An introduction to Ecosystem Services

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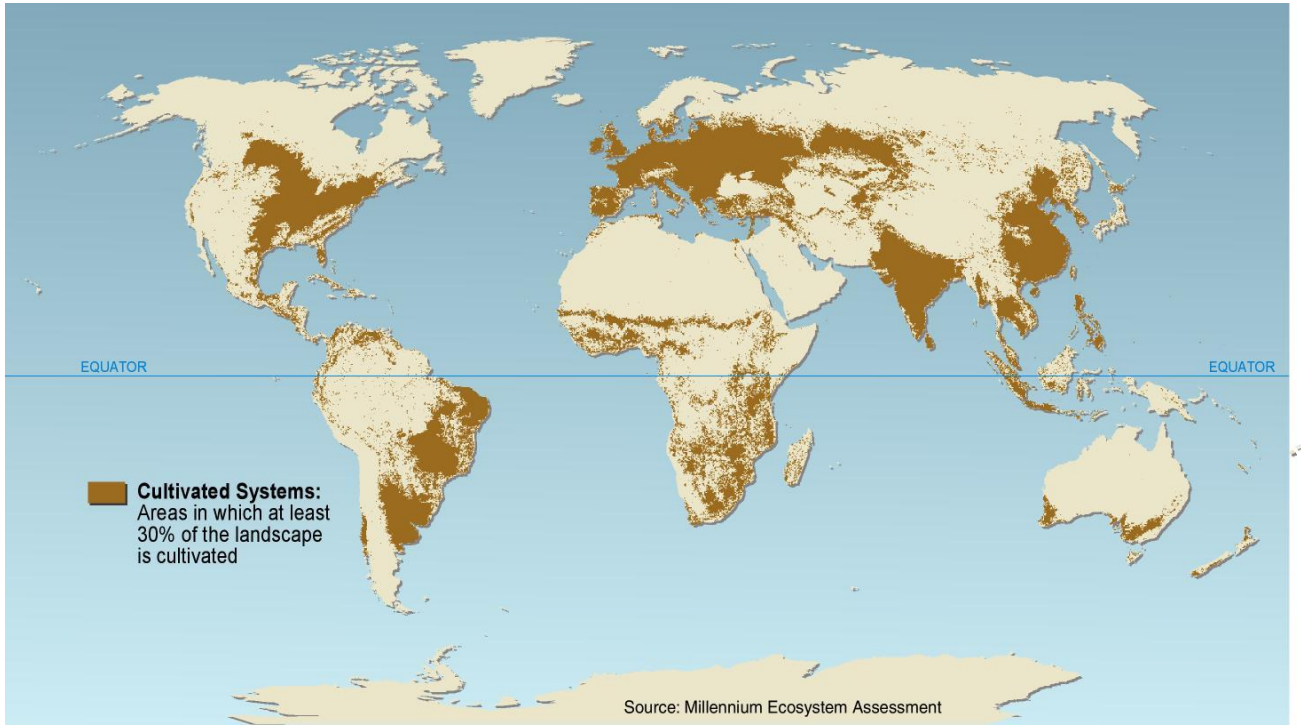
Millennium Ecosystem Assessment

Unprecedented change in structure and function of ecosystems

More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.



Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

(Defined as areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture)

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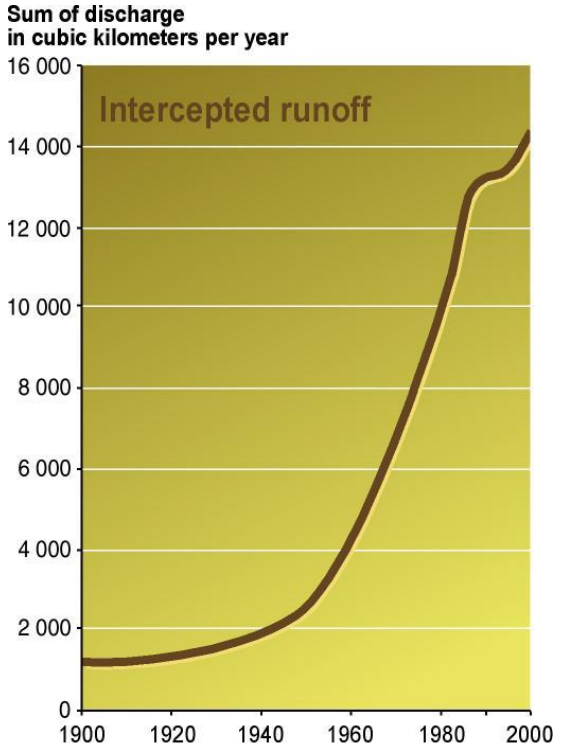
Unprecedented change: Ecosystems

