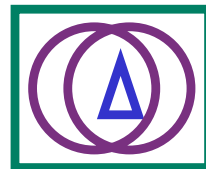


# Linking Land-Use Science to Decision Making: Strategies and Opportunities

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# Topics to be covered

- ❑ Definitions and opportunities
  - Land-use science
  - Decision making
- ❑ A systems perspective to land management
- ❑ Ecological effects of land use and management
- ❑ Dealing with changes to the land
- ❑ Future directions in developing and using research on land use and management



# Land Use Impacts Ecological Processes at Different Scales in the Ecological Hierarchy

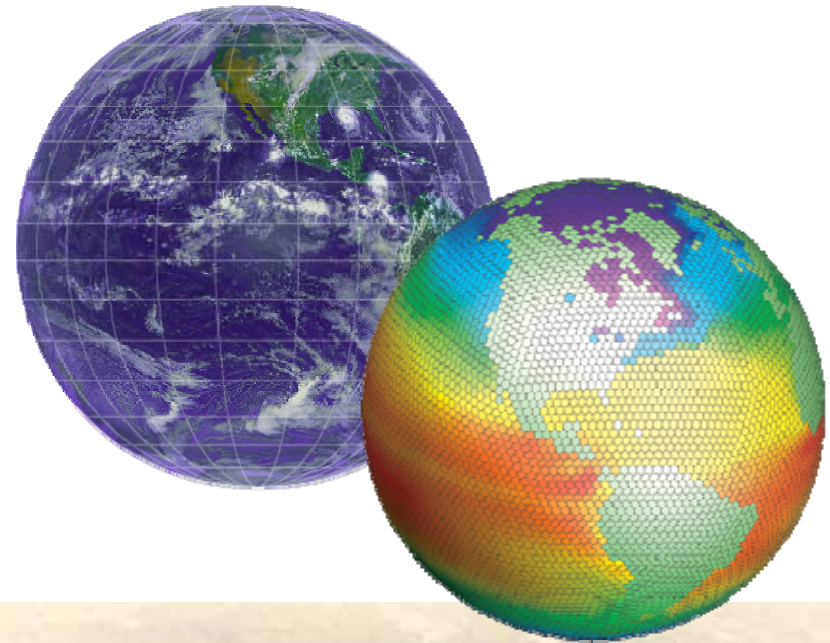
Level of organization	Major processes	Human activities
Biosphere	Energy, carbon, water fluxes	Deforestation
Biome	Evolution/extinction migration	Plant breeding, land management
Ecosystem	Disturbance, nutrient cycling, production, water use, succession, competition	Land management, polluting, exotic pests, disturbance control, resource management
Population	Phenology, reproduction, physiology	Fertilizing, watering, weeding, breeding



# Relation between Research & Decision Making

## Recent trends

- More complex view of world
- Environmental pressures are increasing
- More awareness of environmental pressures
- Stakeholders more educated and actively involved
- World is becoming networked



# Most scientists are “introverted, intuitive, thinking, judging” (INTJ)\*

- ❑ Are visionary and excel at creating systems
- ❑ Can understand complex and difficult subjects
- ❑ Enjoy creative and intellectual challenges
- ❑ Are good at theoretical and technical analysis and logical problem solving
- ❑ Work well alone and are determined even in the face of opposition.



(\*As based on Tieger & Barron-Tieger 1992 in Dale 2002)

# However, INTJs can also

- ❑ Be less interested in projects after creative problem solving is completed
- ❑ Drive others as hard as they drive themselves
- ❑ Be too independent to adapt to corporate culture
- ❑ Have difficulty working with or for others they consider less competent
- ❑ Be inflexible and single-minded about their ideas.



# Decision makers (e.g., politicians) are most often extraverted, intuitive, feeling, judging (ENFJ)\*

- ❑ Tend to promote harmony and build cooperation
- ❑ Respect a variety of opinions
- ❑ Are decisive and organized
- ❑ Are natural leaders.



(\* As based on Tieger and Barron-Tieger 1992 in Dale 2002)

# However, ENFJs also

- ❑ May have trouble dealing with conflict
- ❑ Tend to sweep problems under the rug
- ❑ May not be attentive to factual accuracy
- ❑ May take criticism too personally



# Communication between scientists and decision makers is critical

- ❑ Communication is a two-way street.
- ❑ Decision makers often not aware that science can pertain to a policy issue.
- ❑ Scientific results are rarely expressed in terms that have meaning or value to decision-makers.
- ❑ Regular discussions between scientists and decision makers can build mutual respect.



# How might land managers use ecological information?

Their responses:

- ❑ Planning budgets
- ❑ Provide a “heads up” regarding compliance
  - Heading toward non-compliance?
- ❑ Signal whether on right path toward achieving longer term goals
- ❑ Signal whether on right path to achieve shorter term objectives
- ❑ Suggest need for targeted research



# Land managers noted that some information is conditional

- ❑ “Cheaper is better, but more expensive might be ok”
  - If* associated with
    - Critical land use needs
    - Red list (Endangered Species)
    - Isolated populations (“lucrative targets”)
- ❑ Broad applicability is better, but narrow applicability might be ok

