Module 8

Beginning the cycle of strategic adaptive management

Adaptive management recognizes that we cannot accurately predict the future

We must choose a course of action, monitor its effects and adjust as necessary

This Module guides participants in that action

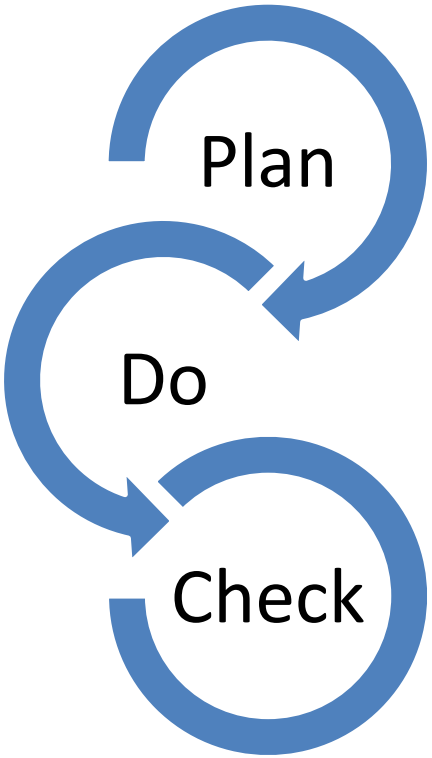
There is more her than can be used; select what is appropriate for you

Module 8

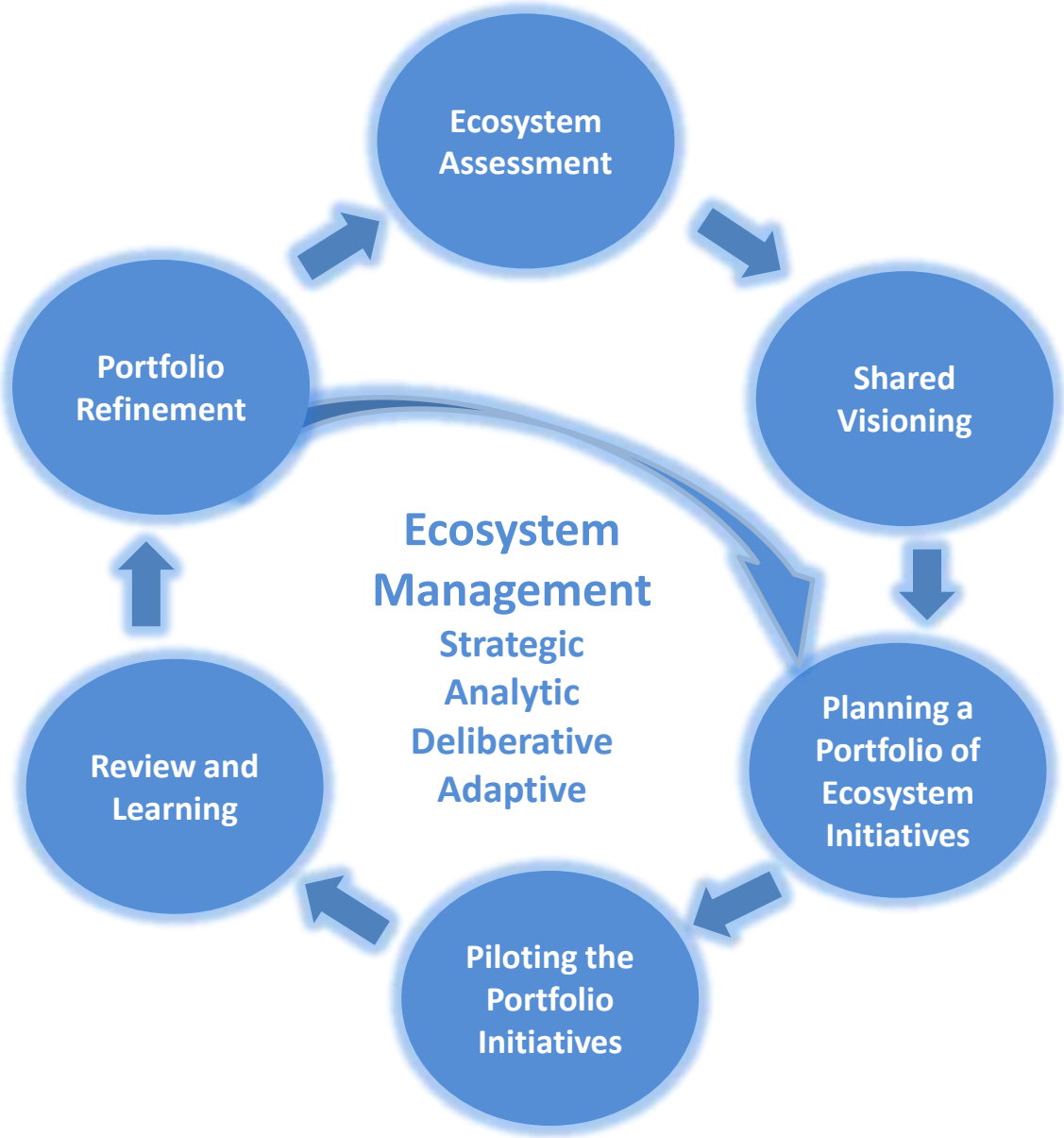
Beginning the cycle of strategic adaptive management