- 20% of the world's coral reefs were lost and 20% degraded in the last several decades
- 35% of mangrove area has been lost in the last several decades
- Amount of water in reservoirs quadrupled since 1960
- Withdrawals from rivers and lakes doubled since 1960



Intercepted Continental Runoff:
3-6 times as much water in reservoirs as in natural rivers

(Data from a subset of large reservoirs totaling ~65% of the global total storage)

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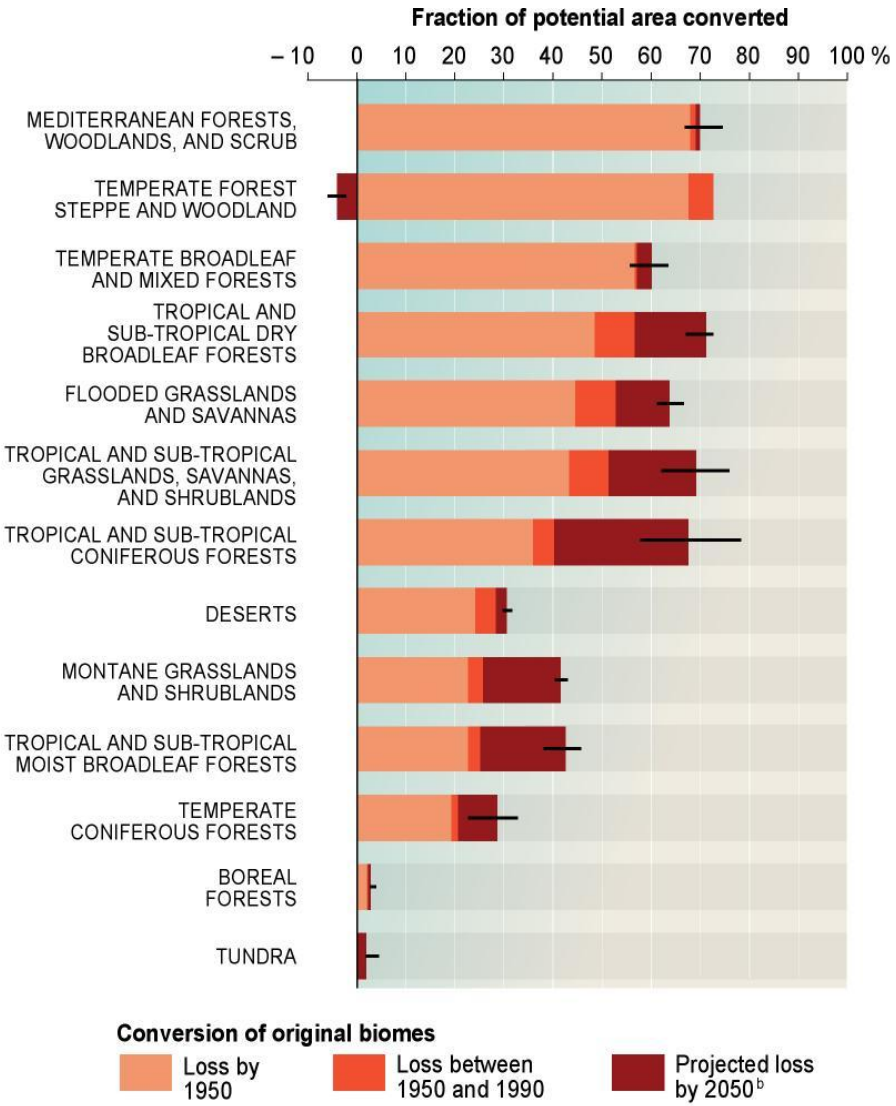
Unprecedented change: Ecosystems

- 5-10% of the area of five biomes was converted between 1950 and 1990
- More than two thirds of the area of two biomes and more than half of the area of four others had been converted by 1990



