Frameworks for analyzing social-ecological systems

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Autumn School 2015
Concepts, frameworks and methods for the comparative analysis of water governance
October 28 to November 6, 2015
Frameworks for analyzing social-ecological systems
Goals

- To get to know different frameworks for analyzing social-ecological systems
- To apply two frameworks (SES / MTF) to a specific case
- To use the databases elaborated for both frameworks for the case analyzed
## Itinerary

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Who</th>
</tr>
</thead>
</table>
| 09:00-11:00  | **Introduction to frameworks**  
The Social-Ecological-Systems Framework (SES)  
Applying the SES framework          | CB / CK all  |
| 11:40-12:00  | Introduction to the SES-database (GoSES)                              | CK           |
| 12:00-14:00  | Working with the SES-database incl. lunch                            | all          |
| 14:00-14:30  | The Management and Transition Framework (MTF)                         | CPW          |
| 14:30-15:00  | Operationalization of MTF  
Introduction to the database         | CK           |
| 15:00-16:00  | Working with the MTF database (incl. break)                           | all          |
| 16:00-17:00  | Comparison and discussion                                            | all          |
What are in your view the characteristics of Social-Ecological Systems?
Social-Ecological Systems (SES)
- systems including social and ecological aspects
- nested
- multi-level systems
- provide essential services to society such as supply of food, fiber, energy and drinking water (Berkes and Folke 1998).

Other terms
- “socio-ecological system” (Gallopín 1991)
- “human-environment system” (Turner et al. 2003; Scholz, 2011a).
Issue

Complex Social-Ecological systems and problems

- Variety of case studies
- Variety of frameworks and methodologies
- Comparison across case studies very difficult

Research demand

- Structured portfolio of frameworks for integrative and interdisciplinary research in SES
  (Turner and Carpenter, 1999; Liu et al., 2007)
- Meta-analyses (Ostrom 2007, 2009)
Research questions

Social System

Ecological System
1. How is the social system and its dynamics conceptualized?
2. How is the ecological system and its dynamics conceptualized?
3. How are the interactions and the dynamics between the social and the ecological systems conceptualized?
4. How can we select the right framework for a specific research issue studied?
**Framework:** A framework provides “a set of assumptions, concepts, values and practices that constitute the way of viewing the specific reality” (Ostrom, 2005).

**Criteria for frameworks selection:**
- Provides concepts for conceptualizing SES‘s
- Include social and ecological systems and some kind of interaction between the systems
- General, used by a wider community
- Different and a specific framework could be representative for a group of frameworks
Driver, Pressure, State, Impact, Response (DPSIR)
The Natural Step framework (TNS)
Social-Ecological Systems Framework (SESF)
Ecosystem Services framework (ES)
Earth Systems Analysis (ESA)
The Material and Energy Flow Analysis framework (MEFA)
The Sustainable Livelihood Approach (SLA)
The Turner Vulnerability framework (TVUL)
Human-Environment System (HES) framework
The Management and Transition Framework (MTF)
<table>
<thead>
<tr>
<th>Methodology</th>
<th>Goal</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DPSIR</strong></td>
<td>Develop an <em>improved understanding of</em>, indicators for, and <em>appropriate responses</em> to impacts of human activities on environment along the causal chain-drivers-pressure-state-impact-responses.</td>
<td>Carr et al. 2007; EU 1999; Svarstad et al. 2008</td>
</tr>
<tr>
<td><strong>SESF</strong></td>
<td><em>Provide a common language</em> for (i) case comparison; (ii) organizing variables; (iii) facilitating selection of variables in case study.</td>
<td>Ostrom 2007, 2009</td>
</tr>
<tr>
<td><strong>ESA</strong></td>
<td><em>Understand</em> global interactions and dynamics of the earth system and its sustainable evolutions</td>
<td>Schellnhuber 1998, 1999</td>
</tr>
<tr>
<td><strong>SLA</strong></td>
<td><em>Analyze</em> which combination of livelihood assets enable to follow what combination of livelihood strategies with <em>sustainable outcomes</em>.</td>
<td>Scoones 1998 Ashley and Carney, 1999</td>
</tr>
<tr>
<td><strong>HES</strong></td>
<td><em>Methodological guide</em> for analyzing (i) the structure of SES, (ii) the dynamics between social and ecological systems; and (iii) the dynamics within different scales of the social system</td>
<td>Scholz and Binder, 2003; Scholz et al. 2011</td>
</tr>
<tr>
<td><strong>MTF</strong></td>
<td><em>Support the understanding</em> of water systems, management regimes, and transition processes; <em>comparative analyses</em>; <em>simulation models</em> based on empirical evidence.</td>
<td>Pahl-Wostl 2009; Knieper et al. 2010; Pahl-Wostl and Kranz, 2010</td>
</tr>
</tbody>
</table>
Kristensen, 2004

