DEPARTMENT
OF ENVIRONMENTAL
STUDIES

Network analysis:

social, ecological, and social-ecological approaches

FSS:ENSb1315 (Spring 2024)

Yanhua Shi & Harald Waxenecker

Session 6

Introduction of the situation-centered institutional analysis:

the Institutional Analysis and Development (IAD) analytical framework

Note: slides preparation accredits to the materials from the seminar course in Institutional Analysis and Development (Y673), Autumn semester 2023, Ostrom Workshop, Indiana University Bloomington

Outline

1. What is an institution?
2. The IAD framework: uncovering its "nested components"
3. Historical development and evolution of IAD
4. Connecting institutional theory with network analysis

Why do we care about studying institutions?

- Recall your previous lectures of network analysis

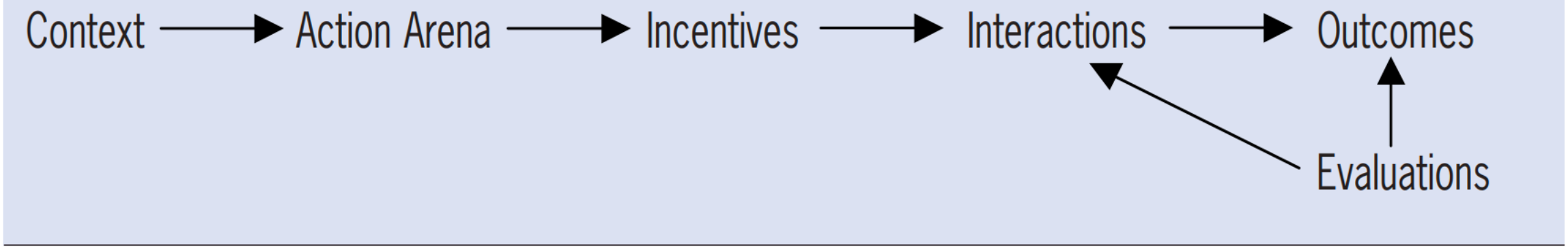
- Key takeaway: Structure Matters in explaining human/agent behavior
- How to understand and study structural influences on behavior?
  - Network analysts: nodes' position in the network;
  - Institutionalists: institutions

- For the following lectures, we explore how institutions and networks can be related

Why do we care about studying institutions?

- Institutions, to a large extend, structure incentives of individual behavior and interactions with others!

Figure 1: The Most General Elements of Institutional Analysis



Source: SIDA report (2002)

Some classic definitions of 'institutions'

- North (*Institutions, Institutional Change and Economic Performance* (1990))

"the humanly devised constraints that structure human interaction…. made up of formal constraints (e.g., rules, laws, constitutions), informal constraints (e.g., norms of behavior, conventions, self-imposed codes of conduct), and their enforcement characteristics."

"Rules of the games"

Some classic definitions of 'institutions'

- Searle (*The Construction of Social Reality* (1995))

A rule or norm created through some "collective intentionality" imposing a "status function" in accordance with "constitutive rules and procedures" attaining "collective acceptance."

Some classic definitions of 'institutions'

- Ostrom (*Understanding Institutional Diversity* (2005))

"Broadly defined, institutions are the prescriptions that humans use to organize all forms of repetitive and structured interactions… Individuals interacting within rule-structured situations face choices regarding the actions and strategies they take, leading to consequences for themselves and for others."

"Institutions are enduring regularities of human action in situations structured by rules, norms, and shared strategies, as well as by the physical world"

Institution v.s. Organization

- Organization:

"…a set of institutional arrangements and participants who have a common set of goals and purposes, and who must interact across multiple action situations at different levels of activity" (Polski and Ostrom 1999)

All organizations (and some institutions) are formed subject to higher level institutions, e.g., establishment of a national park (under National Park Act, in Austria)

Examples of organizations: legislatures, governmental agencies, universities, World Bank, corporates, religious groups, tribes, families, etc.

How do we identify an institutional statement?

What are the differences between rules, norms and shared strategies?

ADICO Grammar of "Institutional Statements"

- Attributes
  - is a holder for any value of a participant-level variable that distinguishes to whom the institutional statement applies (e.g., 18 years of age, female, college-educated, 1-year experience, or a specific position, such as employee or supervisor).
- Deontic
  - is a holder for the three modal verbs using deontic logic: may (permitted), must (obliged), and must not (forbidden).
- aIm
  - is a holder that describes particular actions or outcomes to which the deontic is assigned.
- Condition
  - is a holder for those variables which define when, where, how, and to what extent an AIM is permitted, obligatory, or forbidden.
- Or else
  - is a holder for those variables which define the sanctions to be imposed for not following a rule

Source: Crawford & Ostrom (1995)

ADICO Grammar of "Institutional Statements"

1. All male U.S. citizens, 18 years of age and older, must register with the Selective Service by filling out a form at the U.S. Post Office or else face arrest for evading registration.
2. All senators may move to amend a bill after a bill has been introduced, or else the senator attempting to forbid another senator from taking this action by calling him or her out of order will be called out of order or ignored.
3. All villagers must not let their animals trample the irrigation channels, or else the villager who owns the livestock will be levied a fine.
4. All neighborhood residents must clean their yard when the neighborhood organization organizes a major neighborhood cleanup day.
5. The person who places a phone call calls back when the call gets disconnected.

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Norms: A D I C

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Rules: A D I C O

Norms: A D I C

Shared strategy: A I C

Institutional analysis of environmental and resource governance

Four Types of Goods

The extent to which one's consumption reduces the supply available to others

		Subtractability of Use	
		High	Low
Difficulty of excluding potential beneficiaries	High	*Common-pool resources*: groundwater basins, lakes, irrigation systems, fisheries, forests, etc.	*Public goods*: peace and security of a community, national defense, knowledge, fire protection, weather forecasts, etc.
The extent to which access to the consumption can be controlled	Low	*Private goods*: food, clothing, automobiles, etc.	*Toll goods*: theaters, private clubs, daycare centers

FIGURE 1. FOUR TYPES OF GOODS

Source: Ostrom (2011)

Does the Type of Good Determine the Property System for Managing It?

- Private good: market?
- Public good: state control?
- How to sustainably manage the Commons?

American Economic Review 100 (June 2010): 641–672
http://www.aeaweb.org/articles.php?doi=10.1257/aer.100.3.641

Beyond Markets and States: Polycentric Governance of Complex Economic Systems†

By ELINOR OSTROM*

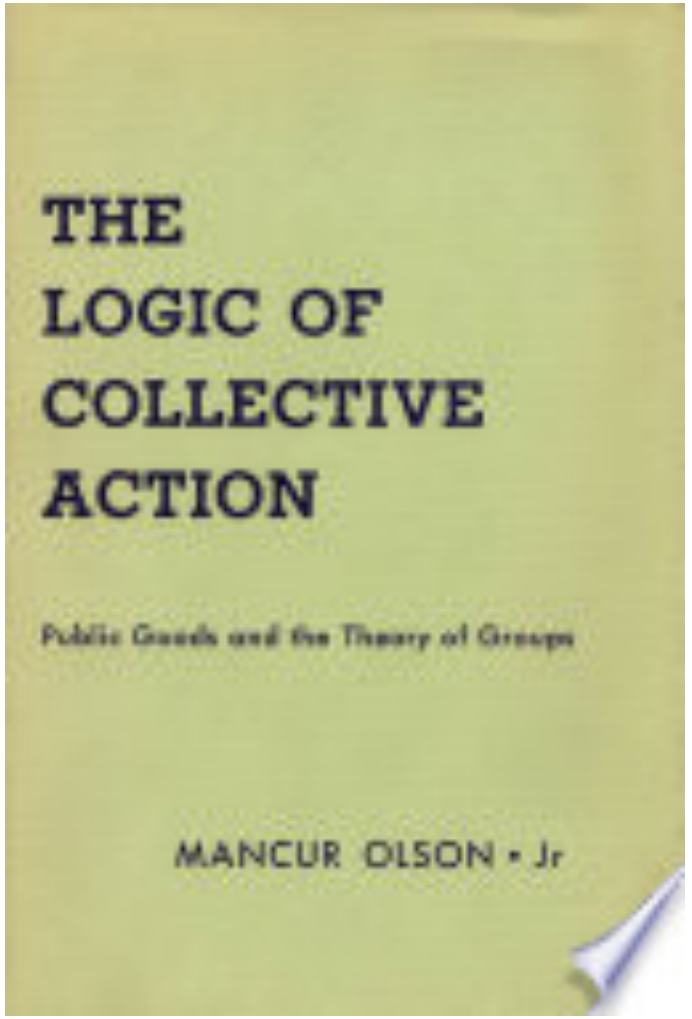
Theories of collective actions

The Logic of Collective Action (Olson 1965)

- "unless the number of individuals is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests."

