

# Bottlenecks to Sustainability in Asia: FLUXNET Perspectives

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# WASA

Swedish Royal  
Warship





# **Lessons** *learned from the* **WASA**

- Tipping Point -

- Excessive schedule pressure with changes upon changes
- Lack of documented plans and technical details
- Excessive innovation & more
- Lack of scientific methods
- Ignoring the obvious



# **Lessons** *learned from the* **WASA**

## Visioneering

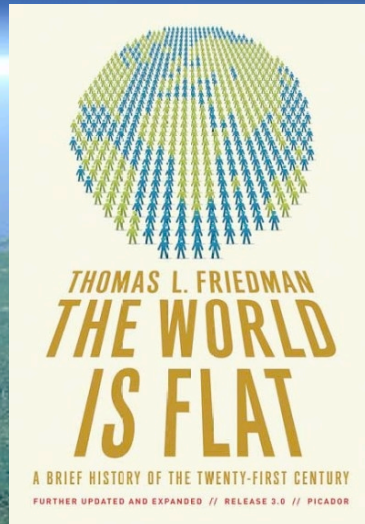
(Kim & Oki, 2011 *Sustainability Science*)

- Visioning only
- Lack of (1) casting vision strategically; (2) celebrating vision systematically; and (3) embracing vision personally
- Lack of engineering of a clear vision
- i.e. “ *Visioneering* ” - a triad of
- (1) governance, (2) management,
- and (3) monitoring