Importance of Strategic Adaptive Management

- **Resources are limited; we cannot do everything**
- **Inherent complexity demands synthetic view**
- **Uncertainty requires review and learning**



Strategic Adaptive Management Cycle



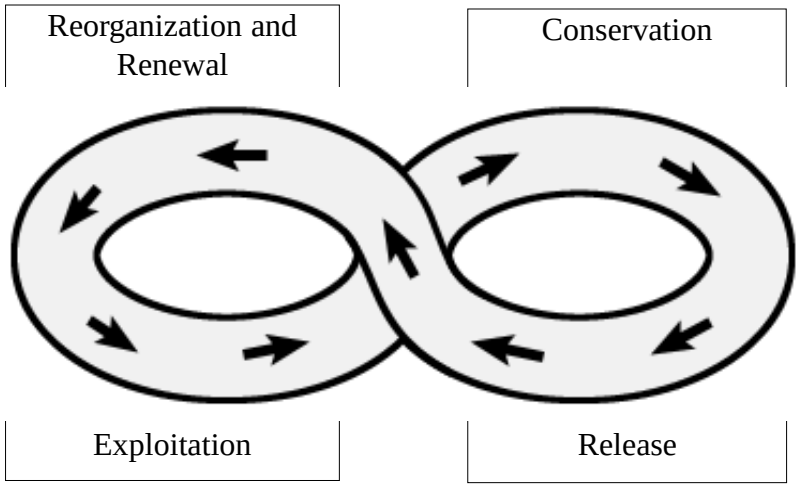
Complex Adaptive Systems

- Ecosystems are made up of many elements
- Ecosystem is a network of interactions
- Changing the system can produce reactions and changes in elements and the environment
- Effects of an intervention in the system cannot be predicted with complete accuracy

Complex Adaptive Systems

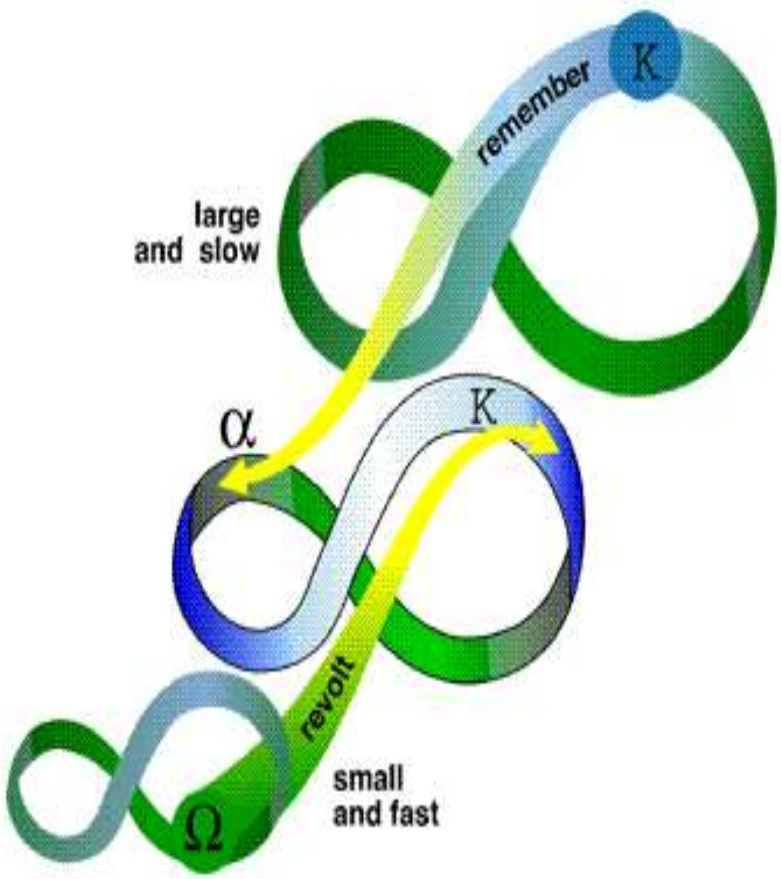
- Hierarchy of self-organizing systems
- Inter-linkages between levels
- Adaptive cycles
- Different time and spatial scales

The Adaptive Cycle



[after Gunderson et al. (1995); Holling (2001)]

