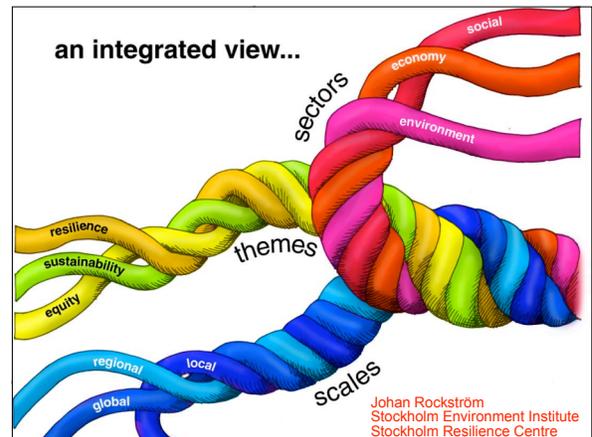


# Resilience Theory and Social-Ecological Systems

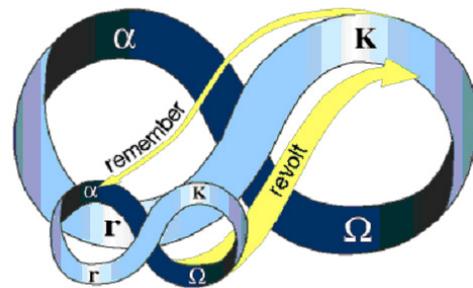
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Global Citizen NGO



## Roots of Resilience

- Capacity to absorb shocks and still maintain function (**sustaining**) (Holling 1973);
- “Engineering resilience” (өөрөө сэргэх чадвар) focuses on maintaining function near single steady state;
- Capacity for renewal, re-organization (self-organization) and development (**developing**);  
Resilience-сэргэн хөгжих чадвар (multi-states, non-linear dynamics)

## Adaptive Renewal Cycle: Panarchy



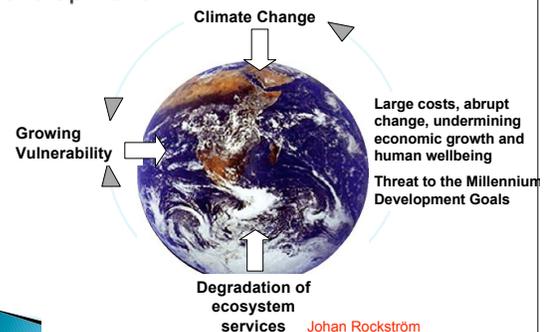
Exploitation (r); Conservation (K); Release (omega); Renewal (alfa)

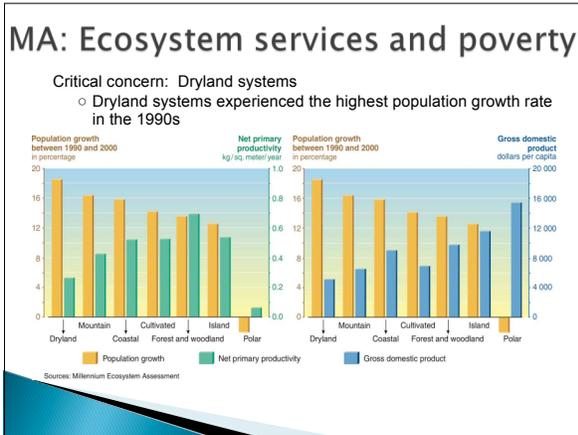
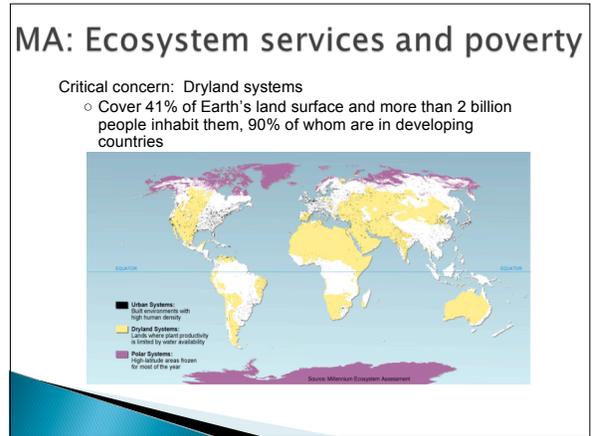
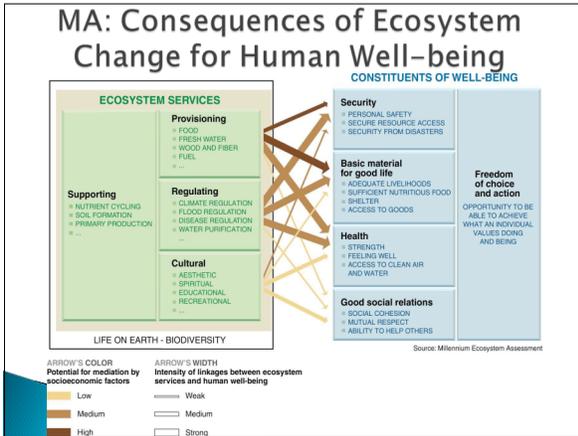
Gunderson and Holling, 2002