Giupponi, 2007
SES-Framework

Social, economic, and political settings (S)

Resource system (RS)

Governance system (GS)

Resource units (RU)

Users (U)

Interactions (I)

Outcomes (O)

Related ecosystems (ECO)

Ostrom, 2009
Figure 1. Sustainable livelihoods framework

Key

H = Human Capital
S = Social Capital
N = Natural Capital
P = Physical Capital
F = Financial Capital

In order to achieve livelyhood outcomes, transforming structures and processes are influenced and accessed by the four sets of livelihood assets. These processes are contingent on the vulnerability context, which can act on the livelihood assets. (DFID 1999: SLA Guidance Sheet 1, p. 1)
Human-Environment System

Primary feedback loop

Intended action/goal/needs/...

Strategy formation

Strategy selection evaluation

Environmental reaction

Post decisional evaluation/learning

Secondary feedback loop

Environmental awareness

Long-term impact of actions on environmental dynamics

Environmental reaction

Action

Environmental awareness

Scholz et al., 2011
Questions studied

1. How is the social system and its dynamics conceptualized?
2. How is the ecological system and its dynamics conceptualized?
3. How are the interactions and the dynamics between the social and the ecological systems conceptualized?
4. How can we select the right framework for a specific research issue studied?
1. How is the social system and its dynamics conceptualized?

*Macro*: social system only at the macro level (i.e. society), not including the level of the individual

*Macro → Micro*: concepts in which the macro level (e.g., societal or governance system) influences the micro level (consumers)

*Micro → Macro*: focus on micro level (individual decision-making and learning) and how this impacts the macro level (e.g., group, society)

*Micro*: considers only the micro level (e.g., individual decision-making) without considering the upper levels

*Macro ↔ Micro*: considers the duality between the macro level (social structure) and the micro level (agency; Giddens, 1984), that is, social structure influences individual behavior, and individual behavior perpetuates or changes the social structure. Synchronic vs. diachronic.
<table>
<thead>
<tr>
<th>Conceptualization of social system</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DPSIR</strong> Driver, Pressure, State, Impact, Response</td>
<td>Macro</td>
</tr>
<tr>
<td>Social system is conceptualized as the aggregated socio-economic processes / variables in particular drivers and responses</td>
<td></td>
</tr>
<tr>
<td><strong>SESF</strong> Social-Ecological System</td>
<td>Macro↔Micro</td>
</tr>
<tr>
<td>Resource users and governance system. The governance system influences resource use by defining rules (e.g., monitoring, sanctioning).</td>
<td></td>
</tr>
<tr>
<td><strong>ESA</strong> Earth Systems Analysis</td>
<td>Macro</td>
</tr>
<tr>
<td>Aggregate of all individual human lives, actions and products and the global subject (e.g., institutions for global governance).</td>
<td></td>
</tr>
<tr>
<td><strong>SLA</strong> Sust. Livelihood Approach</td>
<td>Macro→Micro</td>
</tr>
<tr>
<td>Social system is influenced by external factors and a set of institutional processes in their realization of livelihood strategies</td>
<td></td>
</tr>
<tr>
<td><strong>HES</strong> Human-Environ. System</td>
<td>Macro↔Micro</td>
</tr>
<tr>
<td>Based on decision-making theory. Considers human actions and learning / feedback processes at and between different hierarchical levels of the social system (e.g., individual, society).</td>
<td></td>
</tr>
<tr>
<td><strong>MTF</strong> Management and Transition F.</td>
<td>Macro↔Micro</td>
</tr>
<tr>
<td>Conceptualized in a combination of rational choice (IAD framework) and social constructivism, leading to social learning approaches. Learning and decision making processes of importance.</td>
<td></td>
</tr>
</tbody>
</table>

Binder et al., 2013
How is the ecological system and its dynamics conceptualized?