Holling's nested adaptive cycles: The Panarchy

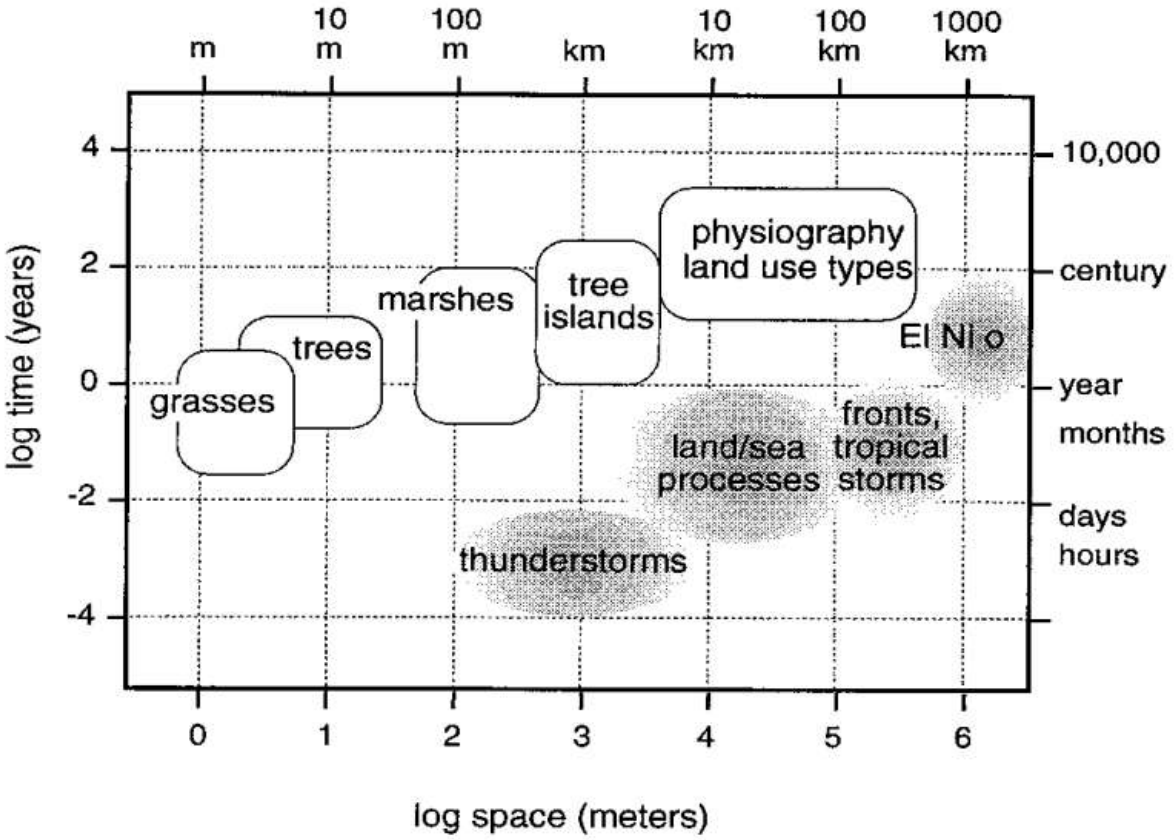


Global environmental systems;
Trade policies;
International Institutions

Domestic policies, institutions
Regional landscapes

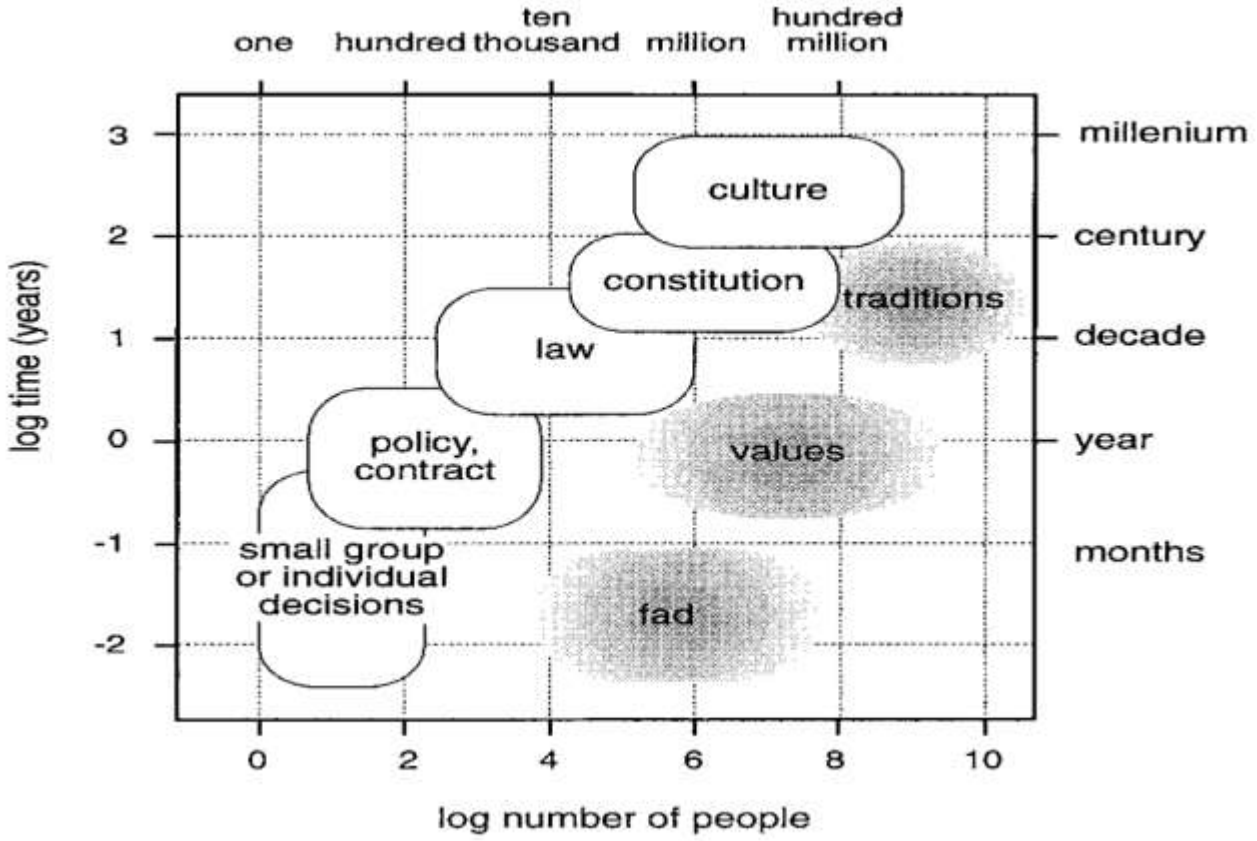
Ecosystems and
Community-scale
Adaptive co-management