- The "zero contribution thesis"

- Rational agents were not likely to participate in cooperation, even when such cooperation will lead to their mutual benefits



Tragedy of the commons (Hardin 1968)

The Tragedy of the Commons

Author(s): Garrett Hardin

Source: *Science*, Dec. 13, 1968, New Series, Vol. 162, No. 3859 (Dec. 13, 1968), pp. 1243-1248

Published by: American Association for the Advancement of Science

Tragedy of the commons (Hardin 1968)

- ”Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satis-factorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability be-comes a reality. At this point, the inherent logic of the commons remorse-lessly generates tragedy” (p.1244)

Tragedy of the commons (Hardin 1968)

- "…the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another…But this is the conclusion reached by each and every herdsman sharing a commons. Therein is the tragedy" (p.1244)

Tragedy of the commons (Hardin 1968)

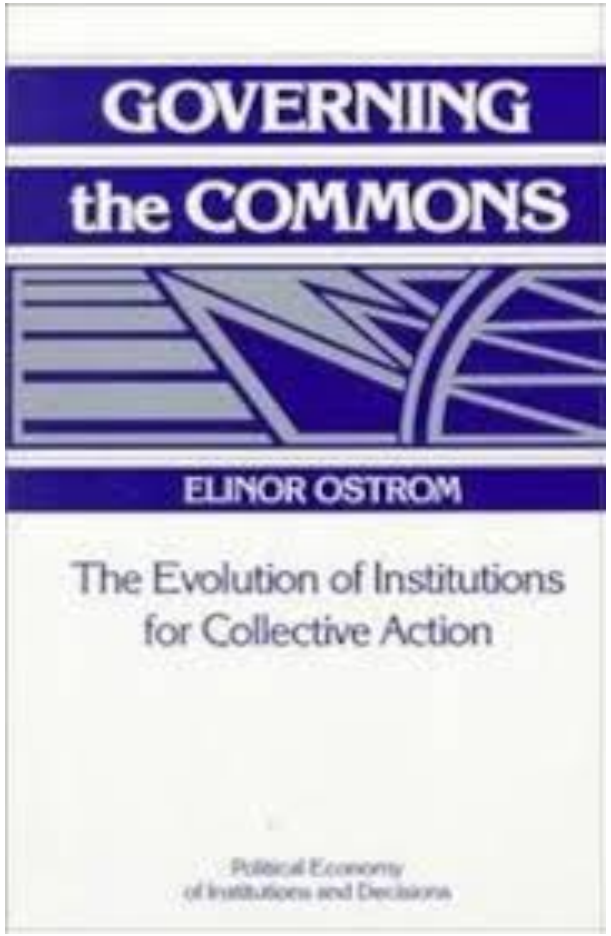
Therefore, Hardin's proposed solution are:

- Privatization;
- State control/top-down management

The underlying propositions made by Olson and Hardin have been adopted in many contemporary public policies, that individuals cannot overcome collective action dilemma, and thus, external forces (e.g., new policies) are needed to achieve their long-term self-interests

Governing the Commons (Ostrom 1990)

- Many empirical observations, where self-organized communities have sustainably managed the common pool resources, contradicted such theory
- Missing of a theory of collective action, that explain such phenomenon
- Governing the Commons: a meta-analysis of existing case studies



Governing the Commons (Ostrom 1990)

- The Eight Design Principles

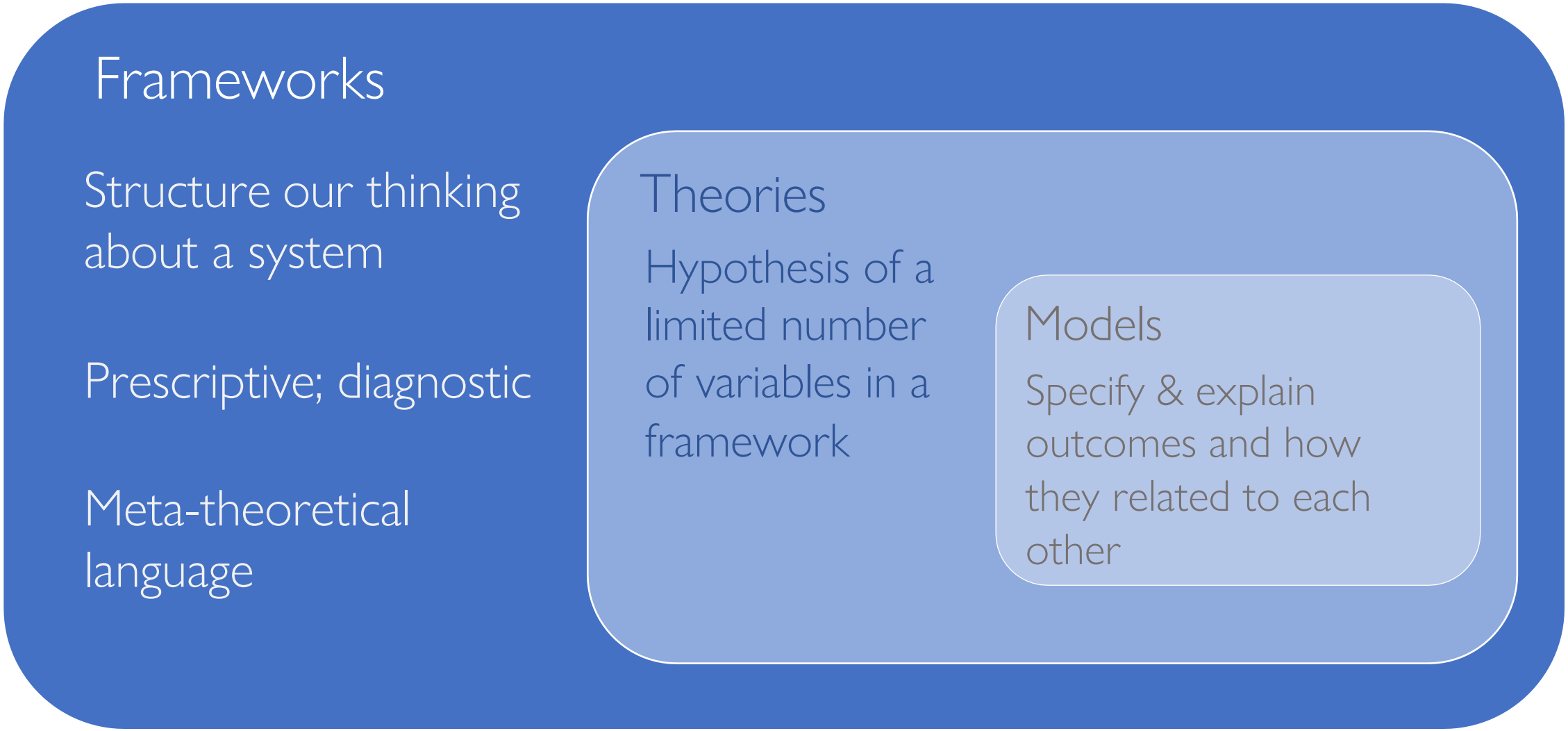
Design Principle	Description
1. Clearly defined boundaries	Membership involving rights to withdraw CPRs and physical boundaries of the resource(s) are clear
2. Congruence between appropriation and provision rules and local conditions	Rules are congruent with local conditions, including consideration of sustainable appropriation quotas
3. Collective choice arrangements	Individuals affected can participate in modifying operational rules
4. Monitoring	Monitors are accountable to the resource users
5. Graduated sanctions	Increasing sanctions apply for against repeat and/or serious rule violators
6. Conflict-resolution mechanisms	Ready access among resource users to low cost conflict resolution process
7. Recognition of rights to organize by external government authorities	Resource management institutions are recognised by government authorities
8. Nested enterprises	Governance activities are organized in multiple layers of nested enterprises for

Outline

1. What is an institution
2. The IAD framework: uncovering its “nested components”
3. Historical development and evolution of IAD
4. Connecting institutional theory with network analysis

Frameworks, Theories, and Models

"…nested concepts related to explaining human behavior" (Ostrom 2011)



