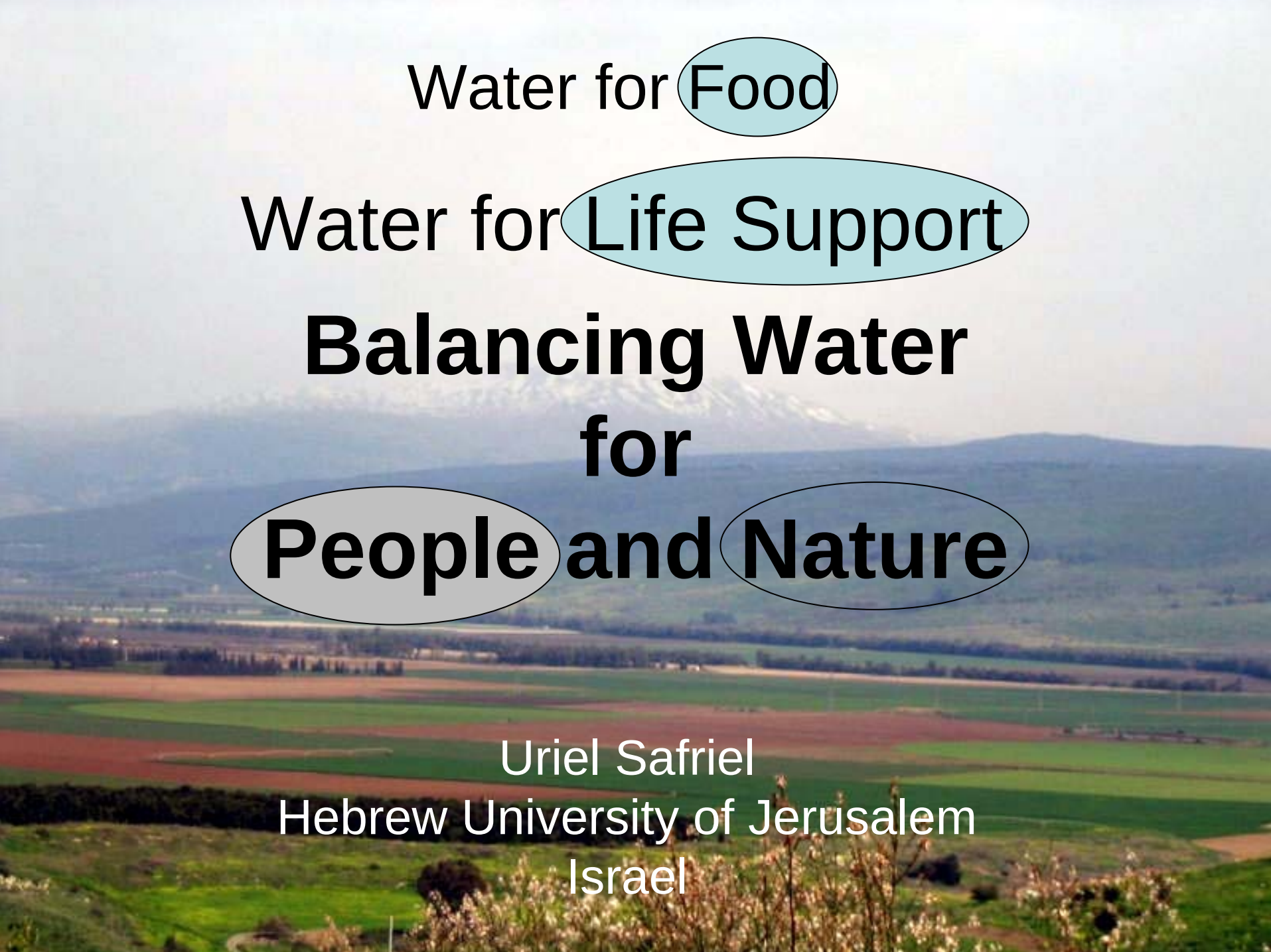

Water for Food
Water for Life Support
Balancing Water for People and Nature
Uriel Safriel
Hebrew University of Jerusalem
Israel

Balancing Water for People and Nature

Competition for limiting resource

growth?

- Population
- Economic

- Population

Water for People and Organisms

Competition for limiting resource ?

Essential

limiting growth?

- Population
- Economic

Water for People and

- Population

People
Ecosystems
other species

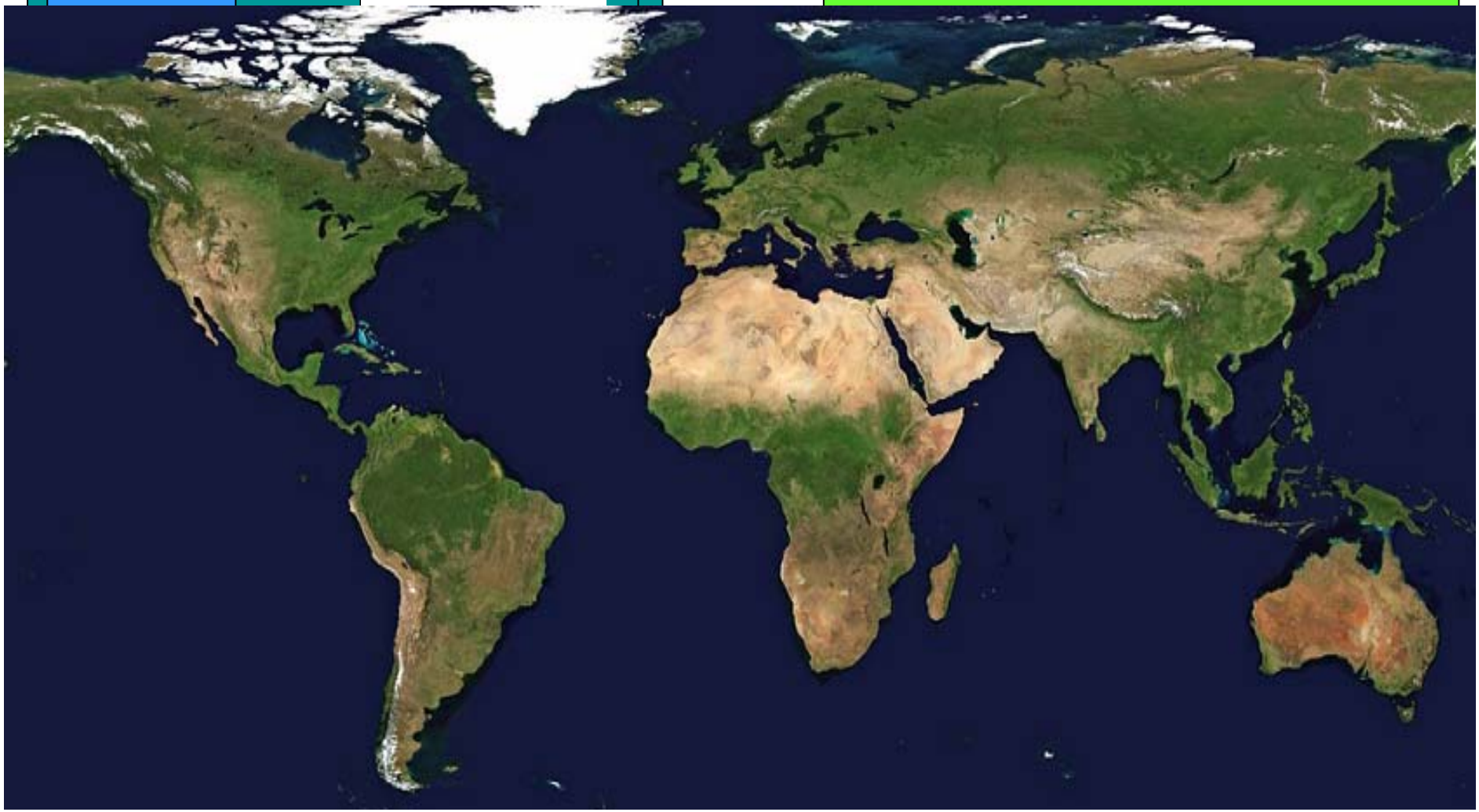
Competition for limiting resource ?

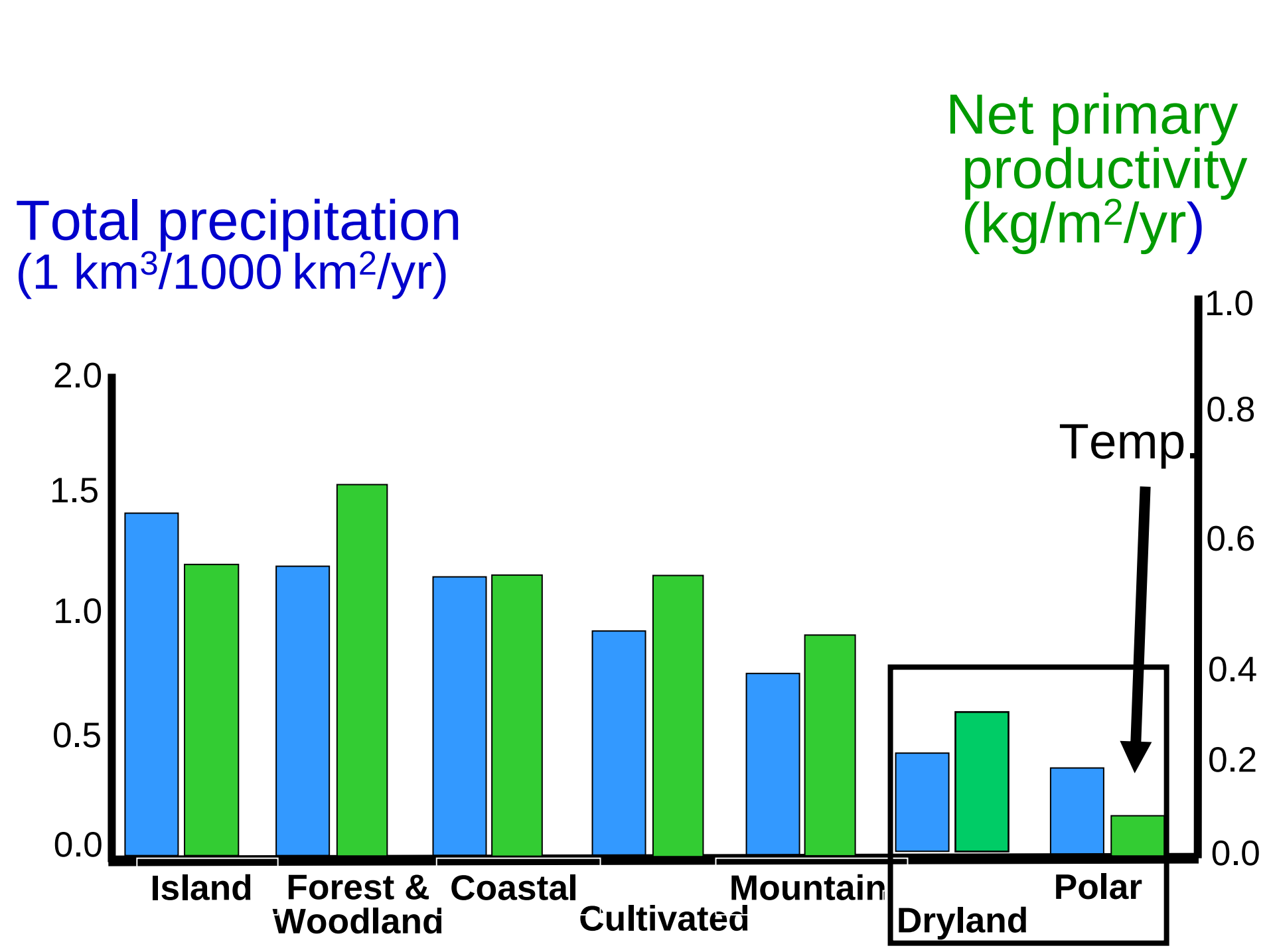
Where growth of people and organisms limited by water?