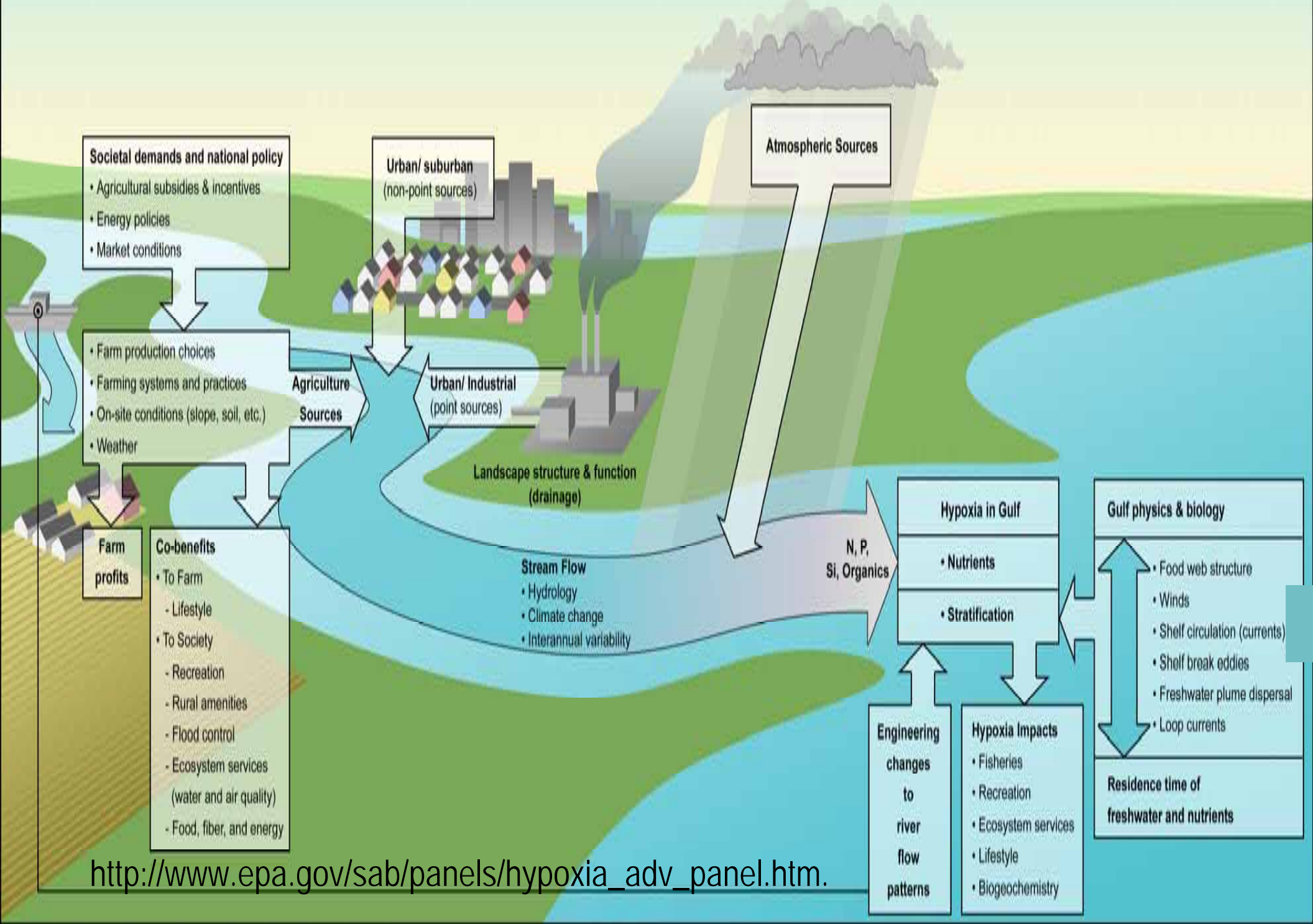


A systems perspective & an engaged management approach provide ways to improve understanding and management of factor affecting land use change.

- ❑ A way to deal with complexity
- ❑ A framework to identify & address gaps in
  - Knowledge
  - Understanding
  - Infrastructure
- ❑ A way to help respond to changing
  - environmental conditions
  - uncertainties



