

# Administrative Staff Teaching Module

## Unit 2. Ecological Footprint within everyday life



# EUSTEPs

Enhancing Universities' Sustainability Teaching  
and Practices through Ecological Footprint

KA 203, Strategic Partnership in Higher Education 2019-2022, Agreement No. 2019-1-  
EL01-KA203-062941

Co-funded by the  
Erasmus+ Programme  
of the European Union



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Advancing the Science of Sustainability



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## Unit 2. Ecological Footprint within everyday life

Basics of the Ecological Footprint, trends and results around the world, and related indicators

a- slides

b – Classroom Exercise

**Rendering society-environment relations researchable - What can we measure, and what are the risks?**

**But ..... why should we measure?**



# Introducing Footprint Indicators

- Since the turn of the 21<sup>st</sup> century, the term “footprint” has become very popular and entered in our daily vocabulary as a metaphor for the impact humans place on the Environment.
- Such metaphoric meaning of the term dates back to the early 1990s and has its origins in the birth of a specific methodology called “Ecological Footprint.”

The New York Times Magazine

WATCH IT

Magazine | ON LANGUAGE

## Footprint

By WILLIAM SAFIRE FEB. 17, 2008

“**The word *footprint*** has taken on meaning,” writes Michel Berger of Oakland, Calif., responding to a recent query in this space, “beyond that of simple circumstantial evidence that someone has walked by, as in Daniel Defoe’s 1719 novel ‘Robinson Crusoe.’ Where are those footprints headed?”



