Market-based Approaches to Protecting Ecosystem Services: The Case of Biodiversity Conservation

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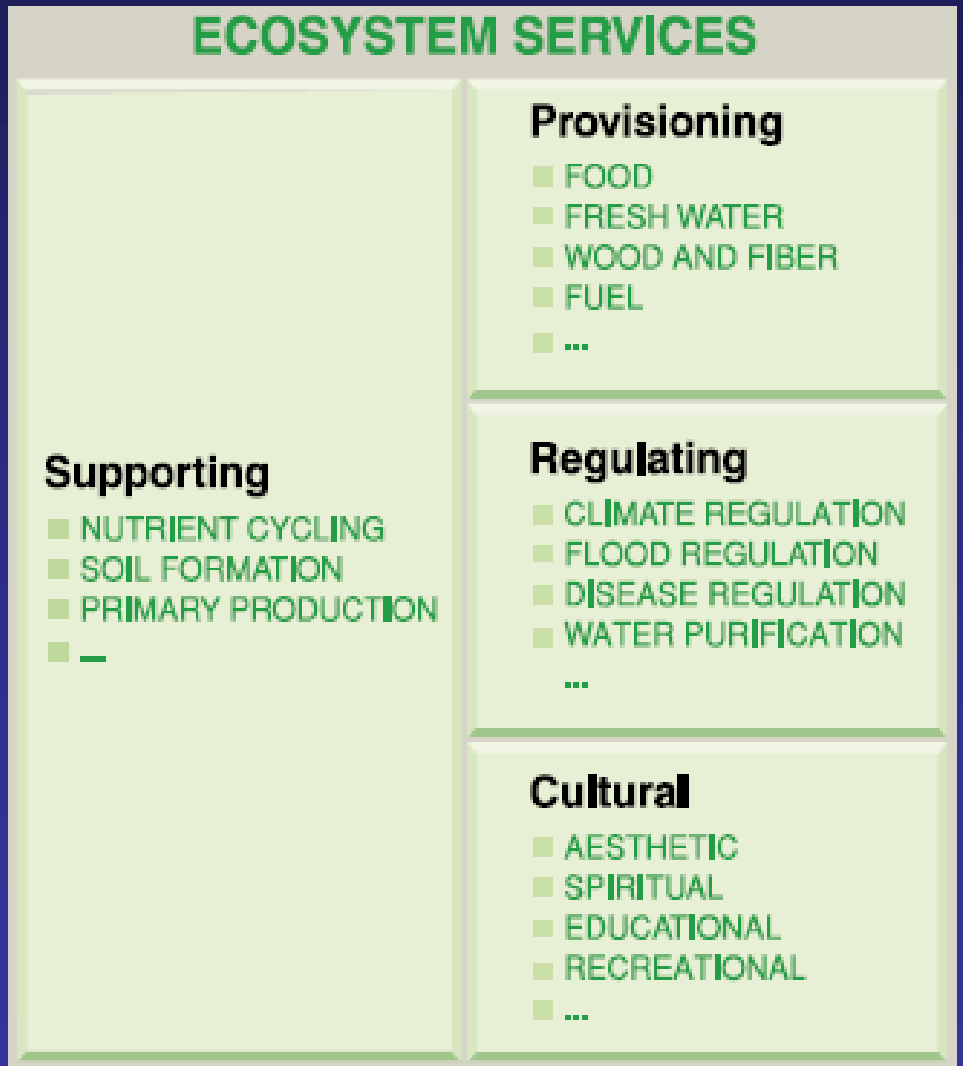
- Ecosystem services defined
- “Market”-based approaches to ecosystem service provision
- Designing ecosystem service “markets”
- Conclusions

What Are Ecosystem Services?