Time and Space Scales: Levels of a hierarchy in wetlands



[from Gunderson and Holling (2001)]

Time and Space Scales: Institutional Hierarchy of Rule Sets



[after Gunderson et al. (1995); Holling (2001)]

Guidance for Adaptive Policies

Adaptive Policy

Ability of policy to adapt to **anticipated** conditions	Ability of policy to adapt to **unanticipated** conditions
(based on a good understanding of cause and effect)	(based on a good understanding of system dynamics and complexity)

Automatic Adjustment

Monitoring to trigger policy adjustments

Integrated Assessment

to perform in a range of anticipated scenarios

Multi-perspective Deliberation

To accurately inform policy design and recognize emerging issues

Formal Review & Improvement

Regular review; pilot testing; experimentation

Subsidiarity

Matching scales of ecosystems and governance

Self-organization & Social Networks

Encourage interaction and initiative to foster innovative responses

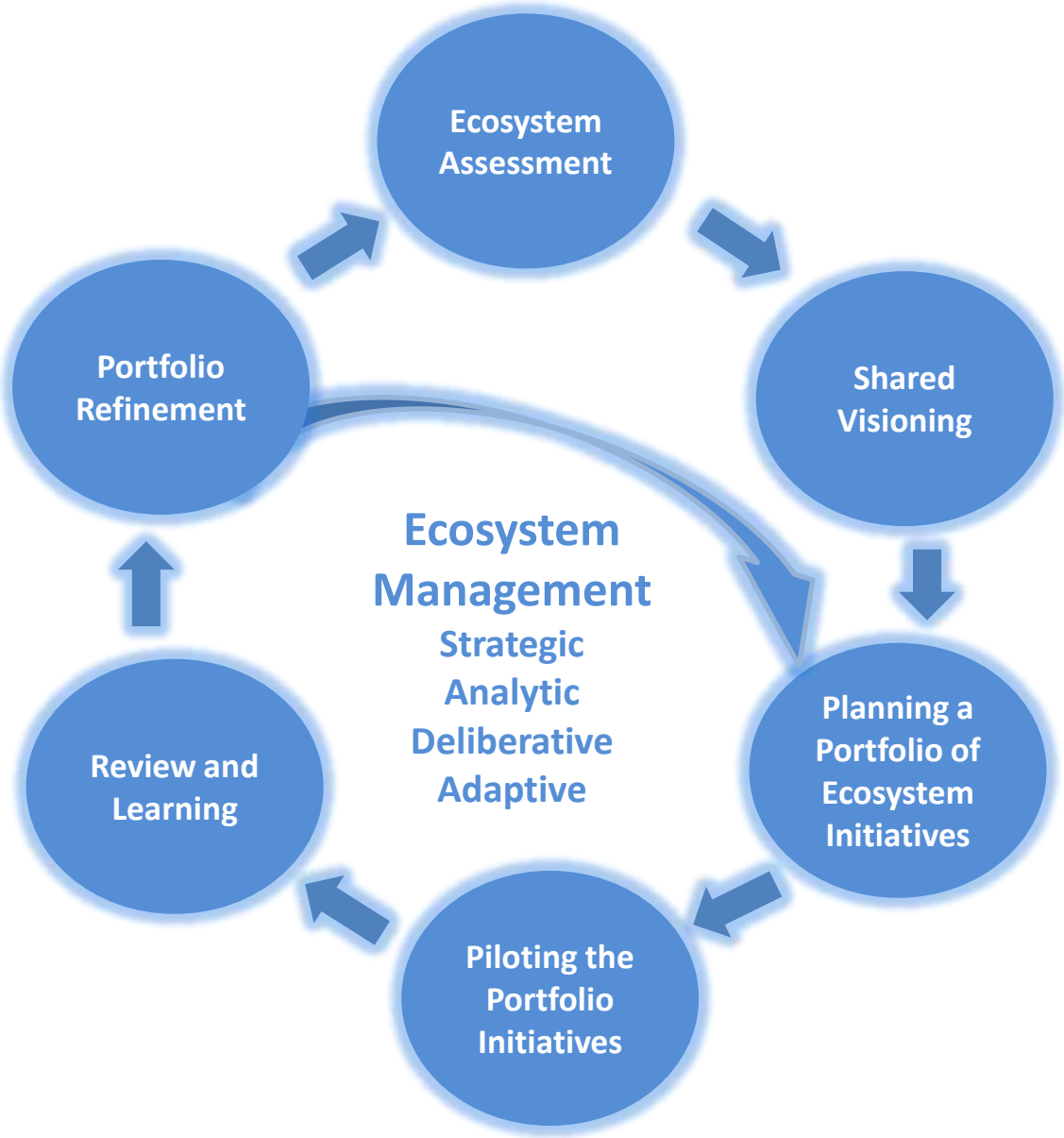
Variation

Multiple interventions; diversity and risk spreading

Discussion (10 min.)

- Review the principles for intervening in complex adaptive systems
- Discuss in small groups which ones you have used in your management experience
- What might be barriers to a strategic, adaptive, ecosystem management approach?