- *Anthropocentric perspective*, (ecological system based on its utility for humans); vs. *Ecocentric perspective* (ecological system based on its internal functioning).
- Hierarchies in scale and space
- Conceptualization of dynamics in ecological system (natural language / formulas).
<table>
<thead>
<tr>
<th>Type</th>
<th>The ecological system</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DPSIR</strong></td>
<td>A</td>
<td>Considers aggregated ecological processes and variables and differentiates into state and impact variables.</td>
</tr>
<tr>
<td>Driver, Pressure, State, Impact, Response</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SESF</strong></td>
<td>A</td>
<td>Resource system (e.g., water, forest) and corresponding resource units (e.g., tree).</td>
</tr>
<tr>
<td>Social-Ecological System</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ESA</strong></td>
<td>E</td>
<td>Linked global sub-systems (e.g. such atmosphere, biosphere, hydrosphere). Linkages between sub-systems: flows of mass and energy.</td>
</tr>
<tr>
<td>Earth Systems Analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **SLA**      | A                     | 1. Part of the context which comprises all social and natural system factors influencing the livelihood  
2. Natural capital, one of the livelihood resources available for pursuing livelihood strategies |
| Sust. Livelihood Approach |                       |                                                                                                                                 |
| **HES**      | A                     | Coupled system to the social system. An HES analysis departs from the ecological system.                                               |
| Human-Environ. System |                       |                                                                                                                                 |
| **MTF**      | A                     | Resource system; variables considered to be important for resource governance and management are included.                               |
| Management and Transition F. |                       |                                                                                                                                 |

**A: Anthropocentric / E: Eco-centric**

Binder et al., 2013
How are the interactions and the dynamics between the social and the ecological systems conceptualized?

- **E → S**
  - the ecological system influences the social system

- **S → E**
  - human activities affect the ecological system or ecosystem services

- **S ↔ E**
  - the reciprocity between the social system and the ecological system is considered, including feedback loops and learning processes in the social system in response to changes in the ecological system.
<table>
<thead>
<tr>
<th>Type</th>
<th>Interaction Social-Ecological Systems</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DPSIR</strong></td>
<td>S→E</td>
<td>Human activities generate pressures on the environment. Pressures change the state of the ecological system leading to negative impacts on humans. These negative impacts (should) lead to a response of the social system.</td>
</tr>
<tr>
<td>Driver, Pressure, State, Impact, Response</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SESF</strong></td>
<td>S↔E</td>
<td>The actors use resources impacting on the ecological system and may cause externalities in related SES.</td>
</tr>
<tr>
<td>Social-Ecological System</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ESA</strong></td>
<td>S→E</td>
<td>Human activities, such as CO₂ emissions, land use, crop harvested, etc. lead to a flow of matter that changes the ecosystem.</td>
</tr>
<tr>
<td>Earth Systems Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SLA</strong></td>
<td>E→S</td>
<td>Options of humans are affected by external boundary conditions among those are environmental assets.</td>
</tr>
<tr>
<td>Sust. Livelihood Approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HES</strong></td>
<td>S↔E</td>
<td>Human activities affect the ecological system intended or unintended. Feedback through environmental awareness and environmental changes to human actions in the short and long-run. Sustainability learning.</td>
</tr>
<tr>
<td>Human-Environ. System</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MTF</strong></td>
<td>S↔E</td>
<td>Ecological → Social system: i) environmental services; ii) environmental hazards. S uses services / prevents hazards. Feedbacks: Changes in perception SES state.</td>
</tr>
<tr>
<td>Management and Transition F.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How can we select the right framework for a specific research issue studied?
Selecting the right framework

1. How do you conceptualize the interaction between the ecological and the social systems?
2. How do you conceptualize the environmental system?
3. Does the research question require an analysis or an action framework?

