



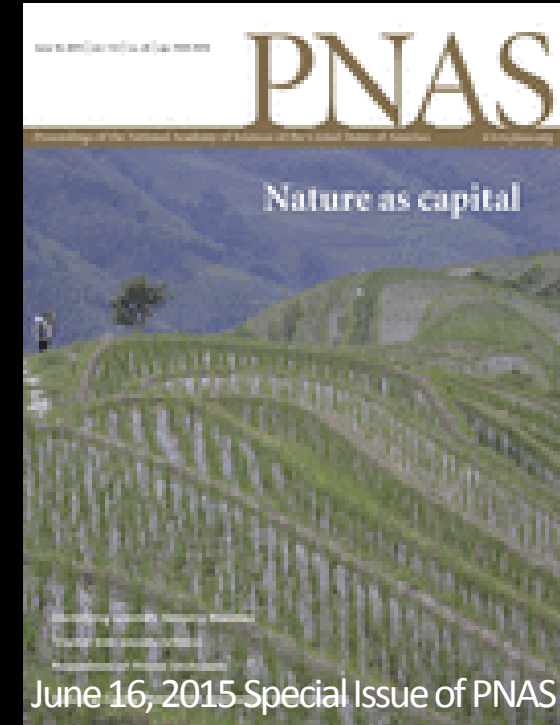
Policy Implications of Natural Capital Accounting

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Nature as capital

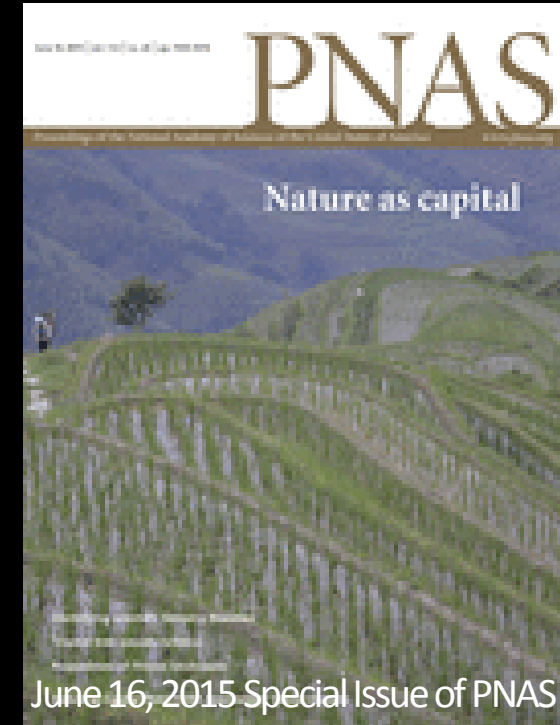
- “The central challenge of the 21st century is to develop economic, social, and governance systems capable of ending poverty and achieving sustainable levels of population and consumption while securing the life-support systems underpinning current and future human well-being”



Guerry, Polasky, Lubchenco, et al. 2015. Natural capital and ecosystem services informing decisions: From promise to practice. *Proceedings of the National Academy of Sciences (PNAS)* 112: 7348-7355.

Mainstreaming the value of natural capital

- “Essential to meeting this challenge is the incorporation of natural capital and the ecosystem services it provides into decision-making.”
- Government decisions
- Business decisions
- Household decisions



Guerry, Polasky, Lubchenco, et al. 2015. Natural capital and ecosystem services informing decisions: From promise to practice. *PNAS* 112: 7348-7355.

Capital assets

- **Capital assets:** economic resources that can be used to produce valuable goods and services
 - Tangible assets: land, buildings, equipment...
 - Intangible assets: reputation, patents, knowledge and skill...

Natural capital

- **Natural capital:**

- Land
- Natural resources (oil, natural gas, minerals...)
- Ecosystems

- **Forest example:**

- Stock of standing timber (inventory)
- Forest ecosystem: regeneration of timber (productive equipment)

Value of capital assets

- **Market value of a capital asset:** the contribution the asset makes to current and future income of the owner of the asset
- **Societal value of a capital asset:** the contribution the asset makes to current and future human well-being for members of society

Divergence of market and social value

- **Natural capital** often generates **societal value** that is greater than the **market value** it generates.
 - “Externalities”
- Forest example:
 - Market value: timber
 - Additional social values: water purification, water flow regulation, habitat for valued species, carbon sequestration...

Measuring the value of capital assets

- **Market value:** present value of the flow of income created by the asset
- Forest example:
 - Revenue from timber sales minus planting and harvesting costs
 - Future revenue and costs are discounted using appropriate interest rate