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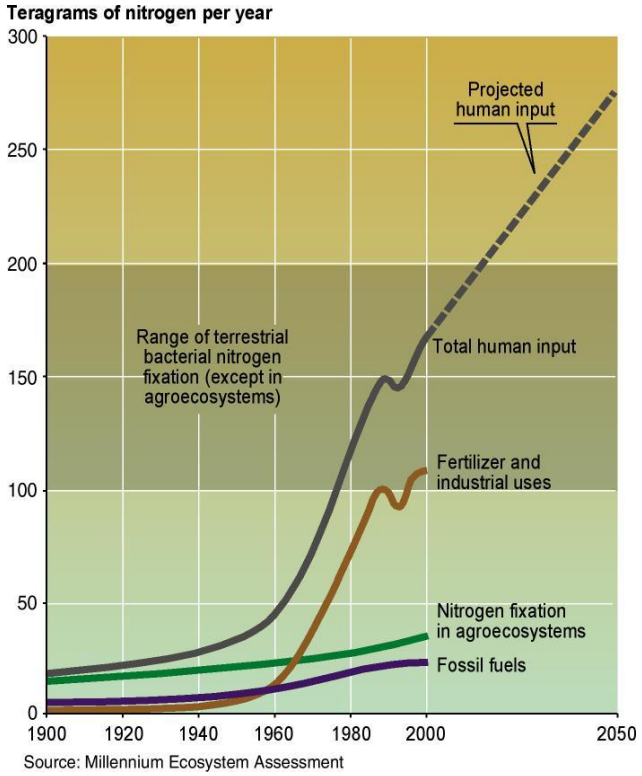
Unprecedented change: Biogeochemical Cycles

Since 1960:

- Flows of biologically available nitrogen in terrestrial ecosystems doubled
- Flows of phosphorus tripled

> 50% of all the synthetic nitrogen fertilizer ever used has been used since 1985

60% of the increase in the atmospheric concentration of CO_2 since 1750 has taken place since 1959



Human-produced Reactive Nitrogen

Humans produce as much biologically available N as all natural pathways and this may grow a further 65% by 2050

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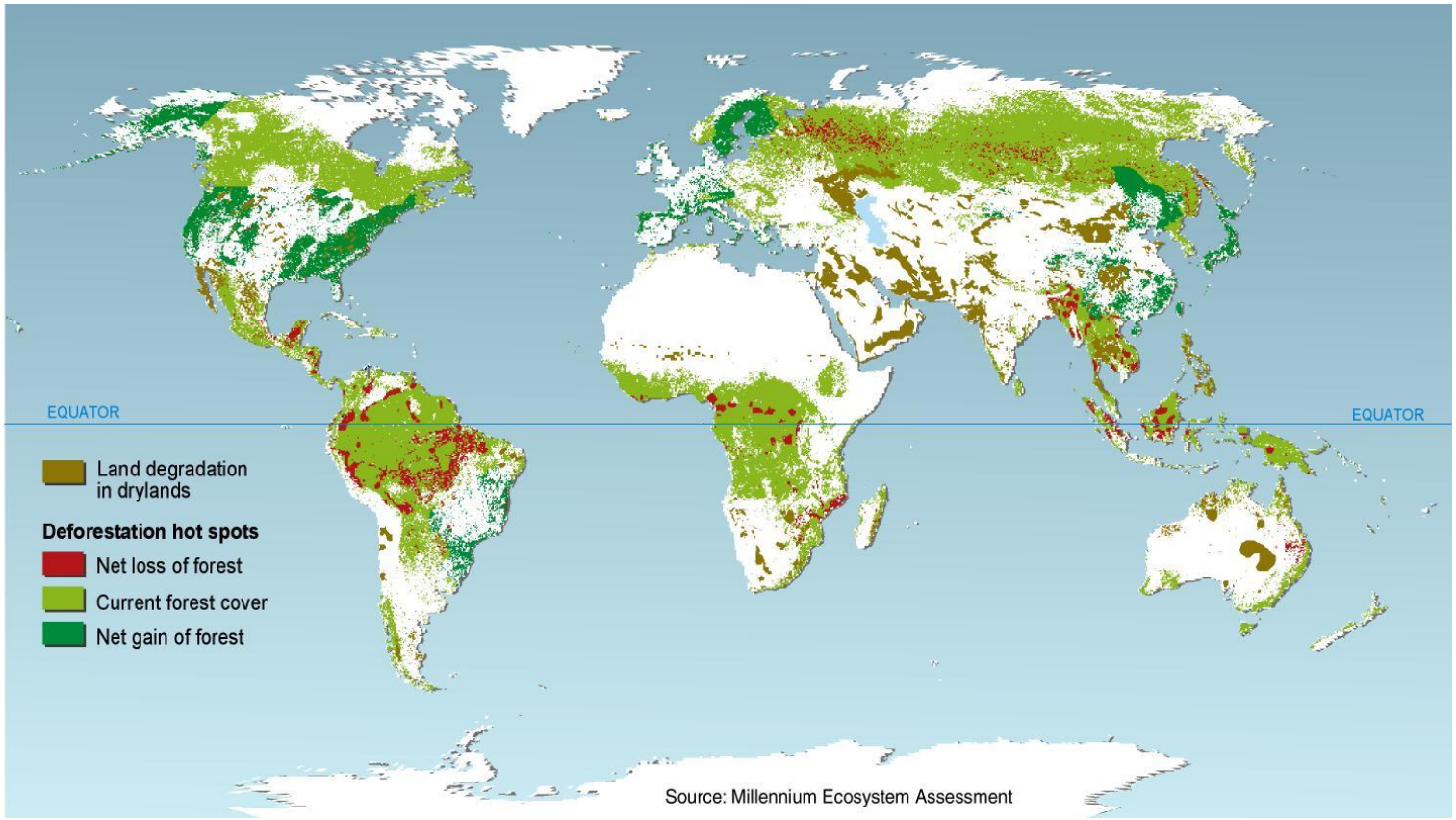
Some ecosystem recovery now underway but high rates of conversion continue