# Hypoxia in Gulf viewed in a systems perspective



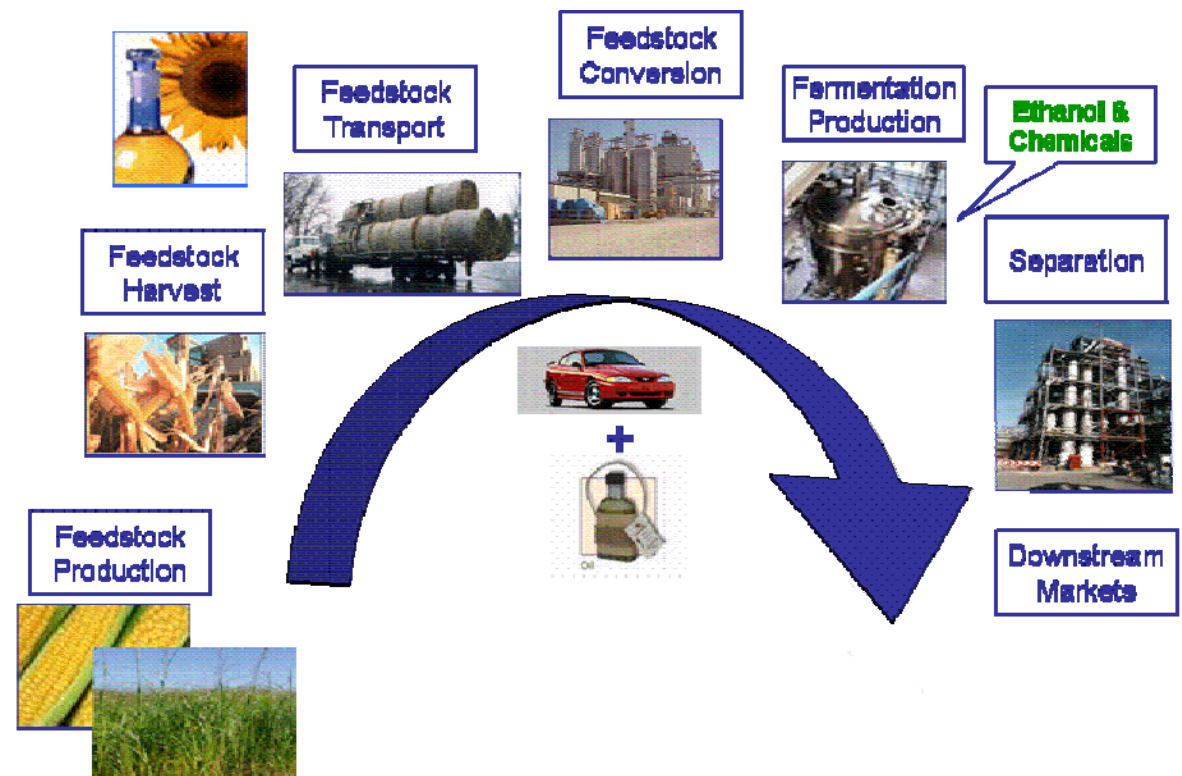
[http://www.epa.gov/sab/panels/hypoxia\\_adv\\_panel.htm](http://www.epa.gov/sab/panels/hypoxia_adv_panel.htm)

# Context: Causes & effects of changes on the land should be examined in view of

- ❑ Land-use condition
- ❑ Regional trends in
  - Population
  - Resource scarcity & quality (e.g., water)
  - Pollution
- ❑ Changing disturbance regimes
  - Invasive species
  - Fire

## ❑ Management

- Means to harvest & manage resources
- Supply & demand for resources
- Access (e.g., transport routes)



# Ecological effects of land use and management affects ecological processes

- ❑ Species changes
- ❑ Land cover changes
- ❑ Changes to disturbance regimes
- ❑ Changes to biogeochemical cycles



# Species changes

- ❑ Local extirpation (e.g. lady slippers)
- ❑ Changes to population (e.g. roads bisecting pop.)
- ❑ Introduction of new species
- ❑ Changes in trophic relations (e.g. Port Orford cedar fungus)



Invasive kudzu overtopping trees

# Land cover changes

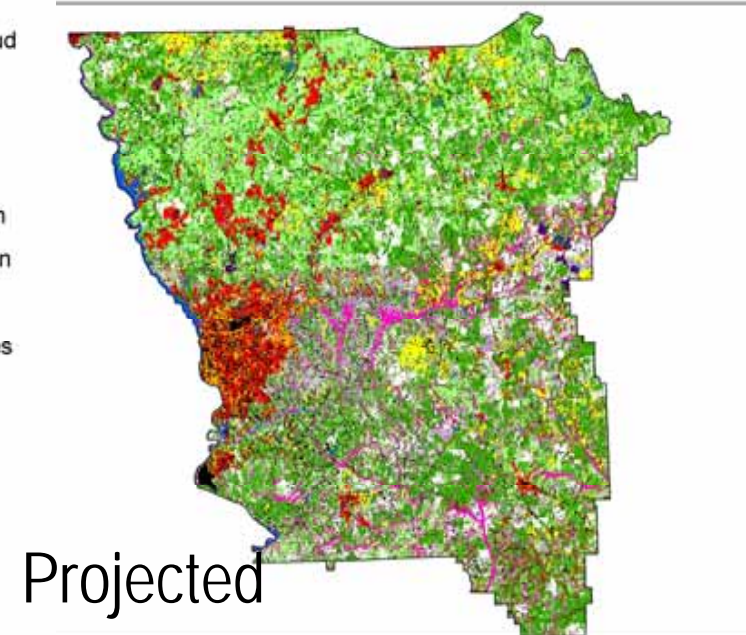
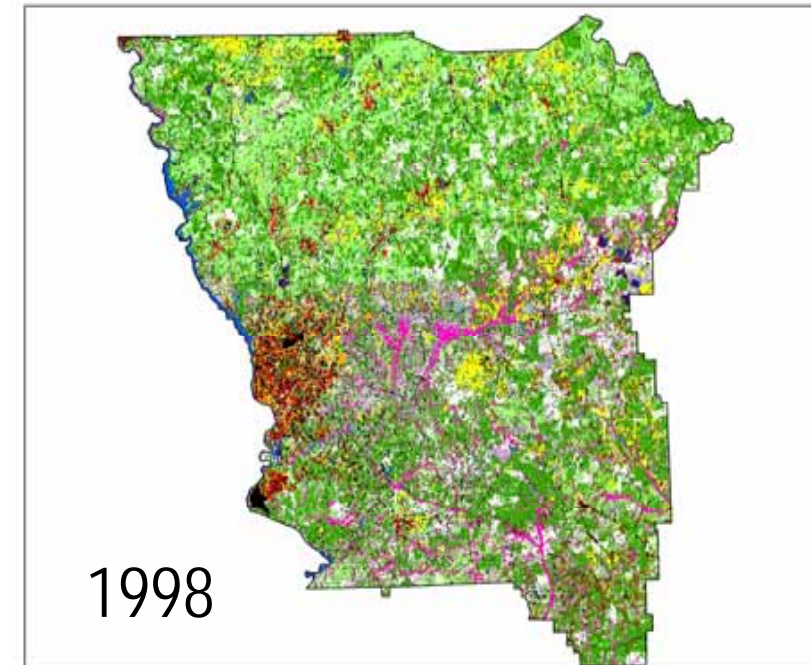
## □ Changes in extent