## Social-Ecological Systems

- Land - The Human-Environmental system in the Global Land Project-joint IGBP-IHDP program (2005);
- The Earth as social-ecological system;
- How globalization (rising connectedness, increased speed, spatial stretching and declining diversity) is affecting resilience of SESs? (Oran 2006).

## Global Environmental Change and Human Development

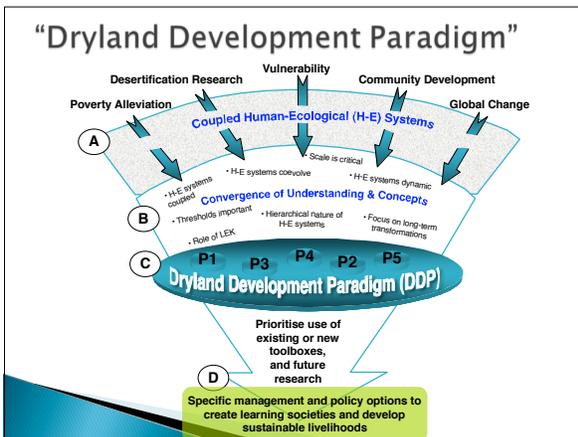




### MA: Ecosystem services and poverty

Critical concern: Dryland systems

- Development prospects in dryland regions of developing countries are particularly closely linked to the condition of ecosystem services
- People living in drylands tend to have the lowest levels of human well-being, including the lowest per capita GDP
- Drylands have only 8% of the world's renewable water supply
- Approximately 10–20% of the world's drylands are degraded (medium certainty)



### Drylands Development Paradigm

- Principle 1. Dryland H-E systems are coupled, dynamic, and co-adapting, with no single target equilibrium point.
- Principle 2. The critical dynamics of dryland systems are determined by "slow" variables, both biophysical and socioeconomic.
- Principle 3. Slow variables possess thresholds that, if crossed, cause the system to move into a new state or condition.
- Principle 4. The involvement of multiple stakeholders, with highly differing objectives and perspectives, illustrates the need to pay attention to the multilevel, nested, and networked nature of H-E systems.
- Principle 5. The key to maintaining functional co-adaptation of coupled H-E systems is an up-to-date body of "hybrid" environmental knowledge that integrates local management and policy experience with science-based knowledge.

Reynolds et al. 2007

## Socio-ecological resilience

- Adaptive capacity;
  - Adaptability – capacity of people to build resilience through collective action;
- Transformations toward more sustainable development pathway.
  - Transformability – capacity to build new social-ecological system;
- Cross-scale dynamic interactions;
- Recent advances include social learning & social memory, mental models & knowledge-system integration, visioning & scenario building, **leadership**, agents & actor groups, social networks, institutional & organizational inertia & change;
- Adaptive governance for socio-ecological resilience.

