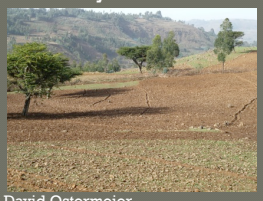
Governing the Environment in Complex Times

Facing Our Reality



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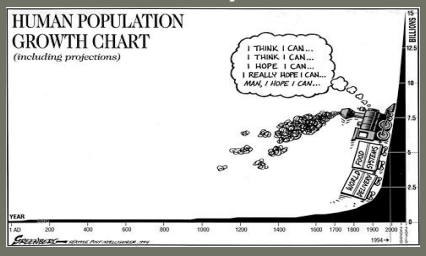
Outline

- Global Environmental Challenges: Population, land & water use for agriculture
- Global status of Ecosystem Services
- Impacts of feeding 9 billion people
- Environmental Governance: Global
- Environmental Governance: Tennessee
- A call for Resilience

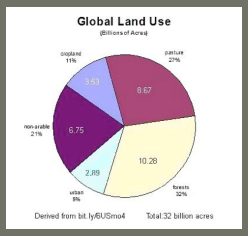
Challenge I: Feeding 9 Billion

From 7 to 9 Billion by 2050: 50M/Year



Challenge II: Land Use for Agriculture

- 35%-40% of ice-free land is used for agriculture



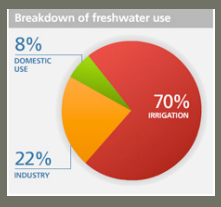
Crop Production to Feed 9 Billion

- Assuming recent growth in developing world economies continues (3% annual), Overall food production to increase by 70%
- FAO stats

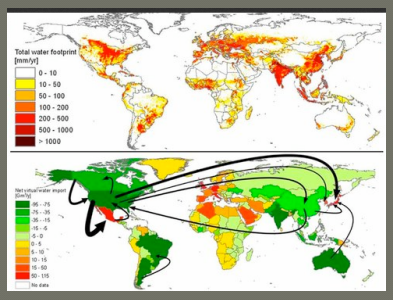
Challenge III: Water Use for Agriculture

- 70% of global water use is for agriculture
- Given current water use, agriculture will double water use to feed 9 billion

International Water Mgmt. Institute



Water Footprint & Virtual Water



Forty Percent of global grain harvest is from irrigation cropping systems

- Rivers Running Dry Due to Use (primarily irrigation)
  - Amu Darya: Uzbekistan/Aral Sea
  - Colorado: U.S.A/Mexico
  - Fen: China
  - Ganges: India/Bangladesh
  - Indus: Pakistan
  - Nile: Ethiopia, Sudan, Egypt
  - Yellow: China

Source: FAO

Countries Depleting Aquifer Supplies (Countries have over 50% of world population)

- **Mideast**: Afghanistan, Iran, Iraq, Israel, Jordan, Lebanon, Pakistan, Saudi Arabia, Syria, Yemen
- **Asia**: China, India, South Korea
- **Africa**: Morocco, Tunisia
- **Americas**: Mexico, United States
- **Europe**: Spain

Source: Earth Policy Institute

Challenge IV: Ecosystem Services

- **SUPPORTING**: Nutrient cycling, Soil Formation, Ecosystem functioning …
- **PROVISIONING**: Food, Freshwater, Wood & fiber, Fuel …
- **REGULATING**: Climate & Flood Regulating, Water Purification, Disease Prevention …
- **CULTURAL**: Aesthetic, Spiritual, Educational, Recreational …