- Habitat alterations
- Changes in corridors
  - Pathways for invasive species (gypsy moth)
  - Disruption of migration routes

## □ Changes in juxtaposition of land cover types

- Effects on invasive species
- Erosion from disturbed areas

Region around Columbus, GA



# Changes to disturbance regimes

- ❑ Disruption of frequency
  - Low level, frequent fires
  - Seasonal floods
- ❑ Increase in intensity
  - Fires in western US
  - Floods
  - Pine bark beetle outbreaks
- ❑ Spread of disturbances
  - long horn beetle
- ❑ Instigating other disturbances
  - Landslides



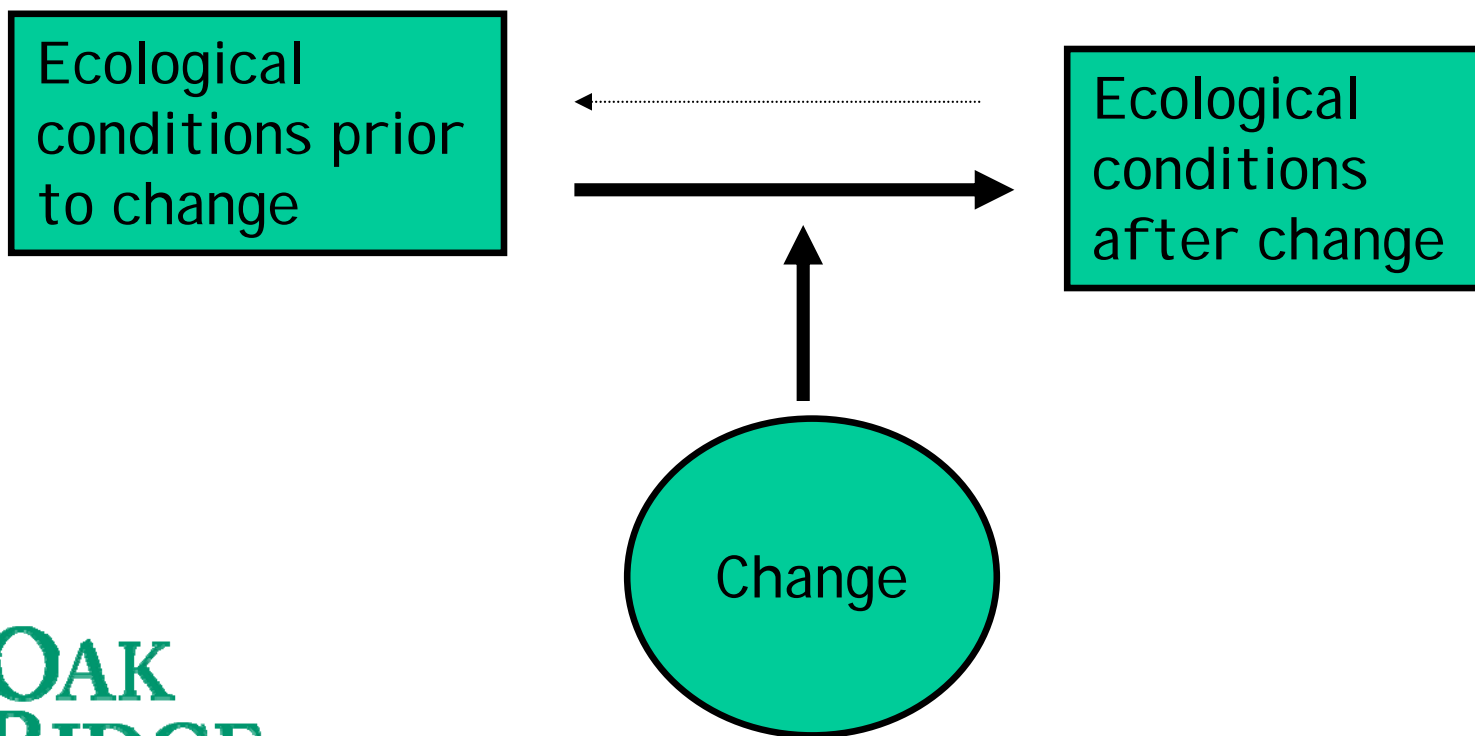
Pines killed by bark beetle

# Changes to biogeochemical cycles

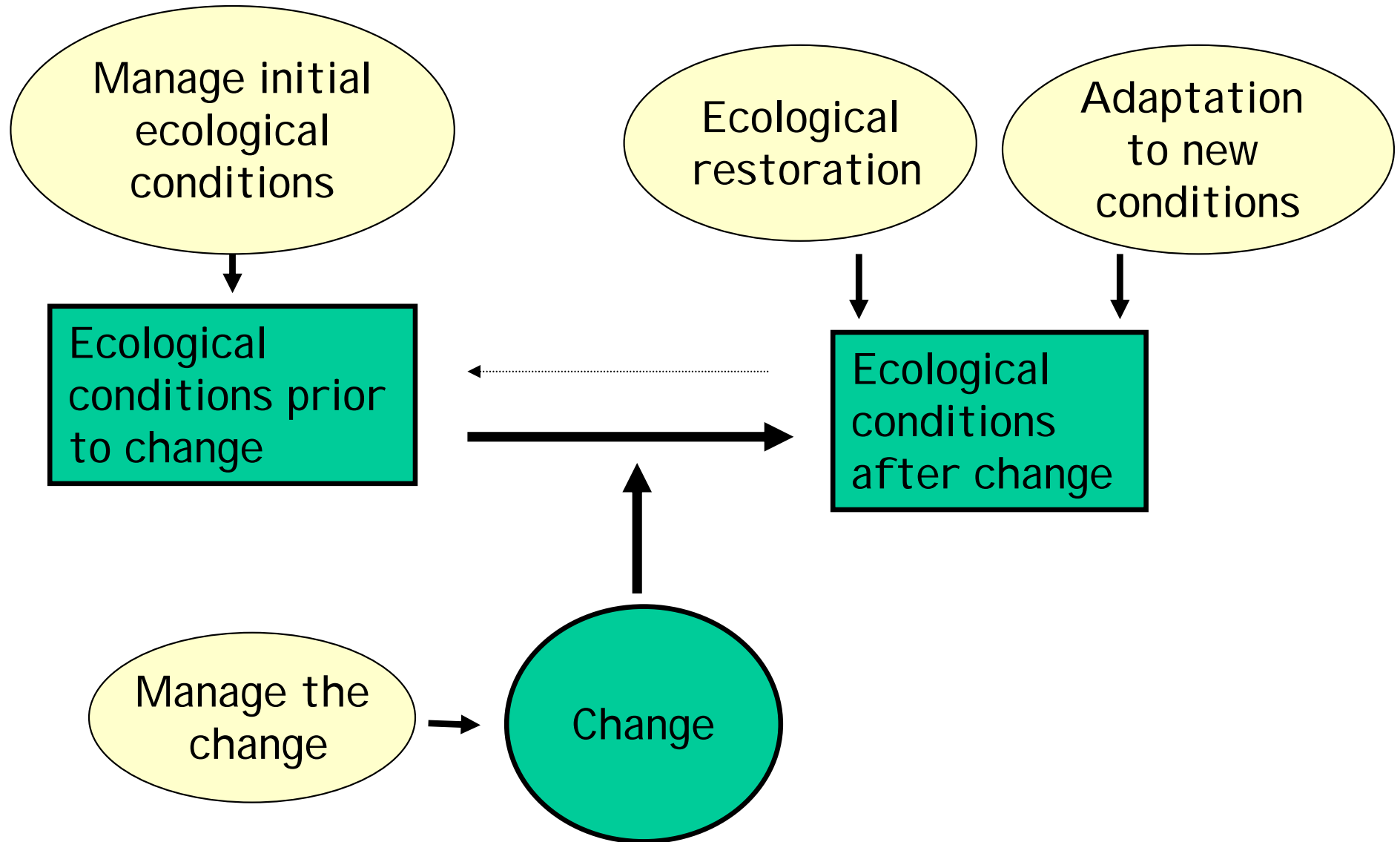
- ❑ Air quality
- ❑ Biomass change
- ❑ Climate change
- ❑ Changes in cycling of water, nutrients and energy



Integrating science & decision making enhances understanding about underlying processes & management implications.