Measuring the value of capital assets

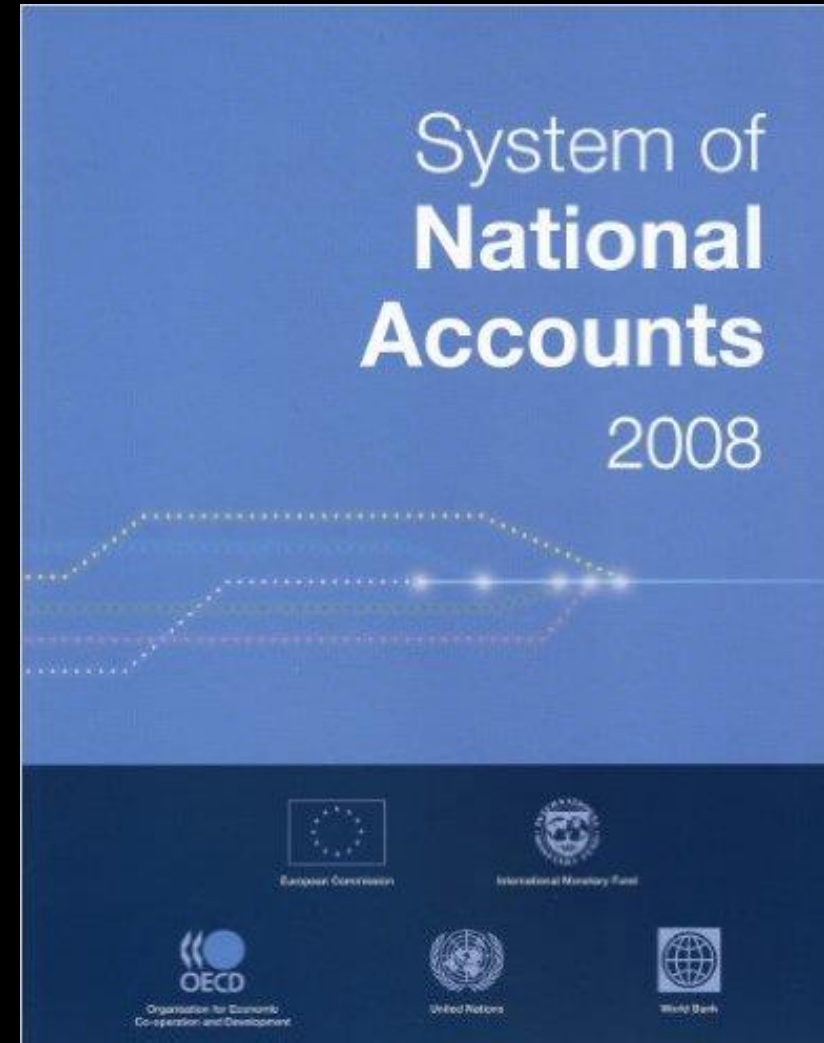
- **Societal value of a capital asset:** present value of the contribution to human well-being measured in a common metric (typically money)
- **Problem:** the value of most contributions do not go through markets and are not measured in a common monetary metric (non-market values)
- Use non-market valuation methods from economics to measure the value of contributions in a common monetary metric

Measuring the value of capital assets

- Forest example:
 - Water purification: present value of avoided cost of building and operating water filtration facilities
 - Water flow regulation: present value of reduced damages from flooding and drought
 - Habitat for valued species: present value of recreation value (travel cost); existence value (contingent valuation surveys)
 - Carbon sequestration: present value of carbon storage using carbon market price or social cost of carbon

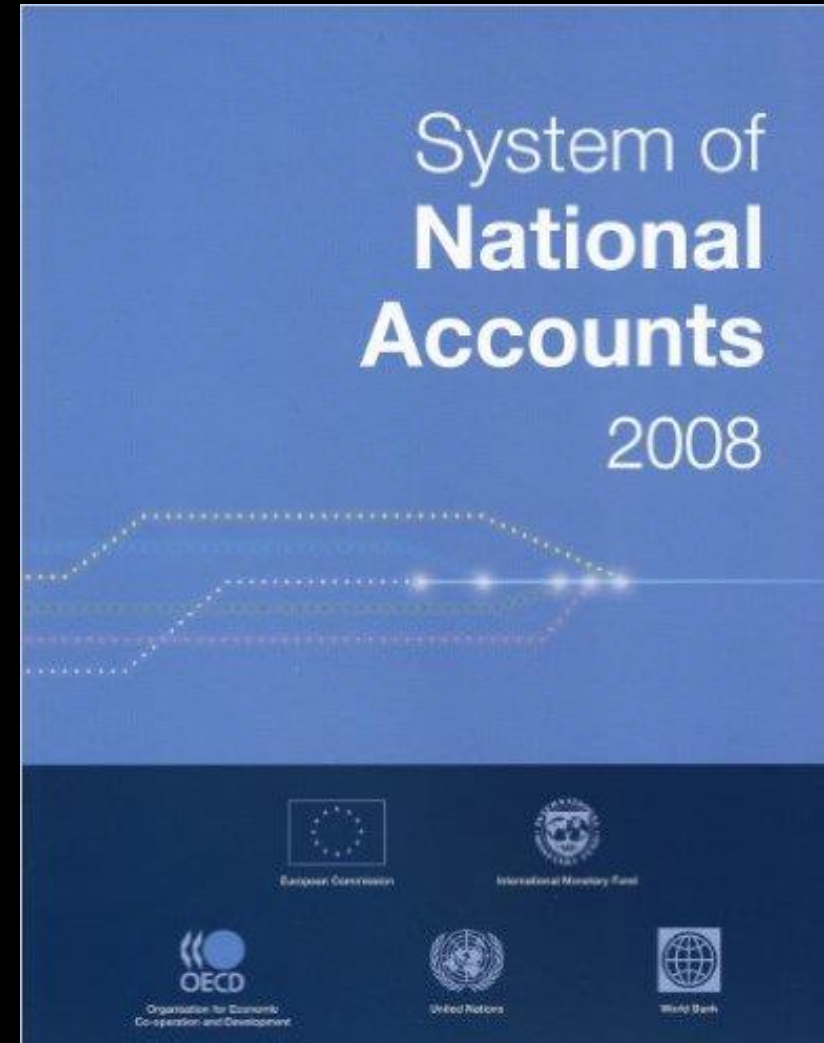
Brief history of economic accounting

- Prior to 1930s: no systematic accounting of the economy
- 1940s: first systematic measure of Gross Domestic Product (GDP)
- 1947: first national income accounts
- System of National Accounts: clear and consistent accounting of income (GDP) and wealth as measured by market values