- Ecosystems in some regions are returning to conditions similar to their pre-conversion states
- Rates of ecosystem conversion remain high or are increasing for specific ecosystems and regions



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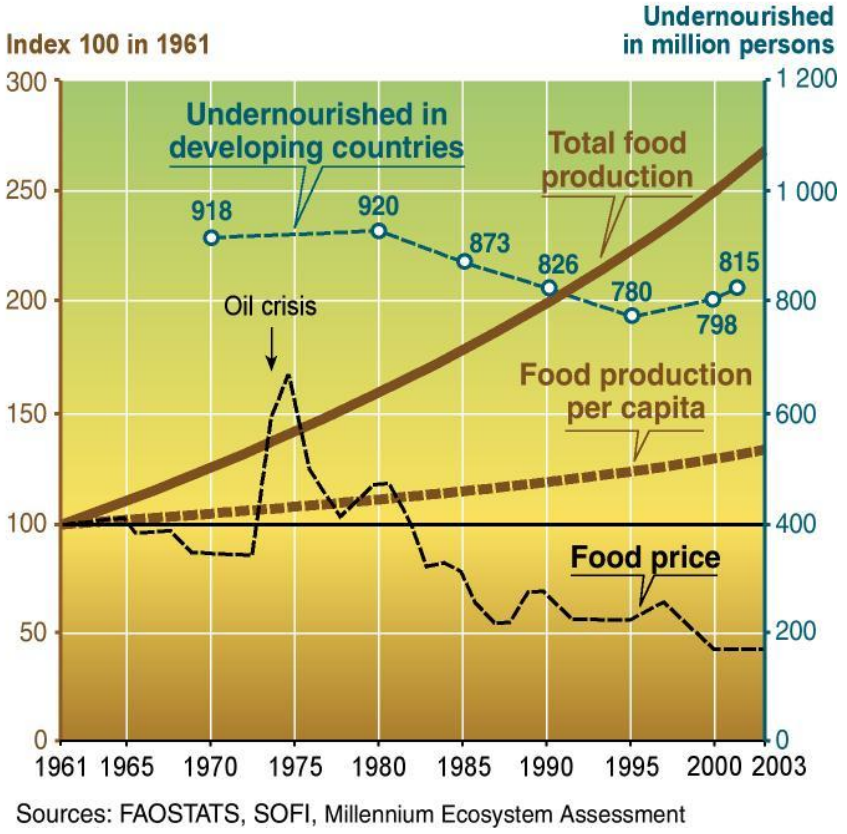
Changes to ecosystems have provided substantial benefits

- Food production has more than doubled since 1960
- Food production per capita has grown
- Food price has fallen