# Integrating science & decision making enhances understanding about underlying processes & management implications.

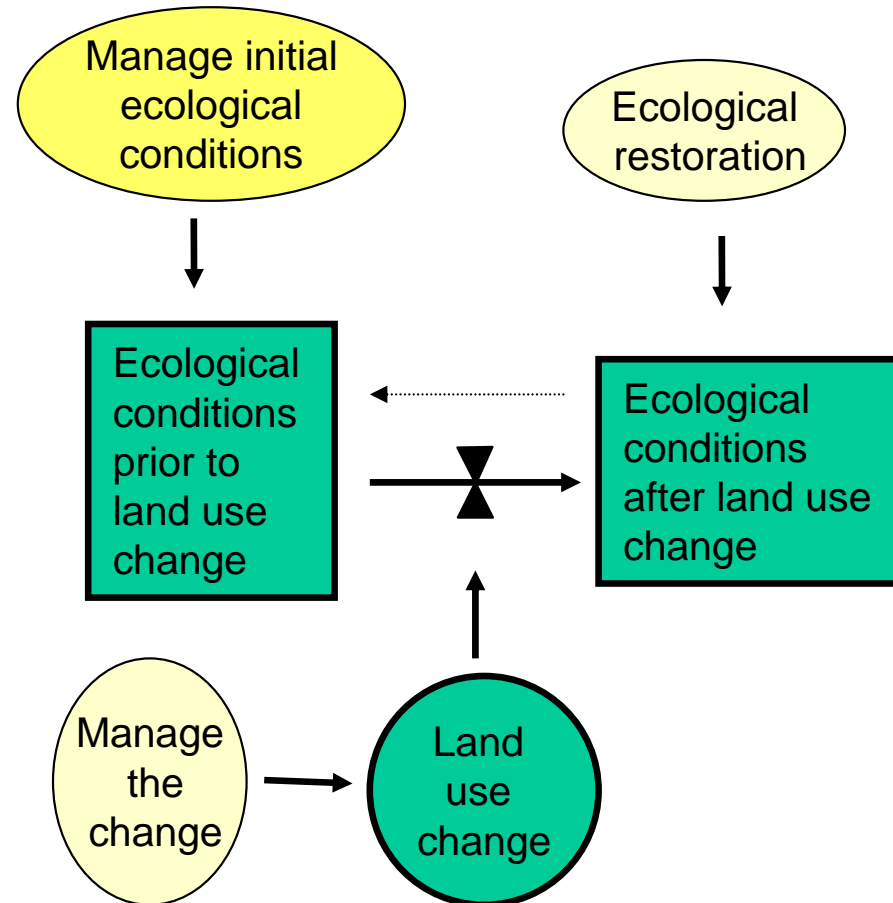


# Coping Strategy: Manage Initial Ecological Conditions

## □ Make the system more resilient

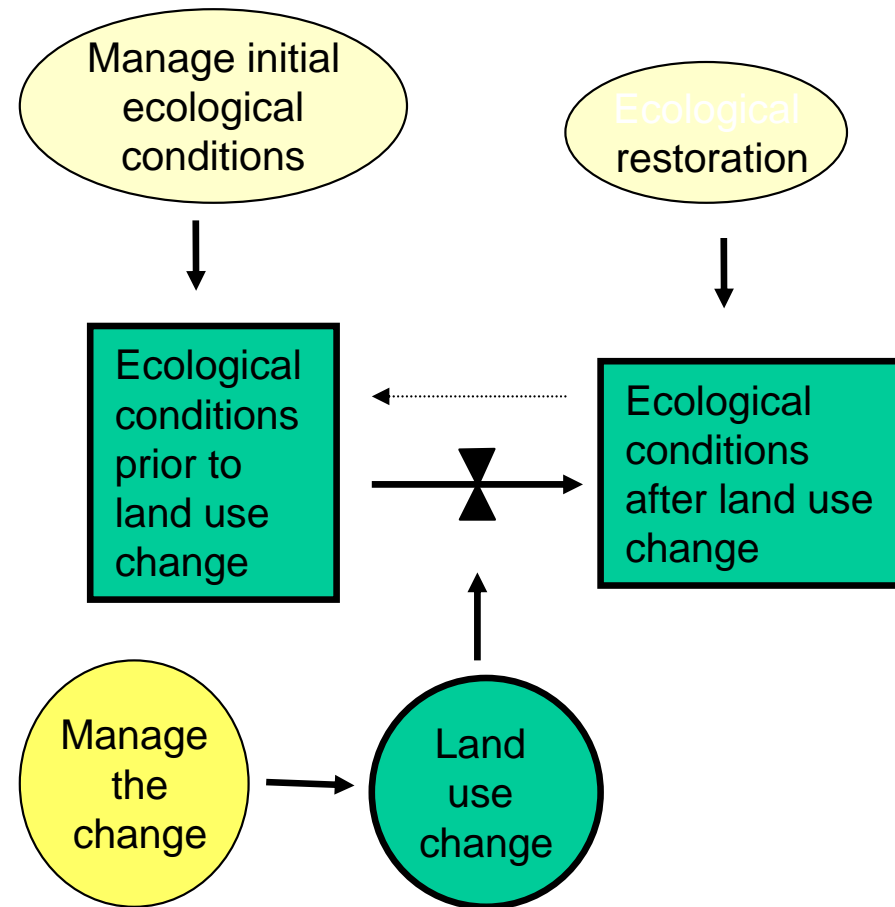
- Set aside protected areas
  - Size matters
  - Distance to other protected areas is important
- Establish resilient organisms

