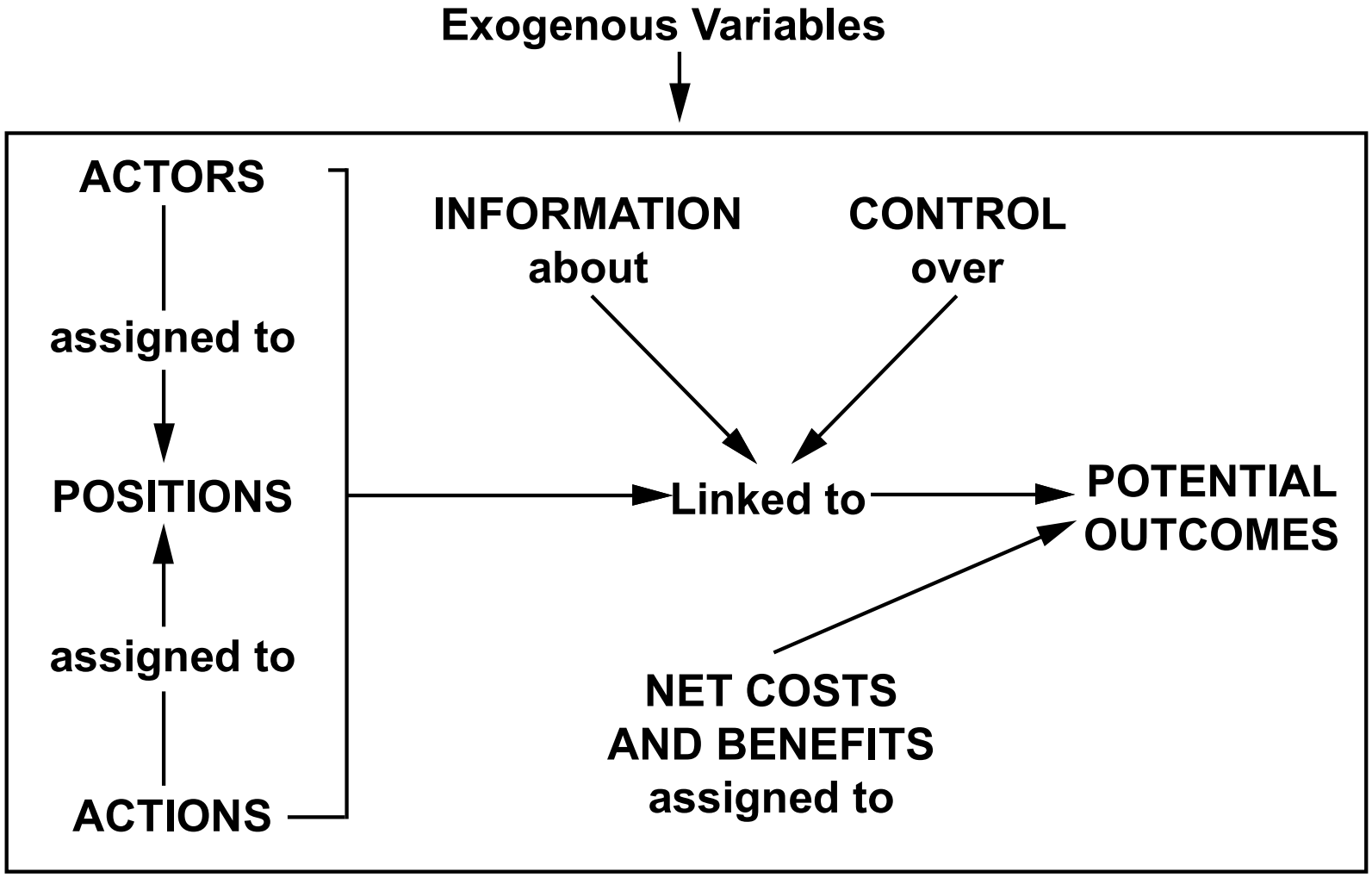
Narrow Disciplinary Boundaries Limit Our Scientific Progress