IAD - Institutional Analysis and Development

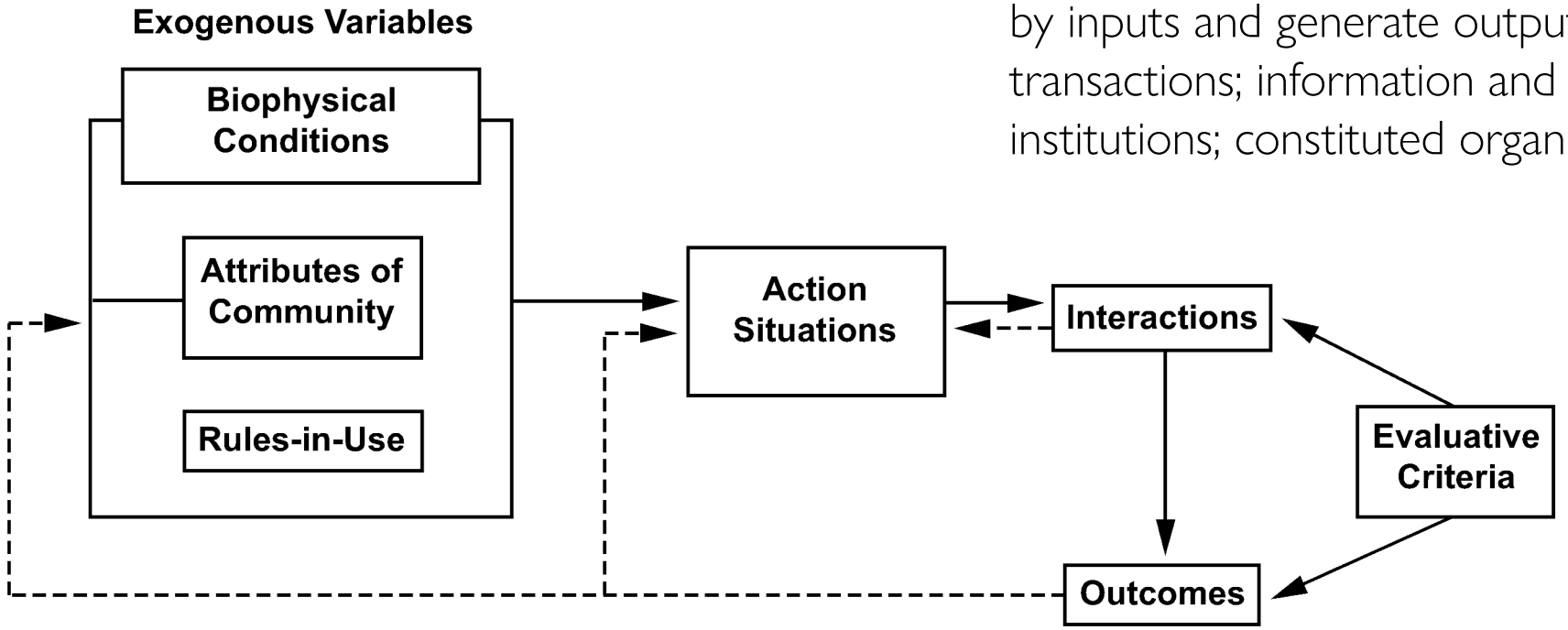
How do institutions structure human incentives, actions, and outcomes?

- Institutions as the formal and informal rules that people follow in a given situation.
- Analysis: decompose complexity of human interactions
- Development: institutional changes are inevitable in repetitive situations; dynamic and process-oriented

IAD - Institutional Analysis and Development

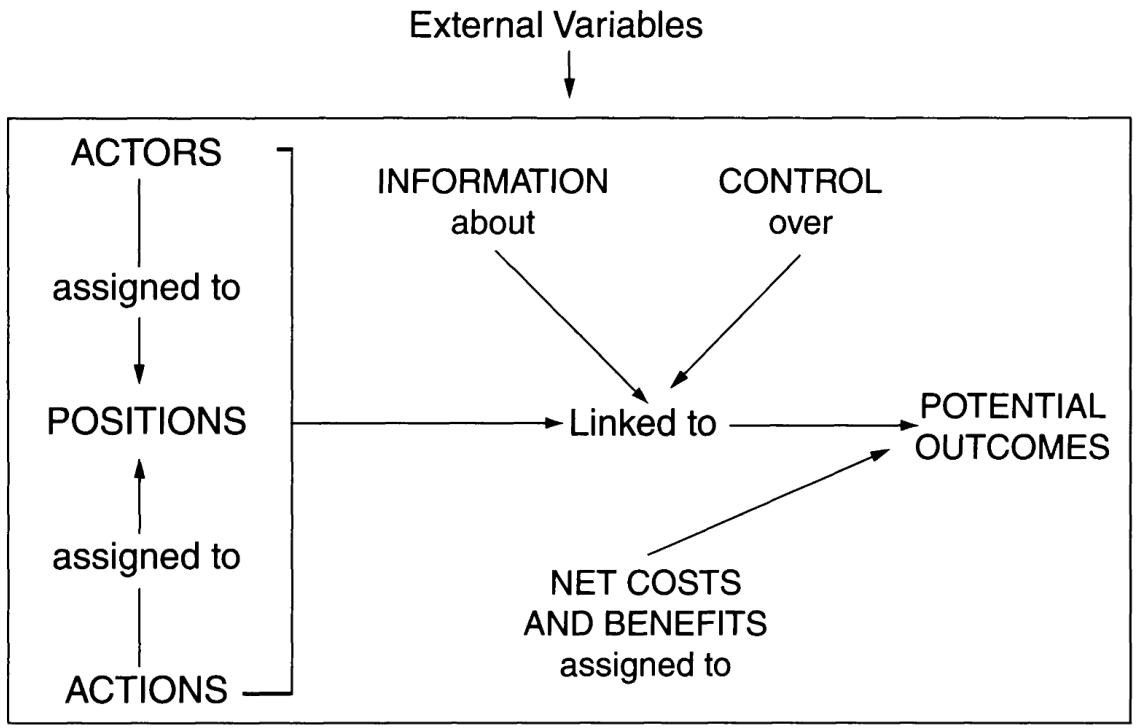
- A dynamic framework: initially based on systems theory approach to policy processes

Dynamic processes within an action situation are triggered by inputs and generate outputs: e.g., biophysical transactions; information and knowledge; rules and institutions; constituted organization



Source: Ostrom (2005)

The internal structure of an action situation

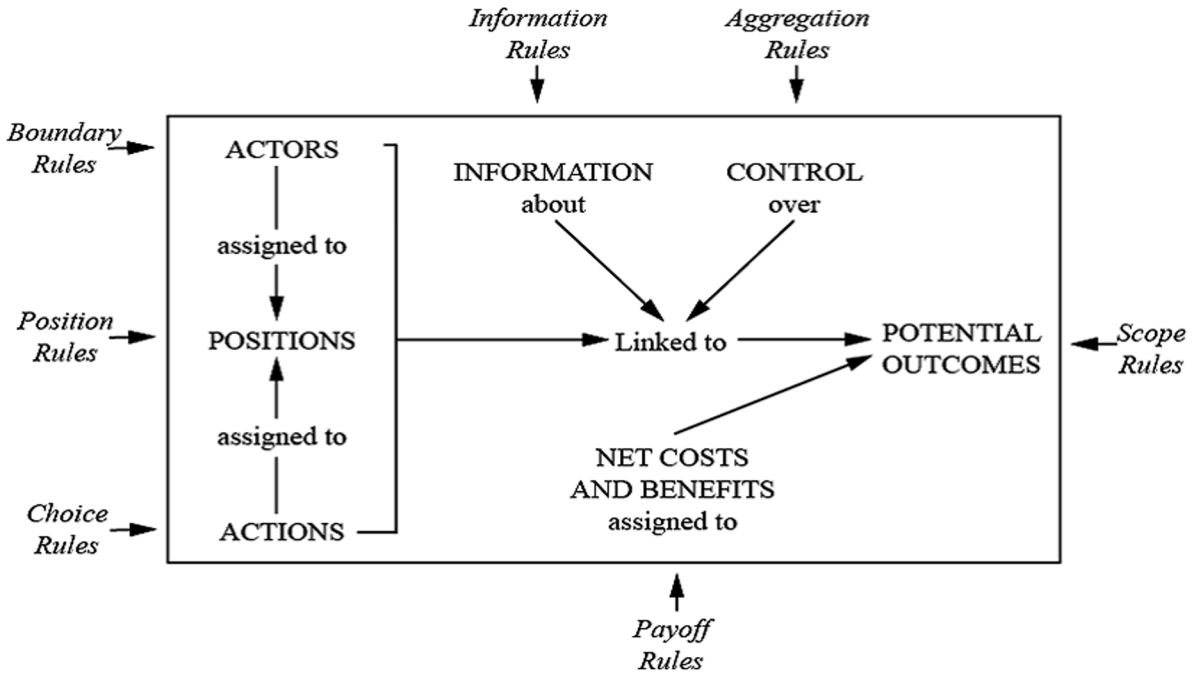


Source: Ostrom (2005)

Working components of an action situation constitute its structure

- ACTORS, who may hold different worldviews, may be assigned to hold POSITIONS, giving them access to ALTERNATIVE ACTIONS, with varying levels of CONTROL over a set of possible OUTCOMES, and have INFORMATION about all this, including their likely BENEFITS & COSTS of actions taken and outcomes observed

The internal structure of an action situation



Source: Ostrom (2005)

