An aerial photograph of a tropical landscape. A river flows through the center, surrounded by dense green forest. The sky is bright and slightly hazy. The overall scene is lush and natural.

# **Defining Ecosystem Services & Developing Mechanisms to Promote their Conservation**


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# Background

- Interest in “ecosystem services” is growing rapidly, and development donors and conservation organizations are jumping on the “bandwagon.”
- This concept has the potential to contribute something new to sustainable economic development and to the conservation of nature and biodiversity across multiple-use landscapes.



**For example, USAID's new PLACE (Prosperity, Livelihoods, and Conserving Ecosystems) IQC, and the TransLinks LWA program, list five "Primary Natural Resource Management Categories":**

- 1. Biodiversity Conservation**
- 2. Sustainable Forestry**
- 3. Ecologically Sustainable Agriculture**
- 4. Sustainable Tourism**
- 5. Provision of Ecosystem Services**



# Background

However...

- There is considerable confusion about this concept, and how it might contribute to environmental conservation, poverty alleviation, and rural economic development.
- There is a real danger that this ecosystem services "bandwagon" could lead to inflated expectations, and disillusionment, before this promising concept can develop to its full potential.



## “Working Hypotheses” of this Presentation

- If we don't have a clear definition of the concept of ecosystem services, then this will impede the development of effective incentives and mechanisms for conserving them.
- If we don't recognize the special ecological, governance, and economic characteristics of ecosystem services that distinguish them from other types of benefits from nature, then this will hinder the development of practical mechanisms for their conservation.



## Other Premises of this Presentation

- Ecosystem services should be conserved because of their irreplaceable value and contribution to sustainable development, livelihood and food security, economic growth, poverty alleviation and avoidance, and conflict prevention.
- Payments for Ecosystem Services (PES) schemes are only one possible mechanism for financing the conservation of ecosystem services, and we should not restrict our thinking only to PES mechanisms.




## What This Talk Will Cover:

1. The concept of ecosystem services, its history, and its definition
2. The relationship between biodiversity and ecosystem services
3. The outline of a process for developing mechanisms and incentives for conserving ecosystem services



# The Concept of Ecosystem Services, Its History, and Its Definition





Ecosystem services are the benefits we derive from ecological functions and processes.



This definition of the concept began with the 1970 Study of Critical Environmental Problems (SCEP), and its report *Man's Impact on the Global Environment* (MIT Press, Cambridge, Mass.).

The SCEP discussed environmental services that would decline if there were a "decline in ecosystem function."

This definition of ecosystem services as the benefits to humans of ecosystem functions and processes was carried forward in many important publications for the next three decades.

For approximately 30 years (1970 - 2000), the concept "ecosystem services" was used by ecologists to refer to the benefits we derive from ecological functions and processes, such as:

- ❑ Major biogeochemical and nutrient cycles (water, carbon/oxygen, nitrogen, phosphorus)
- ❑ Natural pest control by predators in food webs
- ❑ Pollination by insects, bats, birds
- ❑ Decomposition of biomass, wastes, and pollution
- ❑ Soil formation, retention, and maintenance of soil fertility
- ❑ Climate regulation



Source (top to bottom): ARD, Inc;  
<http://www.catie.ac.cr/bdncocanocimiento/N7/Noticias/publicaciones/foquemi/foqui/foqui.htm>  
[http://www.fairnations.com/weekly\\_lessons/02/week20/index.html](http://www.fairnations.com/weekly_lessons/02/week20/index.html), Merlin Tuttle/Bat C



## Box 1: Ecosystems provide “services” that:

- • moderate weather extremes and their impacts
- • disperse seeds
- • mitigate drought and floods
- • protect people from the sun’s harmful ultraviolet rays
- • cycle and move nutrients
- • protect stream and river channels and coastal shores from erosion
- • detoxify and decompose wastes
- • control agricultural pests
- • maintain biodiversity
- • generate and preserve soils and renew their fertility
- • contribute to climate stability
- • purify the air and water
- • regulate disease carrying organisms
- • pollinate crops and natural vegetation