- We need to be developing analytical approaches that draw on disciplinary knowledge but help us to integrate interdisciplinary understanding
- One approach is building a common framework and using it to conduct research related to performance of SESs in regard to governance, productivity, resilience, equity, etc.
- Today, I will discuss in some depth a framework published in *PNAS* in 2007 and in *Science* in 2009 and future research plans

Many Years of Experience Studying Action Situations

- A tool for the analysis of games, experimental settings, case studies, design of research instruments for collecting large sets of comparable data about a common set of micro-level variables
- Have studied action situations embedded in police agencies, irrigation systems, and forests
- Now working with colleagues (here in Madison and across the world) to develop a broader and common framework to include all SESs at multiple scales

The internal structure of an action situation

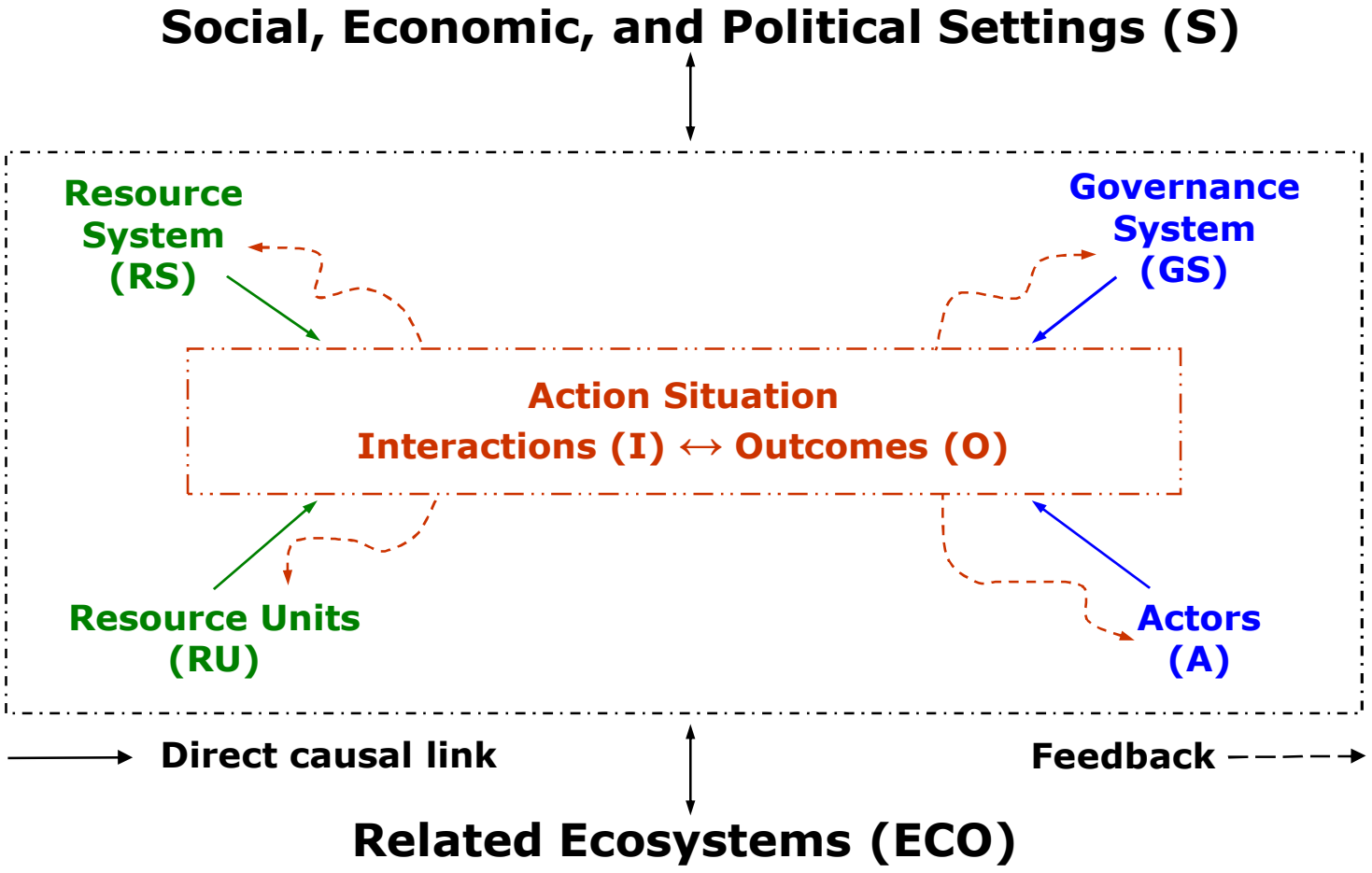


Source: Adapted from Ostrom (2005: 33).

A Broader SES Framework

- Building on 30 years of work using IAD, now need to broaden our metadisciplinary language to posit a broad set (and subsets) of structural variables on Action Situations (and resulting interactions and outcomes)
- A framework provides a method for unpacking the common components of a SES
- A focal system under analysis could be a lake, a river, a fishery, a forest, or the global atmosphere
- All focal systems are composed of four internal systems embedded in two external systems

Action situations embedded in broader social-ecological systems



Source: Adapted from Ostrom (2007: 15182).

How Does a Common Framework Help Us Understand Complex SESs?

- Helps identify variables that affect the structure of Action Situations leading to interactions and outcomes
- Helps us to study similar systems that share some variables while differing in others
  - Avoids overgeneralization (all resources should be privately or government owned) or overspecification (my case is different than yours)
- To diagnose why some systems are not sustainable, have to study similar systems over time and examine which variables differ to enable some systems to survive disturbances while others do not

Initial Second-Tier Variables