Seven types of working rules/rules-in-use

1. Position rule: specify a set of positions and how many actors hold each one
2. Boundary rule: specify how actors were to be chosen to enter or leave these positions
3. Choice rule: specify which actions are assigned to an actor in a position
4. Scope rule: specify the outcomes that could be affected;
5. Aggregation rule: specify how the decisions of actors at a node were to be mapped to intermediate or final outcomes
6. Information rule: specify channels of communication among actors and what information must, may, or must not be shared
7. Payoff rule: specify how benefits and costs were to be distributed to actors in positions

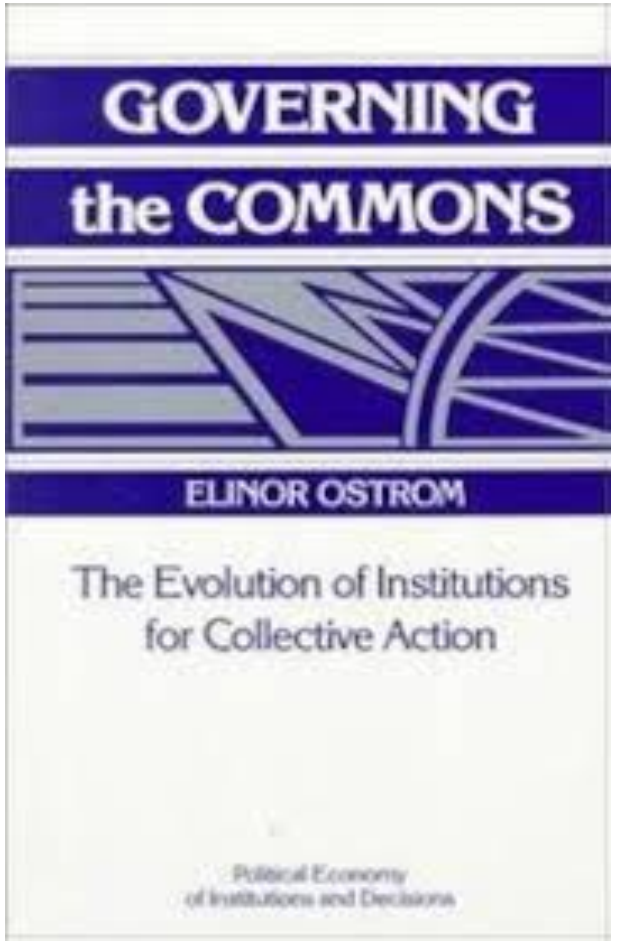
What could be an Action Situation

- Legal disputes in a courtroom
- Legislation in developing environmental education in the Czech Republic
- The upcoming presidential election in Slovakia
- Lectures deciding on the design of the course
- Families planning for the summer holiday
- Co-tenants deciding on the contribution for maintaining the common area
- Small-scale irrigators deciding how much to pay a "gatekeeper"
- Fishers trying to agree on take limits
- …and many more

Action Situations based on governance functions (Ostrom 1990)

In the context of Commons Governance, e.g.,

- Appropriation
  - of resource units from common pool resource system.
- Provision
  - construction & maintenance of infrastructures, and replenishment of common pool (if relevant); may require joint co-production by community members.
- Rule-making
  - Rule-makings for all sorts of activities (operational, collective-choice; constitutional level)
- Monitoring, sanctioning, and dispute resolution
  - Enforcement and compliance with rules; Mechanisms of sanctioning and dispute resolution



Examples of questions to be asked when applying for IAD

McGinnis (How to Use the IAD Framework, 2013)

- What can be done to improve the sustainability of a particular common pool resource? (Policy analysis: what would happen if policy A is replaced with B)
- Hardin concluded that all commons are doomed to exhaustion, unless managed by a central authority or divided up into private parcels, yet many such commons persist for very long periods of time. How can that happen?

  (Puzzle: why does outcome X occur in cases like Y, but not Z)

Others:

- Explore why environmental education centers vary in delivering environmental education program?
- Analyze why health care system in country xx has been increasing in the past five years

Are these situations isolated?

Do situations often exert mutual influences over each other in real life settings?

Outline

1. What is an institution
2. The IAD framework: uncovering its "nested components"
3. Historical development and evolution of IAD
4. General guidance on application

Some Early Versions of the IAD Framework

1982

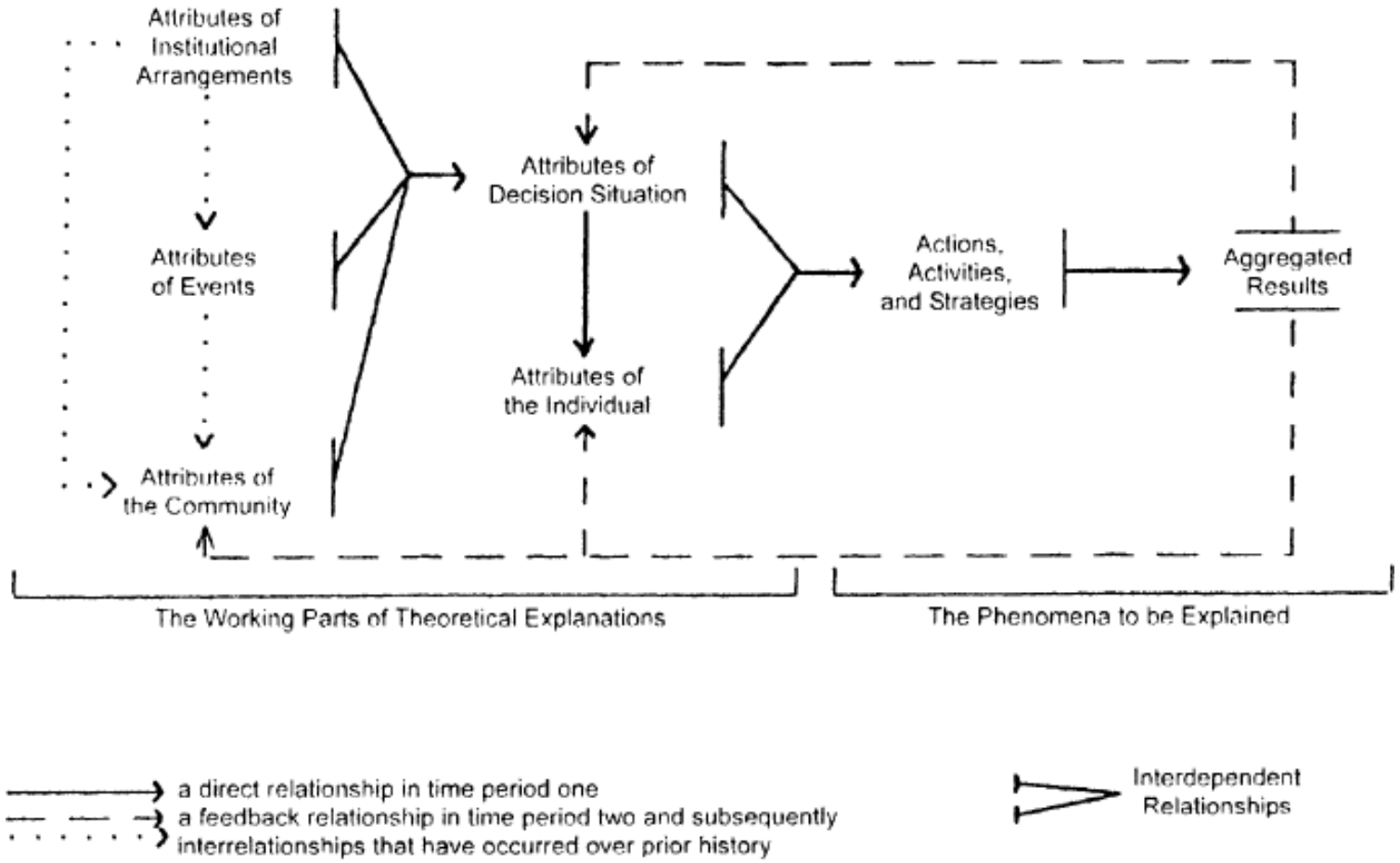
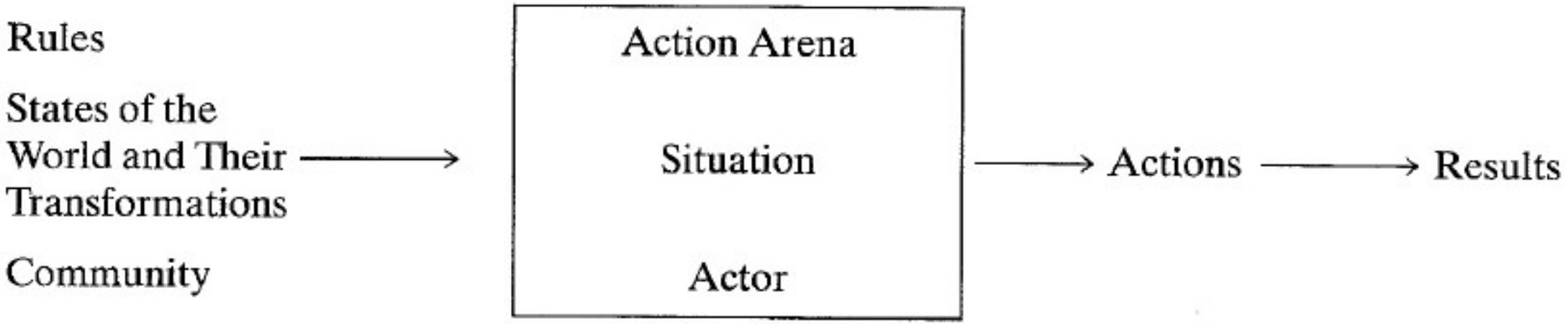