*Ecological Society of America,  
Fact Sheet on Ecosystem Services (2000)*

[http://www.esa.org/teaching\\_learning/pdfDocs/ecosystemservices.pdf](http://www.esa.org/teaching_learning/pdfDocs/ecosystemservices.pdf)

# Three Types of Benefits from Nature

- ❑ Ecosystem Products: direct material uses of wild species
- ❑ Ecosystem Services: material benefits from ecological processes
- ❑ Psychological and Emotional Benefits: non-material values of wild species and ecosystems



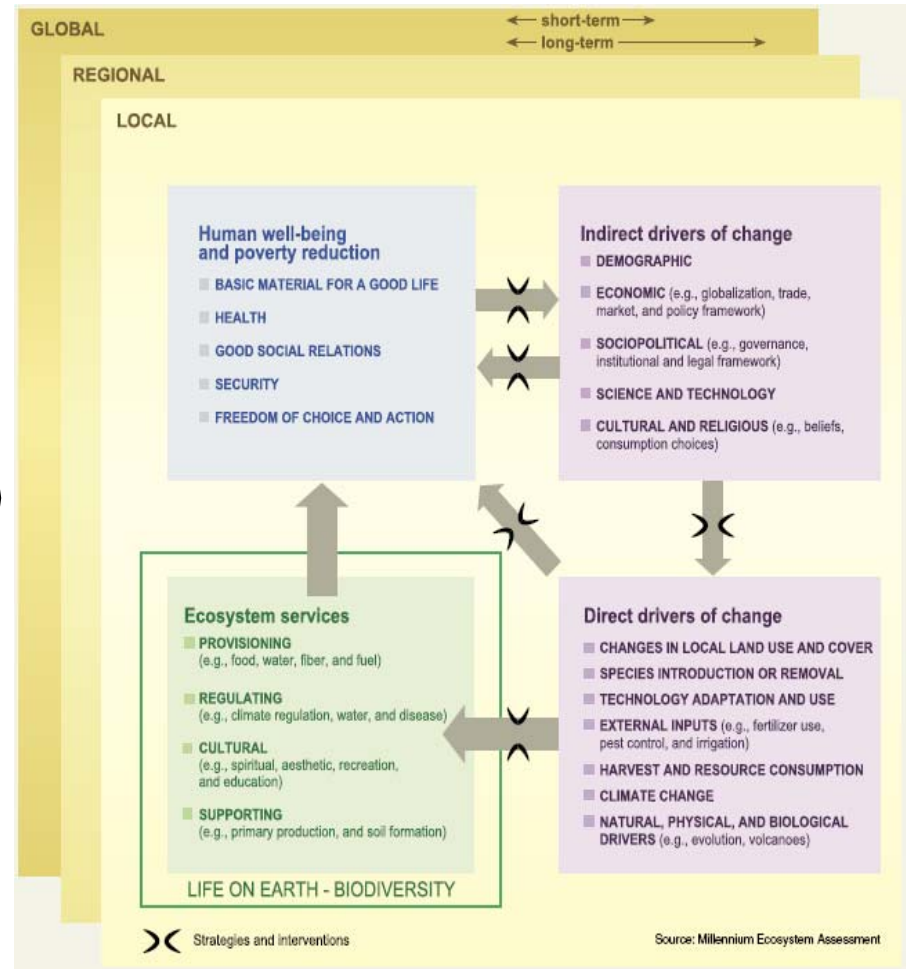
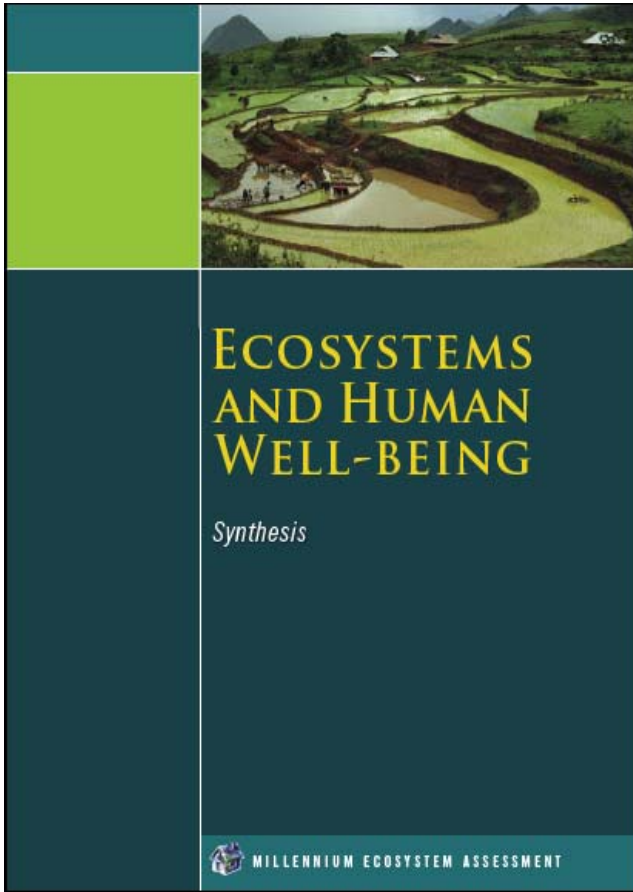
Sources (top to bottom): see previous for waterfall;  
ARD, Inc.; Microsoft, Inc.