- Identified a broad set of variables frequently mentioned in empirical studies of SESs as being important
- Most of these variables have sub-types and sub-sub-types that may themselves be very important in affecting interactions and outcomes
- Several groups of scholars in the US and Europe are working on developing the diagnostic framework further, but letûs look at the currently identified second-tier variables
  - Stars next to variables identified by researcher as associated with self-organization to govern resources

Second-tier variables of a SES

Social, Economic, and Political Settings (S)
S1- Economic development. S2- Demographic trends. S3- Political stability.
S4- Government resource policies. S5- Market incentives. S6- Media organization.

Resource Systems (RS)

RS1- Sector (e.g., water, forests, pasture, fish)
RS2- Clarity of system boundaries
RS3- Size of resource system*
RS4- Human-constructed facilities
RS5- Productivity of system*
RS6- Equilibrium properties
RS7- Predictability of system dynamics*
RS8- Storage characteristics
RS9- Location

Governance Systems (GS)

GS1- Government organizations
GS2- Nongovernment organizations
GS3- Network structure
GS4- Property-rights systems
GS5- Operational rules
GS6- Collective-choice rules*
GS7- Constitutional rules
GS8- Monitoring and sanctioning processes

Resource Units (RU)

RU1- Resource unit mobility*
RU2- Growth or replacement rate
RU3- Interaction among resource units
RU4- Economic value
RU5- Number of units
RU6- Distinctive markings
RU7- Spatial and temporal distribution

Actors (A)

A1- Number of actors*
A2- Socioeconomic attributes of actors
A3- History of use
A4- Location
A5- Leadership/entrepreneurship*
A6- Norms/social capital*
A7- Knowledge of SES/mental models*
A8- Importance of resource*
A9- Technology used

ACTION SITUATIONS [Interactions (I) → Outcomes (O)]

I1- Harvesting levels of diverse actors
I2- Information sharing among actors
I3- Deliberation processes
I4- Conflicts among actors
I5- Investment activities
I6- Lobbying activities
I7- Self-organizing activities
I8- Networking activities

O1- Social performance measures (e.g., efficiency, equity, accountability, sustainability)
O2- Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)
O3- Externalities to other SESs

Related Ecosystems (ECO)
ECO1- Climate patterns. ECO2- Pollution patterns. ECO3- Flows into and out of focal SES.