Fig. 2.1. The working parts of institutional analysis

1986



Phenomena to Be Explained

Explanation Within Frame of an Action Arena

Explanation Viewing Action Arenas as Intermediate Conceptual Units

Fig. 1: Levels of Explanation Used in Institutional Analysis

1991

Figure 1

A FRAMEWORK FOR INSTITUTIONAL ANALYSIS

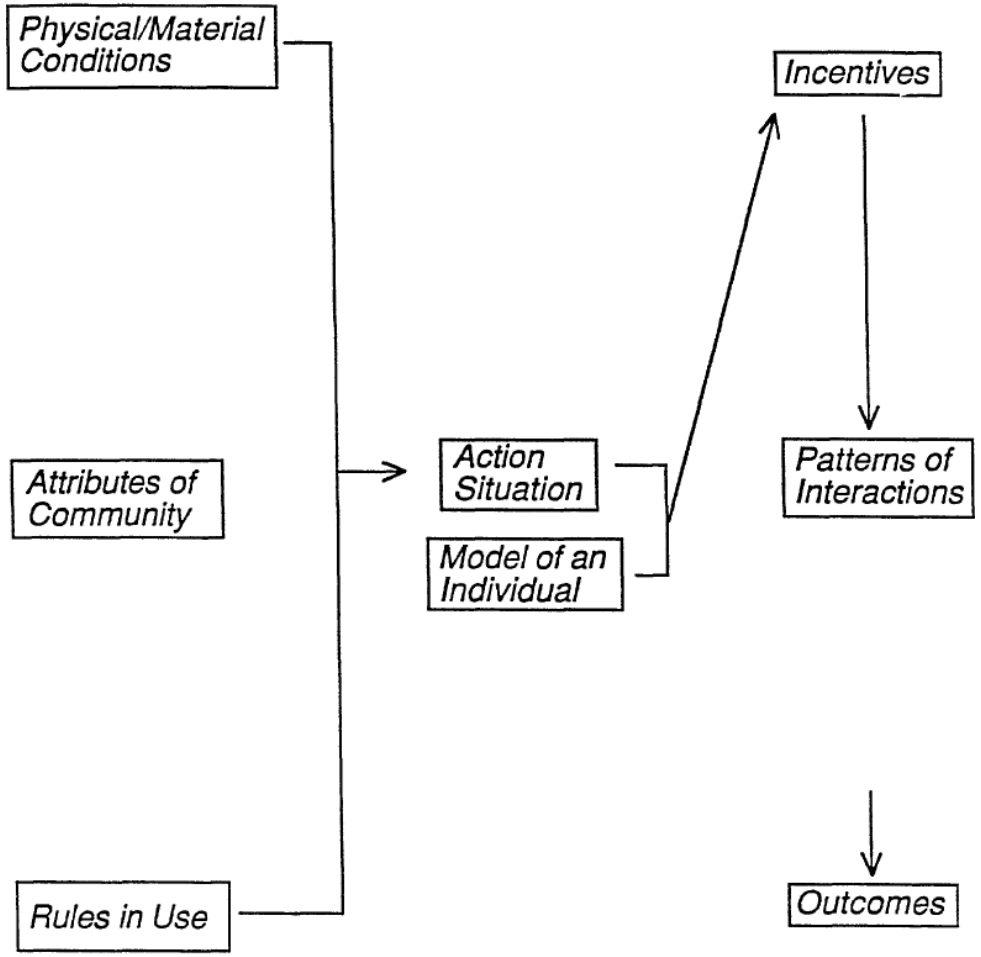
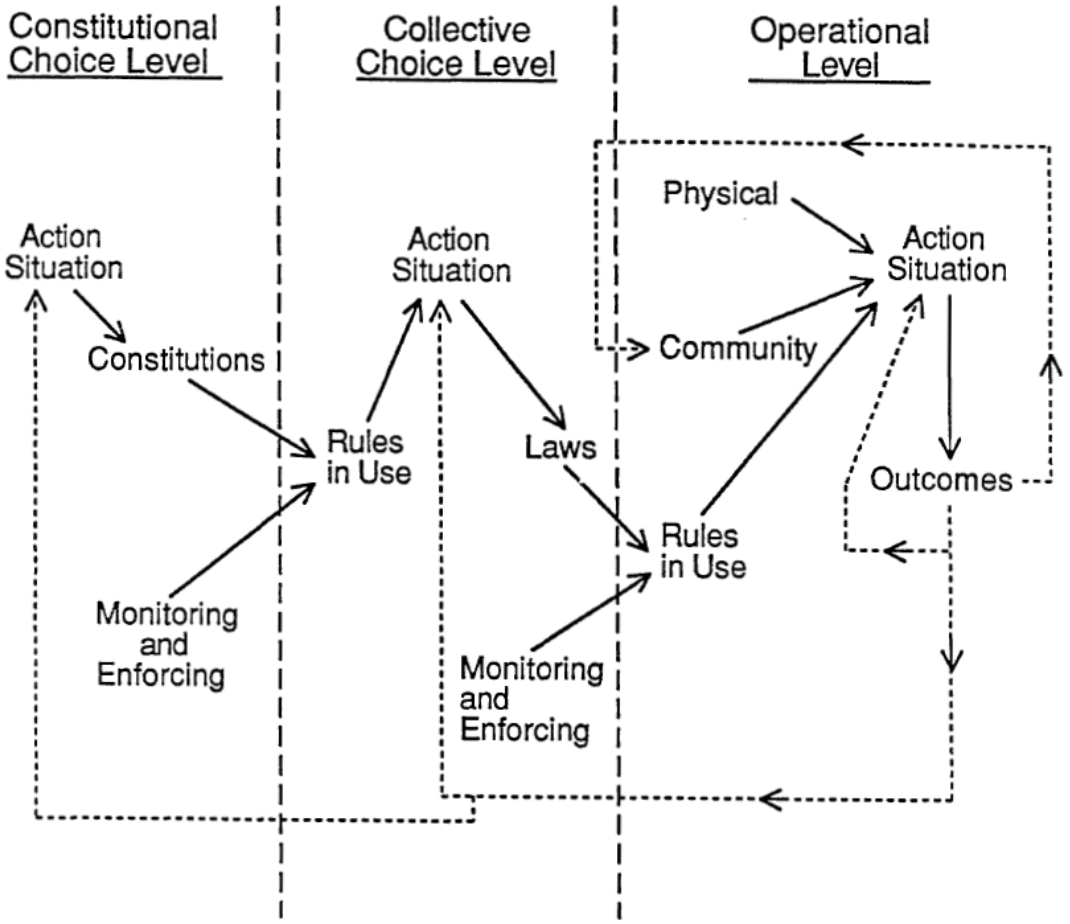
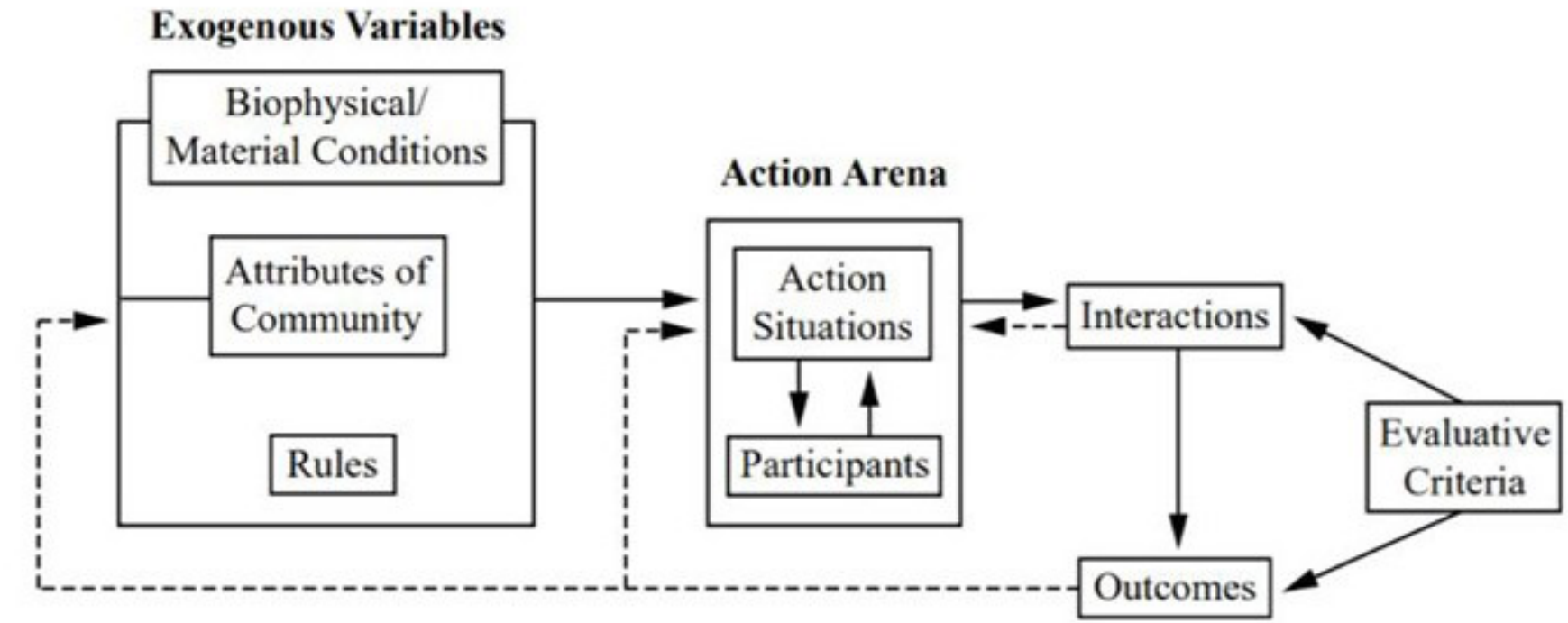