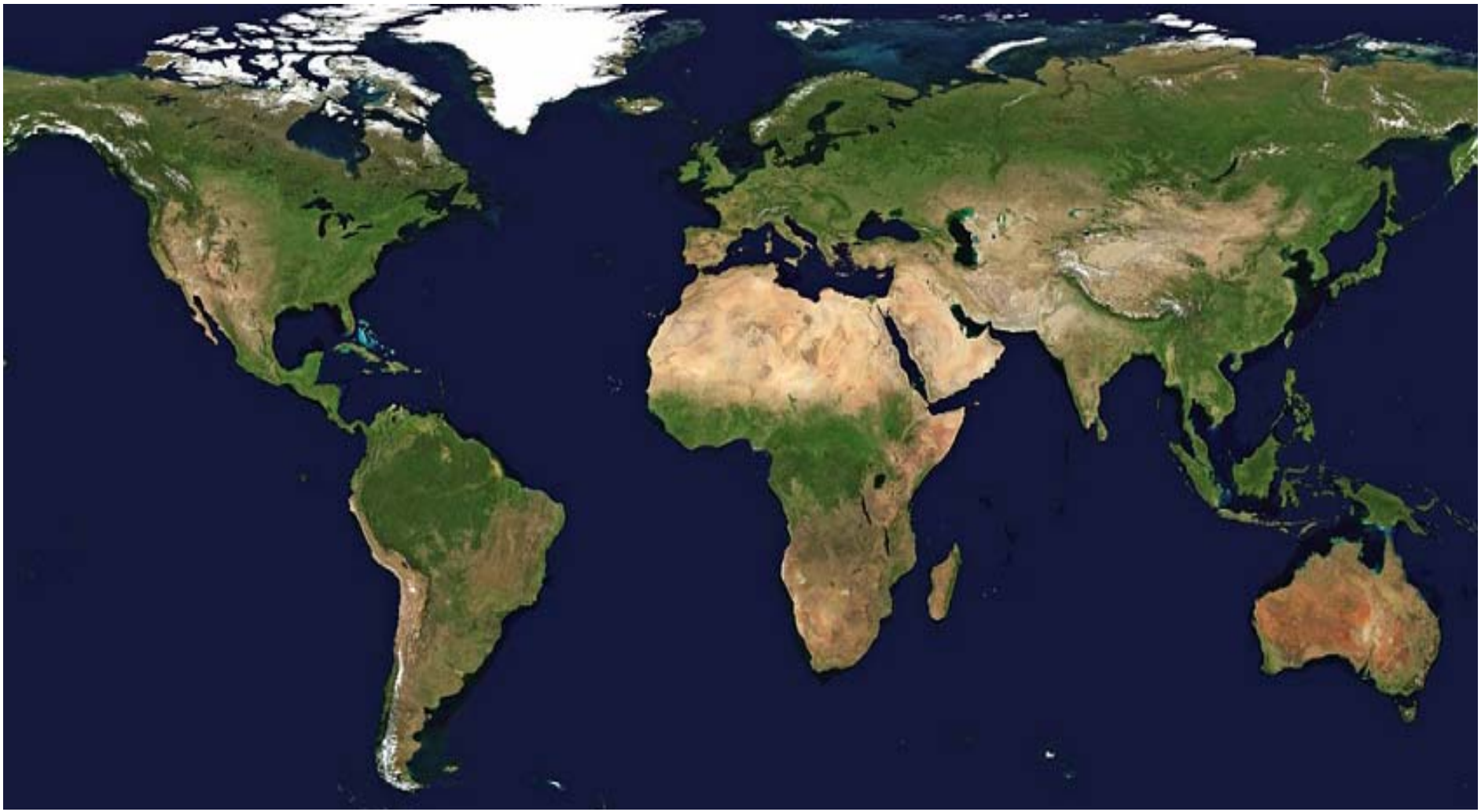
Polar

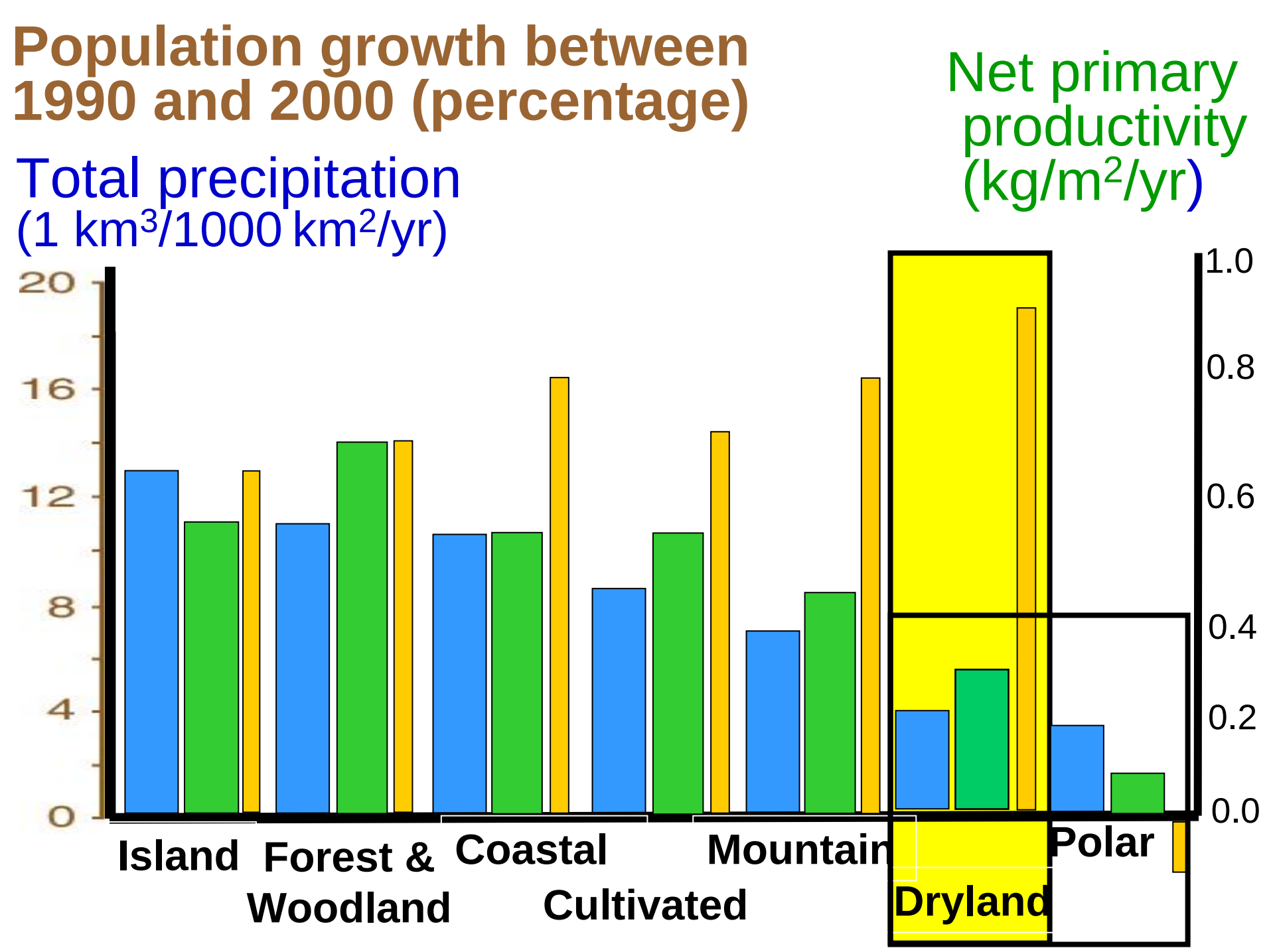
Islands

Forests & Woodlands

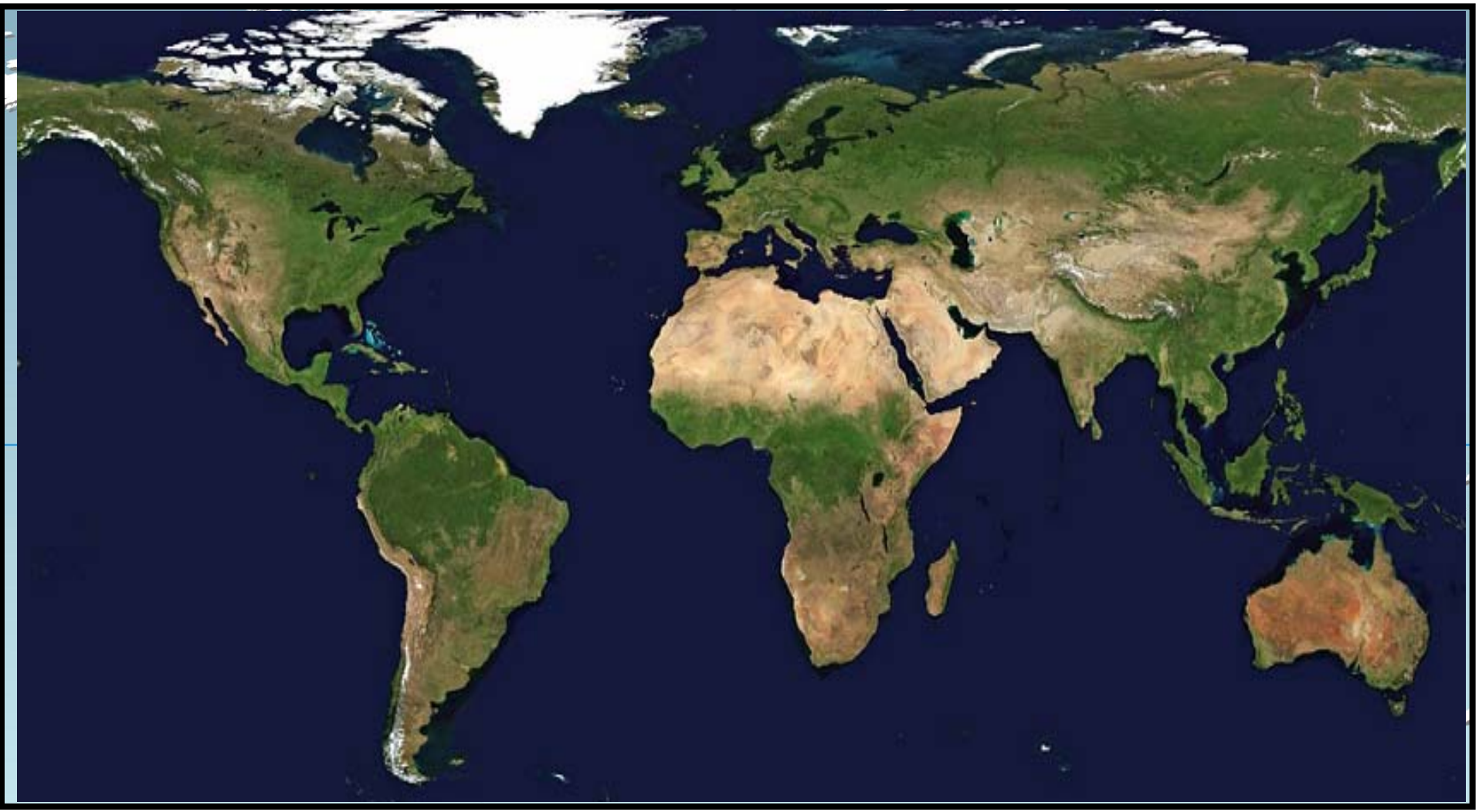



Total precipitation
(1 km3/1000 km2/yr)
Net primary productivity (kg/m2/yr)
2.0
1.5
1.0
0.5
0.0
1.0
0.8
0.6
0.4
0.2
0.0
Temp.
Island
Forest & Woodland
Coastal
Cultivated
Mountain
Dryland
Polar

