Diagnosing Disaster Resilience of Communities as Multi-scale Complex Social-Ecological Systems

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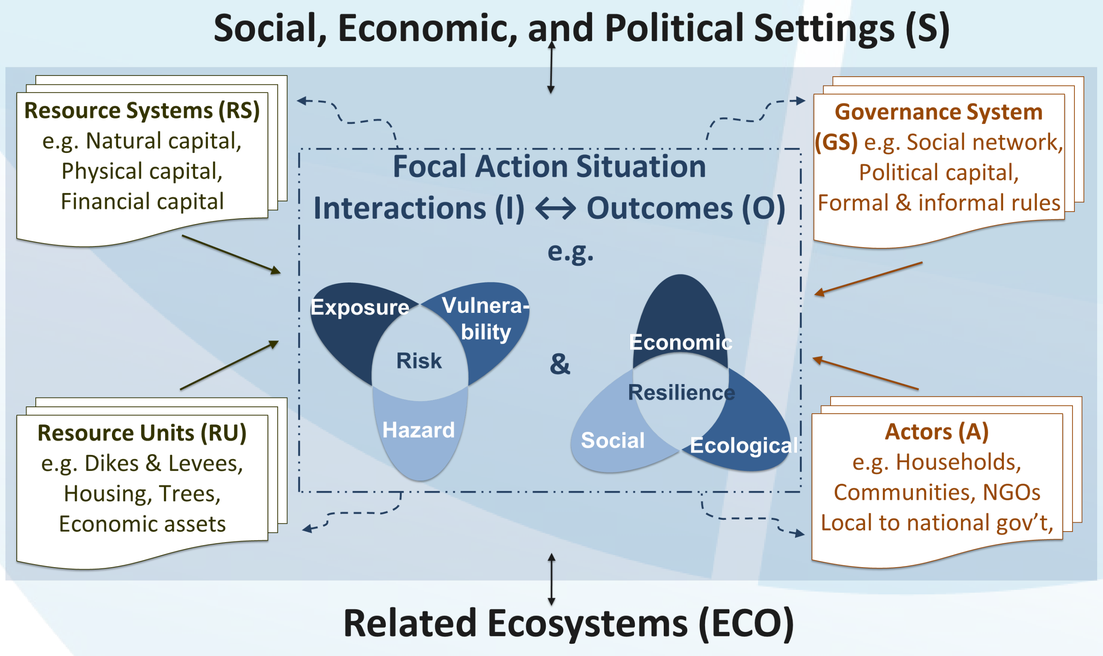
Summary

- **Disaster resilience of communities under global changes cannot be understood without knowledge on the broader social-ecological system (SES) in which they are embedded.**
- **Building on key theories and concepts on SES, resilience, development, and disaster risk, we developed a multi-tier framework for diagnosing community disaster resilience.**
- **We highlight the cross-scale influences and feedbacks on communities that exist from lower (e.g., household) to higher (e.g., regional, national) scales and applied the framework to diagnose and assess disaster resilience in various cases of disaster events in China and Nepal.**

Theories and Concepts

- **Our Definition of Disaster Resilience: The ability of a system, community or society to pursue its social, ecological and economic development objectives while managing its disaster risk over time in a mutually reinforcing way.**
- **Key frameworks, theories and concepts: Ostrom's SES Framework; Holling's adaptive cycle and panarchy; DEID's Sustainable Livelihood Framework; IPCC's Climate Risk Framework**

A Multi-tier and Cross-scale Framework



Second-Tier Variables

Social, Economic, and Political Settings (S)
S1- Economic development. S2- Demographics.
S4- Government resource policies. S6- Media organization.

Resource Systems (RS)
RS1- Sector (e.g., water, forests)
RS2- Human-constructed facilities
RS3- Location
RS4- Financial system

Governance Systems (GS)
GS1- Government organizations
GS2- Nongovernment organizations
GS3- Network structure
GS4- Operational rules

Resource Units (RU)
RU1- Growth or replacement rate
RU2- Durability
RU3- Economic value
RU4- Number of units
RU5- Spatio-temporal distribution

Actors (A)
A1- Number of actors
A2- Socioeconomic attributes of actors
A3- Leadership/entrepreneurship
A4- Knowledge of SES/mental models

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

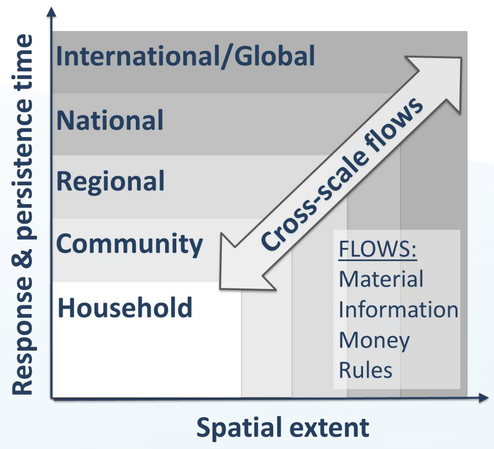
I1- Harvesting and building
I2- Information sharing
I3- Conflicts among actors
I4- Investment activities
I5- Networking activities

O- Resilience and Sustainability
O1- Social (e.g., equity)
O2- Ecological (e.g., biodiversity)
O3- Economic (e.g. efficiency)
O4- Externalities to other SESs

Ecological Rules (ER)
ER1- Physical. ER2- Chemical. ER3. Biological.

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

A multi-scale perspective of communities as social-ecological systems, showing the relationships between the spatial extent, response times, and persistence times of different system elements. Individual elements are nested within each other.