## □ Manage land to reduce spread of disturbances



# Coping Strategy: Manage the Change

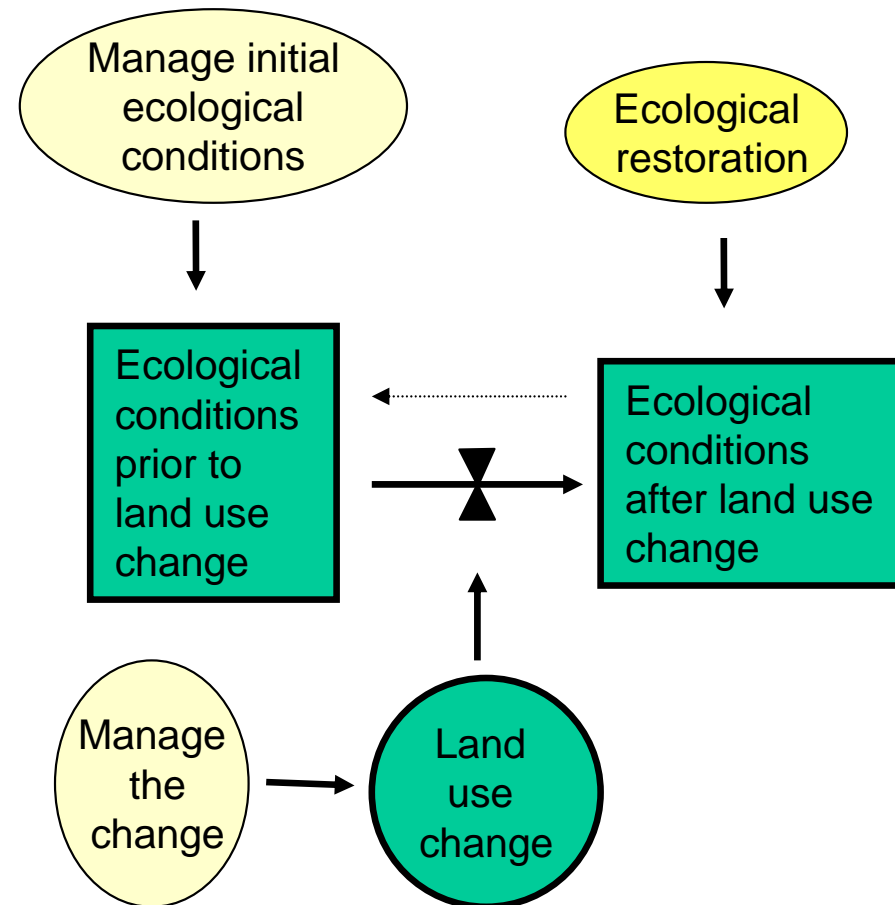
- ❑ Restrict runoff
- ❑ Regulate air and water quality
- ❑ Restrict land changes to hardy locations & avoid sensitive sites
  - Create "sacrifice areas"
  - Protection of what is now common



# Coping Strategy: Ecological Restoration

Manage the land and ecological processes after the land changes

- Restoration is costly, takes time, & often is not possible
- Structural changes can sometimes enhance function



*Lesson: "An ounce of prevention is worth a pound of cure"*

# Future directions of developing & using research for land management

- Know full scope of problem
- Explore diversity of approaches
- Use long-term vision to direct research
- Explore alternative futures in a gaming mode





# Designing Research for Decision Making (place decisions in adaptive management framework)

- ❑ Active collaboration amongst researchers & key decision makers
- ❑ Inclusion of relevant disciplines & expertise
- ❑ A “living” strategic plan of action
- ❑ Commitment to transfer information & technology,
- ❑ Clear recognition of the uncertainties.
- ❑ Focus on appropriate scales of resolution



# Research need: Quantifying land-use legacies

- ❑ What are the types of legacies?
- ❑ How long do legacies persist?
- ❑ Over what spatial extent can legacies occur?
- ❑ What conditions influence the type, duration, and extent of land use legacies?



# Research need: Understanding cumulative impacts of land-use change

- Under what conditions do different impacts of land-use change combine to cause greater effects on the environment