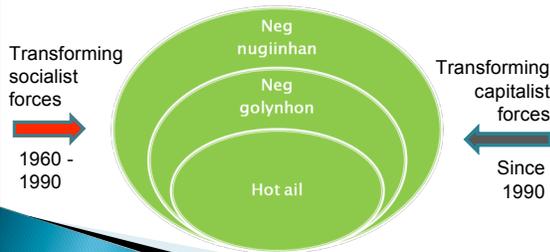
Resilience Conference, 2008, Stockholm

## Resilience and Transformation of Pastoral Community – Cultural Landscape Systems in Mongolia

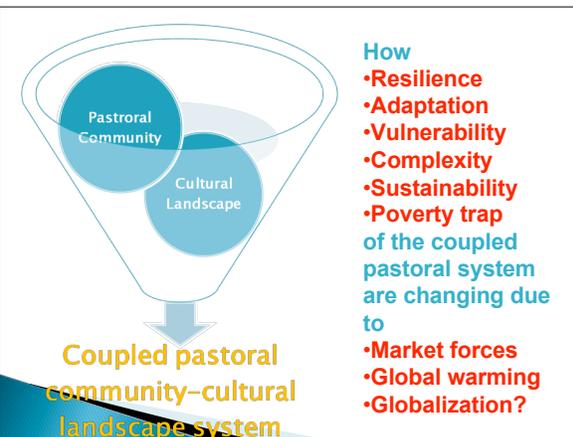
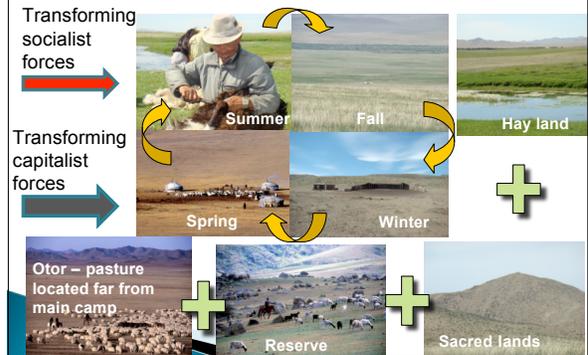
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### Traditional Informal Nested Hierarchy: Social-Ecological Resilience

Traditional pastoral networks emerged in resource limited and highly variable environment, and evolved to increase its resilience.



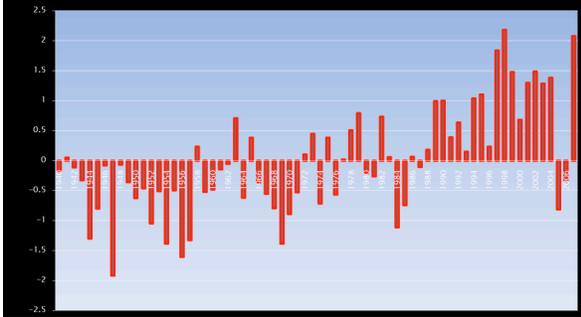
### Traditional Cultural Landscape: Biocomplexity



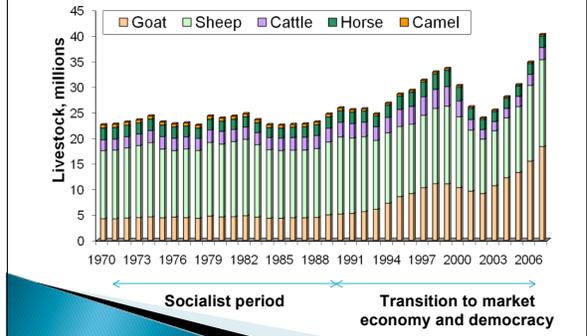
## Application to Mongolia

- ▶ Traditional pastoral community-cultural landscape systems as coupled social-ecological systems;
- ▶ Resilience examples:
  - Recovery of rangeland ecosystems after disturbances such as fire, rodents, grasshoppers, butterflies etc.
  - Recovery after *zud*
    - Diversity of five animals with different rate of recovery;
    - Mutual assistance (social resilience);
  - "Tragedy of commons" is applicable if there isn't any cooperation &
  - Pasture usage efficiency dramatically increases with cooperation (Elinor Ostrom, Resilience conference 2008)