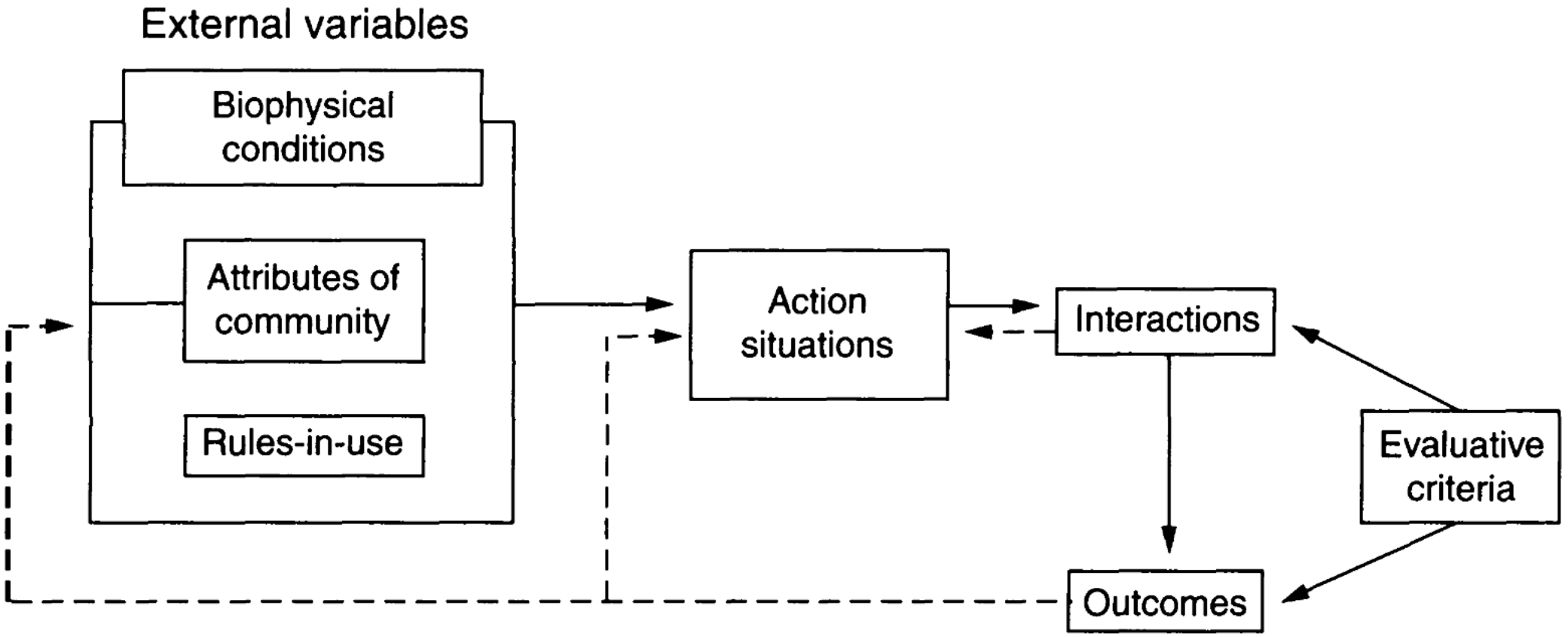
Figure 2



2005


Exogenous Variables
Biophysical/
Material Conditions
Attributes of
Community
Rules
Action Arena
Action
Situations
Participants
Interactions
Evaluative
Criteria
Outcomes

2009. From Ostrom's Nobel Prize Presentation



Is the ecological system being addressed enough in the IAD framework?

Is the ecological system being addressed enough in the IAD framework?

- Many variables related to the social system have been unpacked
- The potential variables in the ecological system have been packed into "the biophysical world"

Social-Ecological System (SES) framework
A need of more explicitly and equally considering the ecological system

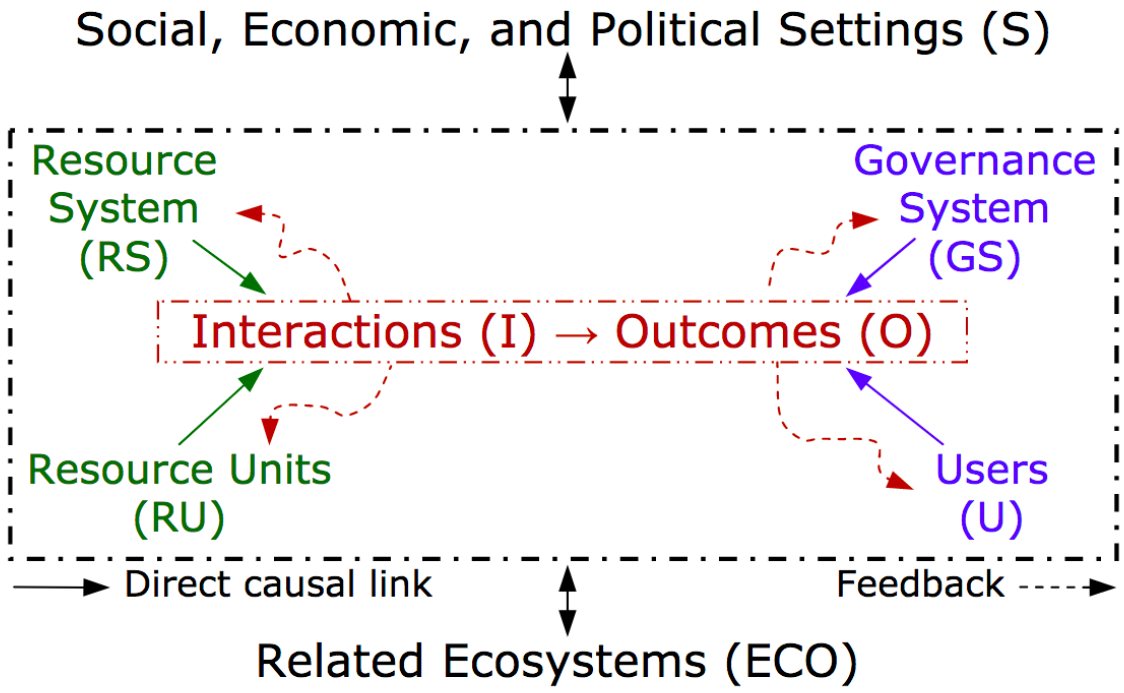


Fig. 1. A multitier framework for analyzing an SES.