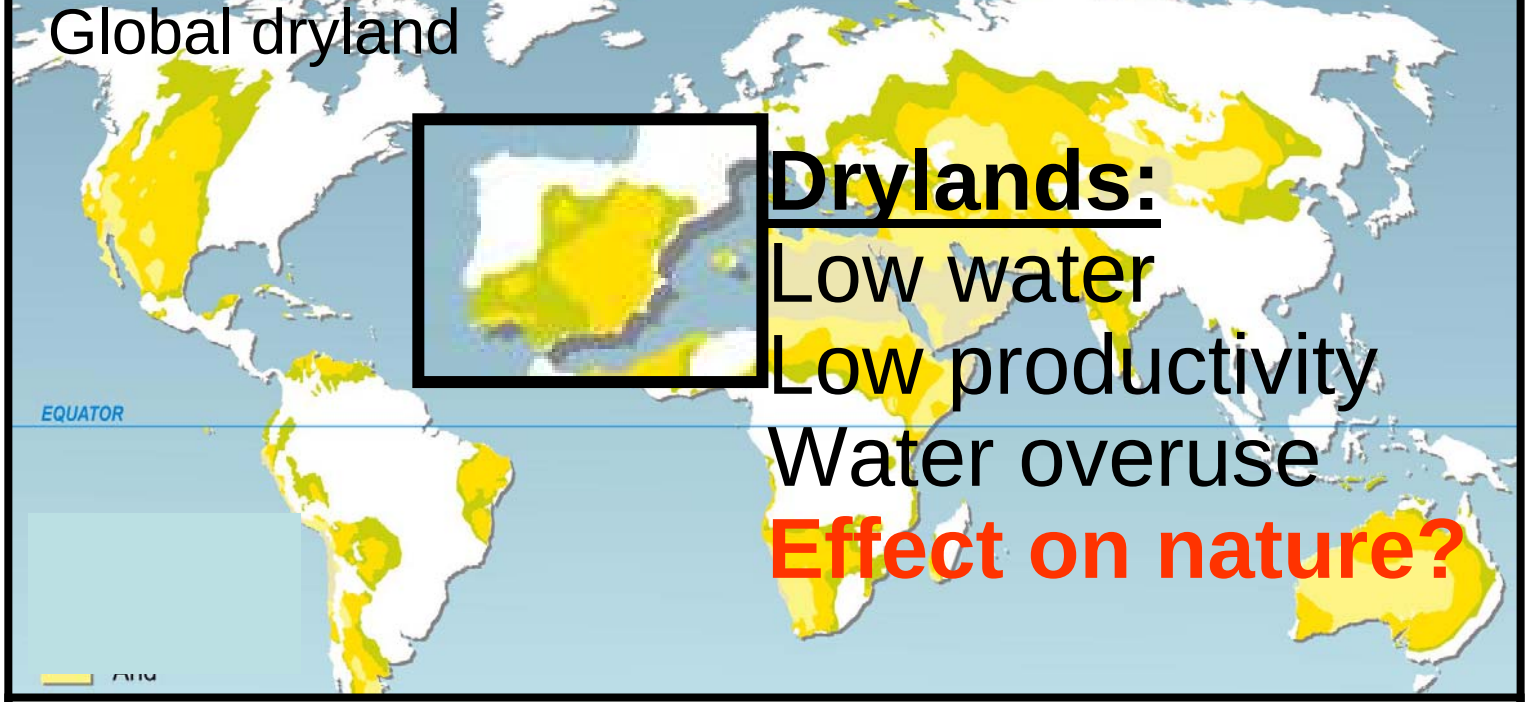



Population growth between 1990 and 2000 (percentage)
Net primary productivity (kg/m2/yr)
Total precipitation (1 km3/1000 km2/yr)
20
16
12
8
4
0
1.0
0.8
0.6
0.4
0.2
0.0
Island
Forest & Woodland
Coastal
Cultivated
Mountain
Dryland
Polar

- **Precipitation at least ~1.5 < evapotranspiration**
- **NPP limited by soil moisture**



% of global land	**41.3%**
% of global population	**35.5%**



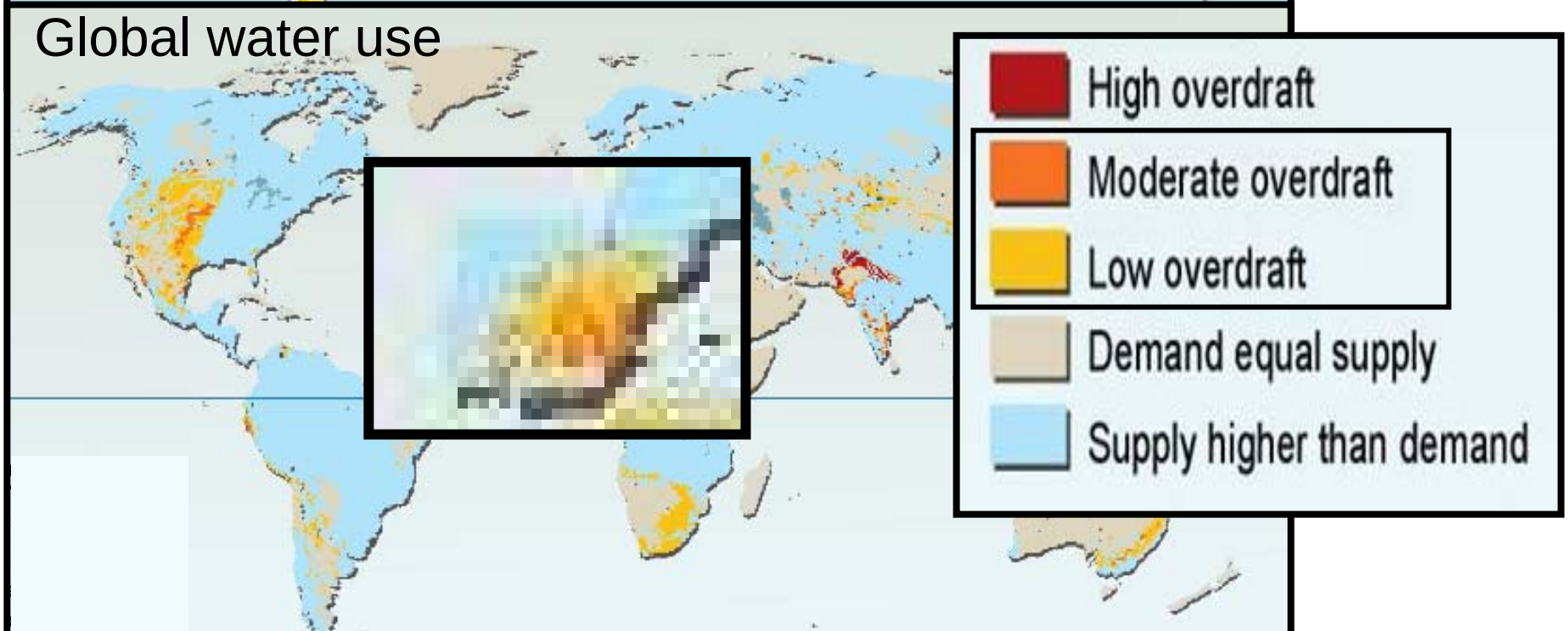
Drylands:

Low water

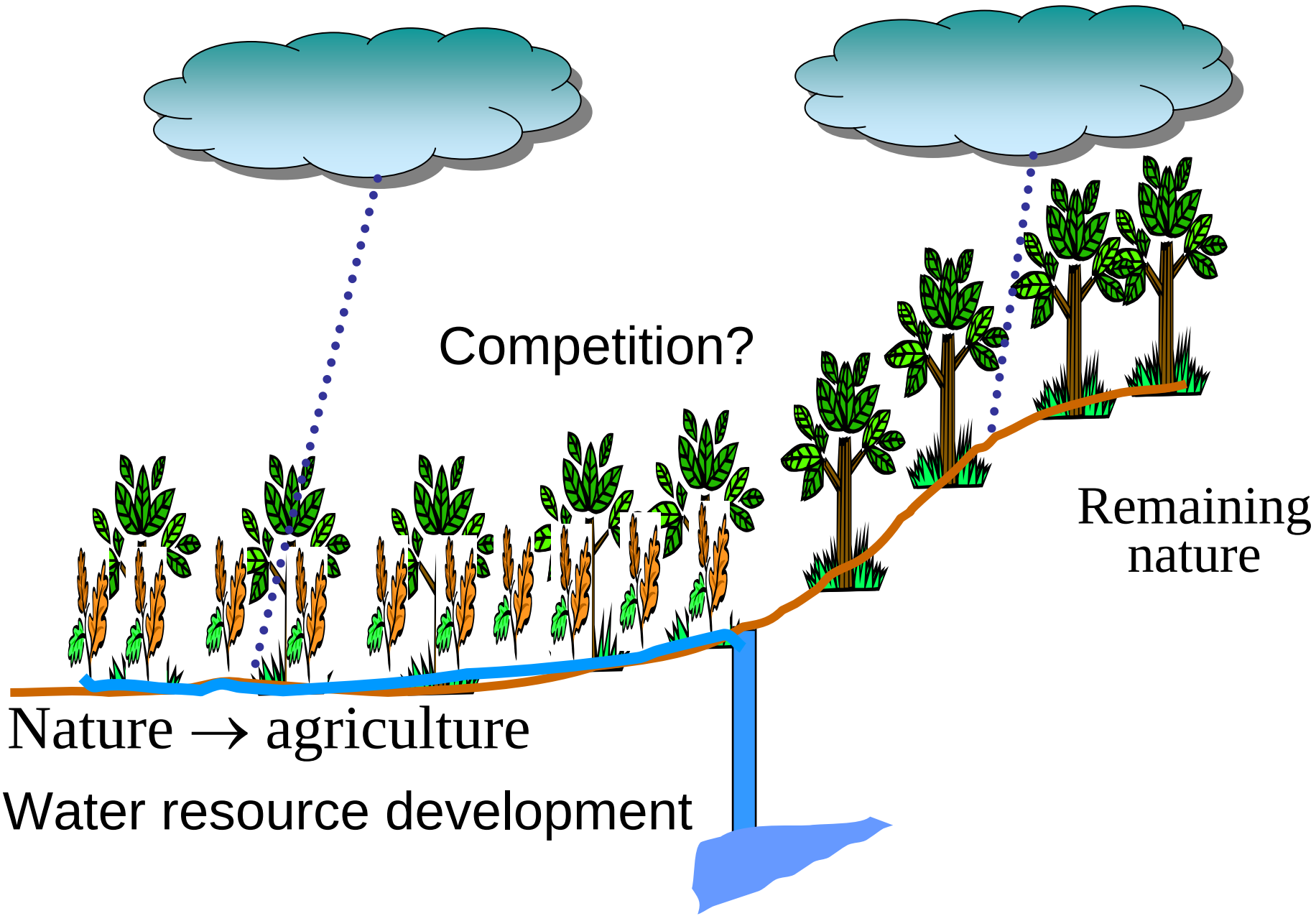
Low productivity

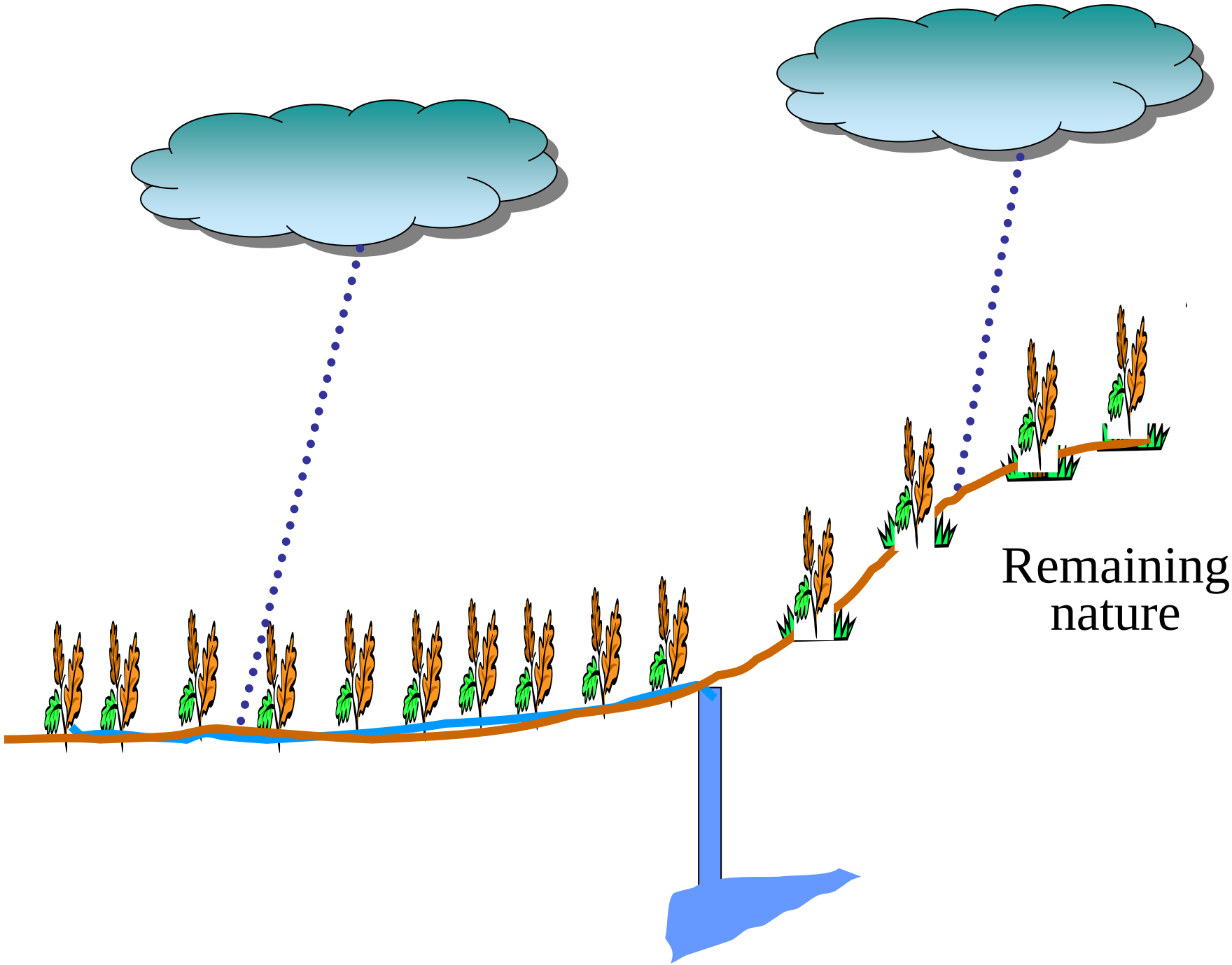
Water overuse

Effect on nature?

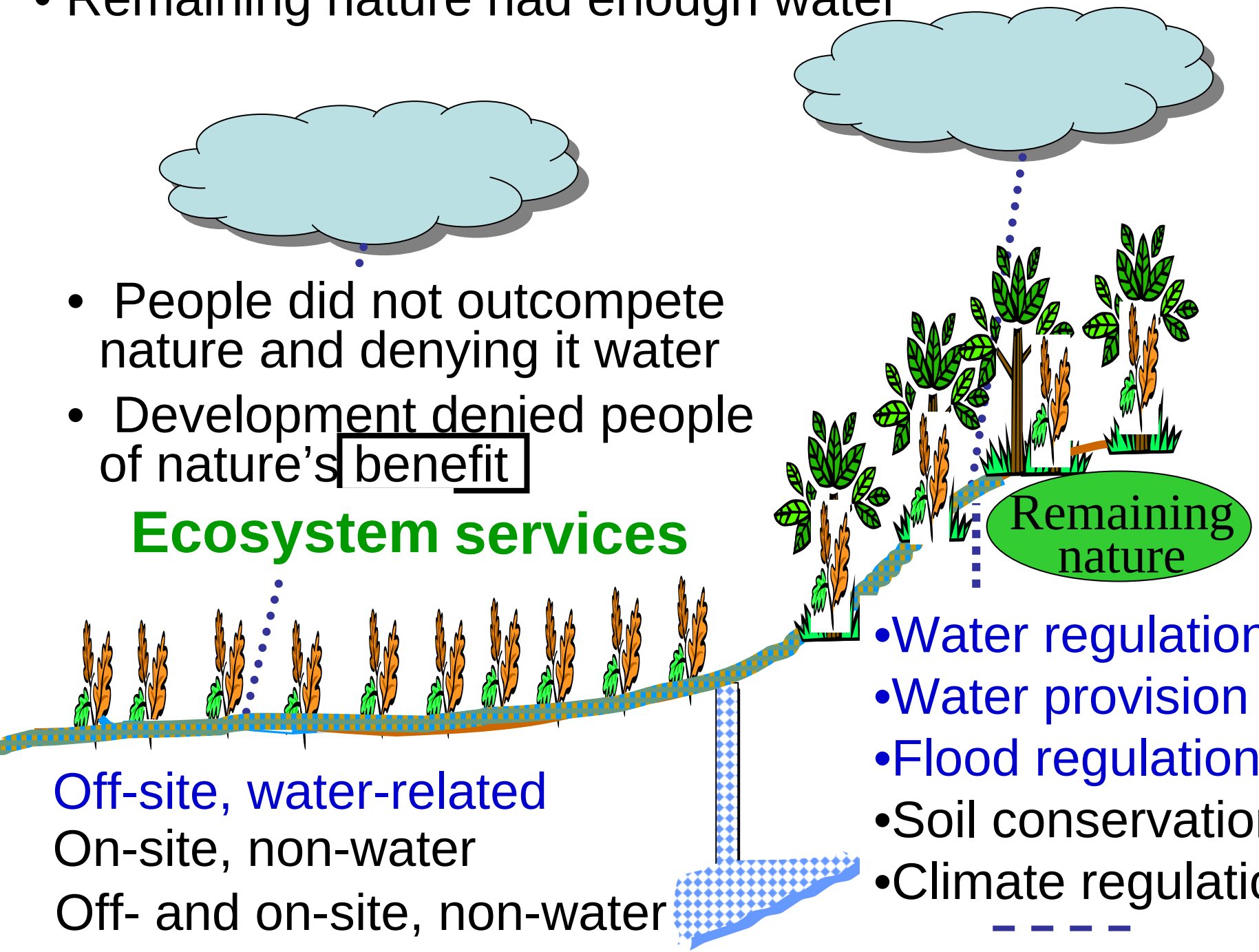


Forest ecosystem in drylands




Remaining
nature

- Remaining nature had enough water



- People did not outcompete nature and denying it water
- Development denied people of nature's benefit

Provisioning

Goods produced or provided by ecosystems

- food
- water provision
- woodfuel
- timber
- fiber
- biochemicals

Regulating

Benefits obtained from regulation of ecosystem processes

- water regulation
- climate regulation
- disease regulation
- flood regulation
- water purification

Cultural

Non-material benefits obtained from ecosystems

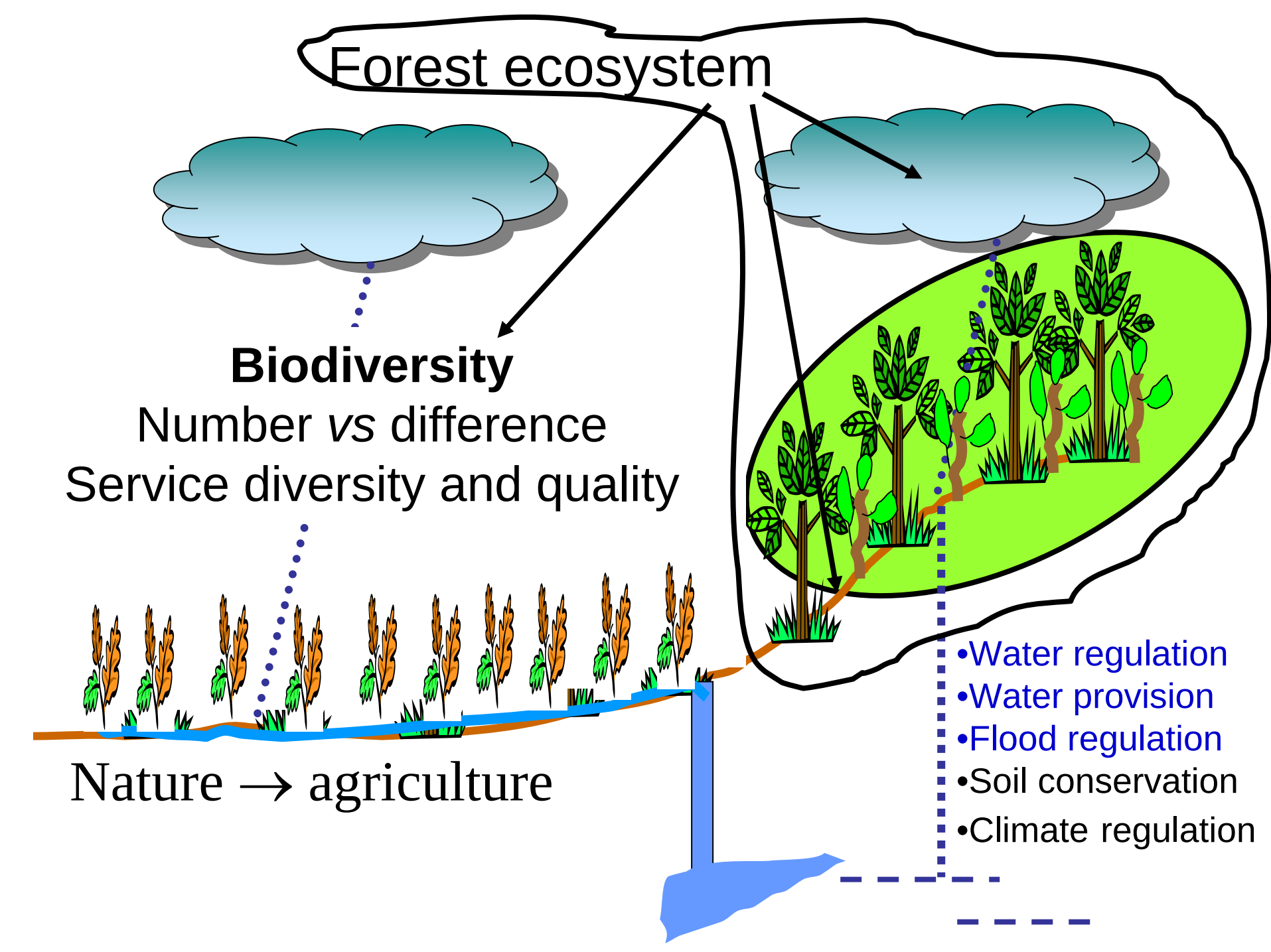
- spiritual
- inspirational
- aesthetic
- educational
- recriational