Strategic Adaptive Management Cycle

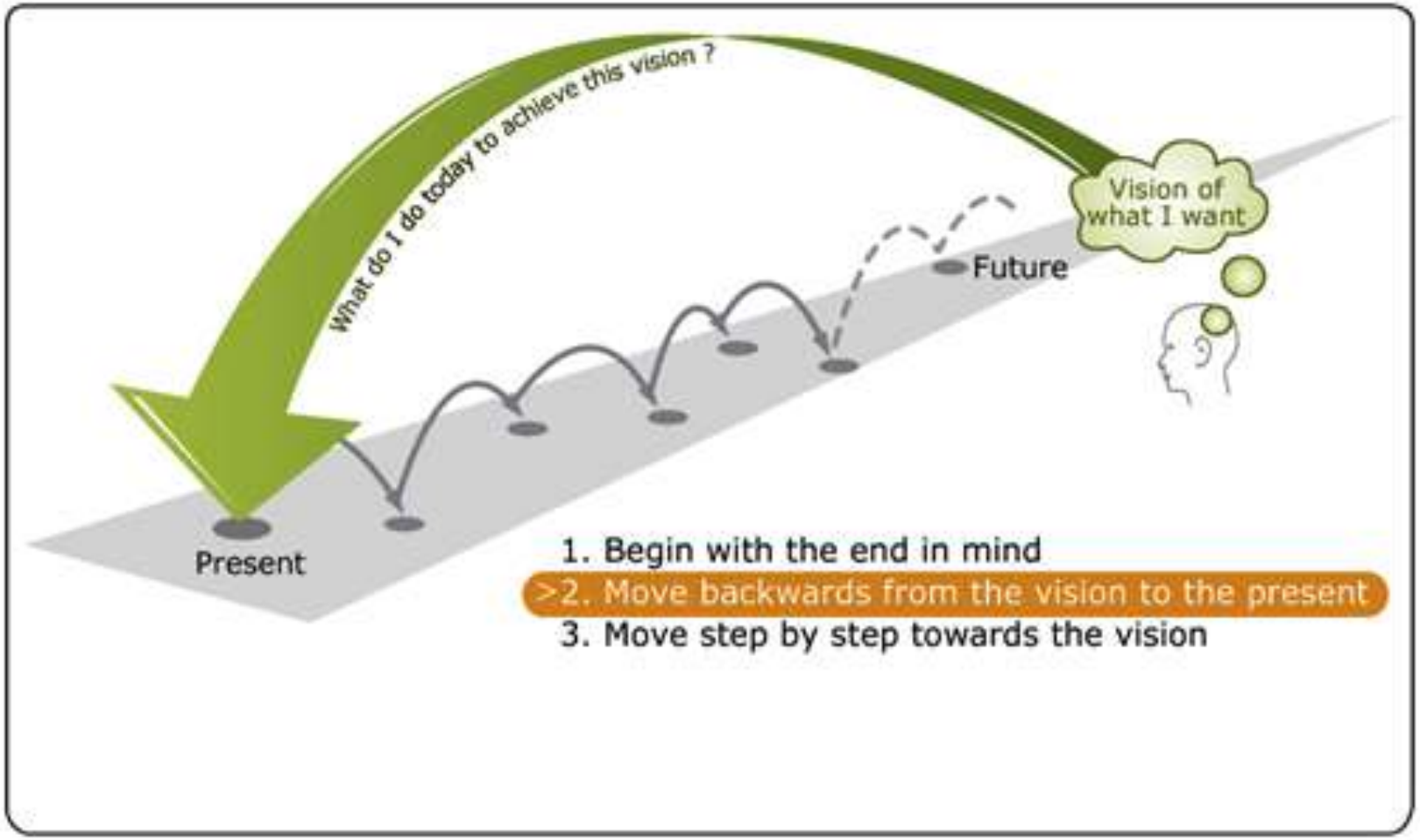


Shared Visioning

- **Desired outcome at this stage is a shared vision of ultimate long-term goals**

- **Intent is to deliberate until a shared space is identified where everyone can agree on the ultimate goal for a desired ecosystem state**

Scenario Backcasting (the Natural Step 2011)



General Visioning Steps

1. Identify key ecosystem issues of concern in your catchment
2. Clarify the state indicator of focus
3. Assess current state and trend of ecosystem indicator of focus
4. State desired future state of the ecosystem indicator

Exercise (10 min.)

Task #1: Identify a key ecosystem issue

Task #2: Focus on an indicator that best represents that issue

Task #3: Assess current state and trend of the ecosystem indicator. **What direction is the state likely to go in the future and why?**

Task #4: Describe desired future state of the indicator. **What timeframe is needed to reach the desired state?**