Ecosystem Services

- Tangible:
  - Biodiversity
  - Water
  - Soil conservation

- Untangible
  - Carbon sequestration
  - Weather regulation

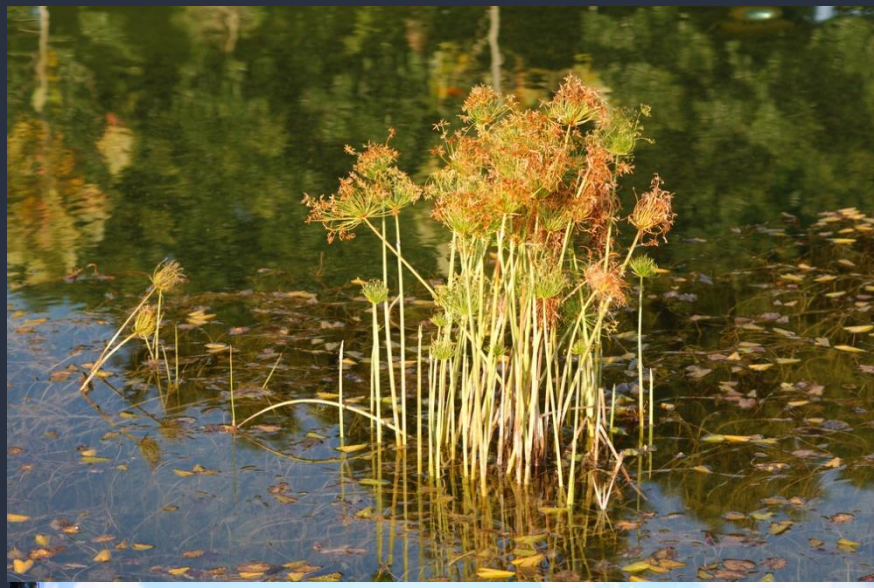
Defining Ecosystems and Ecosystem Services

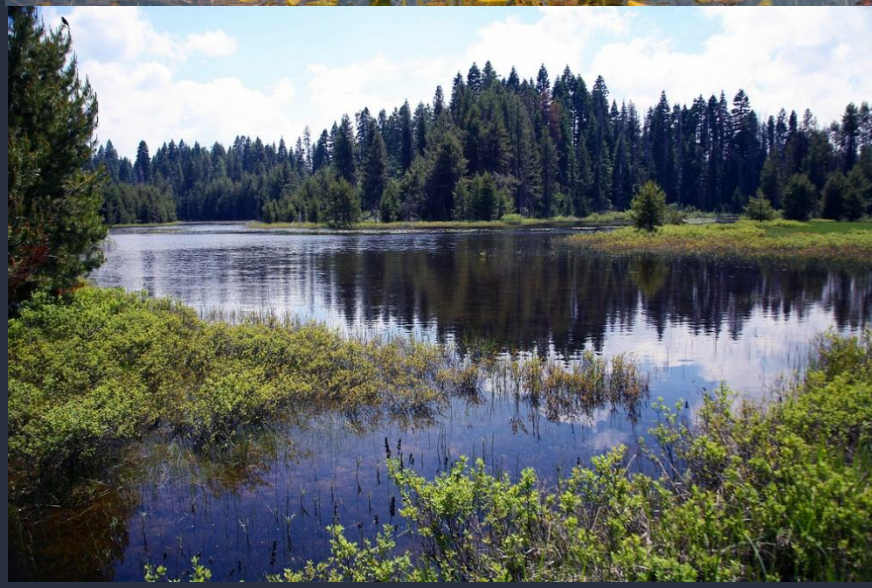
Ecosystems are the combined interactions of:

Biological / living *(plant, animal and micro-organism communities*) components of environment