Supporting

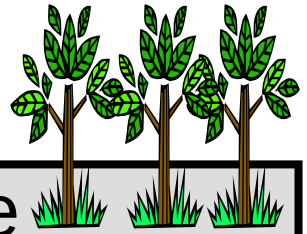
Services necessary for production of other services

(not directly used by people)

- **soil conservation**
- nutrient cycling
- primary production
- supporting biodiversity


Forest ecosystem
Biodiversity
Number vs difference
Service diversity and quality
Nature → agriculture
•Water regulation
•Water provision
•Flood regulation
•Soil conservation
•Climate regulation

Conditions required by a species for optimal service provision



- Large population size
- Presence of other species
  - Food
  - Facilitator
  - Regulator

↓

Habitat

- Conditions
  - Abiotic conditions
  - Presence of other species
- **Size**

Habitat size

- decrease
- fragmentation

↓

Population decrease

↓

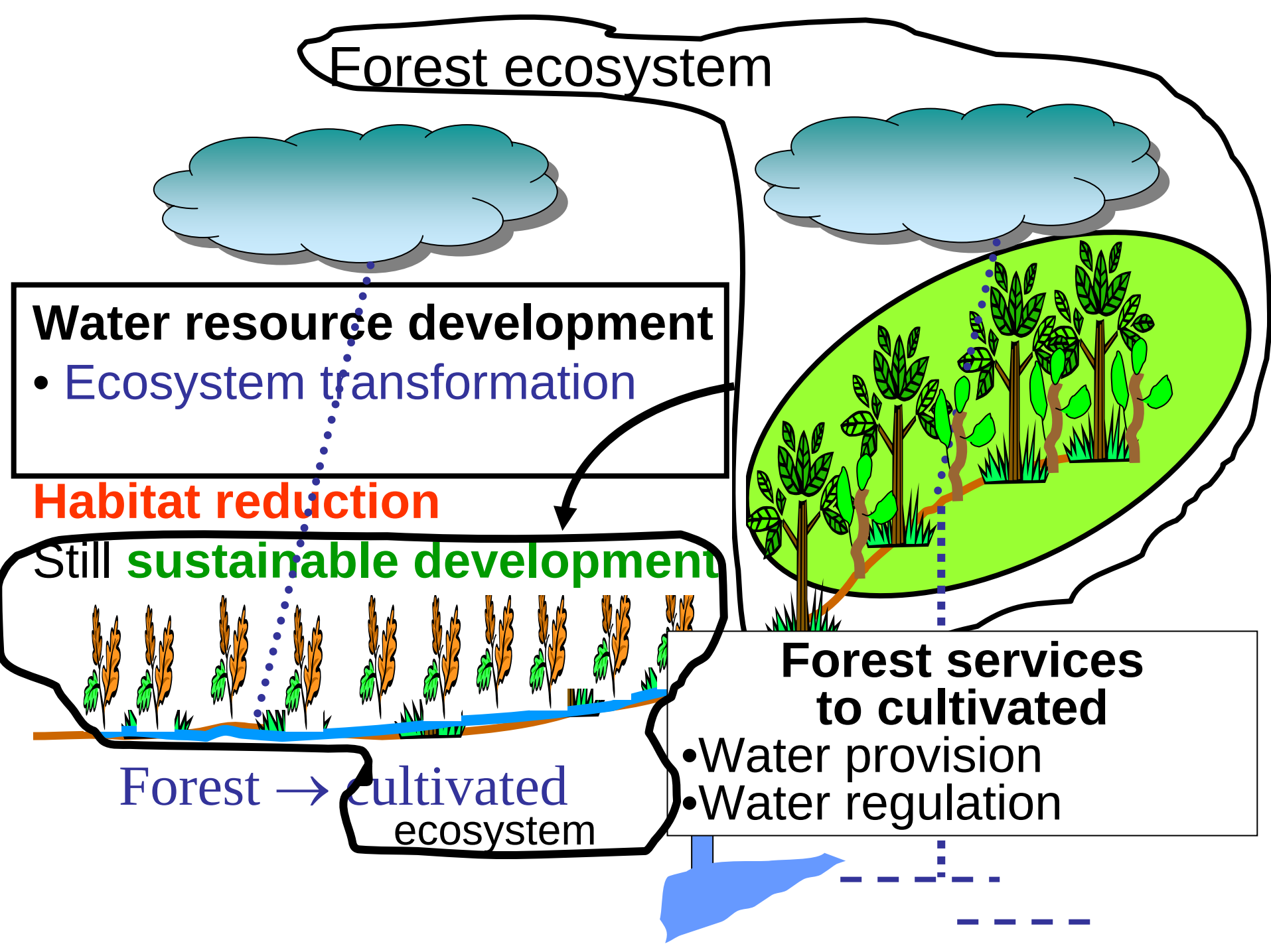
Local extinction

↓

Reduced biodiversity

↓

Service degradation


Forest ecosystem
Water resource development
• Ecosystem transformation
Habitat reduction
Still sustainable development
Forest → cultivated ecosystem
Forest services to cultivated
•Water provision
•Water regulation

