TEQIP-III Short Course on Systems Analysis of Biofuels and Bioproducts

Module 7: Resilience Thinking

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Goals of this Lecture

Introduce the concept of resilience and its importance in Systems Analysis

Learning Objectives

By the end of this lecture, you must be able to:

1. Describe the concept of resilience and it is different from robustness, stability and sustainability
2. Understand the importance of resilience from a systems analysis perspective
3. Describe how resilience perspective is critical to adapting to a changing world

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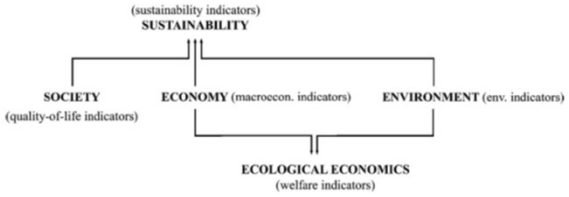
Aspects of Sustainability

- Sustainability: Metrics



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The End of Sustainability??

Society and Natural Resources, 27:777–782
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Routledge
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Policy Review

The End of Sustainability

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S. J. Quinney College of Law, University of Utah, Salt Lake City, Utah, USA

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Resilience

- What is Resilience?
  - "capacity to persist in the face of change, to continue to develop with ever changing environments"
  - "Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, and feedbacks, and therefore identity, that is, the capacity to change in order to sustain identity; resilience is a dynamic concept focusing on how to persist with change (Walker et al. 2004, Folke et al. 2010), how to evolve with change."
- What is Resilience thinking?
  - "…how periods of gradual change interact with abrupt changes and the capacity of the people, communities , societies, cultures to adapt or even to transform into new developments in the face of dynamic change. "
- Brief history of resilience research.
  - Multiple stability domains or multiple basins of attractions for ecosystems (Hollings, 1973)
  - Adaptive management principles
  - Socio-Ecological Systems research

Ref: Folke, C. 2016. Resilience. Ecology and Society 21:44

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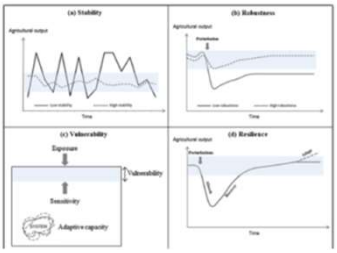
Some Terminology

- Sustainability: Latin *sub* (from below) *tenere* (to hold)→ *sustinere*: hold/support
- Stability: From Latin *stabilis*: to stand firm or steady
- Robustness: Latin *robustus*: strong
- Resilience: Latin *resilio*: rebound
- Vulnerability: Latin *vulnus*: injury
- Fragility: Latin *fragilis*: to break



Ref: Urruty et al. 2016. Stability, robustness, vulnerability, and resilience of agricultural systems. A review.

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Resilience

- Adaptability
- Transformability
- "Planning for not having a plan"
- Resilience…of what for what and for whom? (Carpenter et al. 2001 and Lebel et al. 2006)
- But…." actions aimed at increasing resilience of individuals, communities, nations as the core focus may reinforce unsustainable pathways, undermine biosphere resilience and challenge sustainability"!!!

Ref: Folke, C. 2016. Resilience. Ecology and Society 21:44

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Resilience

- Are robustness and resilience the same?
  - Uncertainties, systems boundaries, feedback systems
- How can we measure resilience?
- Three levels of challenges:
  - Challenge I (Shorter term): Resilience~Robustness
    - Tools of robustness are well suited here.
  - Challenge II (intermediate term): Adaptability
    - Adaptive capacity, tolerance to disturbances
  - Challenge III (longer term): Transformability
    - Hidden fragilities
    - Evolvability

Ref:Andreies et al. 2013. Aligning Key concepts for global change policy: Robustness, resilience, and sustainability.

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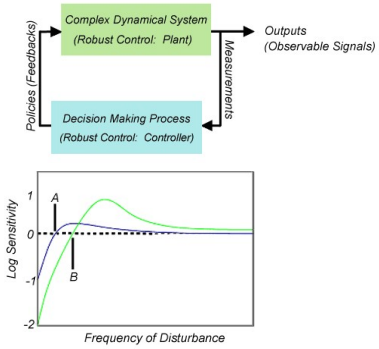
Resilience

- Law of conservation of fragility



Ref:Andreies et al. 2013. Aligning Key concepts for global change policy: Robustness, resilience, and sustainability.