1) Millennium Ecosystem Assessment:



Ecosystem functions vs. ecosystem services vs. ecosystem service values

- *Ecosystem Functions*:

  Biophysical processes in an ecosystem

- *Ecosystem services*:

  Outputs of ecosystem functions that directly or indirectly benefit humans

- *Ecosystem service values*: the utility humans receive from ecosystem services

Examples:

Ecosystem *function*	Ecosystem *service*	Ecosystem *service value*
Habitat provision to pollinators	**Pollination of crops**	**Value of harvested crops (or avoided cost of artificial pollination)**
Absorption of wave energy	**Buffering of tidal surges**	**Avoided/reduced damage to humans, human structures, crops, livestock**

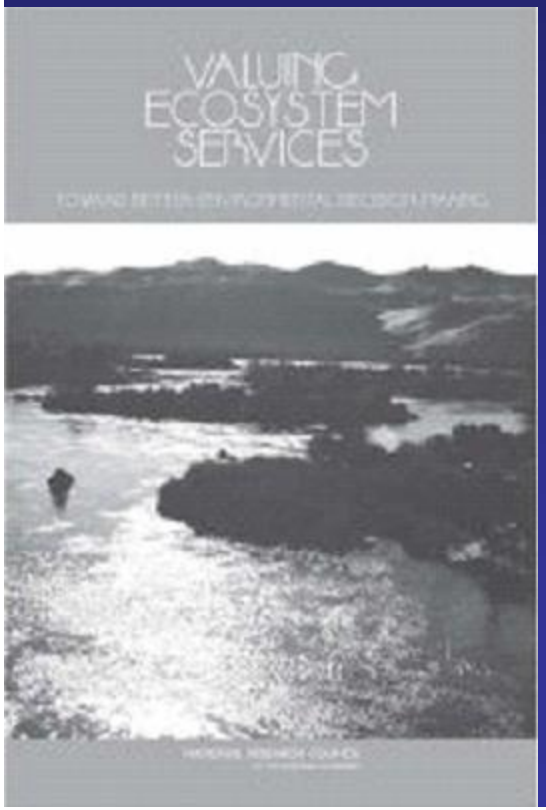
Service values are context-specific!

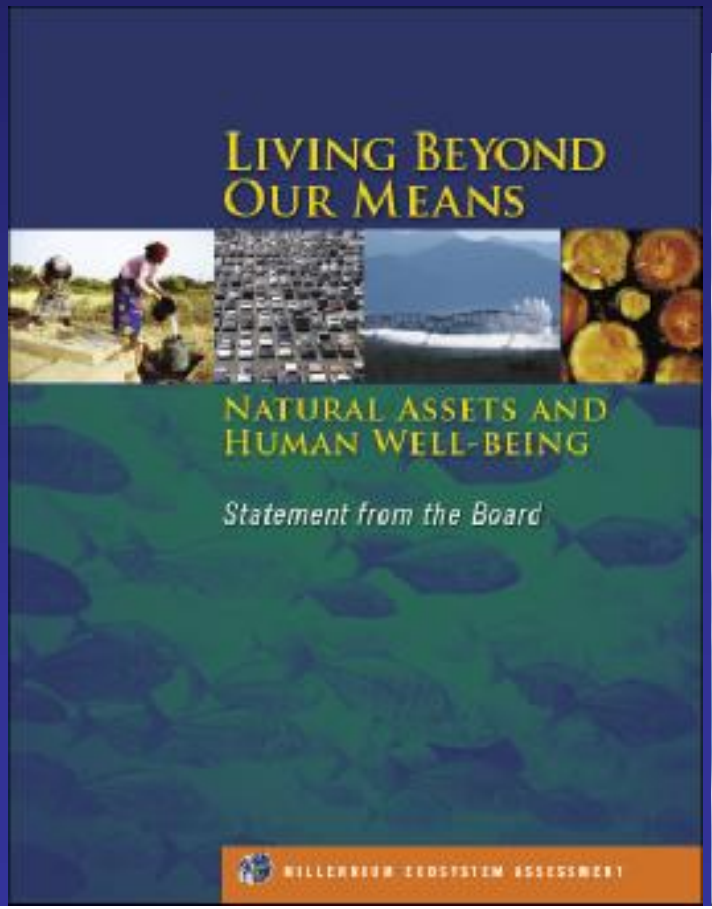
2) Boyd and Banzhaf (2006):

Ecosystem services are end products of nature, that is, "components of nature that are directly enjoyed, consumed, or used to yield human well-being."