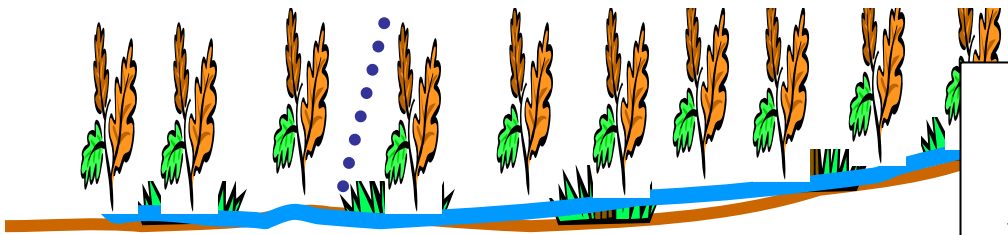
Forest ecosystem

Water resource development

- Ecosystem transformation
- Service tradeoff

Habitat reduction

Still **sustainable development**



Forest → cultivated

Forest services to cultivated

- Water provision
- Soil conservation

Natural water provision → Intensified food provision

Competition is NOT on water

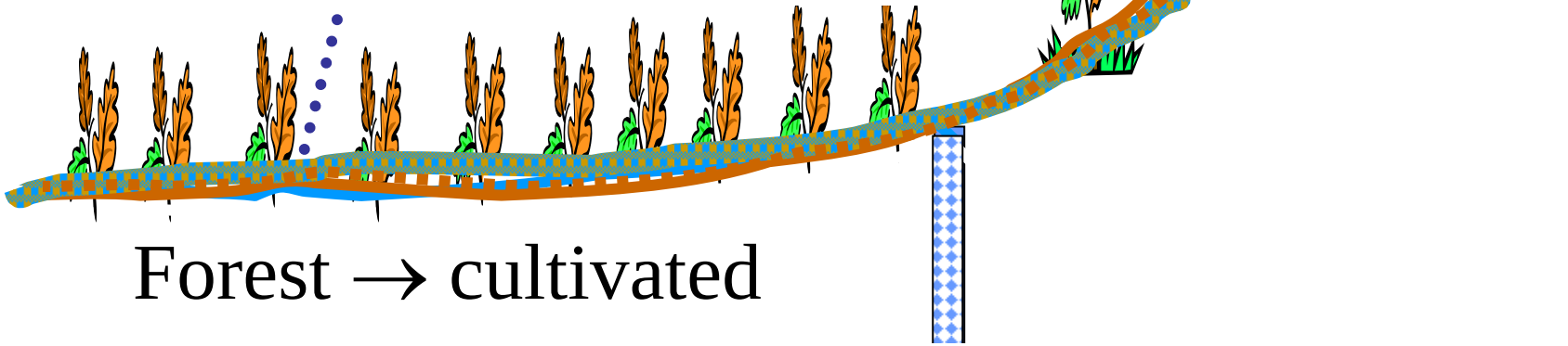
On space

Water resource development

- Ecosystem transformation
- Service tradeoff

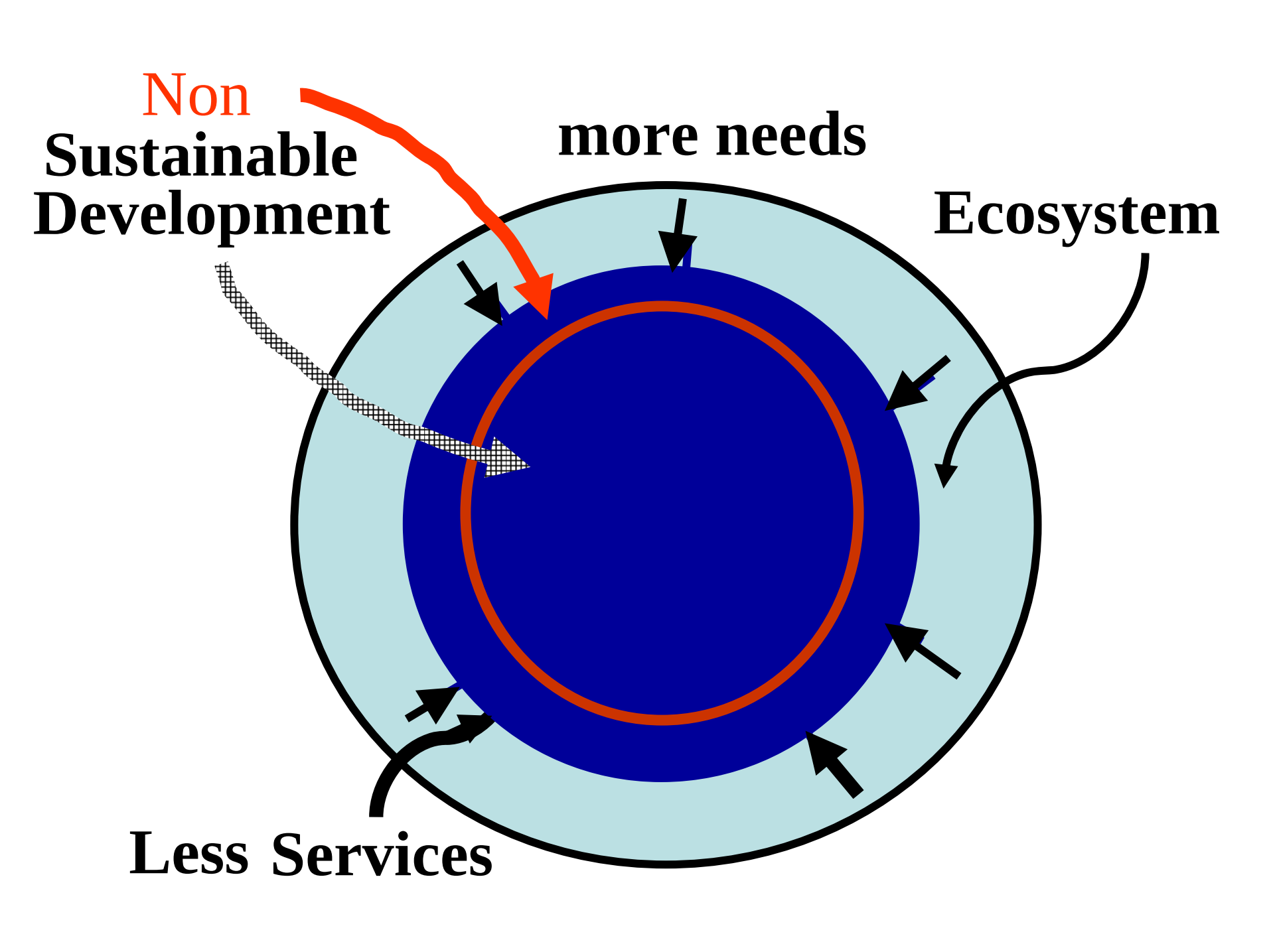
Habitat reduction- **increased**

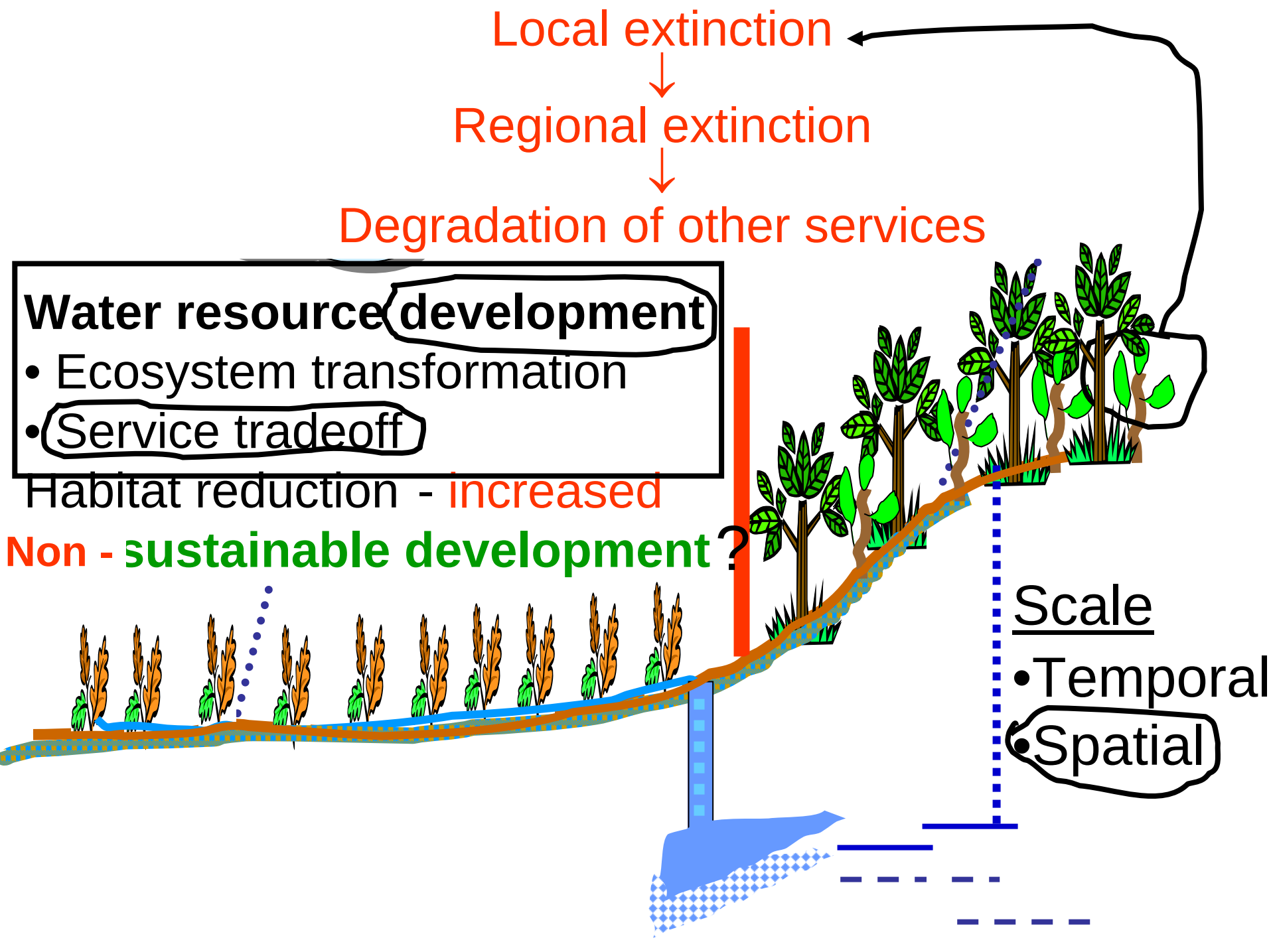
Non - sustainable development



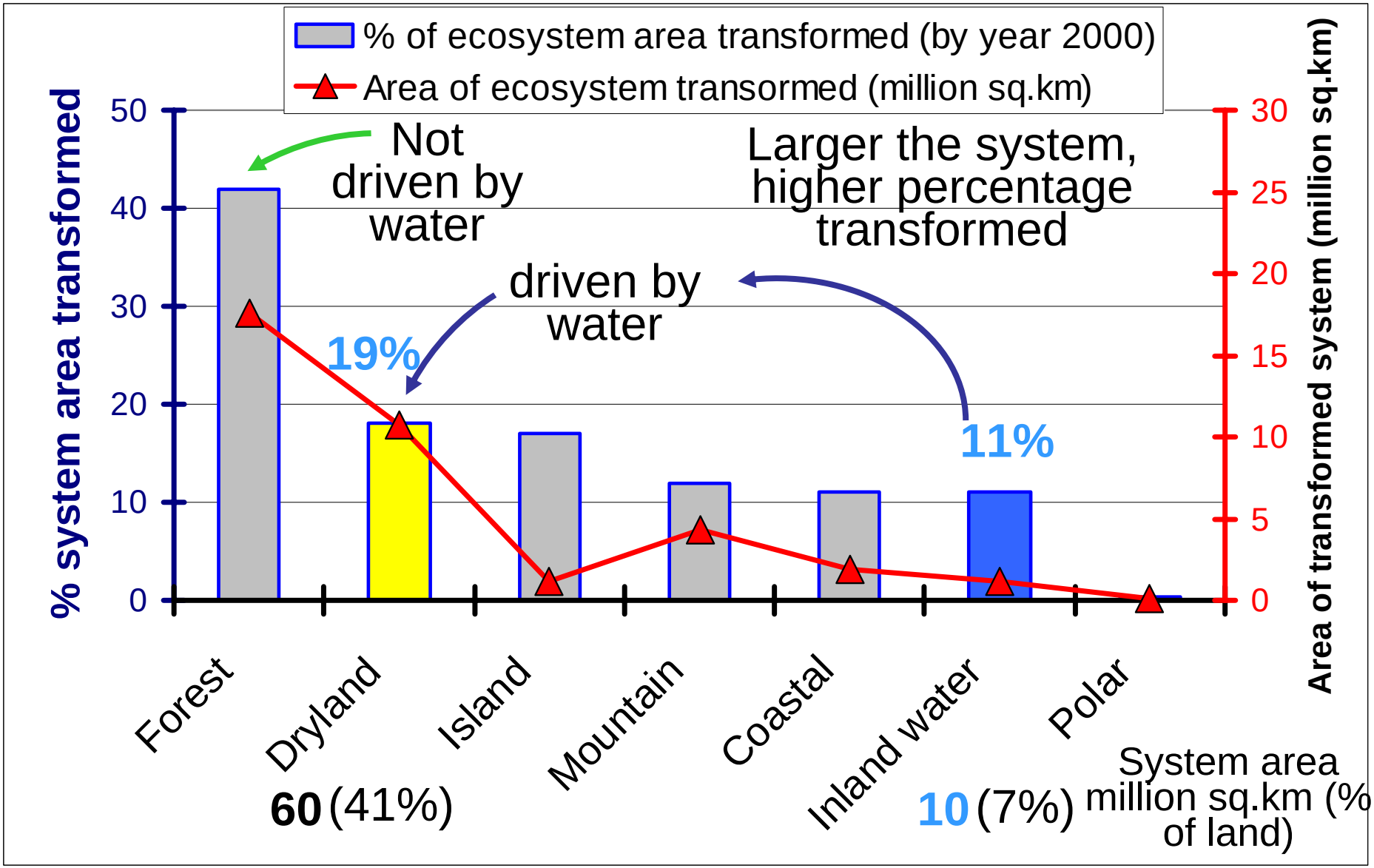
Forest → cultivated

Natural water provision → Intensified food provision


Non
Sustainable
Development
more needs
Ecosystem
Less Services

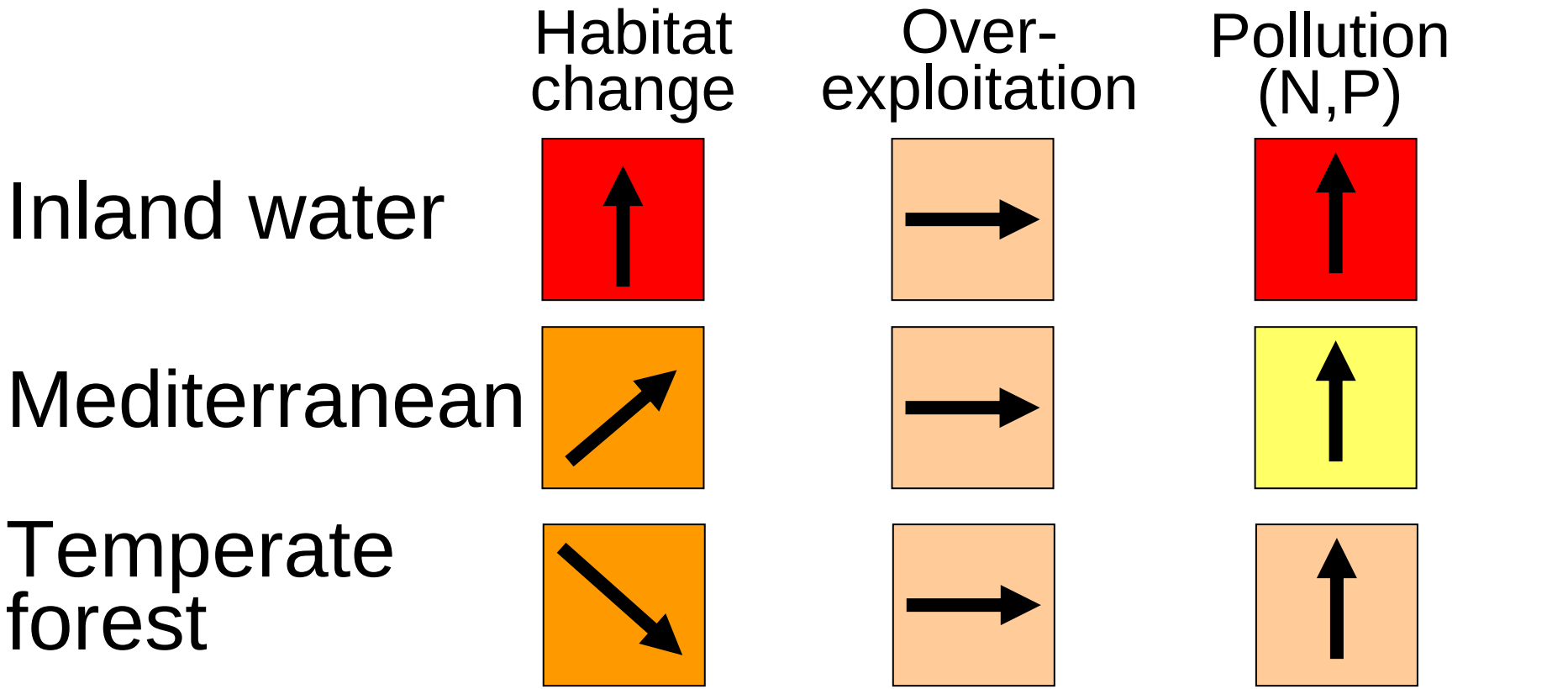

Local extinction
Regional extinction
Degradation of other services
Water resource development
• Ecosystem transformation
• Service tradeoff
Habitat reduction - increased
Non - sustainable development ?
Scale
•Temporal
•Spatial

Ecosystem transformation



37% of total land area transformed