Effects of Atlanta air pollution vs controlled fire for long leaf pine habitat

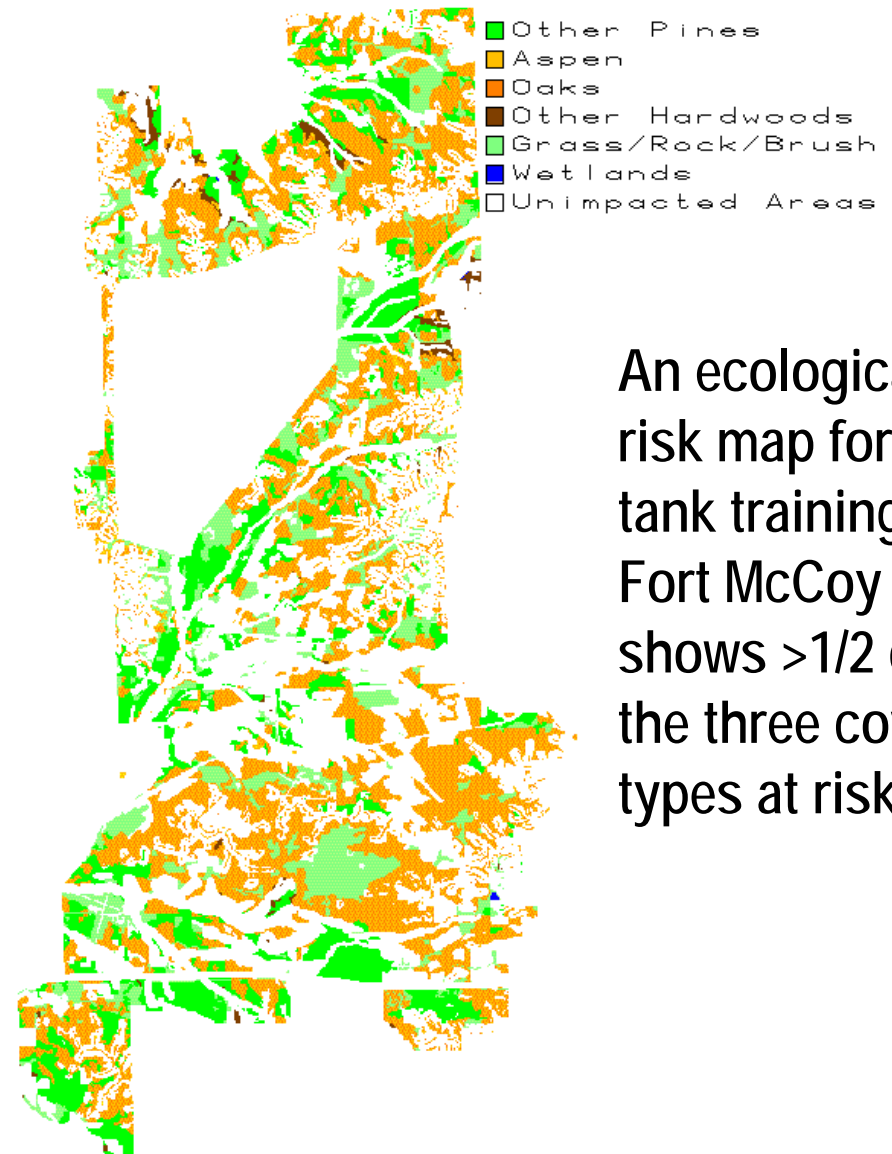
- \*Habitat

- \*Air quality

## Research need:

Determining conditions under which land-use change modifies impacts of other stressors

- Are compounded perturbations common?
- Under what conditions can increased impacts be avoided?

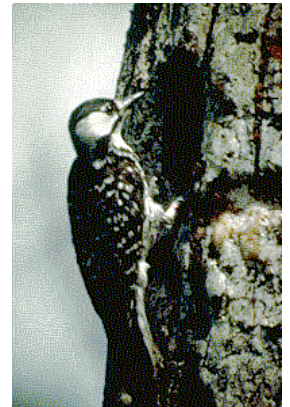


An ecological risk map for tank training at Fort McCoy shows >1/2 of the three cover types at risk.

# Research need:

## Understanding interactions between land cover change and management

- ❑ How can land use or management alter land cover?
- ❑ What determines the duration of management effects on land cover?
- ❑ Under what political, social, or ecological conditions are management options restricted?



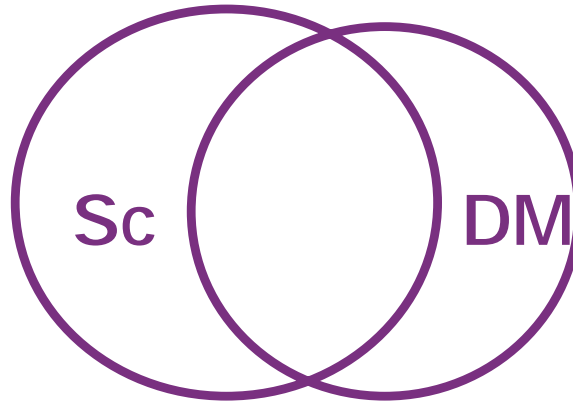
# Conclusions

- ❑ The study of LU effects is complex
  - Interdisciplinary
  - Both short and long-term effects must be considered
  - Broad-scale impacts need more attention
  - LU impacts must be interpreted in view of other stressors
- ❑ Understanding of LU effects is necessary to cope with human impacts on the Earth.



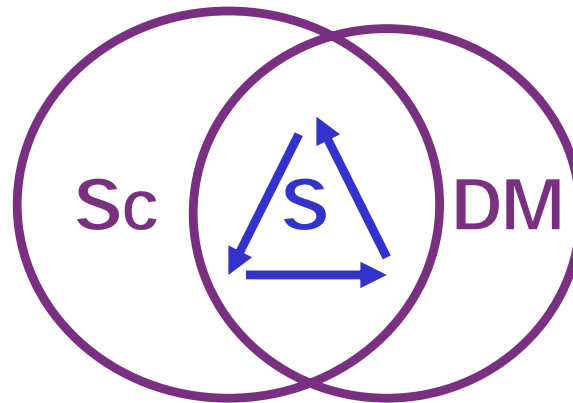
# Summary

- Start with interface between science and decision making



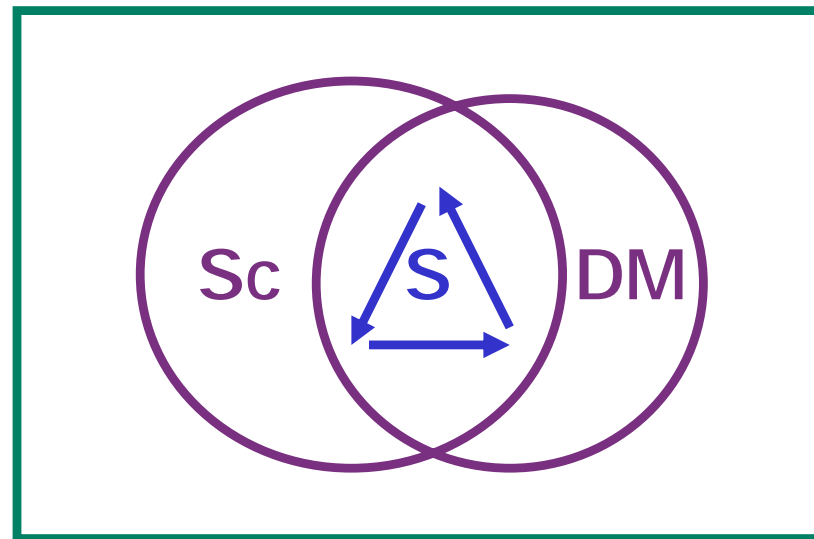
# Summary

- ❑ Start with interface between science & decision making
- ❑ Add system perspective



# Summary

- Start with system perspective
- Add interface between science & decision making
- Place in context



Context