Binder et al., 2013
Frameworks differ in goal, scale, conceptualization of social, ecological systems and their interactions and dynamics. According to three criteria four types of frameworks can be identified:

- Governance,
- Eco-centric,
- Vulnerability; and
- Integrative frameworks.
Selected frameworks (2)

Governance Frameworks
- *The Natural Step* (TNS) framework (Burns, 1999);

Ecocentric Frameworks

Vulnerability
- The *Sustainable Livelihood Approach* (SLA) (Scoones 1998, Ashley 1999).
- The Turner *vulnerability* framework (TVUL) (Turner et al., 2003).

Integrative
- The *Human-Environment System* (HES) framework (Scholz et al. 2011a, b).
The SES-Framework
Point of departure: tragedy of the commons
Tragedy of the commons

- Garrett Hardin (1968)
- A pasture close to its carrying capacity and open to all herdsman
- Each herdsman seeks to maximise his gain
- For each herdsman, it is rational to add another animal to his herd, because
  - the gain from any addition animal (which is his private gain)
  - exceeds the loss due to additional overgrazing (which is sheared by all herdsman)
- The pasture is destroyed
Positive utility

Profit meat & milk (private)

Net profit

Amount of cattle

Individual costs

Reduction of the resource base (social costs)

The discrepancy between the individual and social costs emerges due to lack of property rights (negative externalities)
Tragedy of the commons

- Individual gains A
  - Overgrazing
- Individual gains B
### Biophysical “problem”: Types of goods

<table>
<thead>
<tr>
<th>High excludability</th>
<th>Low excludability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High subtractability</strong></td>
<td><strong>Private good</strong> (House, sandwich)</td>
</tr>
<tr>
<td><strong>Toll good</strong> (Skiing area, toll road)</td>
<td><strong>Public good</strong> (Clean air, peace)</td>
</tr>
<tr>
<td>Property right regime</td>
<td>Characteristics</td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Open access</td>
<td>Absence of enforced property rights</td>
</tr>
<tr>
<td>Group property</td>
<td>Resource rights held by a group of users, who can exclude others</td>
</tr>
<tr>
<td>Individual (private) property</td>
<td>Resource rights held by individuals (or firms), who can exclude others</td>
</tr>
<tr>
<td>Government property</td>
<td>Resource rights held by a government that can regulate or subsidize use</td>
</tr>
</tbody>
</table>
Solving the tragedy of the commons means

- Which governance arrangements solves the common pool resource problems?

According to Hardin there a two solutions

- “Either socialism or the privatism of free enterprise” (Hardin, 1998:682)

- Private property: the herdsman bears the full cost of his own over-use.

- State property: the state allocates limited use-rights to herdsman, monitors and enforces compliance to these rules
But ... (1)

- Hardin's solutions cannot be confirmed empirically
  - Both privately owned as well as government-regulated SES may deteriorate.
More solutions exist than Hardin proposed

- It is not only about property rights, but about a diversity of institutions that regulate resource use
  - Including property rights
  - Culture, norms, mental models, etc.
- self-organization and creation of own local governance arrangements.
A general Framework for Analyzing Sustainability of Social-Ecological Systems

Elinor Ostrom
Nobelprize Laureate 2009
A common classificatory framework is needed to facilitate multidisciplinary efforts towards a better understanding of complex social-ecological systems.
Problem setting

- Worldwide potential loss of fisheries, forests, and water resources.
- Limited understanding of processes that lead to improvements in or deterioration of natural resources.
- Many variables for understanding outcomes of SESs
  - Different scholars/disciplines apply different variables and definitions thereof.
  - Cases are difficult to compare, theories across cases are difficult to build.