Impacts of transformations on biodiversity



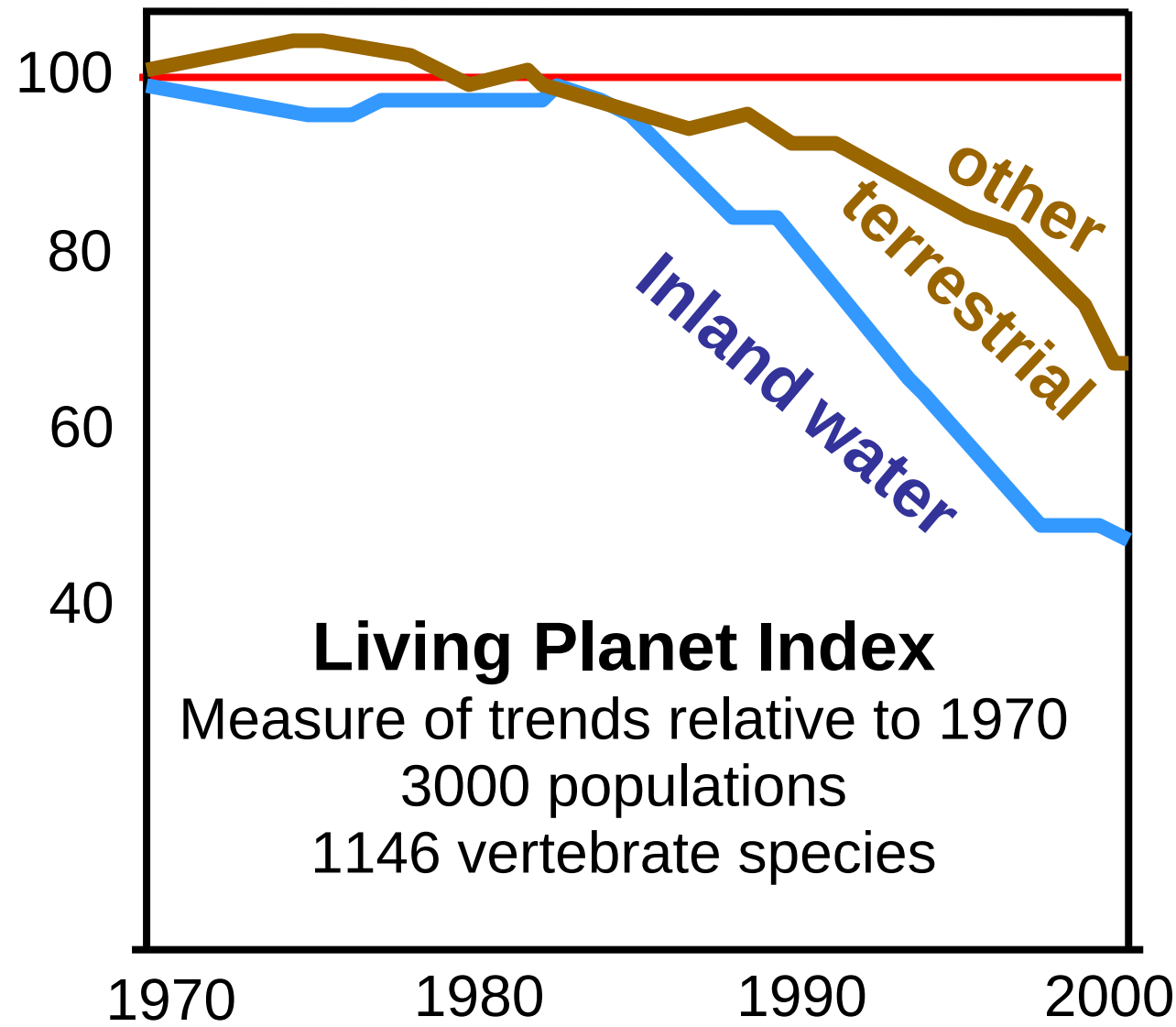
Impact strength

Very high | High | Moderate | Low

Impact trend (last 50-100 yrs)

Fast increase | Increase | Continuing | Decreasing

Biodiversity response to impact



Israel

45% of extinct plant species are aquatic

40 invertebrate species locally extinct

1 (out of 7) amphibians globally extinct

1 fish species locally extinct

10 breeding birds locally extinct as breeders

Allocation of water to Israeli inland water ecosystems

(as % of annual renewable water, 9.4 $km^3/1000km^2/yr$)

Current allocation		Required flow	Loss to other uses
Best rainy year	Worse rainy year		
0.2%	2%	9%	2%

Efforts to restore freshwater biodiversity

do not address damage to terrestrial ecosystems

caused by damage to freshwater ones

Services' tradeoffs

Provisioning services

- Crops, livestock
- Capture fisheries
- Wild food
- **Timber**
- Woodfuel
- Biochemicals

Regulating services

- Global climate regulation
- Local climate regulation
- **Water regulation**
- Water purification
- Flood regulation
- **Disease regulation**
- Pollination