Source: Ostrom (2007)

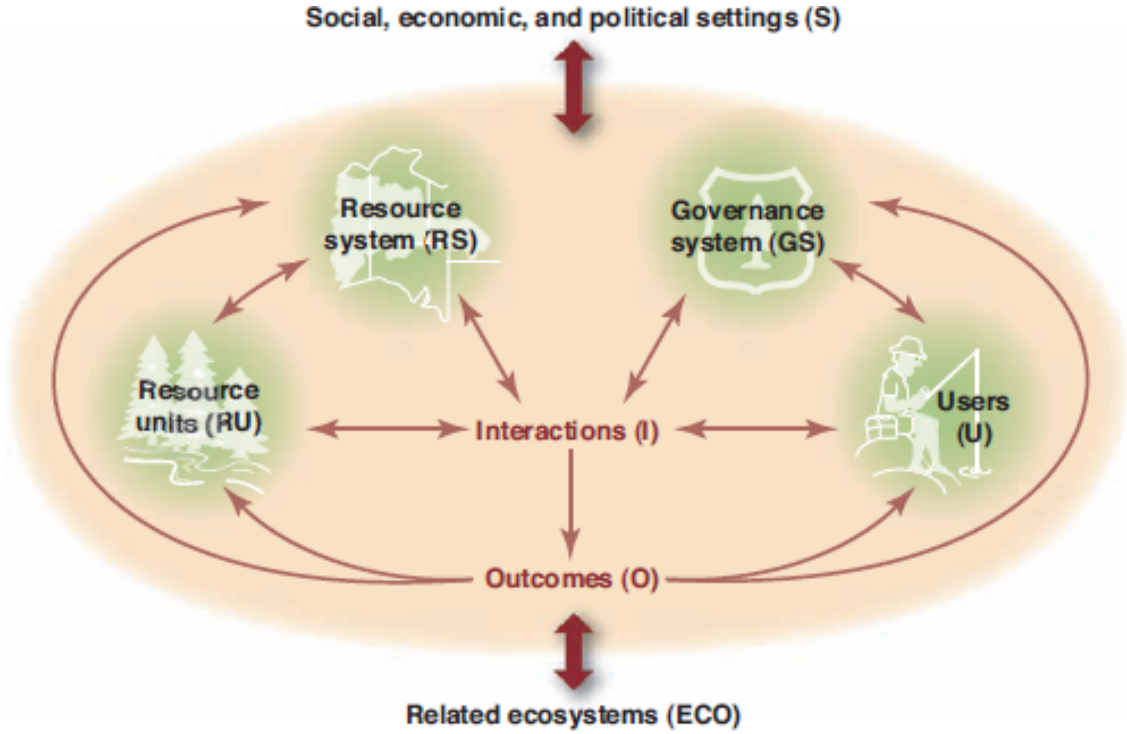


Fig. 1. The core subsystems in a framework for analyzing social-ecological systems.

Source: Ostrom (2009)

Table 1. Second-tier variables in framework for analyzing an SES

Social, Economic, and Political Settings (S)

S1- Economic development. S2- Demographic trends. S3- Political stability.
S4- Government settlement policies. S5- Market incentives. S6- Media organization.

Resource System (RS)	Governance System (GS)
RS1- Sector (e.g., water, forests, pasture, fish)	GS1- Government organizations
RS2- Clarity of system boundaries	GS2- Non-government organizations
RS3- Size of resource system	GS3- Network structure
RS4- Human-constructed facilities	GS4- Property-rights systems
RS5- Productivity of system	GS5- Operational rules
RS6- Equilibrium properties	GS6- Collective-choice rules
RS7- Predictability of system dynamics	GS7- Constitutional rules
RS8- Storage characteristics	GS8- Monitoring & sanctioning processes
RS9- Location	

Resource Units (RU)	Users (U)
RU1- Resource unit mobility	U1- Number of users
RU2- Growth or replacement rate	U2- Socioeconomic attributes of users
RU3- Interaction among resource units	U3- History of use
RU4- Economic value	U4- Location
RU5- Size	U5- Leadership/entrepreneurship
RU6- Distinctive markings	U6- Norms/social capital
RU7- Spatial & temporal distribution	U7- Knowledge of SES/mental models
	U8- Dependence on resource
	U9- Technology used

Interactions (I) →	Outcomes (O)
I1- Harvesting levels of diverse users	O1- Social performance measures (e.g., efficiency, equity, accountability)
I2- Information sharing among users	O2- Ecological performance measures (e.g., overharvested, resilience, diversity)
I3- Deliberation processes	O3- Externalities to other SESs
I4- Conflicts among users	
I5- Investment activities	
I6- Lobbying activities	

Related Ecosystems (ECO)

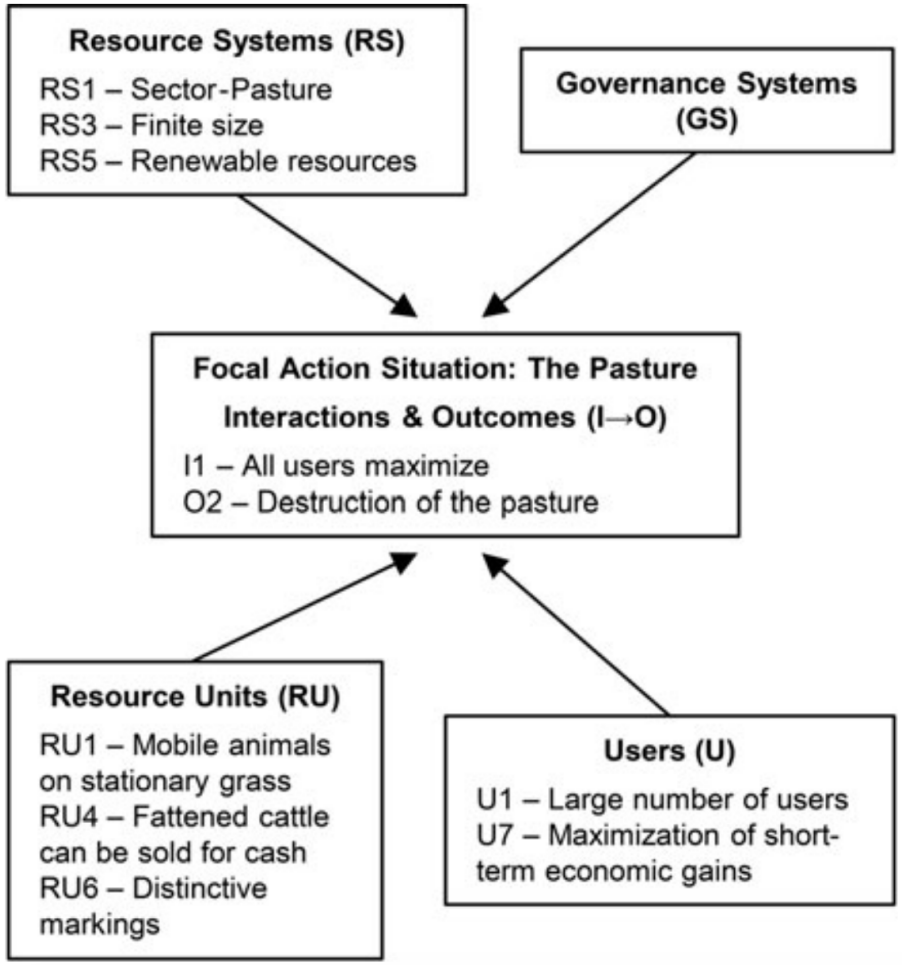
ECO1- Climate patterns. ECO2- Pollution patterns. ECO3- Flows into and out of focal SES.

Source: Ostrom (2007)

Decomposing the SES framework into multi-tier variables

Analyzing "The Tragedy of Commons" via the SES framework

Figure 2. Ostrom's SES diagnosis of the Herder Problem.



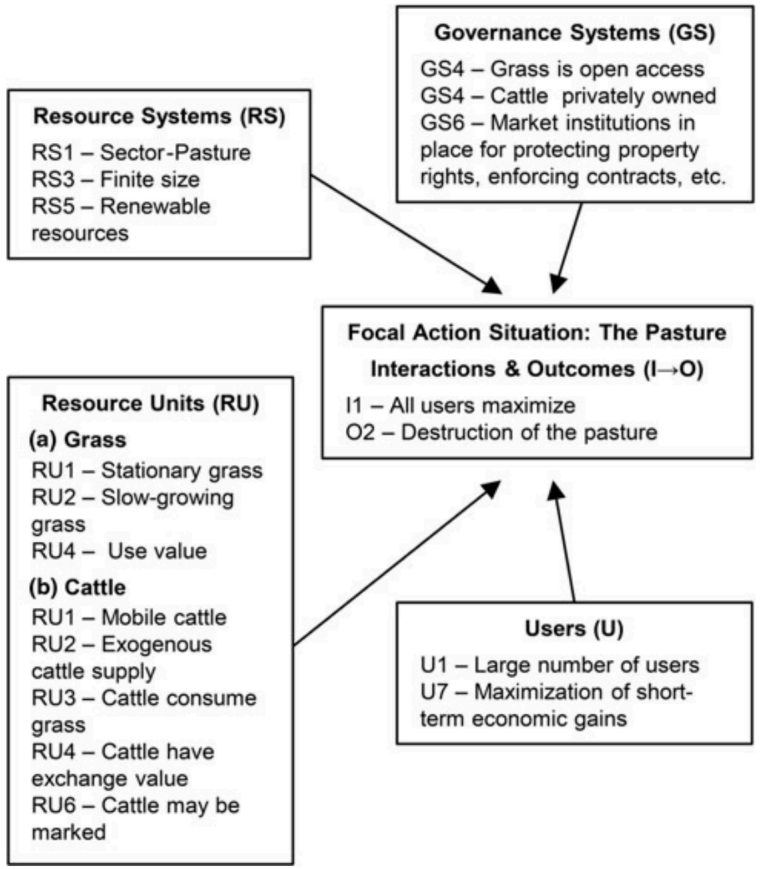
Source: Cole et al. (2014)

The Ostrom (2007) institutional analysis

- Five (groups) assumptions based on first-tier variable in the SES are required to translate Hardin's metaphor into a theory
- a theoretical prediction of very high harvesting of the pasture grasses (I1) and severe overharvesting or destruction of the ecological system (O2).