Need for *common framework to organize findings*, to cumulate isolated knowledge
Two components

• Framework for characterizing decision-making processes
  → IAD: Institutional analysis & development framework

• Specific variables that can be measured to compare across cases
  → SESF: Social-Ecological Systems Framework
Institutional analysis & development framework (IAD)

- IAD developed by Ostrom and colleagues
  - General language, spanning across social-science disciplines, for the **institutional analysis of common-pool resources**.
  - Based on game theory

- Limitations
  - Provides a general framework, but **not the specific variables** that can be measured empirically
  - **Focused on the social/institutional side** and less developed for the biophysical aspects of SES.
The SES Framework

- Based on IAD
- The SES framework is a multi-tier collection of variables that have proven to be relevant for understanding (explaining) outcomes in different SESs (Ostrom 2007, 2009).
  - Developed in the context of forestry, fishery and water resources
  - Attention to the biophysical/ecological side
This framework is further developed collaboratively by scholars in Europe and the US (SES Club).

The objectives are:

- Generalise to other types of SES and social-technical systems
- Make the framework more rigorous
  - Formalisation, ontology
- Pool data on diverse cases

The longer term goal of framework development is to build theory across diverse cases.
Institutional analysis & development framework
IAD
Characterized by:
- Participants
- Positions (roles)
- Potential outcomes
- Action-outcome linkages
- Control of participants
- Types of information
- Costs and benefits
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<td>Working with the SES-database incl. lunch</td>
<td>all</td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>The Management and Transition Framework (MTF)</td>
<td>CPW</td>
</tr>
<tr>
<td>14:30-15:00</td>
<td>Operationalization of MTF Introduction to the database</td>
<td>CK</td>
</tr>
<tr>
<td>15:00-16:00</td>
<td>Working with the MTF database (incl. break)</td>
<td>all</td>
</tr>
<tr>
<td>16:00-17:00</td>
<td>Comparison and discussion</td>
<td>all</td>
</tr>
</tbody>
</table>
Exercise

In groups of two people (10 minutes)
Choose a problem (common pool resource problem) / resource system and a research question you would like to take a look at during this day.

- Define the action situation(s)
- Define the relevant actors, rules, ecological system
- What is the expected outcome?

Be prepared to present your action situation in 5 minutes
- Difficulties?
Social-Ecological-Systems Framework
1. What **patterns of interactions and outcomes**, such as overuse, conflict, collapse, stability, and increasing returns, are likely to result from using a particular set of rules for the governance, ownership, and use of a resource system and specific resource units in a specific technological, socioeconomic, and political environment?

2. What is the **likely endogenous development** of different governance arrangements, use patterns, and outcomes with or without external financial inducements or imposed rules?

3. **How robust and sustainable** is a particular configuration of users, resource system, resource units, and governance system to external and internal disturbances?
 SES framework (1)

Ostrom, 2009
Social, Economic, and Political Settings (S)

Interactions (I) → Outcomes (O)

Resource System (RS)
Resource Units (RU)

Governance System (GS)
Users (U)

Direct causal link
Feedback

Related Ecosystems (ECO)
SES-Framework (3)

Social, Economic, and Political Settings (S)

- Resource Systems (RS)
- Resource Units (RU)
- Governance Systems (GS)
- Actors (A)
- Focal Action Situations
  - Interactions (I) → Outcomes (O)
  - set conditions for
  - are part of
  - are inputs to
  - participate in

Related Ecosystems (ECO)

McGinnis and Ostrom, 2015
Ongoing work

- This framework is further developed collaboratively by scholars in Europe and the US (SES Club)
- The objectives are
  - To generalise to other types of SES as well as social-technical systems
  - To make the framework more rigorous
    - Formalisation, ontology
  - To pool data on diverse cases
- The longer term goal of framework development is to build theory across diverse cases
“At this broad level, one can begin to organize an analysis of how attributes of 
(i) a **resource system** (e.g., fishery, lake, grazing area),
(ii) the **resource units** generated by that system (e.g., fish, water, fodder),
(iii) the **users** (actors) of that system, and
(iv) the **governance system**
jointly affect and are indirectly affected by interactions and resulting outcomes achieved at a particular time and place.”