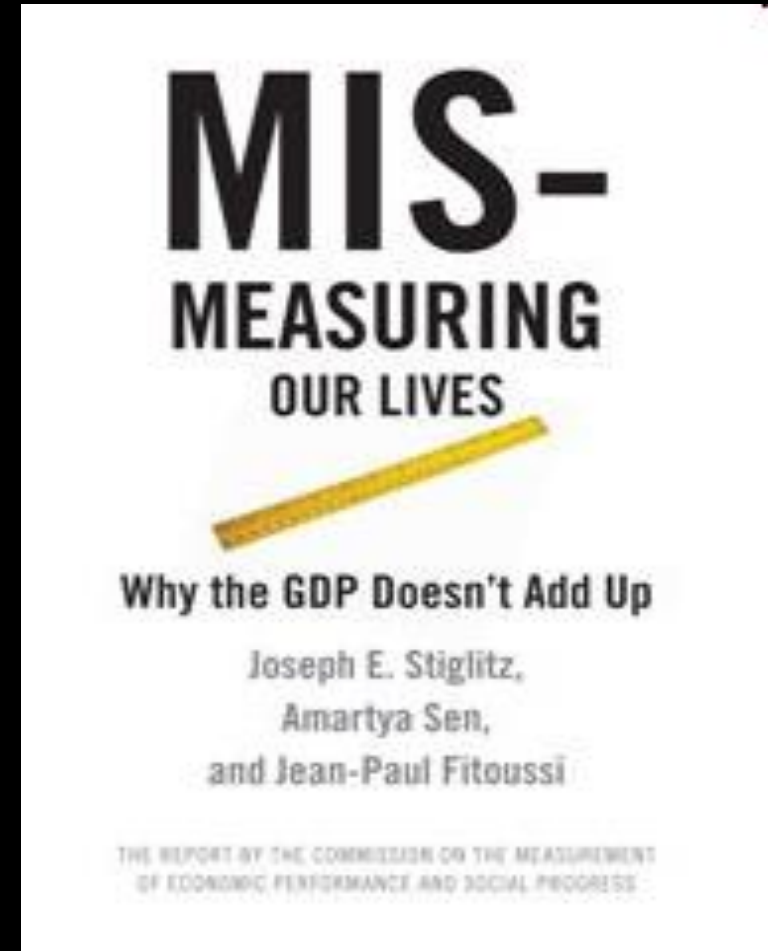
Brief history of economic accounting

- Economic accounts **ONLY** measure market values.
- Economic accounts do not include non-market values.
- Forest example:
 - Income: net revenue from timber operation in a given year
 - Wealth: value of forest land, capitalized value of timber operations
 - Ignores: water purification, water flow regulation, habitat for species, carbon sequestration



Need for expanded accounting

- Include the value non-market values generated by natural capital



Current economic accounting system

	Flow (Income)	Stock (Asset)
Biophysical measure	Amounts of various goods and services provided	Amounts of various capital assets
Monetary measure	GDP: market price times amount produced summed over all goods and services	Measure of wealth: market price times amount of asset summed over all assets

Expanded accounting system to include natural capital and ecosystem services

	Flow (Income)	Stock (Asset)
Biophysical measure	Ecosystem services: amounts of various goods and services provided by natural capital	Amounts of various forms of natural capital
Monetary measure	Gross ecosystem product: GEP	Measure of inclusive wealth (including natural capital)