Ecosystem Services	Benefits
Pollinator populations, soil quality, shade & shelter, water availability	Harvests
Aquifer availability, surface water quality	Drinking water provision
Air quality, drinking water quality, land uses or predator populations hostile to disease transmission, wetlands, forests, natural land cover	Damage avoidance
Surface & groundwater, open land	Waste assimilation
Relevant species populations, natural land cover, vistas, surface waters	Recreation
Natural land cover in viewsheds, wilderness, biodiversity, relevant species populations	Amenities & fulfillment

- Increased recognition of importance and decline of many ecosystem services





- **Large and growing number of ecosystem service payment schemes around the world**

  - In 2002, a survey analyzed 287 cases worldwide of ecosystem service payments for forest services alone

- **Federal initiatives to move toward promoting ecosystem service provisioning**

"Today, I am announcing that USDA will seek to broaden the use of markets for ecosystem services through voluntary market mechanisms. I see a future where credits for clean water, greenhouse gases, or wetlands can be traded as easily as corn or soybeans."

Mike Johanns, U.S. Secretary of Agriculture, August 30, 2005

→ **Shift from Farm Bill commodity programs to Green Box payments?**

- **Lack of protection of ecosystem services via markets (market failure) or regulation**

Market Failure

- Many ES are public goods

- Their value cannot be captured by providers in free markets

- Few created markets for public goods (e.g., wetlands), most poorly designed

Institutional Failure

- Policies and institutions do not (sufficiently) encourage land management for ES provision

- Ecological boundaries don't match political boundaries

- Extending institutional boundaries beyond traditional reach is politically difficult

Market-based approaches to ecosystem service provision

The Idea:

> "The marketing of ecosystem goods and services is basically an effort to turn such recipients [who benefit for free] … into buyers, thereby providing market signals that serve to help protect valuable services."
>
> (Brown *et al*., 2006:1)

So why is designing ES markets a challenge?

Need to determine:

- ***Who*** pays ***whom***?
- ***When***?
- ***For what***? and
- ***How much***?

Who pays whom?

- **Individual to individual**

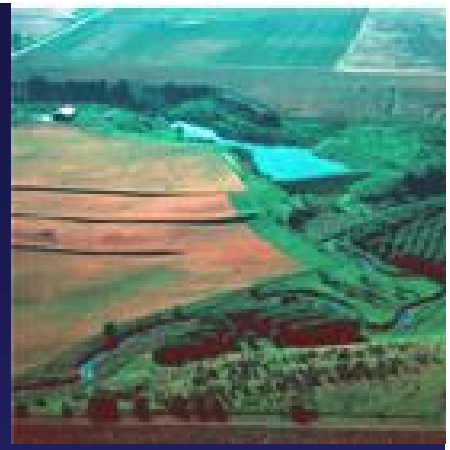
Driven by **self interest**, not regulation:

- Perrier-Vittel pays farmers to use less intensive dairy farming techniques to reduce pollution of its springs (France)
- Costa Rica hydropower plant pays upstream farmers to implement land management practices to reduce soil erosion

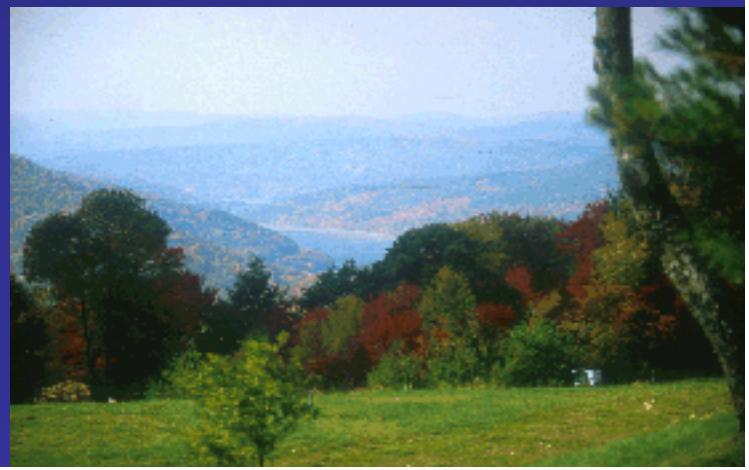
- **Mitigation markets – purely government constructed, regulation driven**