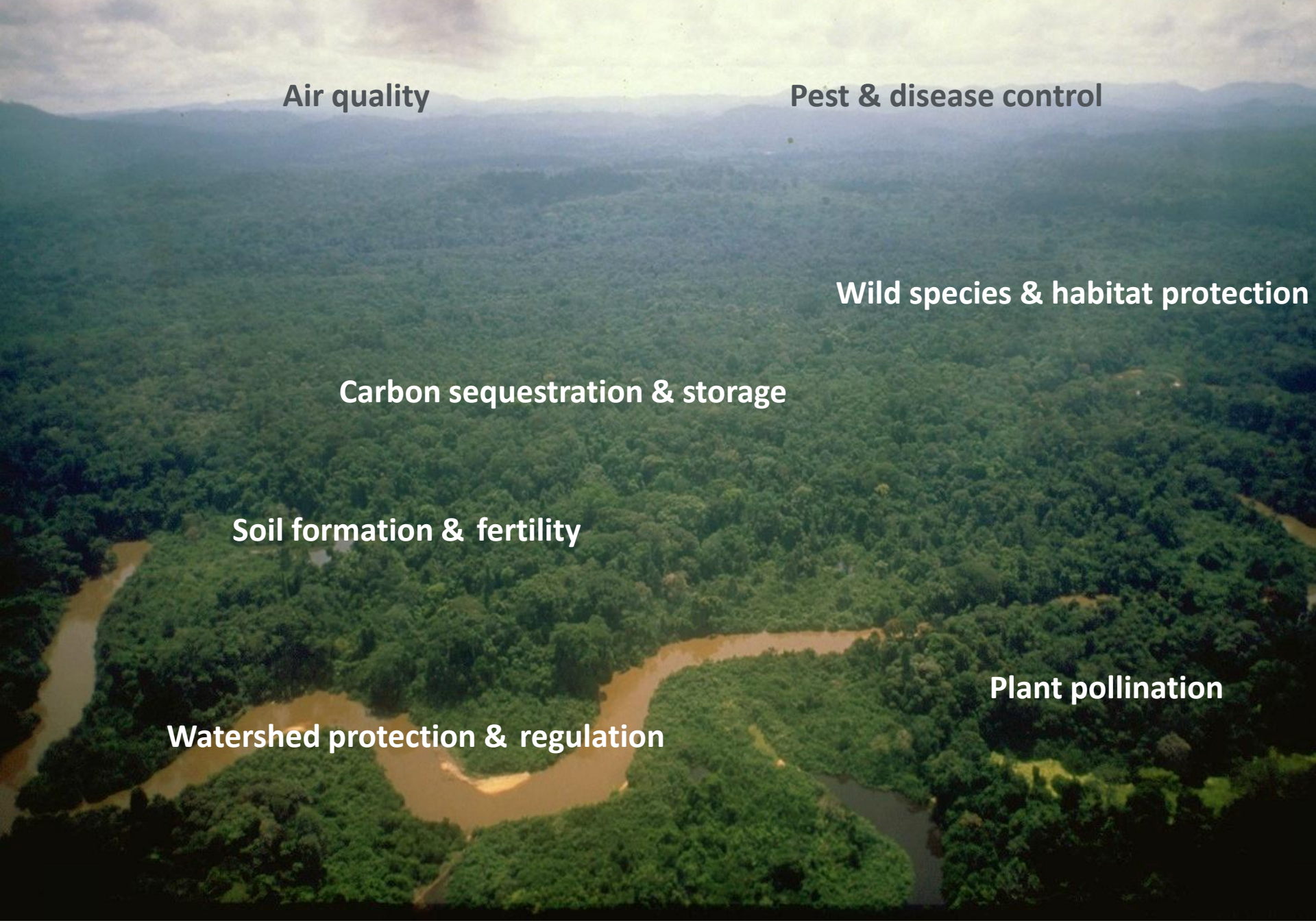
and

Physical / non-living components *(air, water, soil and the basic elements and compounds of the environment)*





Courtesy of US Forest Service



Courtesy of US Forest Service

Ecosystem Services & the Economy

1. Environmental Goods
   food, freshwater, fuel, fiber
2. Regulating Services
   climate regulation, flood regulation, water filtration
3. Supporting Services
   nutrient cycling, soil formation
4. Cultural Services
   aesthetic, spiritual, educational, recreational

Product Inputs

Production Process Inputs

Stable Business Operating Context

Healthy worker fundamentals (e.g., clean air, adequate amounts of water, food, etc.)