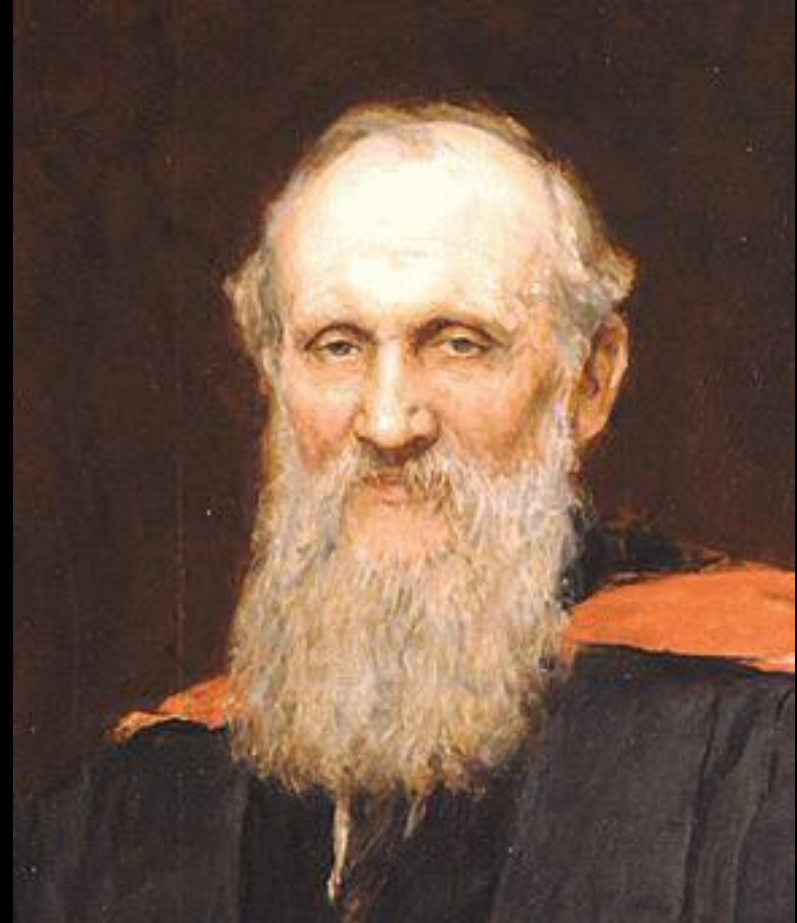
Two important measurement tasks

1. Measuring the biophysical quantities of ecosystem services and natural capital assets
2. Measuring values using both market and non-market values

Importance of measurement

- “If you can measure ... you know something of your subject; but if you cannot measure it, your knowledge is meager and unsatisfactory.”

Lord Kelvin



Importance of measurement

- Modern version I:
“If you can't measure it, you can't manage it.”
- Modern version II:
“If you don't value it, you won't sustain it.”

Trends in
ecosystem
services:

Millennium
Ecosystem
Assessment

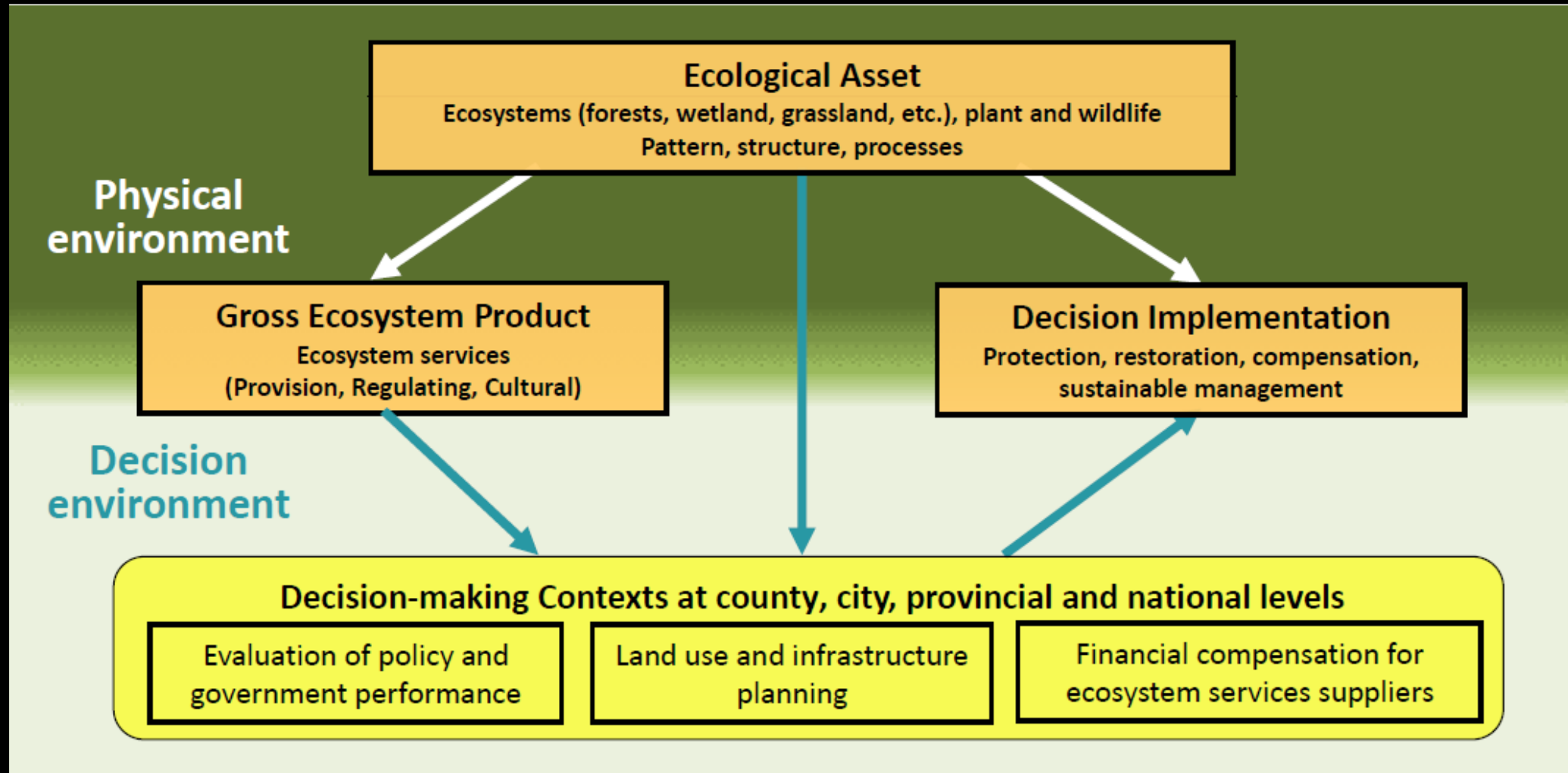
Service	Sub-category	Status	Notes
Provisioning Services			
Food	crops	▲	substantial production increase
	livestock	▲	substantial production increase
	capture fisheries	▼	declining production due to overharvest
	aquaculture	▲	substantial production increase
	wild foods	▼	declining production
Fiber	timber	+/-	forest loss in some regions, growth in others
	cotton, hemp, silk	+/-	declining production of some fibers, growth in others
	wood fuel	▼	declining production
Genetic resources		▼	lost through extinction and crop genetic resource loss
Biochemicals, natural medicines, pharmaceuticals		▼	lost through extinction, overharvest
Fresh water		▼	unsustainable use for drinking, industry, and irrigation; amount of hydro energy unchanged, but dams increase ability to use that energy
Regulating Services			
Air quality regulation		▼	decline in ability of atmosphere to cleanse itself
Climate regulation	global	▲	net source of carbon sequestration since mid-century
	regional and local	▼	preponderance of negative impacts
Water regulation		+/-	varies depending on ecosystem change and location
Erosion regulation		▼	increased soil degradation
Water purification and waste treatment		▼	declining water quality
Disease regulation		+/-	varies depending on ecosystem change
Pest regulation		▼	natural control degraded through pesticide use
Pollination		▼ ^a	apparent global decline in abundance of pollinators
Natural hazard regulation		▼	loss of natural buffers (wetlands, mangroves)
Cultural Services			
Spiritual and religious values		▼	rapid decline in sacred groves and species
Aesthetic values		▼	decline in quantity and quality of natural lands
Recreation and ecotourism		+/-	more areas accessible but many degraded