  - Clean Water Services pays farmers to plant shade trees along Tualatin River to reduce water temperature and comply with U.S. Clean Water Act
  - U.S. Wetland Mitigation Banking – developers must offset filled wetlands to comply with Clean Water Act

- **Government payment programs**



  - Australia's Bushtender program, U.S. Conservation Programs - pay land owners for resource conservation
  - NY City pays landowners in upstream watersheds for agricultural easements and new water quality initiatives on small farms



Most ecosystem service payments to date are based on government created markets or government payment programs

- Reason: many ecosystem services are **public goods** (non-rival, non-exclusive) - property rights are insufficiently defined to attract private investment, and benefits cannot be captured by land owners

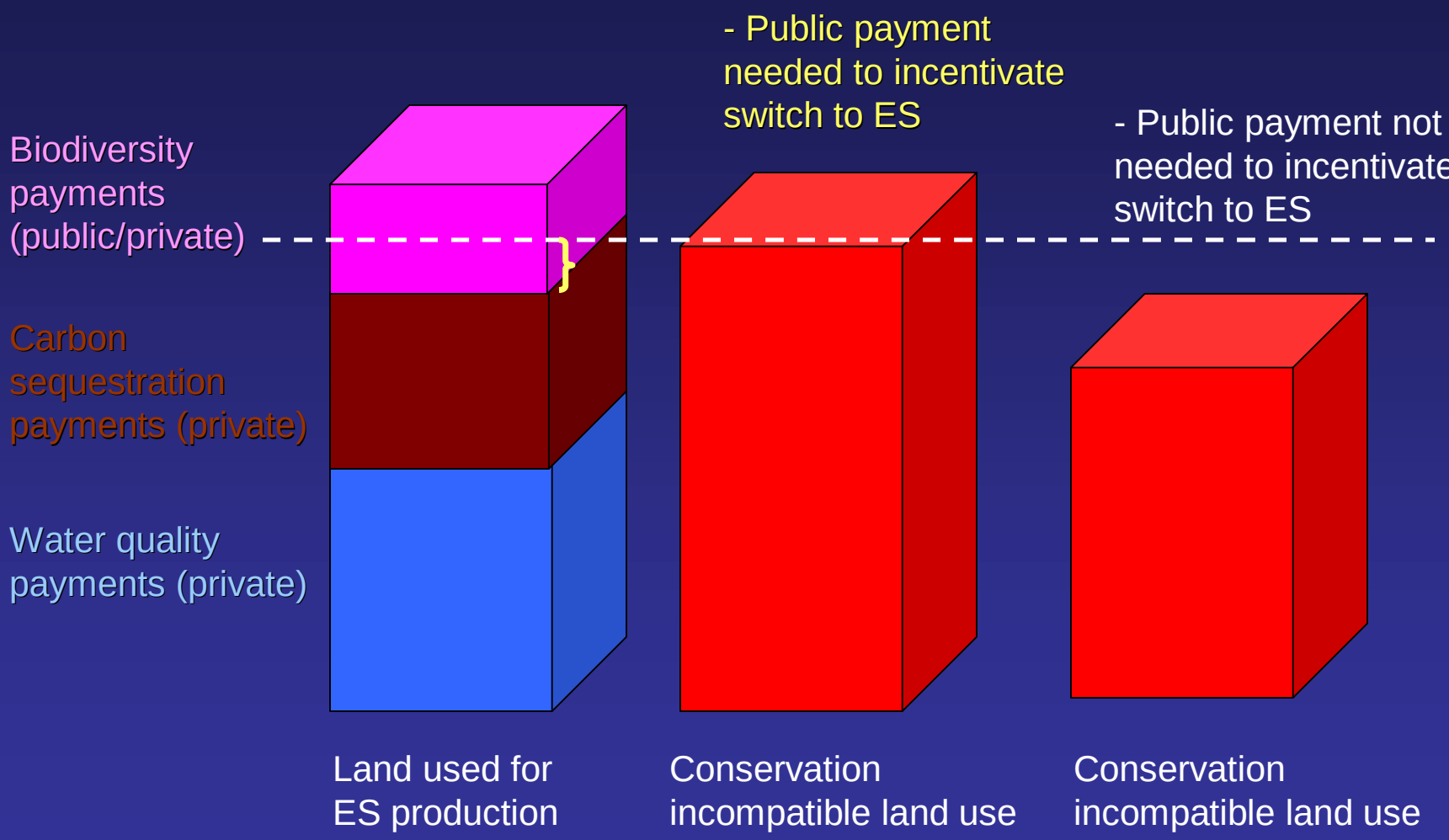
Problem for ES conservation through "free" markets:

- Private incentives insufficient for ES conservation

  private funds will only support production of marketable ES (not public goods)

- Public funds for payment for ES are limited and no match for scale needed, but can complement private incentives

Stacking private and public payments for ecosystem services



Income to landowner from ES vs. conventional land use

Problems for biodiversity conservation through "free" markets:

- Payment gap likely: private funds not sufficiently interested, and public funds not sufficiently large to cover biodiversity protection

Solution:

Create government constructed markets for biodiversity through regulation (species protection coupled with trading)

But:
- Property-rights issues
- Need clear legal base for regulation of biodiversity

Designing Ecosystem Service "Markets"

- Never lose sight of the main objective - **The protection of ecosystem service *values***
- High exchange volume (a "thick" or "robust" market) and low transaction costs for buyers and sellers are desirable, but are not the primary goal of conservation markets – conservation is.

Therefore, the primary market objective should drive:

- The definition of service units (i.e. "currency")
- The setting of exchange rules (trading areas, trading ratios)

Challenges in market design:

- Identification of services of concern
- Measurement of service flows
- Valuation of service flows
- Pricing of services and setting of exchange rules
- Securitization of service contracts
- Stacking of services
- Bundling of services

Measurement of Ecosystem Service flows

- **Assessment methodologies must be robust**:
  - **reasonably accurate**
  - **reasonably inexpensive**
- **Applicable by the land owner, not only trained ES technicians/ scientists**
- Technology and understanding of service provision by ecosystems are improving

Kadyszewski, 2005

Pricing of Ecosystem Services

Prices…

- based on total economic value of services?

vs.

- market-defined, i.e. based on supply and demand?

It depends!

Distinguish between regulated and unregulated services:

- Regulated services: ensure that prices reflect full social value of resources (through adequate currency and exchange rules)

  Problem: Valuation of service flows often difficult

- Non-regulated services: “free” market determines price;

Design challenge for regulation-based service markets (mitigation, govt. payments):

- Ecosystem service markets themselves do not define the units of trade (conventional markets do).
- In an ecosystem market, the environmental good is a public good and the buyer is therefore indifferent to its quality. The buyer is concerned only about satisfying the regulator's definition of an adequate unit.
- Units of trade have to be defined by governments acting as trustees of environmental quality.

→ Importance of defining adequate service units (currencies), backed by credible monitoring and enforcement

Example: U.S.: wetlands mitigation banking:

- Wetland *acre* effectively is the currency used
- But does not capture differences in services and value of different wetlands

Ø **Florida and Virginia: "migration" of wetlands from populated to rural areas and associated loss in service values** (King and Herbert, 1997; Jennings et al., 1999)

- Agencies use exchange restrictions trying to limit harmful trades:

Ø **Trades restricted to the same watershed**
Ø **Very small geographic size of markets**
Ø **Market thinness, little competition, higher prices**

Identify economic values of ecosystem service…

- Valuation is often difficult and complex

Total Economic Value = **Use Value** + **Passive-use Value**

Quantify values: no lack of methods, but often complex and costly

Total Economic Value =

Use value

Direct use value + Indirect use value + Option value

("Ecosystem functional value")

Quantification approaches:

Direct use value	Indirect use value	Option value
Travel Cost Method	Production function approach	Contingent Valuation
Surrogate market valuation	Damage costs avoided	Conjoint Analysis
Hedonic prices	Preventive expenditures	Individual Choice models
Contingent Valuation Methods	Travel Cost Method	
	Surrogate market valuation	
	Contingent Valuation Methods	
	[Replacement cost]	