***Subset of variables found to be associated with self-organization.**

To Do Good Research — Must Choose a Question Carefully

- One question is: When will the users of a CPR self-organize?
- Hardin said never!
- Many policies based on that conclusion
  - Governments must impose uniform solutions on all forests, fisheries, or water systems in their jurisdictions
  - Many failures ð and some successes
- But when will the users themselves organize?
- And why will some survive disturbances and others collapse?

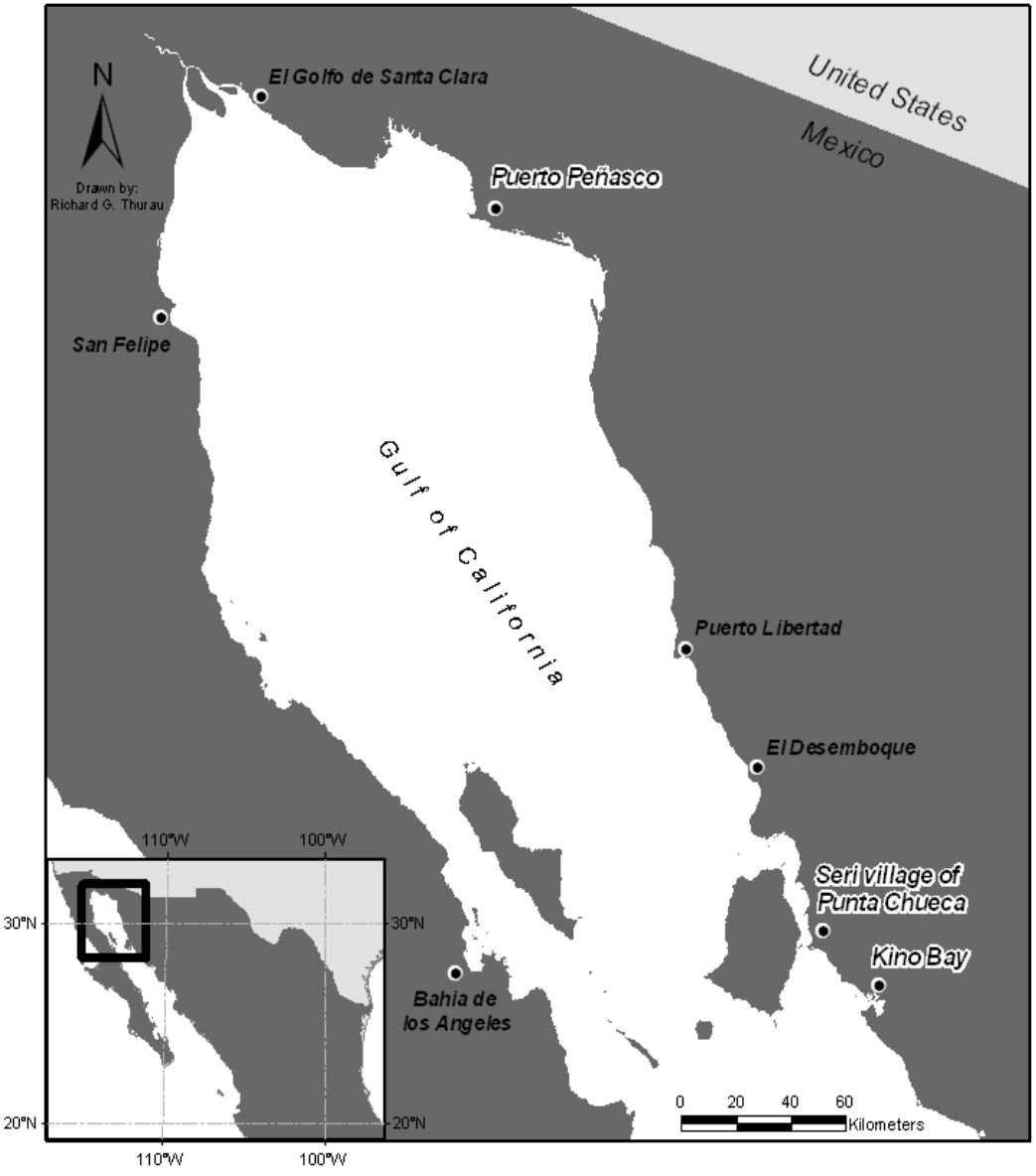
Research Has Now Identified Variables Conducive to Self-Organization