Trends in ecosystem services: Millennium Ecosystem Assessment

Service	Sub-category	Status	Notes	Millennium Ecosystem Assessment
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High
correlation
between
market
value and
increasing
trend

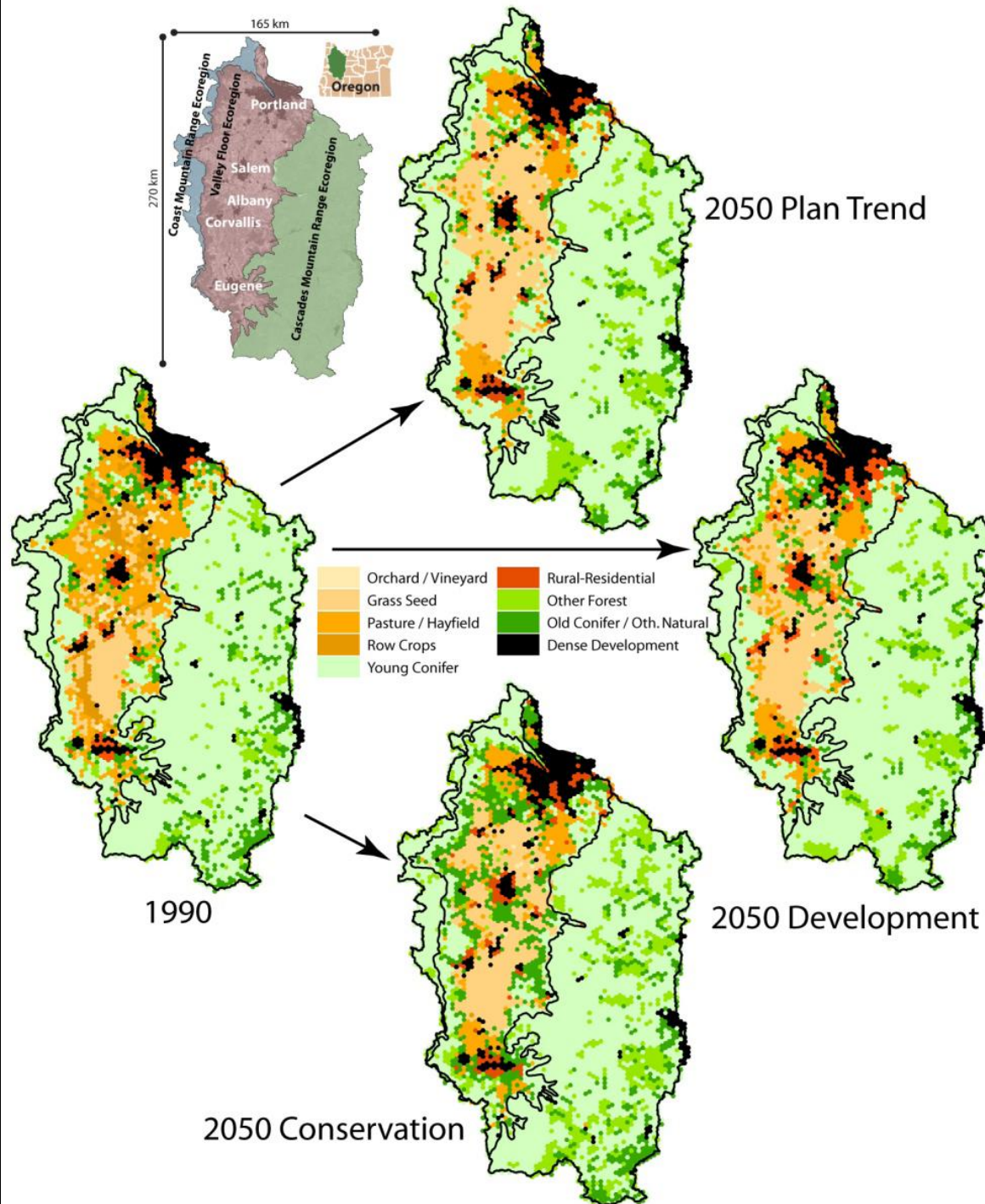
Using natural capital accounting in decision-making