Ostrom, 2007
Definitions (1)

- **Resource Units (RU):**
  - “units extracted from a resource system, which can then be consumed or used as an input in production or exchanged for other goods or services.” (McGinnis, 2012)

- **Resource System (RS):**
  - An ecosystem conceptualized from the perspective of human use. It is defined by all physical and technical processes that contribute to the production of resource units (Hinkel et al., forthcoming).

- **Users (U):**
  - “the individuals who routinely extract resource units from that resource system” (McGinnis, 2012)
- **Governance System (GS):**
  - “the prevailing set of processes or institutions through which the rules shaping the behaviour of the users are set and revised”; (McGinnis, 2012)

- **Social, Economic, and Political Settings (S):**
  - “the broader context within which the governance system per se is located, including the effects of market dynamics and cultural change” (McGinnis, 2012)

- **Related Ecosystems (ECO):**
  - “the broader ecological context within which the focal resource system is located, including the determinants of many potential exogenous influences.” (McGinnis, 2012)
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)
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

Resource Units (RU)
RU1- Resource unit mobility
RU2- Growth or replacement rate
RU3- Interaction among resource units
RU4- Economic value
RU5- Size
RU6- Distinctive markings
RU7- Spatial & temporal distribution

Users (U)
U1- Number of users
U2- Socioeconomic attributes of users
U3- History of use
U4- Location
U5- Leadership/entrepreneurship
U6- Norms/social capital
U7- Knowledge of SES/mental models
U8- Dependence on resource
U9- Technology used

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

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

System boundary

Resource units (RU) ➔ Resource system (RS)

Farmer (A) ➔ Local governance system (GS)

Long-term feedback

Appropriation ➔ benefits ➔ Provision

Changes in Rules

External settings (S)
(e.g. Agricultural policies, price development, tourism, legislation)

Non-agricultural use ➔ Climate change
Example Swiss Meadows (II)

1. Institutional analysis
2. Landuse decisions
3. Analysis of the resource system
4. System Dynamics Model

System boundary

Resource units (RU)

Resource system (RS)

Farmers (A)

Local governance system (GS)

External settings (S)
(e.g. Agricultural policies, price development, tourism, legislation)

Appropriation
benefits
Provision

Rules

Changes in Rules

Non-agricultural use
Climate change

Long-term feedback

Short-term impact

Benefits

Table 1: Variables of the SES in Grindelwald affected by societal transitions. Based on Ostrom (2007, 2009), and McGinnis and Ostrom (2011).