+

Passive use value

Existence value + Intrinsic value + Bequest/Stewardship value

Quantification approaches: Contingent Valuation Methods

Source: *Barbier (2000)*

Example - Biodiversity Conservation and Ecosystem Services: Red Wolf

Reduced populations of raccoons and invasive nutria

- **Fewer raccoons:**

  → more quail → more hunting/income for land owners from quail hunting

- **Fewer nutria:**

  → less damage to dikes and irrigation channels → lower costs for farmers

  → less damage to wetland vegetation → more migratory waterfowl

  → reduced public management costs for control of invasive purple loosestrife (spread by nutria) and nutria

Possible Incentive Mechanisms for Red Wolf Conservation

- State or Federal Tax Credits
- Payments for ecosystem services (Conservation Security Program)
- Community Development Fund (Schools)
- Share of revenues generated by tourists
- Landowner/Farmer recognition programs
- Safe Harbor agreements
- Mitigation banking

Sea Otters - Ecosystem services

- **Protection of kelp forests**
- **Beach erosion control, carbon sequestration, fish & mollusk populations**

Economic Benefits of Expanding California's Southern Sea Otter Population

	Sea Otter Tourism	Sea Otter Non-Market Value	Commercial Fishing
Dollars (millions)	**$1.5 – 8.2** direct income	$21 median recreation use, option and existence values	**-$.61 revenues**
Total Jobs	+143 to +750	N/A	-24 to -26.5

Plus: increased kelp, the estimated value of which is $7,600 /acre/year

Source: Loomis, John. 2006. Estimating recreation and existence values of sea otter expansion in California using benefit transfer. *Coastal Management* 34(4):387-404.

Pricing of Ecosystem Services

- Practical approaches necessarily imprecise – but often only feasible option
- Technology (e.g., GIS) expected to increase feasibility of more precise valuation
- ES quantification and valuation on the cutting edge of research.

Pricing of Ecosystem Services

But currently:

- Very few, if any, ecosystem service payments are based on actual full economic values. This reduces the competitiveness of service production with competing land uses.

Securitization of services

- Insurance/bonds to guarantee fulfillment of service provision contract

  Example: The Environmental Trust (CA)

  What happens when an entity with responsibility for long-term stewardship of conservation banks files for bankruptcy?

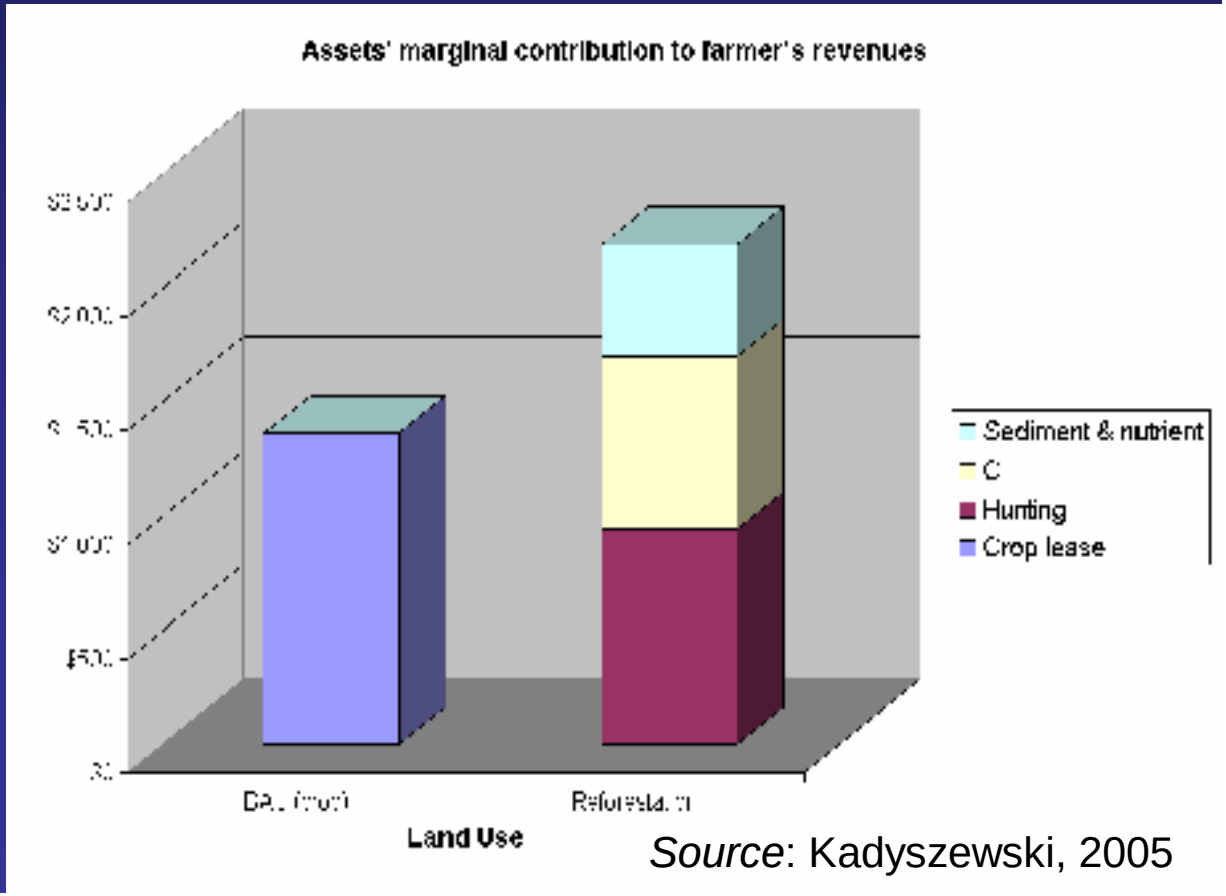
- Need to establish guidelines for financial security and clear chain of liability