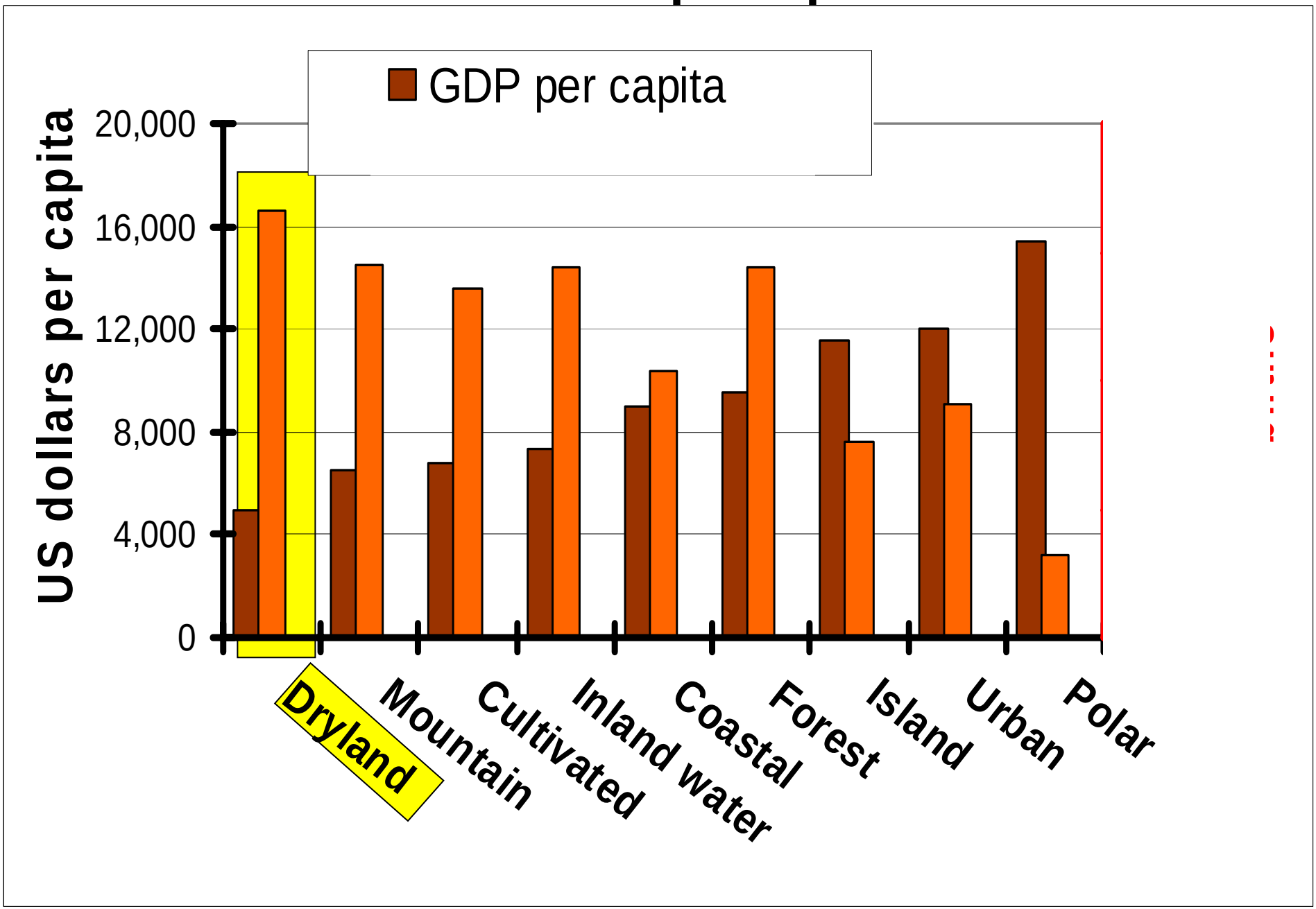
Cultural services

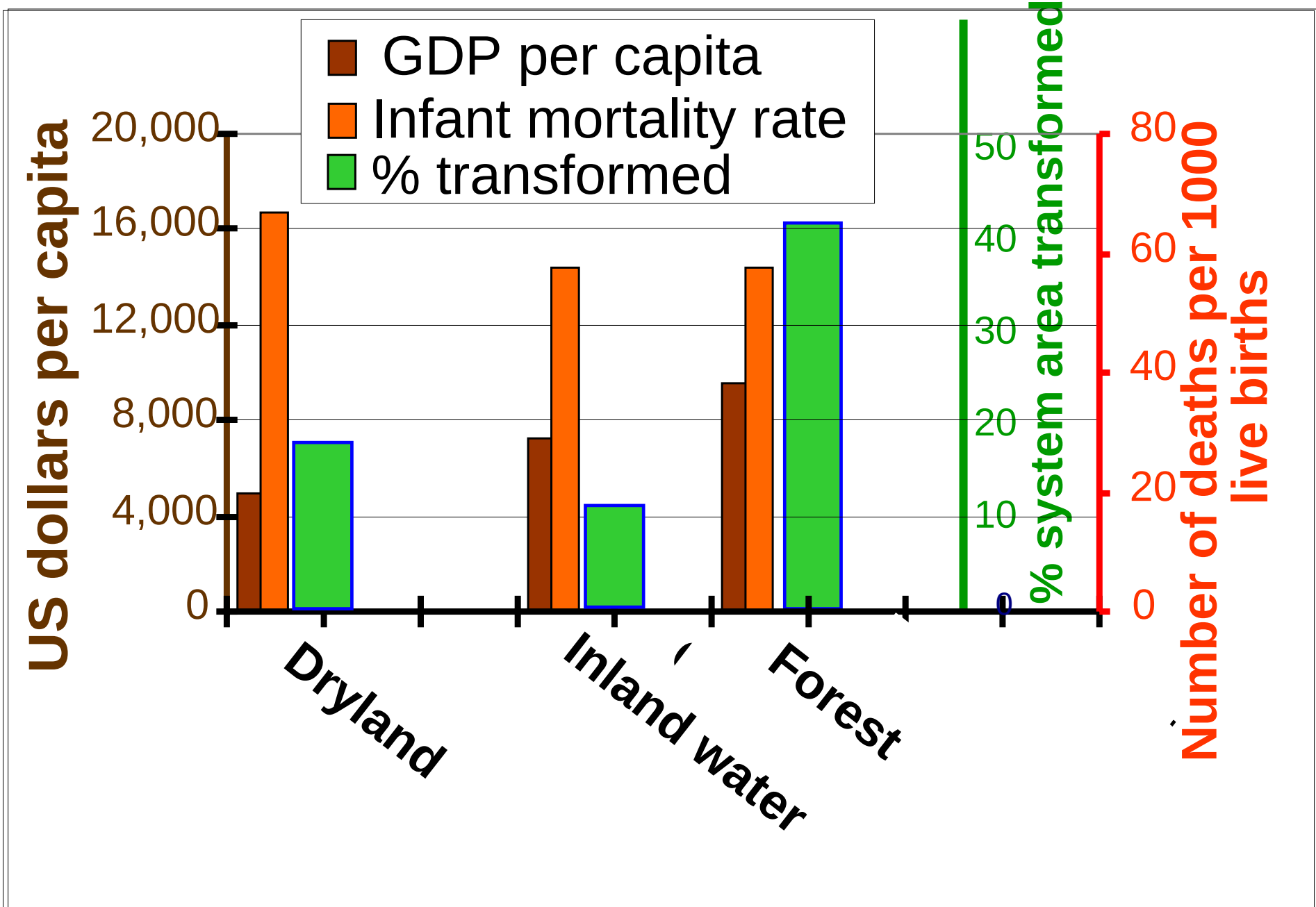
- Spiritual & religious
- Aesthetic
- Recreation

Supporting services

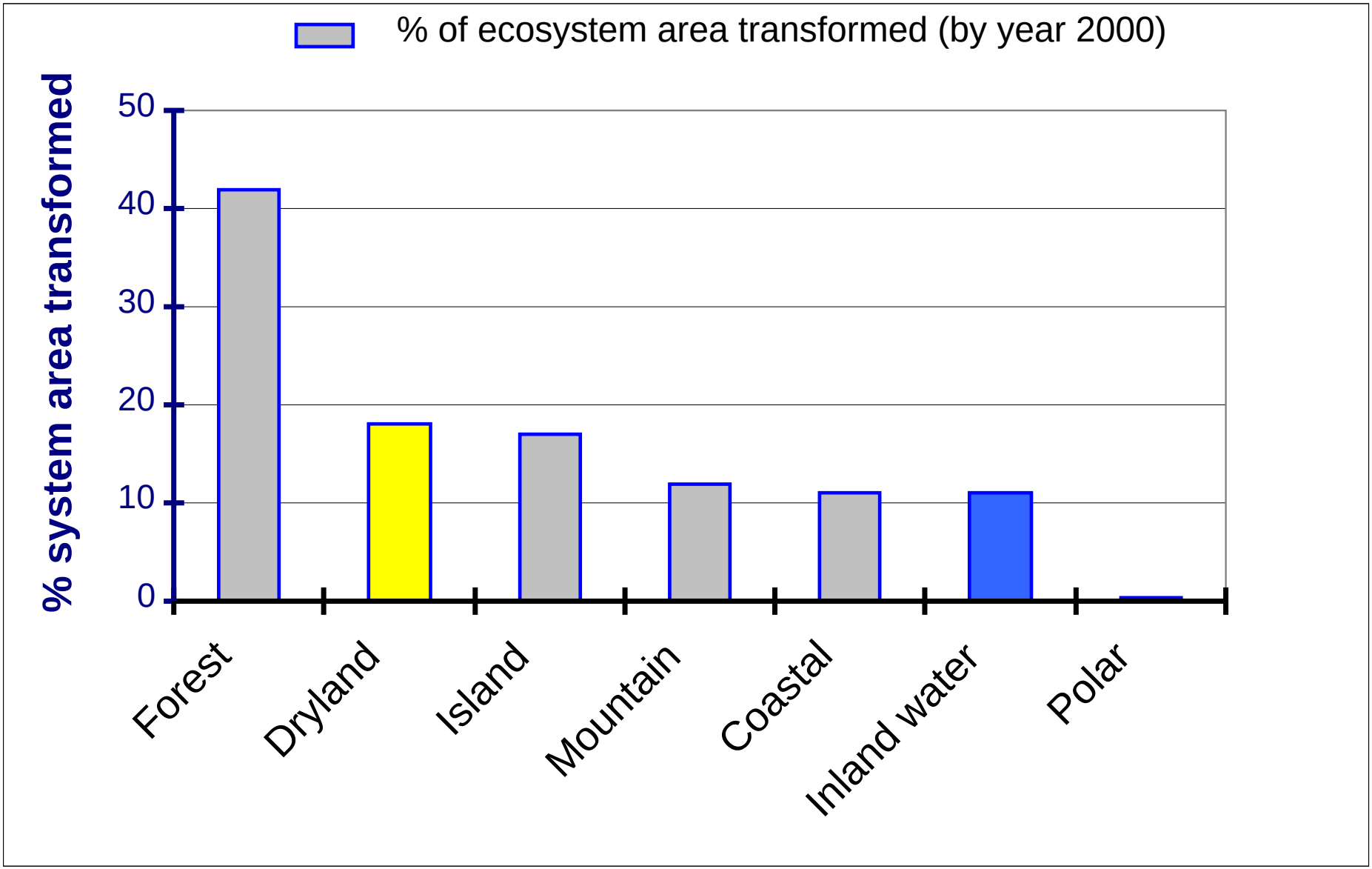
- Soil conservation
- Supporting biodiversity

Effect on people

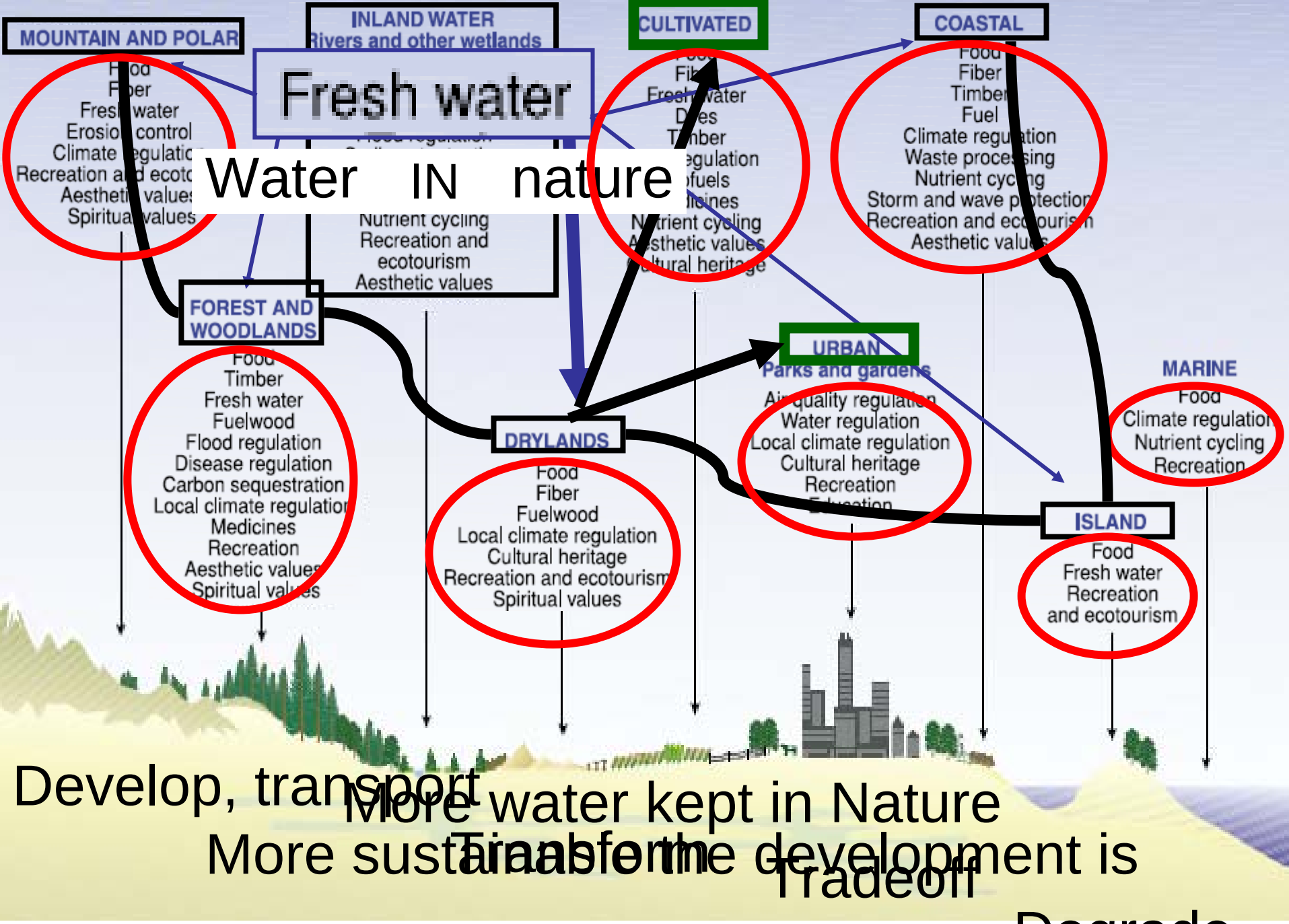



GDP per capita
Infant mortality rate
% transformed
US dollars per capita
20,000
16,000
12,000
8,000
4,000
0
% system area transformed
50
40
30
20
10
0
Number of deaths per 1000 live births
80
60
40
20
0
Dryland
Inland water
Forest

Ecosystem transformation




Low water
↓
More water resource development
↓
Greater damage to freshwater
and non-aquatic ecosystems
& their biodiversity
↓
Degradation of services
↓
Reduced human well-being
Balancing Water
for
People and Nature?



Develop, transport

More water kept in Nature

More sustainable

Transform

The development is

Tradeoff

Degrade