Analyzing "The Tragedy of Commons" via the SES framework

Figure 3. Revised application of the SES framework to the Herder Problem.



Source: Cole et al. (2014)

The Cole et al. (2014) institutional analysis

Changes to Ostrom (2007) made through:

- Explicit division between grass and cattle;
- Prominent changes made in the Governance System

The tragedy is driven by "…interactions among institutions that assign individual rights over the cattle that convert unowned grass from open-access pasture to privately owned beef"

Analyzing "The Tragedy of Commons" via the SES framework

The Cole et al. (2014) institutional analysis

- "Some resource systems and institutions left out of Hardin's allegory entirely, as well as Ostrom's application to it of the SES framework, can play a major role in determining social and ecological outcomes"

- Questions posed by authors: "Where is the water on or near Hardin's patures? And What rules or norms goverm its use? Without answers to these questions, any SES analysis of Hardin's 'tragedy of the commons' must remain incomplete."

In need of a more holistic view, that, in this case, takes account of the nexus of multiple interdependent resource systems → network approach

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Recalling the Eight Design Principles (Ostrom 1990)

- The Eight Design Principles

Design Principle	Description
1. Clearly defined boundaries	Membership involving rights to withdraw CPRs and physical boundaries of the resource(s) are clear
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8. Nested enterprises	Governance activities are organized in multiple layers of nested enterprises for

The development of hypothesis on building blocks in the Social-Ecological Network (SEN) analysis

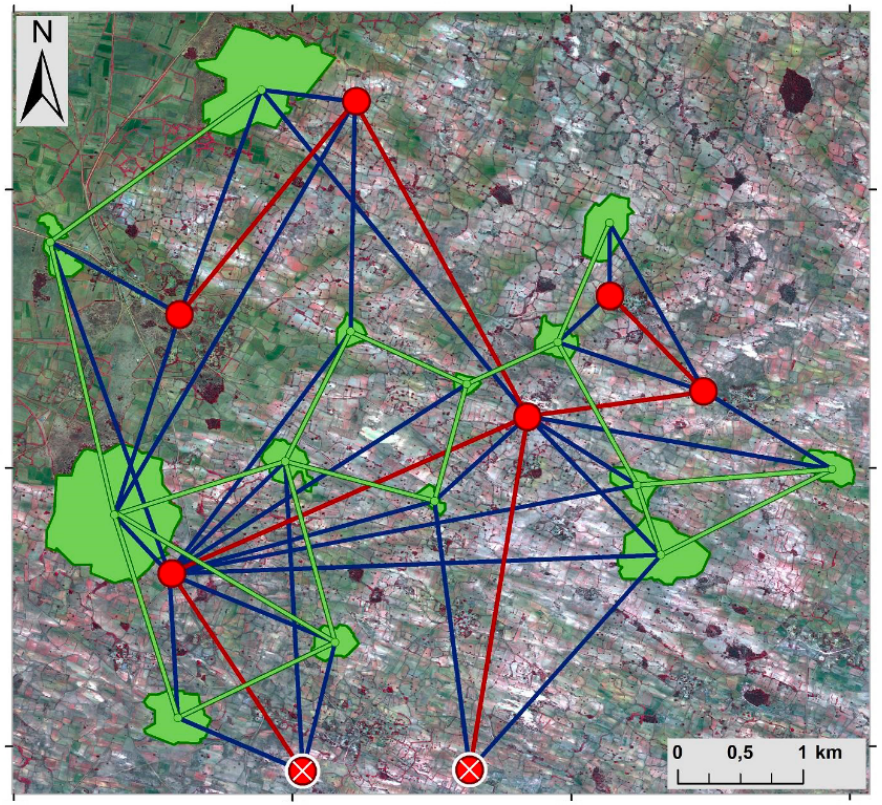
Bodin, Ö., G. Robins, R. R. J. McAllister, A. Guerrero, B. Crona, M. Tengö, and M. Lubell. 2016. Theorizing benefits and constraints in collaborative environmental governance: a transdisciplinary social-ecological network approach for empirical investigations. *Ecology and Society* 21(1):40. http://dx.doi.org/10.5751/ES-08368-210140

Research

Theorizing benefits and constraints in collaborative environmental governance: a transdisciplinary social-ecological network approach for empirical investigations

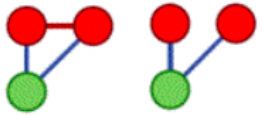
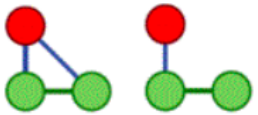
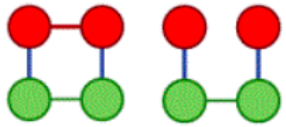
Örjan Bodin[1,2], *Garry Robins*[3], *Ryan R. J. McAllister*[4], *Angela M. Guerrero*[5,6], *Beatrice Crona*[1,7], *Maria Tengö*[1] *and Mark Lubell*[8]

Fig. 3. Social-ecological network of forest patches, clans, and their different interrelationships in an agricultural landscape in southern Madagascar. The red nodes represent clans residing in the landscape, and the green nodes forest patches. The tiers between clans represent various forms of social relations, the ties between clans and forest patches represent use and managerial responsibilities, and the ties between the forest patches represent seed dispersals (figure from Bodin and Tengö 2012).



The development of hypothesis on building blocks in the Social-Ecological Network (SEN) analysis

- **Resource users with social relationships**, which enables communication, negotiation, institutional development, etc., that are **more likely to avoid collection action dilemma**
- Institutional fitness and alignment: institutional development taking account of biophysical conditions are more likely to achieve sustainable outcome

Social-ecological building block	**Governance challenge**
Common-pool resource management	
Resource sharing with and without a social tie (closed and open common pool triangle) 	If two (or more) noncooperating actors share a resource (right), there may be a strong incentive for these actors to overharvest the resource. This governance challenge can, however, be addressed if the actors collaborate and agree on some common resource regulations (Ostrom 1990). This implies that the two actors need to be socially tied (left). Note that this does not imply that actors being tied to other actors is good in general, rather it emphasizes that collaboration is beneficial for actors sharing common ecological resources (Bodin et al. 2014).
Social-ecological fit and alignment	
Managing an ecosystem versus managing a subcomponent (closed and open ecosystem triangles) 	If an interconnected ecological resource is managed as separate entity (right), the governing structure is not well aligned with the structure of the ecosystems (Cumming et al. 2006, Bodin et al. 2014). This governance challenge resembles the notion of social-ecological misfit implying that the effect of management activities can, through ecological interdependency, spread to other resources beyond the realm of managing actor. Thus, a closed triangle (left) hypothetically suggests a better fitting building block because ecological costs and benefits occurring beyond the managed resource are internalized (Bodin et al. 2014).
Two actors managing interconnected resources being socially connected or disconnected (closed and open four-cycle) 	A lack of collaboration between two actors managing interconnected ecological resources (right) represents a similar type of governance challenge as above because the extent of the interconnected ecological resources is not aligned with the extent of the governance structure (social-ecological scale mismatch; Cumming et al. 2006). If the actors are socially tied (left), a better social-ecological scale alignment (fit) is accomplished (Bodin and Tengö 2012).

Additional information

https://ostromworkshop.indiana.edu/pdf/teaching/how-to-use--iad-framework-slides.pdf

How to Use The IAD Framework: An Application to Elinor Ostrom's *Governing the Commons*

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Revised Oct. 1, 2013

This summary is organized around
10 analytical steps identified in
"How to Use the IAD Framework,"
Mike McGinnis, Aug. 25, 2012

Key messages taken home

- Definitions of institutions, e.g., rules of the game
- The ADICO Grammar to distinct between rules, norms, and shared strategies
- Institutions shape individual resources, perceptions, values, available options, preferences, choices in many, many ways
- Ostrom's theory of collective actions (e.g., Eight Design Principles) in avoiding/addressing cooperation dilemma for commons governance
- IAD framework, in a process-oriented analytical fashion, aim to understand institutional incentives, together with other inputs, in structuring interactions and behaviors, that give rise to outputs

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