Stacking of services

- Payments for different ecosystem services provided by a given land area

Example:

Winrock International's *Carbon, Habitat and Water* project in Arkansas



Source: Kadyszewski, 2005

- **Stacking** allows land owners to maximize income from conservation.
- **But**: Requires legal support - currently, agencies often refuse to allow stacking of credits

Bundling of ecosystem services

- Potential solution for protection of services that suffer from market failure, such as biodiversity:

  Ø Identify marketable (private benefit) services that are co-products of nonmarketable (public good) services

Southwestern Willow Flycatcher

- Many empirical examples of biodiversity bundling with:
  - **Carbon sequestration**
  - **Water quality preservation**
  - **Landscape beauty preservation**

Bundling of ecosystem services

- Challenges:
  - **Overlap between protection of biodiversity and many other services, but far from perfect** (Chan et al., 2006)
  - **Protection of ecosystem services vs. protection of ecosystems (e.g., C sequestration: plantation vs. forest)**

Conclusions

Promises

- Attract more financing and increase private incentives for protection of ecosystem and their services
- Make conservation more competitive with alternative land uses
- One more tool in the tool box for conservation

Challenges

- Close gaps in measurement and valuation of flows
- Make ES measurement and valuation user friendly
- Require mitigation markets and govt. payment schemes to employ strong currencies that capture the full economic value of services
- Close gaps in incentives for production of public good ecosystem services
  - Sufficient funds public funding for public good ES?
  - Identify and use bundling opportunities
  - Reduce regulatory obstacles to stacking

Cautions

- Relying on markets by themselves will not ensure protection of biodiversity (myopia, market power, imperfect information, uncertainty, threshold effects, public good services)
- Govt. created mitigation markets and payment programs are subject to pressures of political economy ("cheap" and weak currencies, insufficient control of exchanges, weakening of conditions for payments - but holds true for all regulation)
- Mitigation markets and govt. payment schemes require sufficient funding to monitor and enforce compliance

Take Home Messages

- Viable markets in ecosystem services require standardized units of trade and low-cost measurement and valuation of service flows
- Conservation through markets requires adequate currencies that account for nonfungibilities of services across space, time, and service type
- Role for the public sector in guiding market development and conduct (monitoring and enforcement)
- Consider alternatives: conservation banks, cost-share of practices, and other incentives to complement private markets
- Think about market premiums attained through certification

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http://www.biodiversitypartners.org/econ/index.shtml


Questions?