- Have developed a formal model of the calculus that users are likely to use in calculating whether they invest or not in costly self-organization
- Relevant benefits and costs specified in the model extremely difficult to measure in the field
- Scholars have identified the starred variables as affecting probability of self-organization
- Empirical research is supportive of this theory ð more is needed

To Illustrate Use of Framework — Compare Three Cases in Mexico

- Rarely have quantitative information about the specific benefits and costs for particular users
- With good fieldwork, however, can make an estimate of the differences among cases on a key set of diagnostic variables similar to those that are starred in the framework and discussed above
- Illustrate the variables discussed above with an example for the Gulf of California studied by Xavier Basurto

Three fishing villages in the Gulf of California, Mexico



Harvesting of the sessile mollusk sea pen shell

Left to right. **Photo#1:** Two adult specimens of the sessile bivalve mollusk commonly known as sea pen shell (Atrina tuberculosa) and harvested by small-scale fishers of the three communities under study. **Photo #2:** Shows two abductor muscles pertaining to the two individuals of photo#1. Sea pen shells are harvested for their abductor muscle, which reaches high prices in the Mexican national seafood market. Fishers are paid up to $20 usd per kilogram at the beach ï therefore there is great demand for them. Only shrimp and abalone reach such high prices. Their U.S. analogue are bay scallops. **Photo #3:** Typical small-scale fishing boat used in the Gulf of California, Mexico. Benthic mollusks are harvested by diving (photo #4), note the air compressor in the middle of the boat in photo 3 that provides air to the diver in photo # 4. Diver in **Photo # 4** is walking on the bottom (using plastic boots) harvesting sea pen shells in a shallow fishing area.

Comparison of key variables for three coastal fisheries in the Gulf of California

	Kino	Peñasco	Seri
Actors (A)			
A1 (number of actors)	Rapid growth	Rapid growth	Slow growth
A5 (local leadership)	Absent	Present	Present
A6 (trust and reciprocity)	Lacking	High levels	High levels
A7 (shared local knowledge-mental models)	Lacking	High levels	High levels
A8 (dependence on resource)	Low	High	High
A9 (technology)	Same	Same	Same
Governance System (G)			
GS4 (formal property rights)	Absent	Absent	Present
GS5 (operational rules)	Present	Present	Present
GS8 (monitoring and sanctioning)	Mostly absent	Mostly present	Mostly present
Resource System (R)			
RS3 (resource size)	Large	Small	Small
RS5a (indicators)	Least available	Moderately available	Mostly available
RS7 (predictability)	Least predictable	Moderately predictable	Moderately predictable
Resource Units (RU)			
RU1 (Resource unit mobility)	Low	Low	Low
Successfully self-organized	No	Yes	Yes

Two SESs are Self-Organized

- Peñasco and Seri SESs were similar on most variables
- Kino was different ð the Resource Size (RS3) of Kino was MUCH larger
- Indicators of the productivity of the system (RS5a) less in Kino than the other two
- Predictability of system (RS7) less for Kino
- Local leadership (A5) in Kino was absent
- Trust and reciprocity (A6) in Kino were absent

Kino Bay = Open access

Sea pen shells have been overexploited (Moreno et al., 2005)

This is a picture showing the number of boats working off Kino Bay fishing grounds. Kino Bay is governed under an open-access regime. Our boat counts regularly yielded 70+ boats, a symptom of their inability to control access to other fishers. As a result of the open-access regime, their sea pen shell fishery (sea pen shells = a sessile mollusk that lives buried in the sand) has been overexploited. In this context, overexploitation is measured by fishersô inability to sustain constant harvesting of sea pen shells year-round before they become too scarce and small in size. In contrast, the Seri are able to sustain their fishery over time.