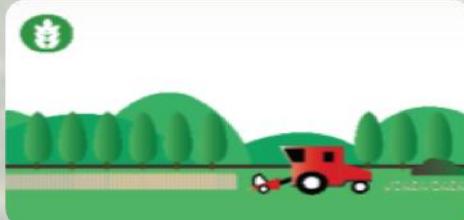
Ps  
ity TEaching  
Footprint



Built-up areas  
infrastructures



Carbon  
sequestration



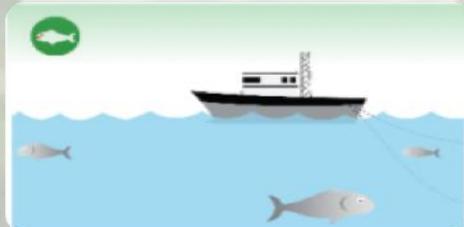
Cropland



Grazing land



Forest land



Fishing grounds

# THE STORY OF TODAY



# DAILY ECOLOGICAL FOOTPRINT

# Why EF...?

daily

MY INDIVIDUAL  
ECOLOGICAL  
FOOTPRINT



EF = 125 m<sup>2</sup>



EF = 4.5 hectares

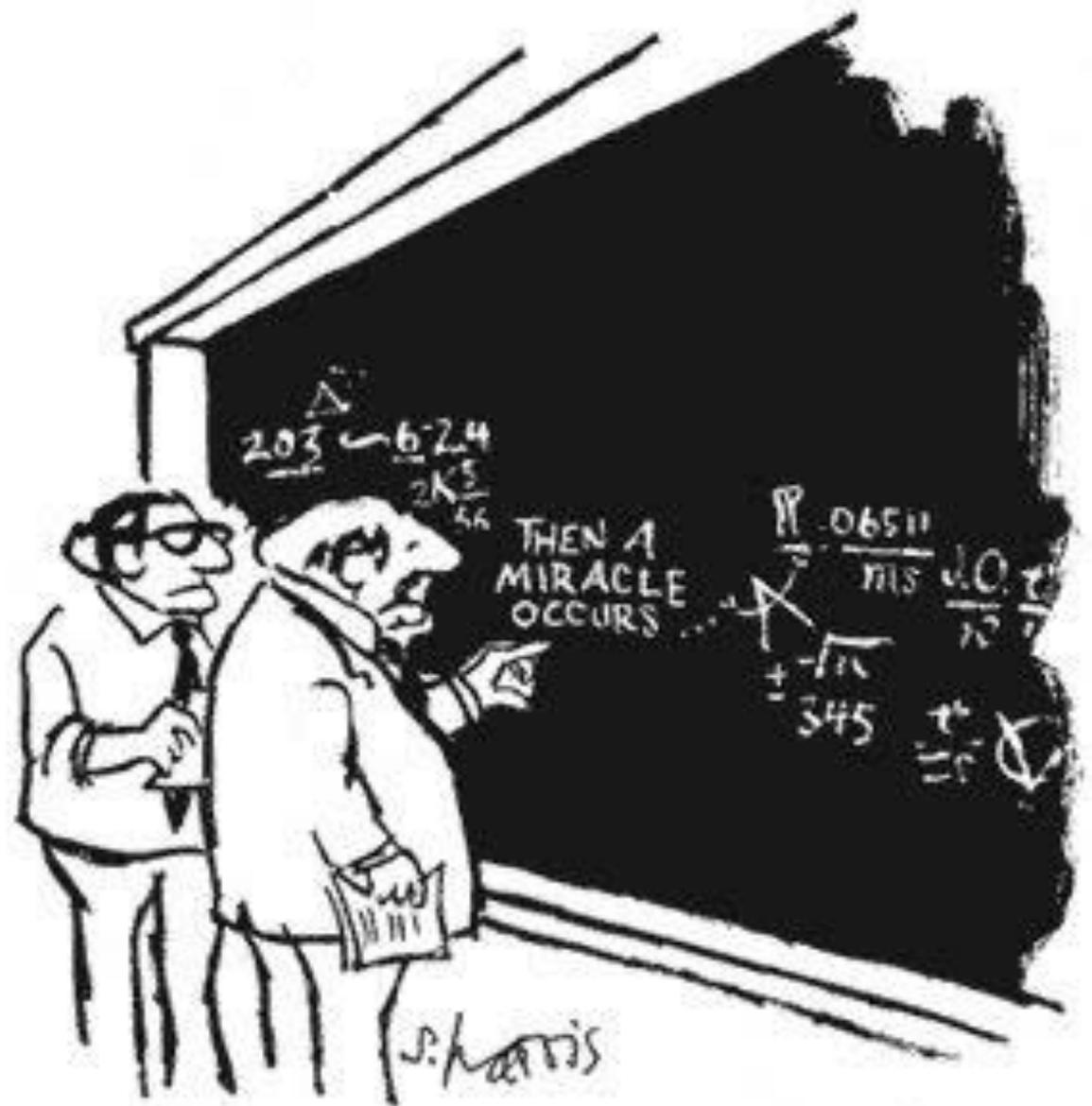


**BUT.....I AM NOT ALONE ON THIS PLANET...**



**I AM SHARING IT WITH ABOUT OTHER 7.8 BILLION PEOPLE!!!**

# What is the Ecological Footprint?



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

# ECOLOGICAL FOOTPRINT: An Ecological Balance Sheet For Countries

The Ecological Footprint is an environmental accounting tool that identifies the extent to which human activities exceed **two types of environmental limits:**

- resource production
- waste absorption



# THE ECOLOGICAL FOOTPRINT

The Ecological Footprint measures the amount of biologically productive land and water (fishing grounds) area required to:

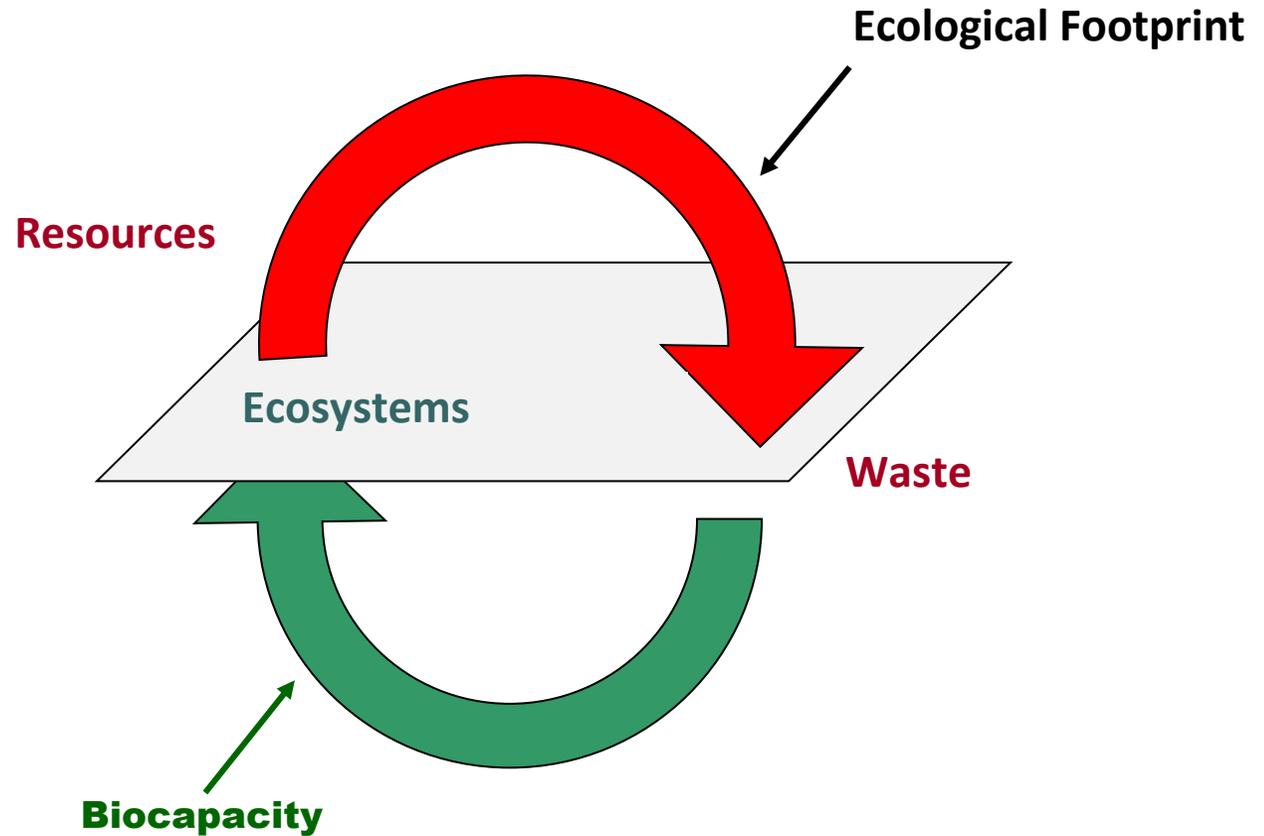
- produce all the resources an individual, population or activity consumed
- to absorb the wastes they generated, given prevailing technology and resources management practices.

The final Ecological Footprint of an individual or a country is the sum of all these different types of land, irrespective of where they are located.



Societies use resources (food, energy, etc.) and produce wastes.

## ECOLOGICAL FOOTPRINT: An Ecological Balance Sheet For Countries



Nature turns wastes back into resources

# BIOCAPACITY

- Measures the amount of biologically productive land and sea area available to provide the ecosystem services that humanity consumes.
- The biocapacity represents the natural capital that provides the basic life-support services, expressed as the available regenerative capacity of the biosphere.
- The biocapacity represents the ability of the biosphere to produce crops, timber, livestock as well as to absorb carbon dioxide.
- The total biocapacity of a Nation (or planet) is calculated as the sum of the biocapacity supplied by each land type.
- It depends on natural conditions but also on dominant agriculture and forestry practices.