Select a spokesperson to present in plenary

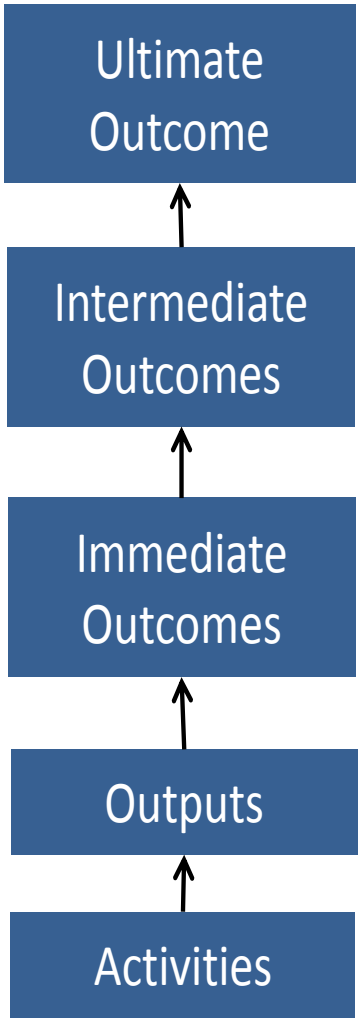
Visioning Worksheet

	Issue #1
General description	
Environmental state variable of focus	
Current state	
Desired future state (target level and year)	
Key ecosystem services and human well-being aspects supported	

Portfolio Planning

- This stage focuses on describing potential pathways to the desired future
- Here we emphasize importance of exploring and implementing a variety of ecosystem initiatives
- At this stage, not all stakeholders may agree on the path to the desired future

Outcome-based Management Framework



A long-term outcome representing a sustainable change of state (environmental, social, economic)

A medium-term outcome representing a change of **behaviour or practice**

A short-term outcome representing an increase in **awareness, capacity or access**

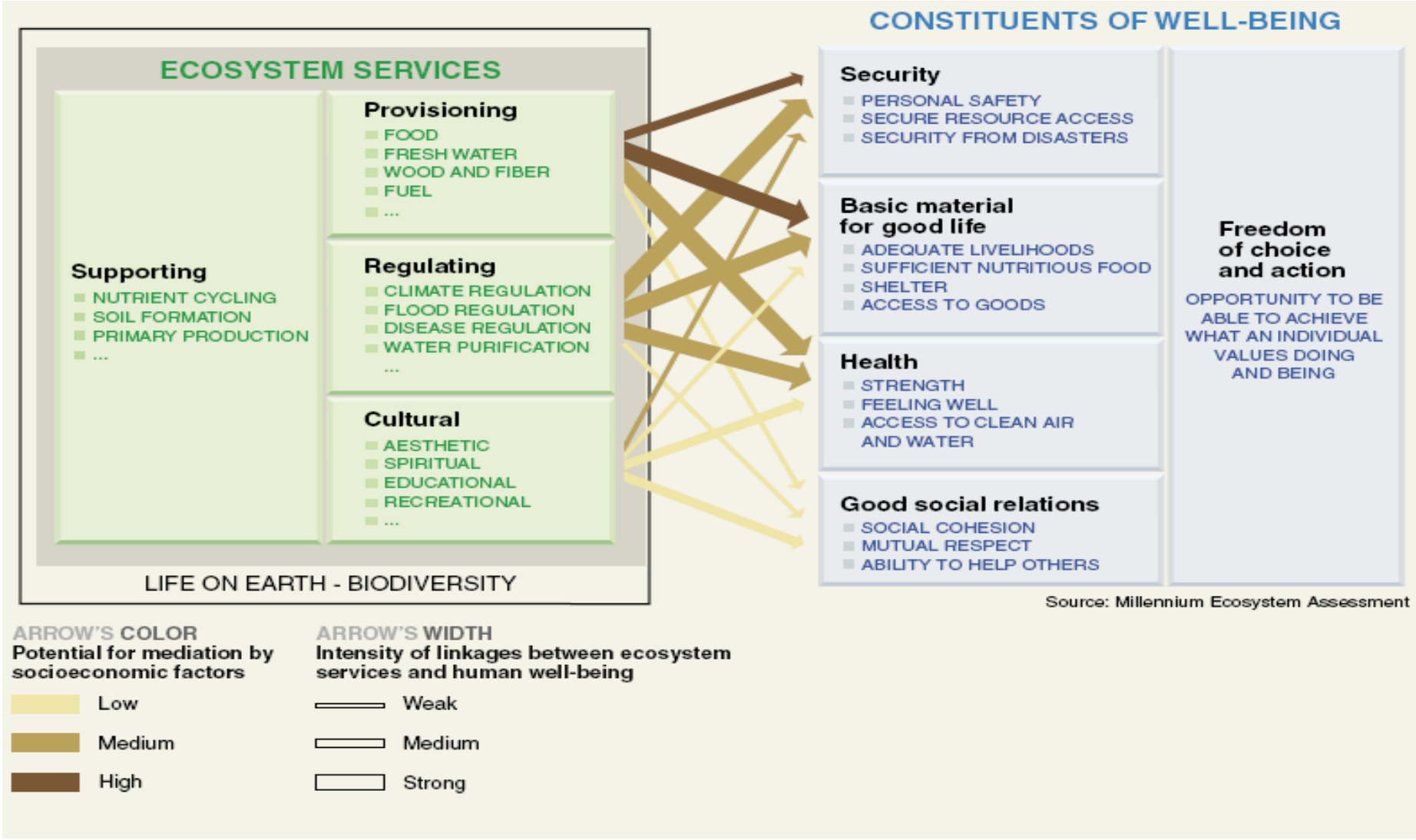
Knowledge generated or services delivered