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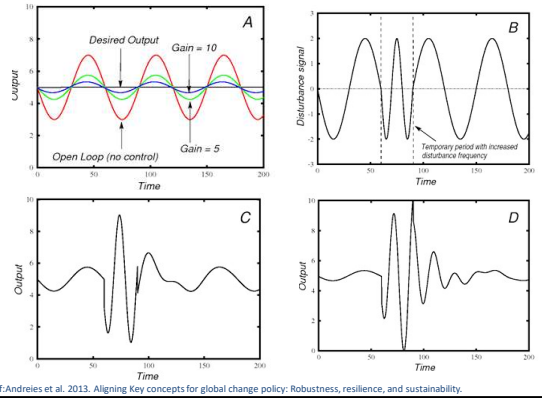
Resilience

Example: Response of farmers to weather variations



Ref:Andreies et al. 2013. Aligning Key concepts for global change policy: Robustness, resilience, and sustainability.

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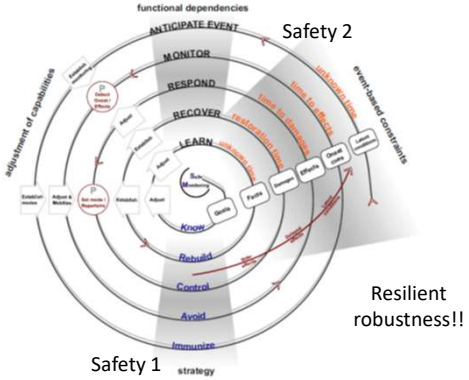
Systemic Resilience Model



Ref: Lundberg and Johansson. 2015. Systemic Resilience Model

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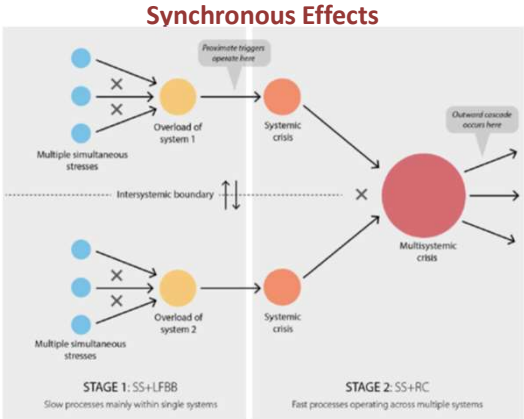
Synchronous Effects



Ref: Homer-Dixon et al. 2015

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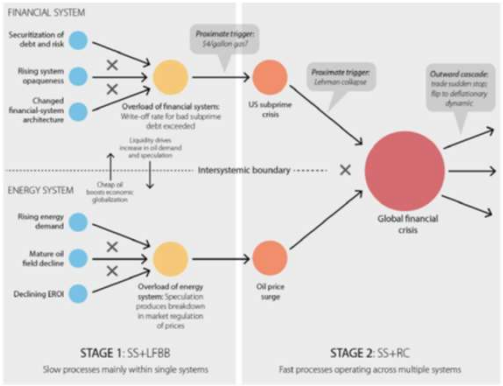
Synchronous Effects



Ref: Homer-Dixon et al. 2015

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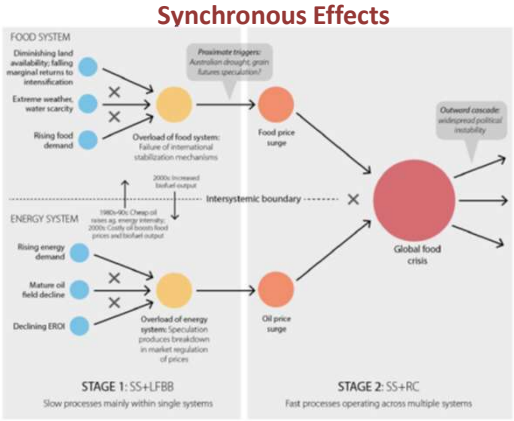
Synchronous Effects



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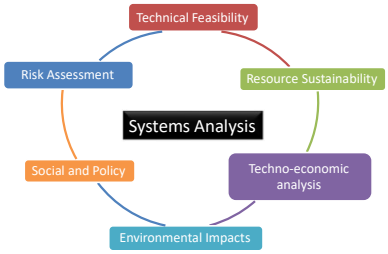
Connecting it all Together

Importance of systems perspective in a resource constrained world



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Happy Learning!!

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