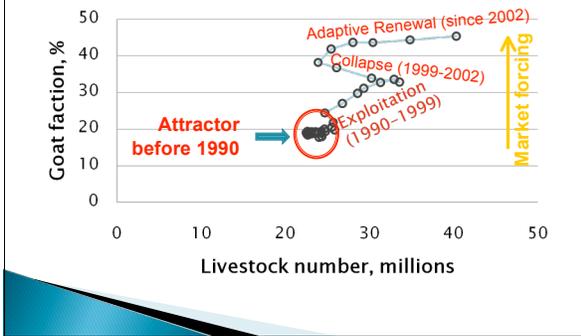
### Temperature difference from the average in Mongolia /1940-2007/: Critical slow variable?



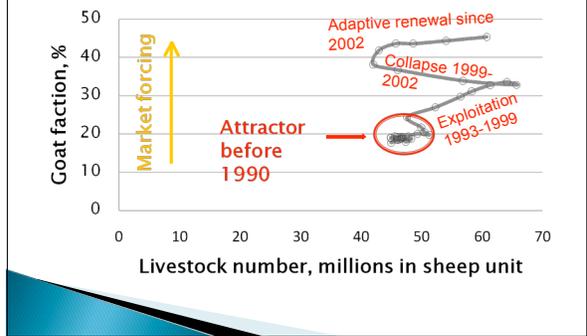
### Regime Shift since 1990: Dynamics of the Coupled Pastoral System



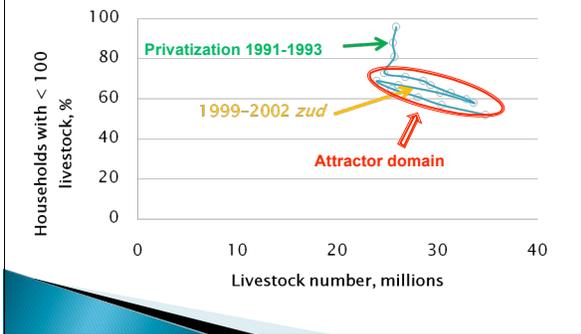
### Regime Shift since 1990: Cashmere



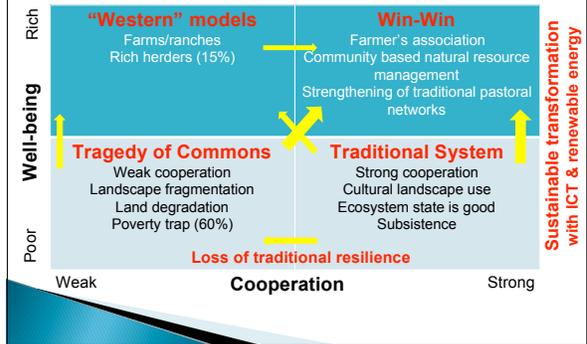
### Regime shift since 1990: Cashmere



### Regime shift since 1990: Poverty Trap



### Scenarios for pastoral social-ecological systems



## Conclusions

- ▶ **Sustainable community development:**  
Strengthening of traditional and newly re-emerged pastoral community-cultural landscape systems, remotely located from cities and infrastructure, with modern technologies such as renewable energy, distance learning, wireless communication, distance diagnosis etc.
- ▶ **Transformation** of herders, who lost their traditional resilience mechanisms and are living in forest steppe and meadow steppe, especially near big cities and infrastructures, into sustainable farmers.