Actions taken which mobilize inputs to produce outputs

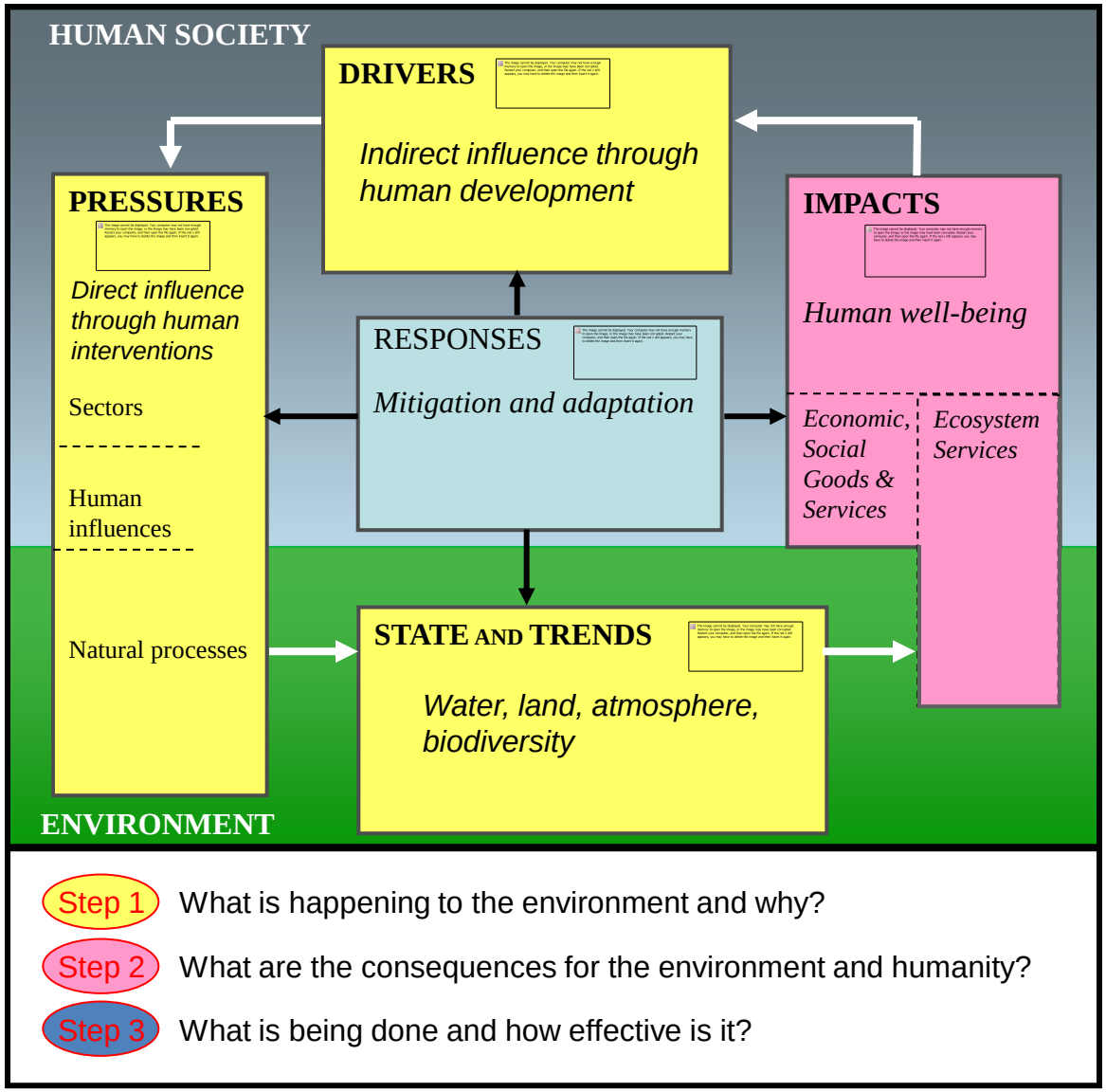
Role of the ecosystem manager

- **Work with stakeholders to identify options leading toward potential intermediate-level outcomes (changes in practice and behavior) that could deliver desired changes in ecosystem state**

Thinking Like an Ecosystem



DPSIR Recap



Step 1 What is happening to the environment and why?

Step 2 What are the consequences for the environment and humanity?

Step 3 What is being done and how effective is it?

Case study

Conceptual Phase

- **Main issues: urban sprawl (population growth) and industrial development**
  - **Soil erosion by uncontrolled land development**
  - **Shortage of water supply system for the growing population**
  - **Shortage of municipal waste water treatment plants for the growing population → contaminate ground water**
  - **Untreated industrial waste water → deterioration of water quality**
  - **Development of water resources area of upper stream → deterioration of water quality**

Parameters related to water issues

DPSI	Parameter
(D) Driving Force	(1) Population Density (2) Migration (3) GDP per capita (4) Climate Change
(P) Pressure	(5) Municipal water demand (6) Industrial water demand (7) Waste water discharge (8) Land use Change (9) Infrastructure (10) Soil erosion
(S) State	(11) Ecosystem (12) Water quality status (BOD/ SS/ Heavy metals/ NO_3) (13) Available Water Quantity (surface/ under ground)
(I) Impact	(14) Disease by water (15) Environmental accident (16) Water shortage (17) Natural Disaster (High flood/drought)

Rules to Select an Indicators

Related to the objective

Simple and Easy to collect

Quantifiable and Accurate

Practically Integrated

Sensitive to other indicators

Selection of Responses (alternatives)