Contributors to 'license to operate'

Courtesy of US Forest Service

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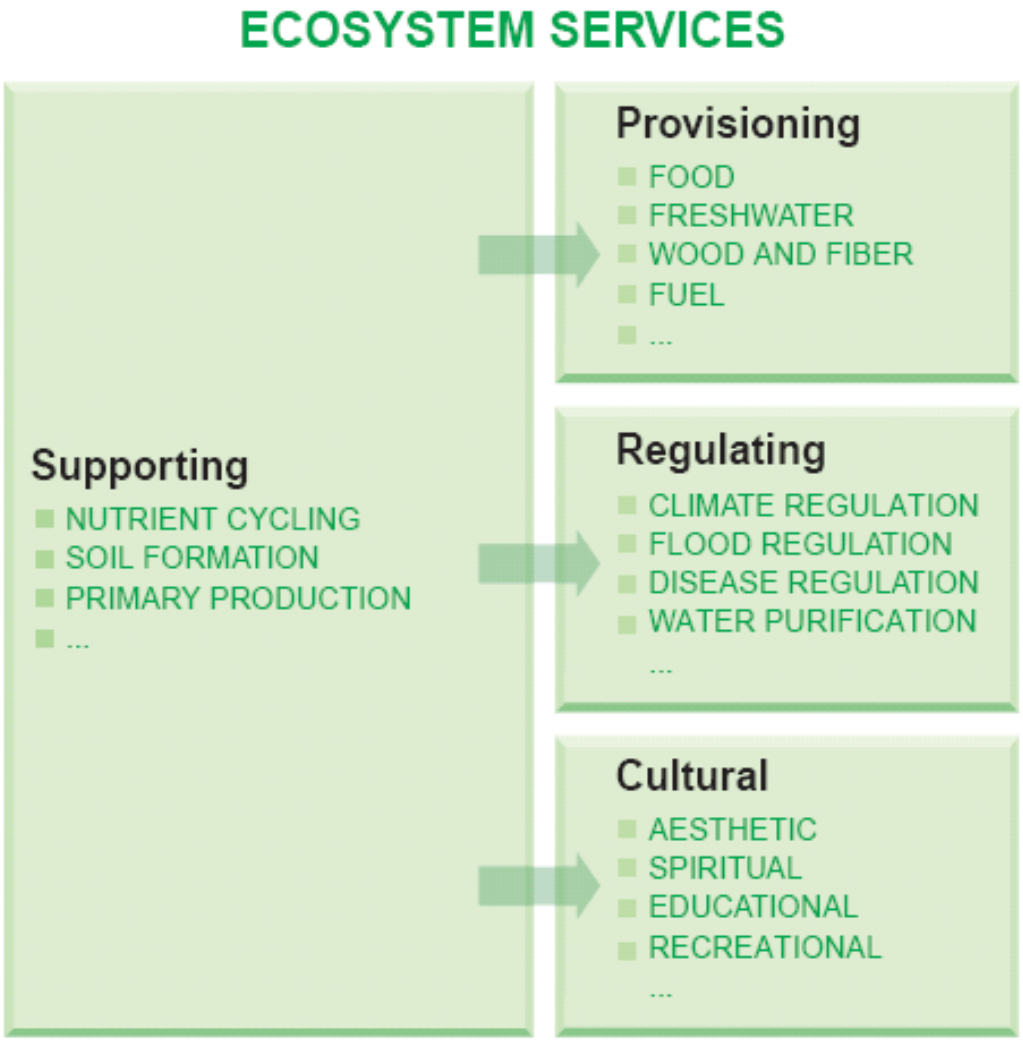
Focus: Ecosystem Services

The benefits people obtain from ecosystems



The Three Challenges of Ecosystem Service Valuation

1. Ecology: quantities/qualities of ecosystem services
2. Economics: values of ecosystem services
3. Linking ecology and economics

Courtesy of Stephen Polasky

Challenge 1: Ecology

What is the ecological production function? (*quantity/quality* of services)

From ecosystem structure and function

To ecosystem services

- do we know how services are produced?

- do we know how production changes as ecosystem is altered?

Courtesy of Stephen Polasky

Challenge 2: Economics

What are the *values* of services?

From quantities (quality)

To values

- what methods can be applied to ascertain values?
- are these methods reliable?
- total values or marginal values?

Courtesy of Stephen Polasky

Challenge 3: Linking ecology and economics

- Production function (ecology)
- Valuation (economics)

Often studies by one group do not mesh with studies by other group

Studies of ecologists and economists need to link together to get estimates of value of ecosystem services

Courtesy of Stephen Polasky

Examples

Organized examples by increasing scale/complexity

- Value of a single service in an ecosystem
- Multiple services within an ecosystem
- Comprehensive services measures

Courtesy of Stephen Polasky

So… what are we going to learn in this PDS

- Different perspectives on measuring ecosystem services.
- Econometric aspects to quantify those services.
- Learn about advanced monitoring techniques for ecosystem services in dry forests.