Seri Village of Punta Chueca

In the Seri village of Punta Chueca (which means crooked point), the Seri have developed a common-property regime to govern their sea pen shell fishery, and successfully control the number of boats that have access to their fishing grounds. At any given time, you observe only 10ï 15 outboard motor boats using their fishing grounds.

Two SESs have a chance of being robust over time because they self-organized, but is self-organization sufficient?

- No!
- The reserve set up in Peñasco was so successful, it attracted fishers from miles away after they had destroyed their own fisheries. Mexican government did not support their right to their own rules. Key design principles not present.

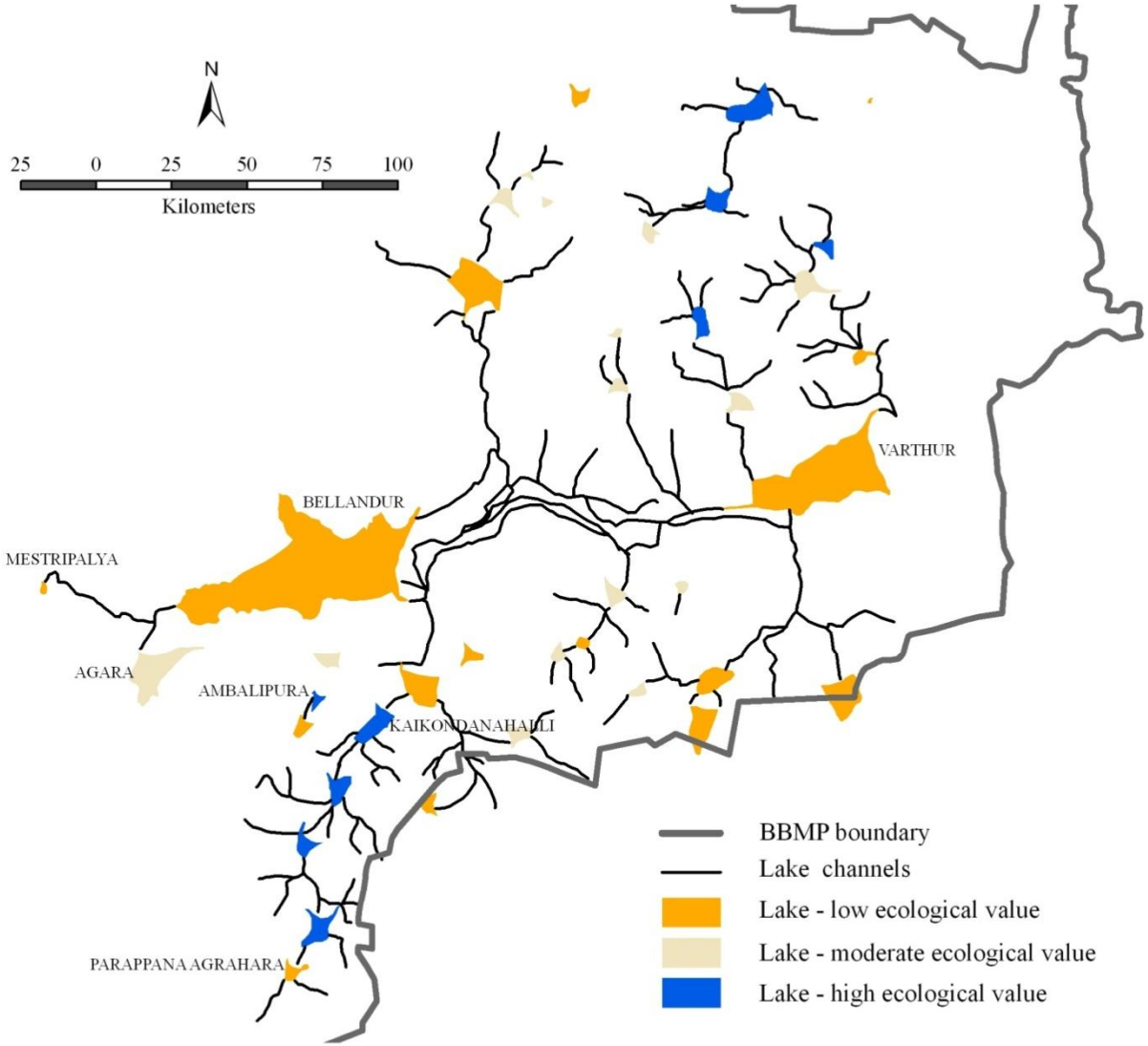
Which Design Principles Were Absent?