Institutional alternative

- ✓Charge user fee to all water users
- ✓Pollution charge system
- ✓Water source protection
- ✓Facility permit system
- ✓Land use planning for pollutant control
- ✓Enforce environment impact
- ✓Monitoring system
- ✓Solid waste management system

Infrastructural alternative

- ✓Reusing water
- ✓Build local WWTPs
- ✓Improvement water supply system
- ✓Development water source

Governance alternative

- ✓Participation and capacity building

✓ **Evaluation of proposed alternatives in terms of technical, economical and administrative feasibility by local experts**

Apply DPSIR to your conceptual catchment (30 min)

DPSI	Parameter
(D) Driving Force	
(P) Pressure	
(S) State	
(I) Impact	

Rules to Select an Indicators

- Related to the objective
- Simple and Easy to collect
- Quantifiable and Accurate
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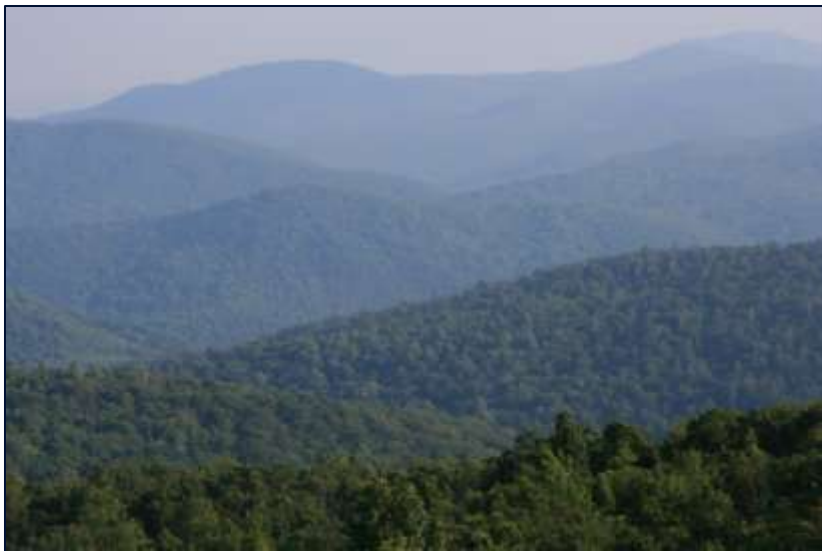
- Sensitive to other indicators

DPSIR Indicators to Evaluate Water Resources

Driving force (economy and social indicators)		Pressure (human activity)	State (current status and environmental change)	Impact (ultimate impact of environmental change)	Response (alternatives or regulation)
Social	•Population density •Population growth rate •Education level •Average age of citizens •Number of house	•Urbanization rate •Change of forest area by industrialization •Increase of mining area •Number of production factory •Emission load of waste water •Fertilizer use •Impervious area rate •Available seawater resource •Maximum daily rainfall •Totally available water resource •Altitude and watershed slope •SOx, NOx emission rate •Water demand for agriculture •Industrial rate	•Household water use per day •Water resource supply rate •Achievement rate of environmental flow in river •Irrigation rate •Water resource use per people •Water resource per agricultural land •BOD goal achievement rate •River water quality •Groundwater quality •Floods frequency •Drought rate •Change rate of temperature •Change rate of water quality •Change rate of ecosystem	•Days under water quality goal •Number of environmental accident •Death rate of below age of 5 years •Population and damage area due to the limited water supply •Drought damaged property density •Decrease of river water resource •Disease problem caused by water quality	•Regulated area by the law •Expenditure for government land preservation •Sewage treatment rate •National river (big river) ratio •Violation record of pollutant emission •Number of public servant in water resource field •Law on numerical water supply •Development of alternate energy •Regulation of fossil fuel use •Improvement of environment policy •Distribution of irrigation facility •Development of groundwater •Expansion of law related to water resource
Economical	•GDP per people •Unemployment rate •Asset value •Number of car per people •Investment of environment part •Development rate				
Environmental	•Water bodies •Forest •Agriculture production rate •Number of dams •Protection area				

Identifying Co-benefits

- DPSIR is a useful tool for finding co-benefits among issues
- Addressing a pressure or driver may benefit several environmental states
- Improving one environmental state may benefit several aspects of well-being
- Co-benefits analysis helps managers understand potential joint gains among seemingly disparate stakeholder groups



Co-benefits Matrix

States, Pressures, Drivers and Impacts	Environmental State Issues of Concern in the Ecosystem		Commonalities and Stakeholders
	Issue #1	**Issue #2**	
State of the Environment List the state of the environment			
Pressures List direct pressures on the state			
Drivers List the high-level drivers of change influencing direct pressures, along with any specific targets			
Impacts State primary impacts associated with changes in the environmental state. Use ecosystem services and human well-being categories to assist you			

Example: MEA Synergies Worksheet

States and Pressures (Note: Drivers and Impacts on next slide)	MEA Goals and Targets Corresponding to Environmental State, Pressures and Drivers		Key Synergies
	MEA #1 (Climate Change)	**MEA #2 (Combating Desertification)**	
State of the Environment State that the MEA is addressing, along with specific targets	Atmosphere • Climate Change	Soil • Desertification	• Climate change intensifies drought and desertification
Pressures Direct pressures on state	• Rising CO_2 from energy use • CO_2 emissions from land-use changes	• Land-use intensification • Water shortages	• Application of fertilizers • Land use changes increase atmospheric CO_2