However...

- This long-standing, focused definition of ecosystem services as the benefits of ecological processes has recently become blurred...







The Millennium Ecosystem Assessment (MA) (2005) used the term “ecosystem services” as an umbrella term, lumping together the three different types of benefits of nature listed above:

Type of Benefit

- Ecosystem Goods
- Ecosystem Services
- Non-Material Benefits

MA Terminology

- “Provisioning Services”
- “Regulating Services”
- “Cultural Services”






The motivation of the Millennium Ecosystem Assessment, and others who combine the three different types of benefits societies derive from nature, is to emphasize in general terms the full and sometimes forgotten value of nature.



BUT, this "lumping" mixes distinct types of benefits of with different ecological, governance, and economic characteristics - and understanding those differences can be critical in developing mechanisms for sustainable use and conservation of each type of benefit.

Source (top to bottom): ARD, Inc;  
<http://www.apples.umn.edu/photos/honeycrisp/index.html>;  
<http://www.localharvest.org/oranges.jsp>



Returning to the original, more focused definition of ecosystem services will emphasize their unique ecological, governance, and economic characteristics, and help us develop practical tools and mechanisms for their conservation.




# The Relationship between Biodiversity and Ecosystem Services



## Biodiversity is...

the diversity of species,  
the diversity of the genes they contain,  
and the diversity of the ecosystems they  
create.



**Biodiversity is not itself an ecosystem service, but rather the source of ecosystem services.**





# How does biodiversity provide ecosystem services?


- 1) A diversity of species interact with each other and the physical environment to create ecosystems;
- 2) Ecological processes and functions emerge from these systems;
- 3) We benefit from these system-level functions.



## Examples of ecological functions:

- Photosynthesis: plants capture and store solar energy
- Food webs: energy flows from eaten to eater in complex pathways
- “Biogeochemical” (or “nutrient”) cycles: materials cycle through food webs and cycle back to physical environment (e.g., water cycle, carbon cycle, nitrogen cycle)



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- Studies often show a positive relationship between the diversity of species in an ecosystem and the level and stability of ecological functions.
  - The exact relationships between species diversity and a particular ecological function are not well understood and this is an area of active scientific research.



# Outlining a Process for Developing Mechanisms to Conserve Ecosystem Services

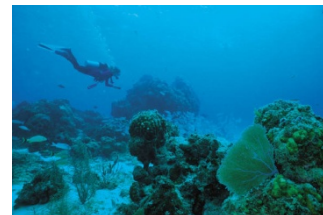


# Seven Steps Toward Developing Mechanisms for Conserving Ecosystem Services

1. Categorizing the benefits potentially available in an ecological landscape
2. Selecting one or more ecosystem services for attention
3. Understanding the ecological characteristics
4. Understanding the governance characteristics
5. Understanding the economic characteristics
6. Applying relevant valuation methods
7. Developing appropriate mechanisms

# Categorizing the benefits potentially available in an ecological landscape:

- ❑ Ecosystem Products: direct material uses of wild species
- ❑ **Ecosystem Services: material benefits from ecological processes**
- ❑ Psychological and Emotional Benefits: non-material values of wild species and ecosystems



Sources (top to bottom): see previous for waterfall; ARD, Inc.; Microsoft, Inc.