## ECOLOGICAL FOOTPRINT: ASSESSING COUNTRIES' ECOLOGICAL BALANCE

### **Biocapacity:**

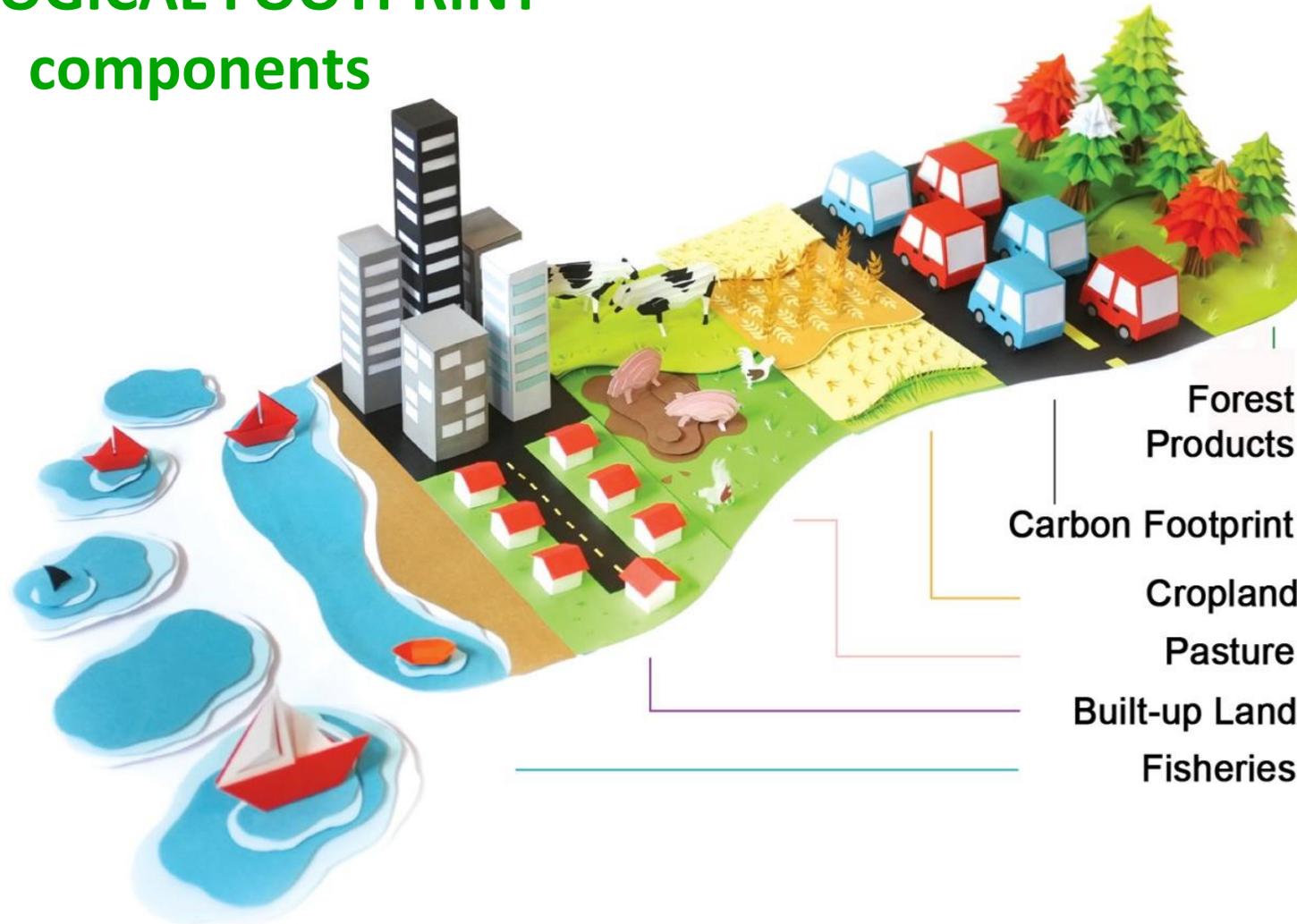
How much bioproductive area is **available to us?**



### **Ecological Footprint:**

How much bioproductive area do we **demand?**

# ECOLOGICAL FOOTPRINT components



Forest  
Products  
Carbon Footprint  
Cropland  
Pasture  
Built-up Land  
Fisheries

**CARBON**  
CO<sub>2</sub> emissions associated with use of fossil fuels, electricity and energy intensive commodities, converted into biologically productive areas (such as forest land) necessary for their sequestration.

**GRAZING LAND**  
The area of grasslands used to raise livestock for meat, dairy, hide and wool products. It includes all grasslands used to provide feed for animals, including cultivated pastures, wild grasslands and prairies.

**FOREST**  
The area of forests required to support the annual harvest of fuel wood, pulp and timber products.

**FISHING GROUNDS**  
The area of marine and inland waters required to support annual catches of aquatic species (fish and seafood).

**CROPLAND**  
The area required to grow all crop products required for human consumption (food and fiber) and for livestock feeds, fish meals, oil crops and rubber.

**BUILT-UP LAND**  
The area of land covered by human infrastructure such as transportation, housing, industrial structures and reservoirs for hydroelectric power generation.

The Ecological Footprint is a flows indicator, though it is measured in terms of the bioproductive land areas needed to generate such flows (expressed in the unit of global hectares - gha).

$$EF = \frac{P}{Y_N} \cdot YF \cdot EQF$$

Input variable: flow of resource used by humans

From FLOW to AREA :

- $Y_N$  is used to convert the consumption of a resource flow into the correspondent amount of area locally required to produce that flow
- $YF$  is used to scale national to world average productivity for a given land use type
- $EQF$  is used to scale world average productivity for a given land type to gha.

$$BC = A \cdot YF \cdot EQF$$



**Biocapacity**



**Ecological Footprint**

## Unit: hectare-equivalent or Global hectare

The Ecological Footprint is an indicator of human appropriation of Earth's photosynthetic capacity, although expressed in hectare-equivalents.