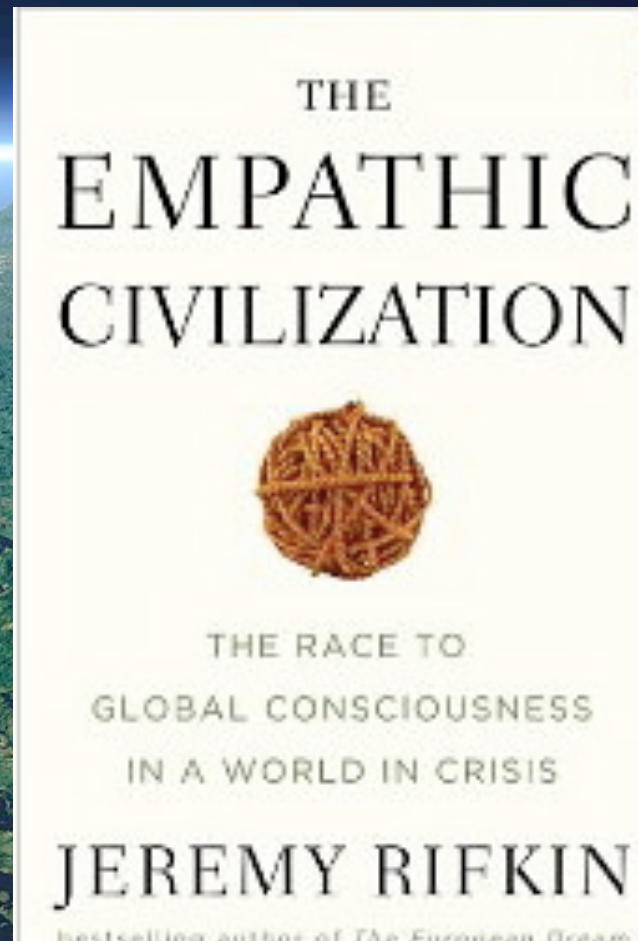


# ENTROPIC JUGGERNAUT





# EMPATHY / ENTROPY PARADOX



*“ Critical Test of Sustainability ”*

Seoul National University

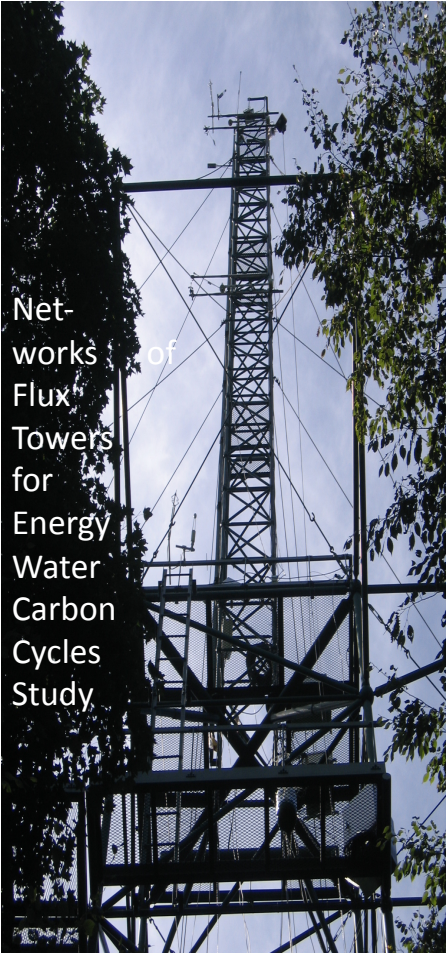




Eddy covariance monitoring systems



Networks of Flux Towers for Energy Water Carbon Cycles Study



# AsiaFlux : The Asian pillar of FLUXNET (tower-based global flux monitoring network)

**Mission:** Nurturing *biosphere consciousness* by bringing key ecosystems in Asia under observation to ensure quality and sustainability of life on earth







# **Vision** “Thinking Community, Learning Frontier”

*in Ecosystem Science, Service, and Stewardship  
by Creating and Practicing Knowledge*

## **CONSILIENCE**

- Synthesis of knowledge in holistic, exploratory, perspectival ways

## **CONTEXTUALIZATION**

- Reformulation of scientific knowledge in social and pedagogical context by embracing its implications as well as the applications

## **CULTURAL DIVERSITY**

- Building resilience by welcoming diversity and conflict, tolerating ambiguity, and embracing paradox through teaching and learning



# ***Bottlenecks to Sustainability***

## **“ Lack of Three Basics ”**

- (1) Clear vision and its engineering –  
*Visioneering* (thus, no willingness  
to embrace & implement changes)
- (2) Resilience and capacity building to  
perform the transformation needed
- (3) Understanding of the complex  
social-ecological systems (SES)





# ***Fundamental Bottleneck in Asia***

**Abandonment of the spirit**

溫故知新

*“Keep cherishing old wisdom & understanding  
while continually learning & teaching  
new (knowledge) to serve others”*





## *since Rio Declaration & Agenda 21...*

- Focus has been on “Sustainability”
- Definitions have evolved ...
  - **Development** that meets the needs of the present without compromising the ability of future generations to meet their needs (WCED 1987);
  - **Cultural Adaptation** made by society as it becomes aware of the emerging necessity of non-growth (Daly 1993);
  - **Process** that is farseeing enough, flexible enough, and wise enough not to undermine the social-ecological systems of support (Meadows et al. 2004);
  - **Possibility** and **Destiny** that human and nature will prosper together forever (Kim & Oki 2011).
- Regional & global partnership to conserve, protect, restore the health & integrity of the biosphere





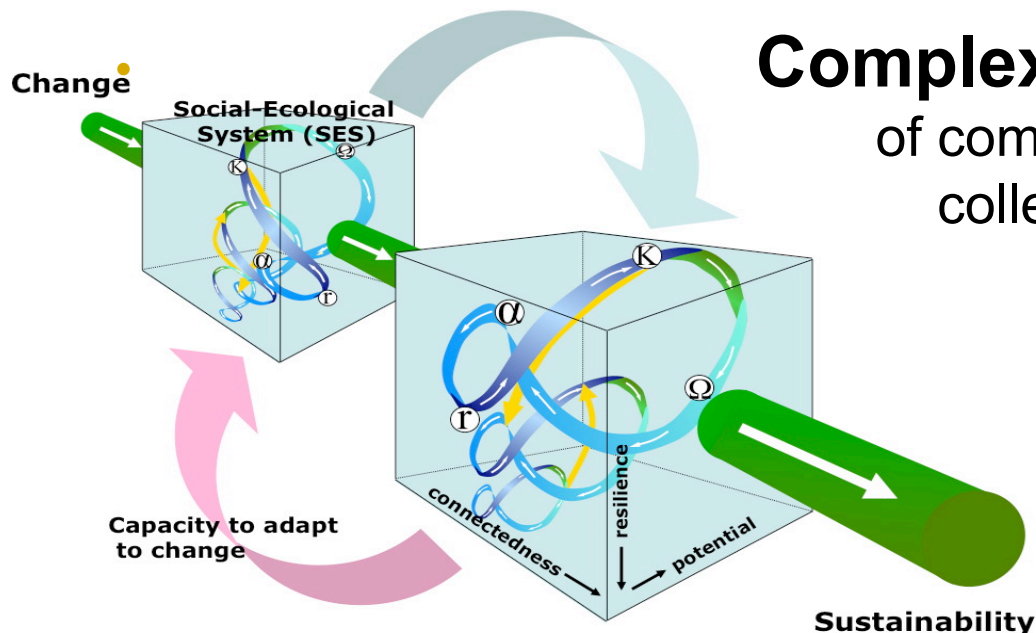
# ***Sustainability / Complexity Sciences***