# Why Categorize by Type of Benefit?

Working Hypothesis: If we don't recognize the special ecological, governance, and economic characteristics of *ecosystem services* that distinguish them from other types of benefits from nature, then this will hinder the development of practical mechanisms for their conservation.



## Characteristics of Benefits and “Nature, Wealth, and Power:

- Ecosystem services (and products and non-material benefits) have unique ecological, economic, and governance characteristics (i.e., “nature,” “wealth,” and “power”)
- The institutional or governance framework (tenure, rights, ownership) is often what enables economic incentives to function.

# Ecological Characteristics by Type of Benefit

## Type of Benefit

## Ecological Characteristics

Ecosystem Products

Properties of single species


Ecosystem Services

System-level (“emergent”) properties

Non-Material Benefits

Human psychological & emotional responses; no direct ecological properties





# Governance Characteristics by Type of Benefit

## Type of Benefit

Ecosystem Products

Ecosystem Services

Non-Material Benefits

## Governance Characteristics

“Tenurable”: Individual or group can own, limit access

Sometimes not “tenurable” because of large scale; may be able to limit access for some services at smaller scales

Often “tenurable” at smaller scales



# Economic Characteristics by Type of Benefit

## Type of Benefit

Ecosystem  
Products

## Economic Characteristics

Usually consumable, "rival";  
often substitutable; direct  
market valuation possible

Ecosystem  
Services

May be non-consumable,  
"non-rival"; often impossible  
or expensive to substitute;  
indirect/non-market valuation  
methods often used


Non-Material  
Benefits

Sometimes "rival," sometimes  
"non rival"; substitution often  
possible; direct market valuation &  
indirect valuation methods used

# Determining "Type of Economic Good" for Ecosystem Services...

Table 4. Types of Economic Goods Defined by *Rivalness* and *Excludability* (with typically used examples)


	Excludable (can limit access)	Non-excludable (cannot or do not limit access)
Rival (consumable, usable only once)	Private Good Examples: food, wood, clothing	Common Pool or Open Access Resource Examples: water, open-ocean fish
Non-rival (not consumed, can be "used" more than once)	Club Good Examples: cable TV, private ecotourism lodge	Public Good Examples: air, climate regulation

- 
- Each type of ecosystem service will have its own specific ecological, governance, and economic characteristics, with associated valuation methods. These characteristics will require specific conservation mechanisms for each type of service.
  - These mechanisms will involve some kind of payments or rewards (incentives, compensation, etc.) from beneficiaries to “producers”




## Payments or rewards could include:

- Direct, cash payments
- In-kind assistance
- Tenure security agreements
- Training & extension programs
- Tax benefits
- Subsidies
- etc.



PES schemes are only one possible mechanism for financing the conservation of ecosystem services, and we should not restrict our thinking only to PES mechanisms.

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- Experiments with PES or other mechanisms have mainly involved water-cycle and carbon sequestration services.
  - Development of mechanisms for conserving other ecosystem services are urgently needed!



# Possible Mechanisms Appropriate for Conserving Different Types of Benefits from Nature

## Type of Benefit

## Possible Mechanisms

Ecosystem Products

Sustainable Use; Natural Resource Based Enterprises

Ecosystem Services

Compensation, Rewards, Payments, Other Incentives

Non-Material Benefits

Ecotourism; Scientific & Educational Reserves; Sacred Forests & Other Sacred Sites



# Integrated Management of Multiple-Use Landscapes



- The same landscapes can produce some combination of all three types of benefits
- The challenge is to optimize the total value in a way that is ecologically, socially and economically sustainable



A tropical landscape featuring several palm trees in the foreground and a white building with a balcony in the background. The scene is set against a backdrop of dense green foliage and a clear sky.

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