Also called Green Infrastructure Services

Ecosystem Services: Another View

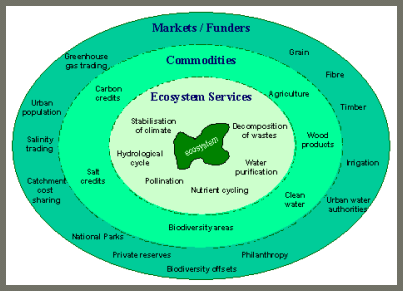


Table 1 | The Condition of Ecosystem Services

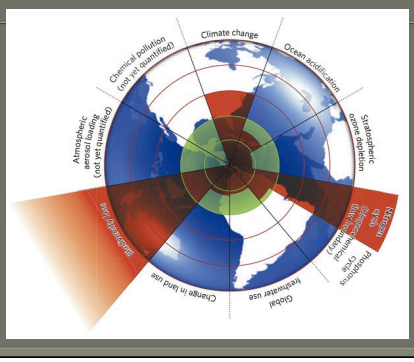
Ecosystem Services	Degraded	Mixed	Enhanced
Provisioning	Capture fisheries Wild foods Wood fuel Genetic resources Biochemicals Fresh water	Timber Fiber	Crops Livestock Aquaculture
Regulating	Air quality regulation Regional and local climate regulation Erosion regulation Water purification Pest regulation Pollination Natural hazard regulation	Water regulation (e.g., flood protection) Disease regulation	Carbon sequestration
Cultural	Spiritual and religious values Aesthetic values	Recreation and ecotourism	

Link to Resilience---Source Millennium Ecosystem Assessment

Challenge V: Impacts of Human Activity

- 2009 Study in *Nature* Foley et al identified 9 biophysical thresholds, 3 we may have passed
  - Biodiversity Loss
  - Nitrogen cycle
  - Climate Change

9 Biophysical Thresholds



Biodiversity Loss

- Threshold should not exceed 10X historical long term rate
- Scientists estimate current rate is 100 to 1000 times historical rate

Nitrogen Cycle Threshold
Changes in Global Chemistry

- Human activity releases 121 M tons of Nitrogen; Scientists suggest 35 M tons is a safe level

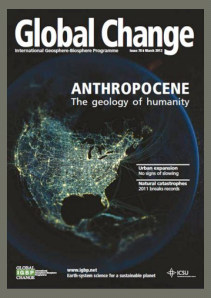
GHGs Thresholds & Uncertainties

- Corral reefs & Marine ecosystems
- Increases in severe weather
- Changing global weather patterns
- Early springtime snow melt & snowmelt decline (18%/decade vs 11 percent for Arctic sea ice—Derksen & Brown *Geophysical Research Letters, 2012)*
- Artic Methane Release
- Human impacts include earth and atmospheric linkages, establishing significant change and uncertainty

The Anthropocene: Age of Man

- Historically, scientists pieced together Earth's history from signals of significant change such as "a supercontinent drifting over the South Pole"
- The suggestion: Humans are impacting the earth so much, we are transitioning from Holocene to The "Age of Man" Paul Crutzen Nobel Prize holder *Nature*, 2002?

Anthropocene?



Governing the Environment in Complex Times

- Change and interconnectedness are on steroids
- Complexity and uncertainty are norms
- Importance of Adaptive capacity and Resilience—What is our ability to respond to shocks? How resilient are we?

Governing the Environment in Complex Times

- Governing Processes

- Who should be involved?
- What decision process should be used?
- Learning: How can policy makers develop & use knowledge?
- Public learning: How can relevant publics learn—users, consumers, other citizens?
- Improving the system of governing & rule making

Environmental Governance at International Level

- I: Global Environmental Facility-GEF
- Independent & largest funder to improve the global environment
- Directly funded $9.2 billion & co-financed $40 Billion
- Ten primary partners: United Nations (UNDP, UNEP, FAO), World Bank, Regional Banks (African DB, Asian DB, Inter-American DB), International Fund for Ag. Development, European Bank for Reconstruction & Development
- Has multiple mechanisms including Small Grants Program

GEF Operations

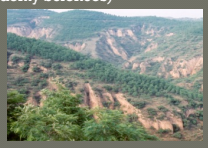
- GEF is financial mechanism for:
  - Convention of Biological Diversity
  - UN Framework on Climate Change-UNFCCC
  - UN Convention to Combat Desertification
  - Convention on Persistent Organic Pollutants
- First international institution to finance conservation trust funds, now in 30 countries
- First to support payment for ecosystem services

GEF Problems

- Cumbersome bureaucracy that works through a network of agencies
- Historically underfunded given task
- Climate money encouraging turf-wars
- Developed (donor) countries support World Bank
- Developing countries support UNFCCC - UN Framework Convention on Climate Change
- Is GEF a compromise?