Example of natural capital accounting in land-use and infrastructure planning: Modeling multiple ecosystem services and tradeoffs at landscape scales



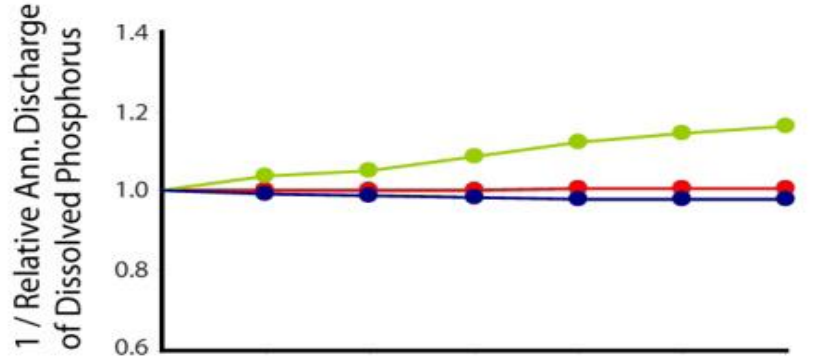
Nelson et al. 2009. *Frontiers in Ecology and Environment* 7(1): 4–11.



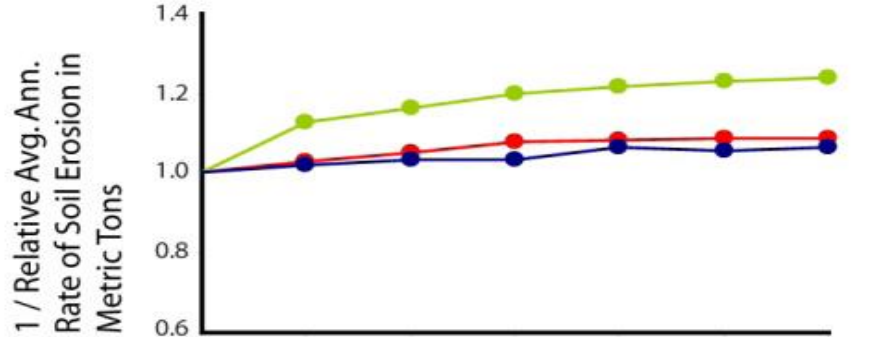
Projected land use
change in 2050
under three
scenarios