- have emerged as vibrant fields of education and research that transcend the disciplinary boundaries and focus on understanding the dynamics of complex “***social-ecological systems (SES)***.”
- Sustainable future will require purpose-driven transformation of society at all scales, guided by “***Visioneering***” with resilience-based systems thinking that science can provide



# Social-Ecological System (SES)

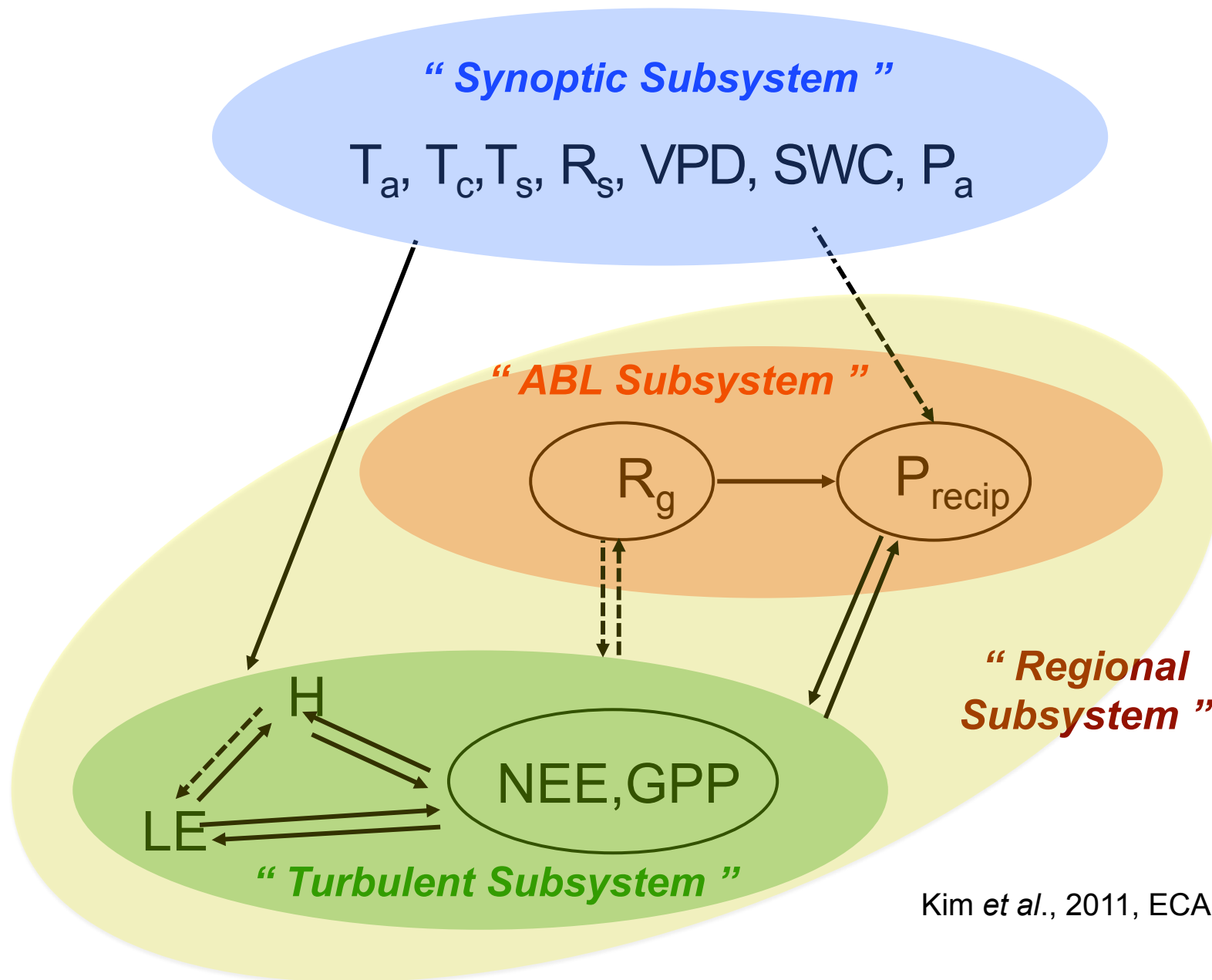
- **SES:** A combined system of social and ecological components and drivers that interact and give rise to results, which cannot be understood based on social or ecological considerations alone. A pivotal hinge to connect these two different systems in dimensionality & complexity is needed (e.g. thermodynamics)