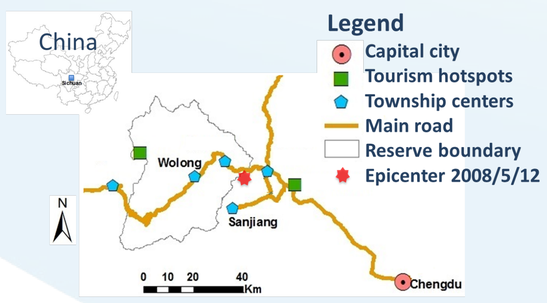


Application and Discussion

1. Wolong Nature Reserve and the 2008 Sichuan Earthquake

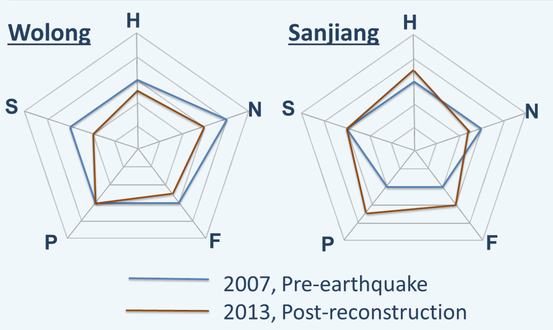
Comparison of Key Variables

	Wolong	Sanjiang
Social, Economic, and Political Settings (S)		
S4a- Conservation policies	Strong	Moderate
S4b- Reconstruction implementation	Slow	Fast
Actors (A)		
A1- Number of actors	Slow growth	Rapid growth
A2- Leadership/entrepreneurship	Lacking	High levels
A3- Trust and reciprocity	Lacking	Moderate
A4- Knowledge of SES/mental models	Moderate	Moderate
Governance System (GS)		
GS1- Government organizations	Special district	Normal
GS2- Nongovernment organizations	Few	Many
GS3- Network structure	Hierarchy & Tele-coupling	Hierarchy
GS4- Property rights	Open-access and CPR	CRP and private
GS5- Monitoring and sanctioning	Moderately strong	Weak
Resource System (RS)		
RS1 Location	Damaged road	Better road, but deadend
RS2- Human constructed facilities	Moderate	Moderate
RS3- Financial system	Weak	Moderate
RS4- Predictability	Least predictable	Moderately predictable
Resource Units (RU)		
RU1- Growth or replacement rate	Low	Low
RU2- Durability	Low	High
RU3- Economic value	High	Moderate
Outcomes (O)		
O1a- Income inequality	High	Moderate
O2a- Biodiversity	High	Moderate
O3a- Income level	Medium	High
O3b- Income diversity	Low	High
O4- Externalities to other SESs	Negative	Positive

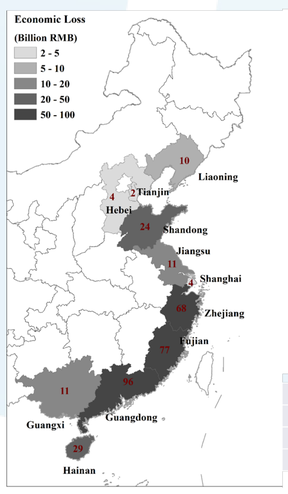


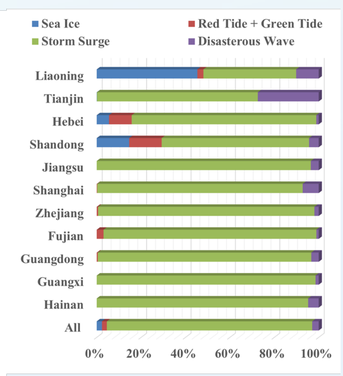
Wolong Nature Reserve is a flagship reserve in China and home giant pandas and rich biodiversity. **Sanjiang township** is located to the southeast of the Reserve. Both areas were devastated by the 7.9 Ms Wenchuan earthquake in 2008, and suffered great damages, but have undergone quite different post-quake recovery trajectories.

Livelihood Assets – Five capitals
H: Human; S: Social; N: Natural; P: Physical; F: Financial

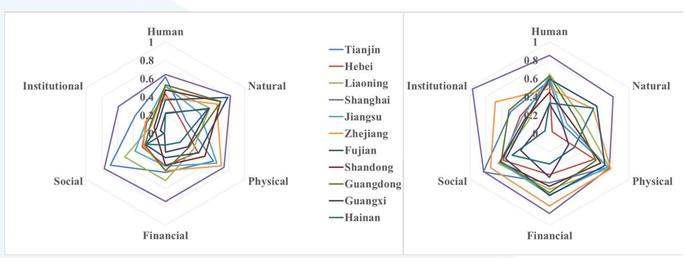


2. Coastal disasters in China

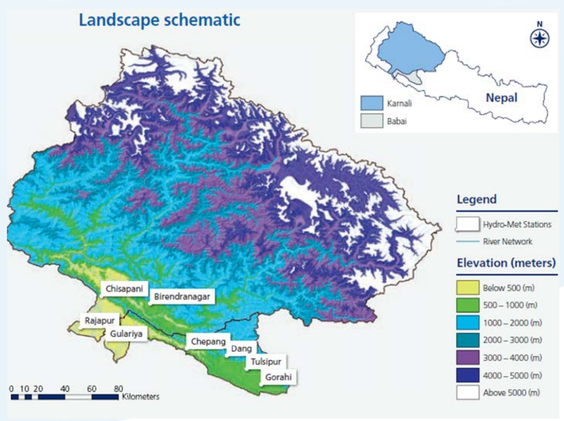




Type	Proportion
Storm Surge	92.49%
Disastrous Wave	2.95%
Red Tide + Green Tide	2.19%



3. Karnali river flood, Nepal



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