- Boundaries of actors and resource are clear
- Congruence between benefits and costs
- Actors had procedures for making own rules
- Regular monitoring of actors and resource conditions
- Graduated sanctions
- Conflict-resolution mechanisms*
- Minimal recognition of rights by government*
- Nested ï or polycentric ï enterprises*

Now, let us move across the Pacific to Bangalore, India

- Working with Harini Nagendra in using the SES framework to understand why such differences in the quality of the lakes
  - In earlier times local villages were responsible maintaining the lakes but Bangalore now governed by multiple large scale agencies
- Let us first look at a map of the extensive lake system in Bangalore and then at then at a couple of pictures that illustrate the differences among them.

Ecological condition of a sub-chain of lakes in south-east Bangalore



Kaikondanahalli lake ï formerly polluted but recently restored through collaboration between residents and government, now in good ecological condition

Varthur lake ï one of the larger lakes at the end of the lake chain, heavily polluted with sewage as well as toxic hospital effluents and industrial waste

Now let me share our initial analysis of the SES variables for 7 of these lakes

	Agara	Ambalipura	Bellandur	Kaikondanahalli	Mestripalya	Parappana Agrahara	Varthur
Resource System (RS)							
RS3: Size of resource system	Moderate	Small	Large	Moderate	Small	Small	Large
RS4-a: Scale and type of pre-existing pollution	High, mostly sewage	Low, mostly sewage	High, toxic sewage and industrial waste	Low, mostly sewage	Low, dry lake	High, mostly sewage	High, toxic sewage and industrial waste
Actors (A)							
A2: Number of actors	Moderate	Moderate	Large	Moderate	Small	Moderate	Large
A2-a: Socioeconomic groups excluded	Yes	No	No	No	Yes	No	No
A5: Leadership	Lacking	Present	Present	Present	Present	Absent	Absent
A6: Norms of trust, social capital	Low	High	Moderate	High	Low	High	Moderate
A8: Importance of resource/ dependence	Low	Moderate	Moderate	Moderate	Moderate	High	Moderate
Governance System (GS)							
GS5: Operational community rules	Absent	Present	Absent	Present	Present	Absent	Absent
Interactions (I)							
I8: Networking with government	Low	High	Low	High	High	Low	Low
I9: Informal norms for monitoring	Absent	Present	Absent	Present	Absent	Absent	Absent
Outcomes (O)							
O1: Social performance measure (collective action)	Moderate	High	High	High	High	Low	Moderate
O2: Ecological performance measure	Low	High	Low	High	Low	Low	Low

Two Lakes Successful on Both Outcome Variables

- One rather small and one moderate but shared similar rankings on *all* other variables
  - Have been able to cope with pollution levels ï the only two to achieve high ecological performance ratings (as well as effective collective action)
  - Networking with government officials ï important interaction to cope with pollutionð usually beyond the scope of the neighborhood surrounding a lake
  - Bangalore is not a polycentric system
  - Some neighborhoods protesting pollution

Polluted water from Bellandur lake - the froth, water color and odor indicate the heavy extent of pollution. The Bellandur village, located nearby, depends on water from ground water wells which have been polluted because of the lake

Protest against the condition of Bellandur lake, by a mixed group of local village residents and affluent corporate sector employees living/working near the lake. February 2011.

Protest and not nested levels of governance

- Responsibility for lakes at large scales divided among multiple agencies
- Responsibility for developing local rules re use practices has been organized by some neighborhood groups very effectively but do not have authority to deal with industry, hospitals, and other sources of pollution
- Polycentricity is not a panacea ï but very important for dealing with nested ecological systems!

Questions