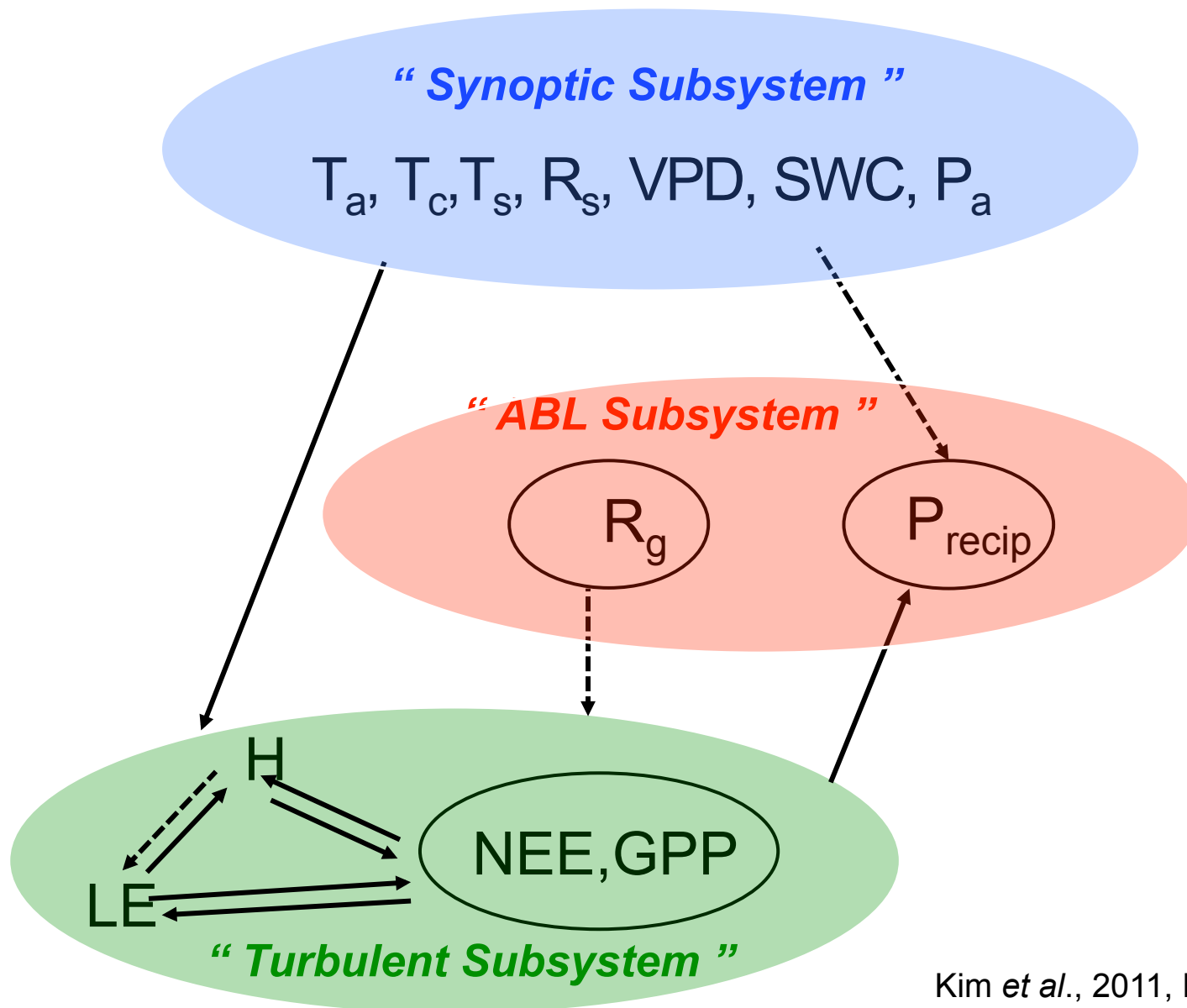
**Complex system:** Large networks of components give rise to complex collective behavior, sophisticated information processing, and adaptation via learning



# Process Network of Ecohydrological System in Forest Ecosystem at Green-Up



# Process Network of Ecohydrological System in Forest Ecosystem at Drought





# Paradigm Shift

*From*

*To*

Human <b>EXTERNAL</b> to the system	<i>INTRINSIC, both drivers and beneficiaries</i>
PAST is a guide to the future	<i>NON-stationary world, unexpected variability</i>
Predicting, assuming <b>FIXED</b> systems	<i>EVOLVING, complex adaptive systems</i>
Learning from studying <b>LOCAL</b> to extrapolate	<i>COMPARATIVE learning across scales/along gradients</i>