Ecosystem service outputs through time

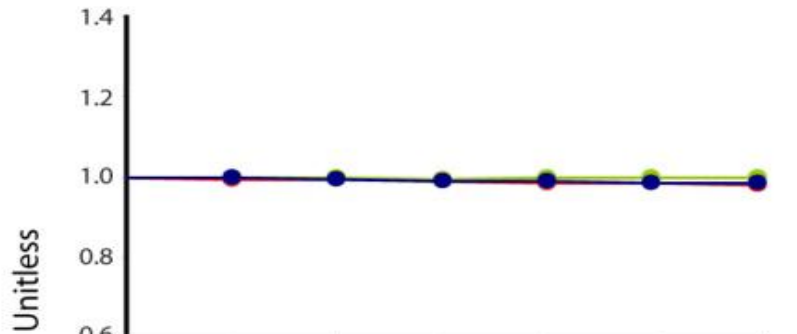
Water Quality



Potential Soil Conservation

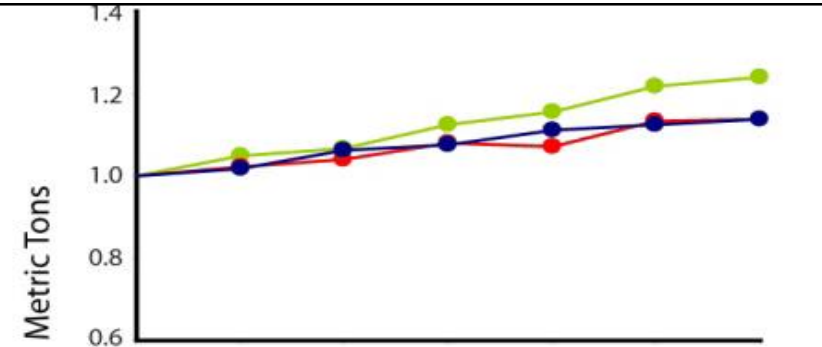


Storm Peak Management

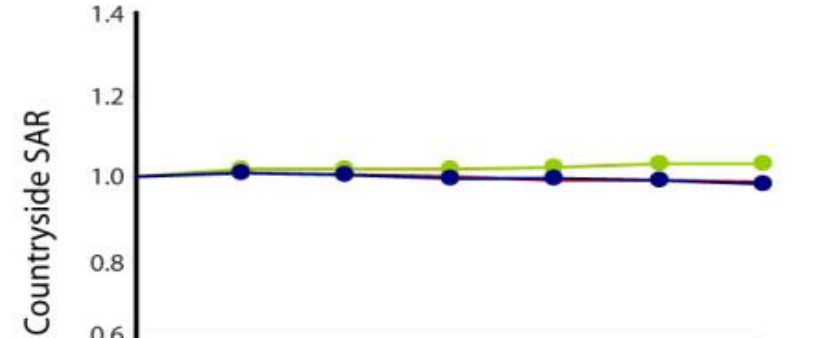


● Plan Trend ● Development ● Conservation

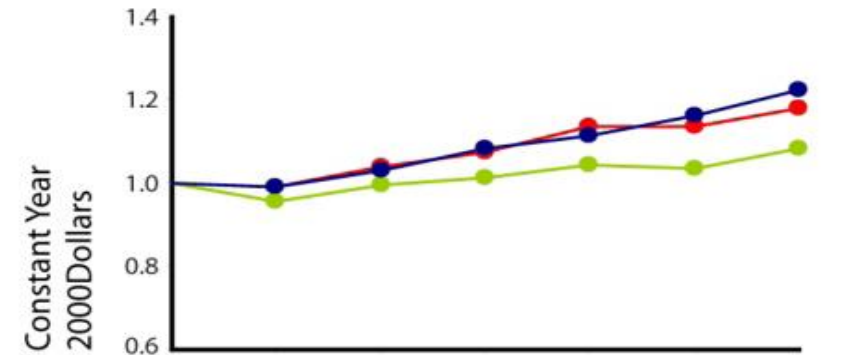
Carbon Sequestration



Biodiversity

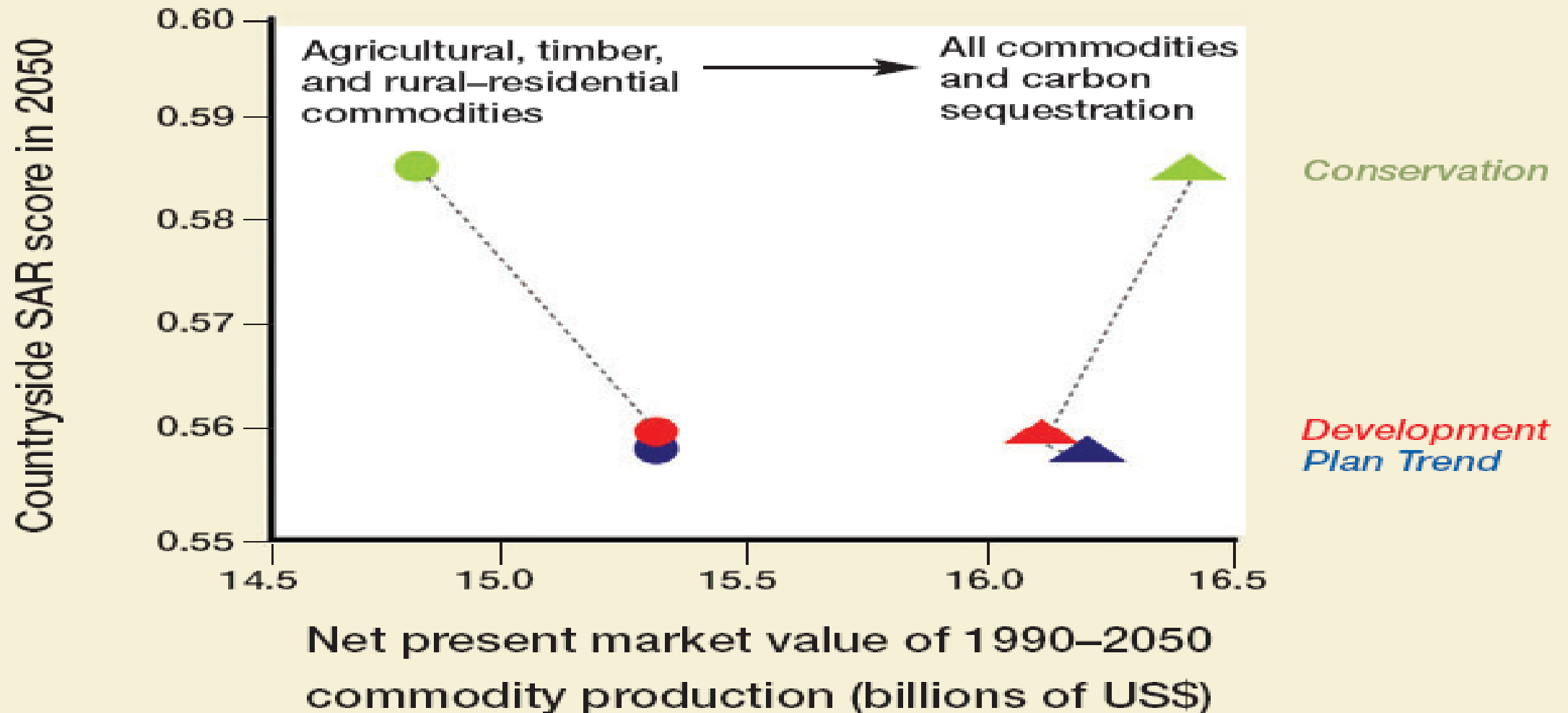


Market Value



● Plan Trend ● Development ● Conservation

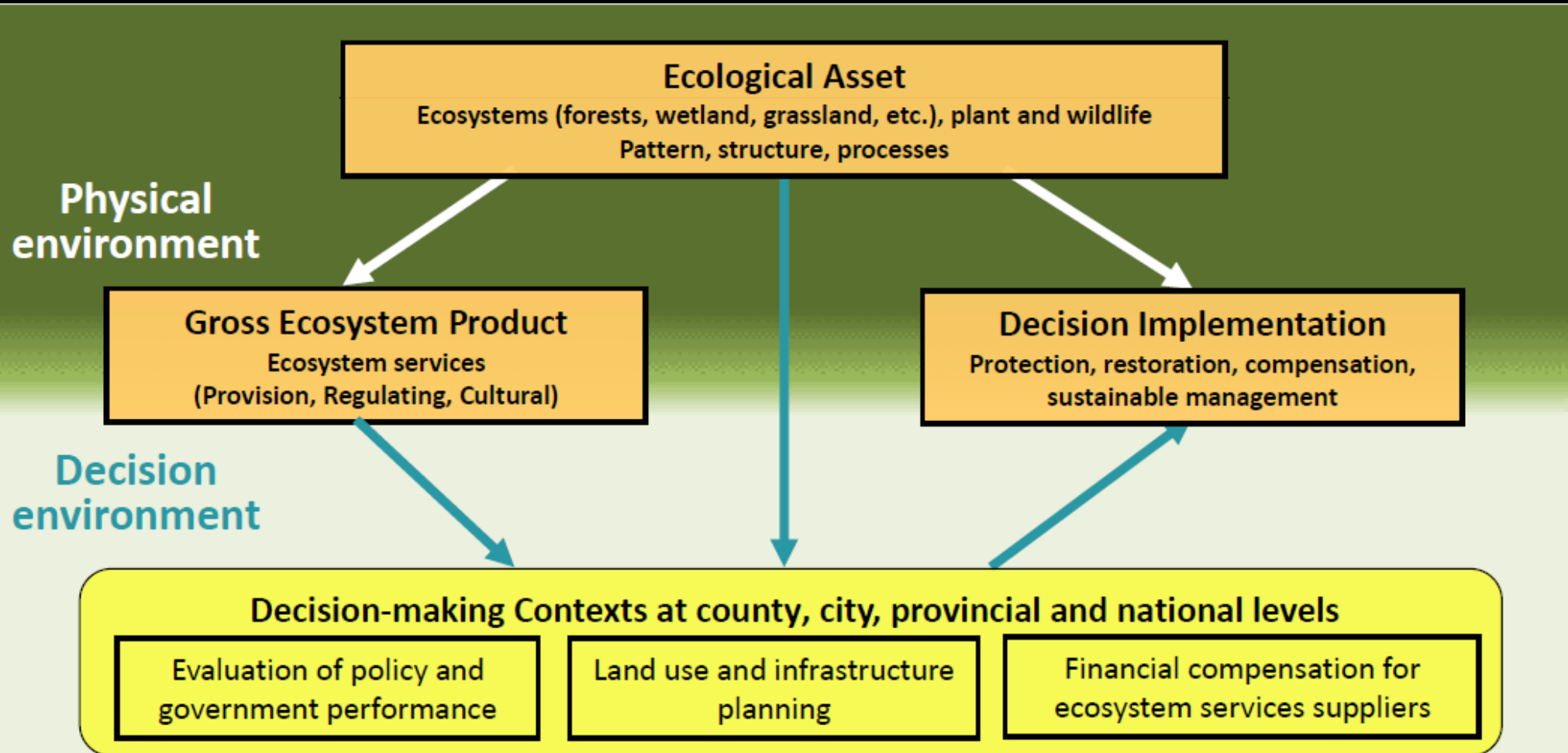
Net present value and tradeoffs



Role for policy: shifting outcome from plan trend to conservation pathway

- **Mainstream value of natural capital:** align market and social values (“internalize the externalities”)
- **Various policy approaches**
 - Payments for ecosystem services (PES)
 - Regulatory approaches (e.g., land use zoning)

Using natural capital accounting in decision-making



Using natural capital accounting in decision-making

- Evaluation of policy and government performance
 - How do government decisions affect the well-being of citizens?
 - Having job performance of government officials depend on GEP and measures of value of natural capital in addition to GDP
- Land use and infrastructure planning
 - Ecological Function Conservation Areas
 - Ecological Redlining
- Financial compensation for ecosystem service providers
 - Tie incentive payments to positive impact on service provision and maintenance of important natural capital

Importance of natural capital accounting

- **Current economic accounting measures only market values:**
Distortions in social decision-making from ignoring non-market contributions to social values
- **Exclusive focus on GDP or GEP:** these are measures of current income and ignore changes in assets and their impact on future values
 - Forestry example: harvest trees faster than they regenerate gives high current income but low future returns

Importance of natural capital accounting

- Measuring the value of natural capital and ecosystem services (GEP) AND incorporating these values into decision-making is essential for sustainable development.
- The People's Republic of China is leading in both measuring GEP and the value of natural capital and incorporating these values into decision-making.
- This effort promises better outcomes for Chinese citizens and sets an inspiring example for other nations to follow.



谢谢