<table>
<thead>
<tr>
<th>Social, Economic, and Political Settings (S)</th>
<th>Resource Systems (RS)</th>
<th>Governance Systems (GS)</th>
<th>Actors (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>†S1-Economic development</td>
<td>RS1-Sector (e.g. water, forests, pasture, fish)</td>
<td>GS1-Government Organizations</td>
<td>†A1-Number of actors</td>
</tr>
<tr>
<td>†S2-Demographic trends</td>
<td>RS2-Claarity of system boundaries</td>
<td>GS2-Nongovernment organizations</td>
<td>†A2-Socioeconomic attributes of actor</td>
</tr>
<tr>
<td>†S3-Political stability.</td>
<td>RS3-Size of resource system</td>
<td>GS3-Network structure</td>
<td>†A3-History of use</td>
</tr>
<tr>
<td>†S4-Government resource policies.</td>
<td>RS4-Human-constructed facilities</td>
<td>GS4-Property-rights systems</td>
<td>†A4-Location</td>
</tr>
<tr>
<td>†S5-Market incentives.</td>
<td>RS5-Productivity of system</td>
<td>GS5-Operational rules</td>
<td>†A5-Leadership/entrepreneurship</td>
</tr>
<tr>
<td>†S6-Media organization.</td>
<td>RS6-Equilibrium properties</td>
<td>GS6-Collective-choice rules</td>
<td>A6-Norms (trust-reciprocity)</td>
</tr>
<tr>
<td>†S7-Predictability of system dynamics</td>
<td>RS7-Predictability of system dynamics</td>
<td>GS7-Constitutional rules</td>
<td>A7-Knowledge of SES/mental models</td>
</tr>
<tr>
<td>†S8-Storage characteristics</td>
<td>RS8-Storage characteristics</td>
<td>GS8-Monitoring and sanctioning rules</td>
<td>†A8-Importance of resource (dependence)</td>
</tr>
<tr>
<td>RS9-Location</td>
<td>RS9-Location</td>
<td></td>
<td>A9-Technology used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource Units (RU)</th>
<th>Action Situations: Interactions (I) → Outcomes (O)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>†RU1-Resource unit mobility</td>
<td>*I1-Harvesting levels</td>
<td>I12-Information sharing</td>
<td>O1-Social performance measures (e.g., efficiency, equity, accountability, sustainability)</td>
</tr>
<tr>
<td>RU2-Growth or replacement rate</td>
<td>I13-Deliberation processes</td>
<td>I14-Conflicts</td>
<td>O2-Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)</td>
</tr>
<tr>
<td>RU3-Interaction among resource units</td>
<td>*I2-Investment activities</td>
<td>I16-Lobbying activities</td>
<td>O3-Externalities to other SESs</td>
</tr>
<tr>
<td>†RU4-Economic value</td>
<td></td>
<td>I17-Self-organizing activities</td>
<td></td>
</tr>
<tr>
<td>RU5-Number of units</td>
<td></td>
<td>I18-Networking</td>
<td></td>
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<tr>
<td>RU6-Distinctive markings</td>
<td></td>
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<tr>
<td>RU7-Spatial and temporal distribution</td>
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</tr>
</tbody>
</table>
Three levels of rules
(McGinnis, 2012)

Operational Choice:
- “implementation of practical decisions
- individuals who have been authorized to take these actions as a consequence of collective choice processes.”

Collective Choice:
- “processes through which institutions are constructed and policy decisions made,
- actors authorized to participate in the collective decisions as a consequence of constitutional choice processes”

Constitutional Choice:
- “processes through which collective choice procedures are defined, including legitimizing and constituting all relevant collective entities involved in collective or operational choice processes.”
GS7 CONSTITUTIONAL RULES
(Taleinung → Bergschaften)
- Formal organization of the corporations
- Membership positions

GS6 COLLECTIVE CHOICE-RULES
- Taleinung → Bergschaft → Besetzerschaft
- What are the decision-making processes?
- Voting rules

GS5 OPERATIONAL RULES
(Bergschaft → prescribes Besetzer action and the sanction)
- Rights
- Duties
- appropriation
- provision
In groups of two (15 minutes):

- Take the same case you studied before.
- Apply the SES-framework for your case

Be prepared to present your results in 5 minutes
Procedure for applying the SES framework

- Choose a case and research question
- Define the outcome of interest according to the research question
  - Using and extending the variables attributed to O.
- (Re)Define **focal appropriation action situation** by answering the question: Which users (U) appropriate which resource units (RU)?
- **Define the RS** by answering the question: What natural and technical processes are involved in generating the RU?
  - Technical artefacts involved in the RS: “Human-constructed facilities (RS4)”
- Interpret the variables of RS, RU and U
- Governance system
  - Which rules, property-right and monitoring & enforcement processes govern resource use?
  - Which actors make these rules? The users or other organisations?
  - Other actors and their roles?
Variables

- Interpret the variables for the given case
  - How is the variable interpreted in the particular SES you are looking at?
    - e.g. for the variable “Clarity of system boundaries”: What are the system boundaries in the SES?
  - What value does the variable take on in the SES considered?
    - e.g. for the variable “Clarity of system boundaries”: Are boundaries clear?
  - How does the variable affect the outcome of interest?
    - e.g., if system boundaries are unclear, it is difficult to monitor users extracting RU
• Which aspects of the SES could you easily represent?
• Which aspects were difficult to represent?
• Which concepts/variables are missing in the SES framework?
• Which variables are important for explaining which outcome?
• What have you learnt about your SES by applying the SES framework?