( adapted from Sivapalan, 2006 Water Res. Res. )



# Paradigm Shift

*From*

*To*

Analyst at small scales or synthesist of large scales	<i>Both Analyst &amp; Synthesist across scales</i>
Observation, prediction & management SEPARATE	<i>INTERACTIVE learning with feedback &amp; updating</i>
Strong SEPARATION between disciplines	<i>CONSILIENCE: Integration into a HOLISTIC teaching</i>
Focus: Teaching established solution to current problem	<i>EVOLVING adaptive skills to solving new problems</i>

( adapted from Sivapalan, 2006 Water Res. Res. )





*Vision starts with concerns !*



Mental picture of what *could be* and *should be*



# ***Seoul National University offers***

- **New cross-disciplinary graduate program** in “***Agricultural and Forest Meteorology***”
- **Joint degree program** among the Colleges of Agriculture and Life Sciences, Natural Sciences, and Engineering, mobilizing students towards
- **Sustainability:** to address complex local, regional, and global challenges related to sustainability and to innovate science, service, and stewardship for building resilience in complex social-ecological systems (SES)



# ***New Education & Research Program***

## Paradigms Shift in “ ***THINKING*** ”

from	to
Self-assertive	<i>Integrative</i>
Rational	<i>Intuitive</i>
Analysis	<i>Synthesis</i>
Reductionist	<i>Holistic</i>
Linear	<i>Non-linear</i>

( Adapted from Capra, 1997 )





# ***New Education & Research Program***

## Paradigms Shift in “ ***VALUES*** ”

from	to
Self-assertive	<i>Integrative</i>
Expansion	<i>Conservation</i>
Competition	<i>Cooperation</i>
Quantity	<i>Quality</i>
Domination	<i>Partnership</i>

( Adapted from Capra, 1997 )



# Agric. & Forest Meteorology Program

- Prepare students to become unique functional groups through team learning with scientists & practitioners to build resilience in complex social-ecological systems at various scales.
- The Master and Ph.D. programs consist of 24 and 60 semester hours, respectively, including exciting internships in domestic (e.g., National Center for AgroMeteorology, NCAM at SNU) or international settings (e.g., AsiaFlux/FLUXNET, WMO); all courses are offered in English.



# *Visioneering toward Sustainability*

- (1) **Management:** working professionals in various settings that focus on sustainability issues related to food production and food security;
- (2) **Monitoring:** scientists & engineers equipped with problem solving skills in complex SES and creative thinking to advance sustainability in underdeveloped & developing nations; and
- (3) **Governance:** science advisors with resilience thinking for sustainable decision-makings & policy changes enabling adaptation & transformation





# 15 REQUIRED COURSES

- Agricultural and Forest Meteorology
- Agroforest Ecosystems & Climate Change
- Biogeochemical Cycles in Complex Ecosystems
- Biometeorological Monitoring and Application
- Disease Management in Agroforest Ecosystems
- Experimental Design and Scientific Writing
- Internship in Agricultural & Forest Meteorology I & II
- Remote Sensing of Ecosystem Structure & Function
- Responsibility, Justice, and Sustainability Science
- Thermodynamics of Life and Earth Systems ...



# 33 ELECTIVES

- Agricultural Ecology; Atmospheric Turbulence
- Bioinformatics; Brain and Cognitive Sciences
- Computational Fluid Mechanics; Crop-Water Relations
- Data Mining Technology; Dynamic Systems
- Ecological Economics; Forest Management & Modeling
- Geostatistics; GIS/Remote Sensing; Numerical Modeling
- Physics of Complex Systems; Plant Biochemistry
- Plant Stress Physiology; Plant Structure & Function
- Rural Resources Information Systems; Soil Physics
- Tree Physiology; Watershed Hydrology ...



# ***Nurturing 8 Functional Groups***

1. Visionary & Inspirer
2. Knowledge Carriers & Retainers
3. Interpreters & Sense Makers
4. Networkers & Facilitators
5. Stewards & Leaders
6. Innovators & Experimenters
7. Entrepreneurs & Implementers
8. Reinforcers & Followers





# ***New Program Starts in Spring 2012***

- Contact: Joon Kim
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## *Seeing beyond the Majority*



*Foresight with Insight based on Hindsight*