II: Payments for Ecosystem Services (PES)

- Payments to conserve ecosystem services
- China: Largest PES in world, since 1999, $100 Billion (cash & rice) & for 120 million farmers to reforest steep land & encourage new sources of employment (Proc. Nat. Academy Sciences)

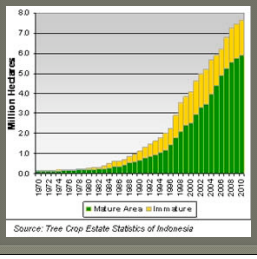


PES & Costa Rica

- Since 1997, Payments of $45-$163/hectare for reforestation with funding from W.Bank, Hydo-Company, 15% petrol surcharge

III: REDD--A Climate Change PES

- Reduced Emissions from Deforestation & Forest Degradation: Keeping trees & forests in tact to reduce emissions & sequester carbon



UN Framework Convention on Climate Change UNFCCC

- Developed nations, corporations, NGOs, & individuals compensate developing countries for forest emissions reduction
- Deforestation accounts for nearly 20% of GHGs (UN)
- GEF is financial link
- Current financial flows/commitments near $4-$5 Billion yearly & projected to $30 Billion by 2020 (UN)

REDD Structure

REDD Tensions

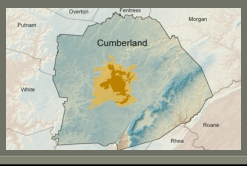
- REDD requirements are centralizing tropical forest management after 30 years of efforts of decentralization & community involvement
- How to balance local community issues with requirements needed to ensure REDD goals?

Environmental Governance in Tennessee: Habitat Conservation Planning

- Issue: How to foster continued economic growth in Crossville & Cumberland County while also conserving threatened and endangered species

HCPs as a Tool

- Cumberland HCP: A collaborative agreement between the U.S. Fish & Wildlife Service, Crossville & Cumberland County
- 30 year planning period: 1-Projected impact to T&E species and 2-Conservation measures necessary to sustain the species



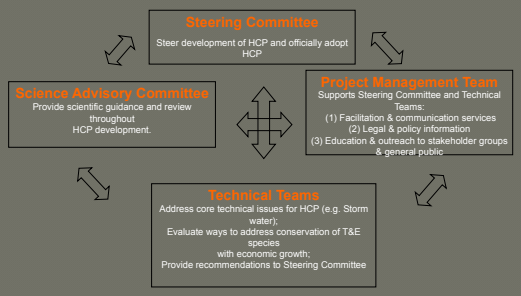
Primary Partners

- Funders: U.S. Fish & Wildlife Service via Tennessee Wildlife Resources Agency
- Project Facilitating Team: The Nature Conservancy, The University of Tennessee, Tennessee Tech University
- Local Government Implementation: City of Crossville and Cumberland County

Other Involved Partners

- Local conservation groups
- Local development interests
- Other business interests
- Tennessee Department of Environment & Conservation
- TVA
- Corps of Engineers

A Network of Committees, Teams, and Communication Flow



Primary Activities

- Projecting commercial growth in 30 years
- Identifying what land activities to include (Example: Activities impacting Storm Water Runoff)
- What will be impact of these activities on T&E species?
- What are biological goals needed to sustain species given impacts?
- What conservation strategies and practices are needed to reach biological goals & sustain species?
- What funding & monitoring program will be needed?

Summary: HCP as example of Environmental Governance

- Complex network of involved institutions
- Limited government funding
- Absence of policy to create market based payments for ecosystem services
- Challenge of employing new schemes
- Tension between bureaucratic guidelines & local participation
- Significant learning: decision makers & citizens
- Development of civic capital

Environmental Governance in the Anthropocene

- Collaborative work is necessary but not sufficient
- Seizing the imperative of "co-creating the future"
- Co-creating a fundamentally different relationship with earth's natural systems
- Beyond environmental governance toward holistic governance at political, economic and social levels
- Aristotle: "How OUGHT we live together?"
- Resiliency of natural systems and our place in those systems