The release of 1 t of CO<sub>2eq</sub> does not mean that this amount has actually been released (no molecule called CO<sub>2eq</sub>). Rather, it means that various GHGs with the equivalent global warming potential of 1 t of CO<sub>2</sub> have been released.

Similarly, having a per capita Ecological Footprint of 1 gha doesn't mean that 1 ha of physical land are used. It rather means that the capacity of 1 hectare-equivalents (or gha) is needed to produce (via photosynthesis) the renewable resource provisioning services consumed and to sequester the carbon dioxide emitted

# Unit: hectare-equivalent or Global hectare

For example, if this hectare is twice as productive as a world average, biologically productive hectare. Then it is worth 2 gha.



2 gha

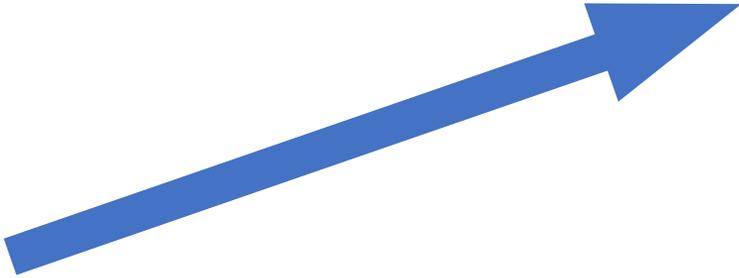
For example, if this hectare is half as productive as a world average, biologically productive hectare. Then it is worth  $\frac{1}{2}$  a gha.



$\frac{1}{2}$  gha

# ECOLOGICAL FOOTPRINT: SCALE OF APPLICATION

Various methodological approaches  
but same rationale



Cities



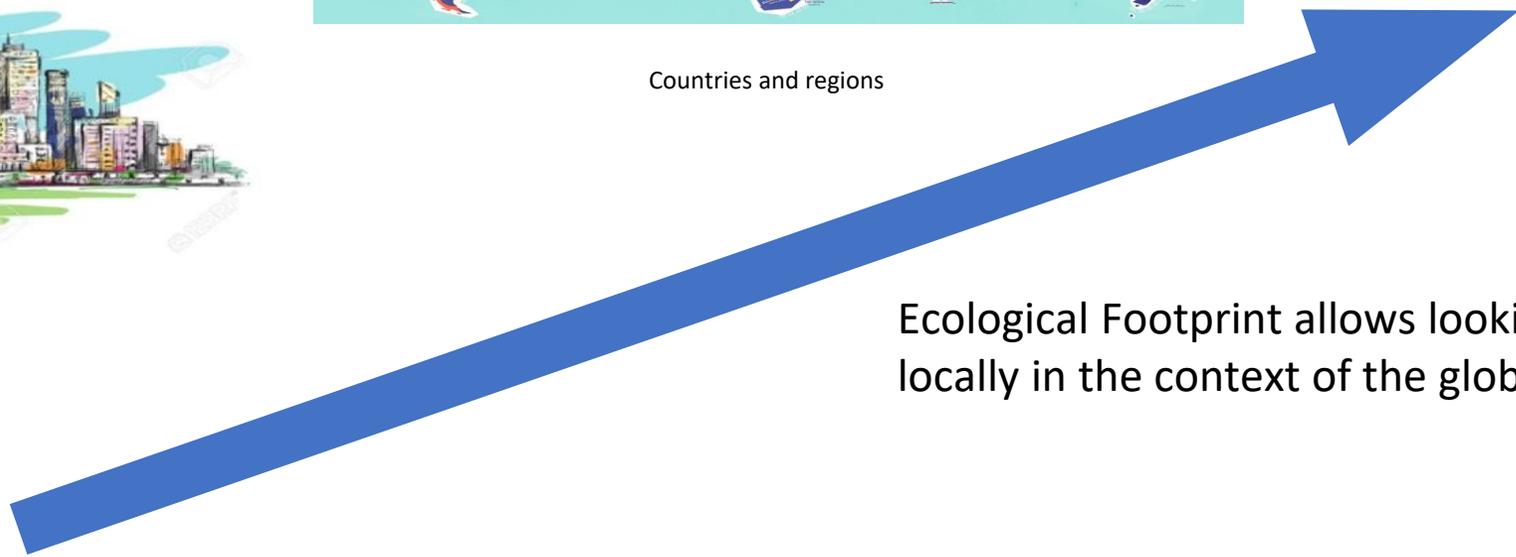
Individuals



Countries and regions



World | Humanity

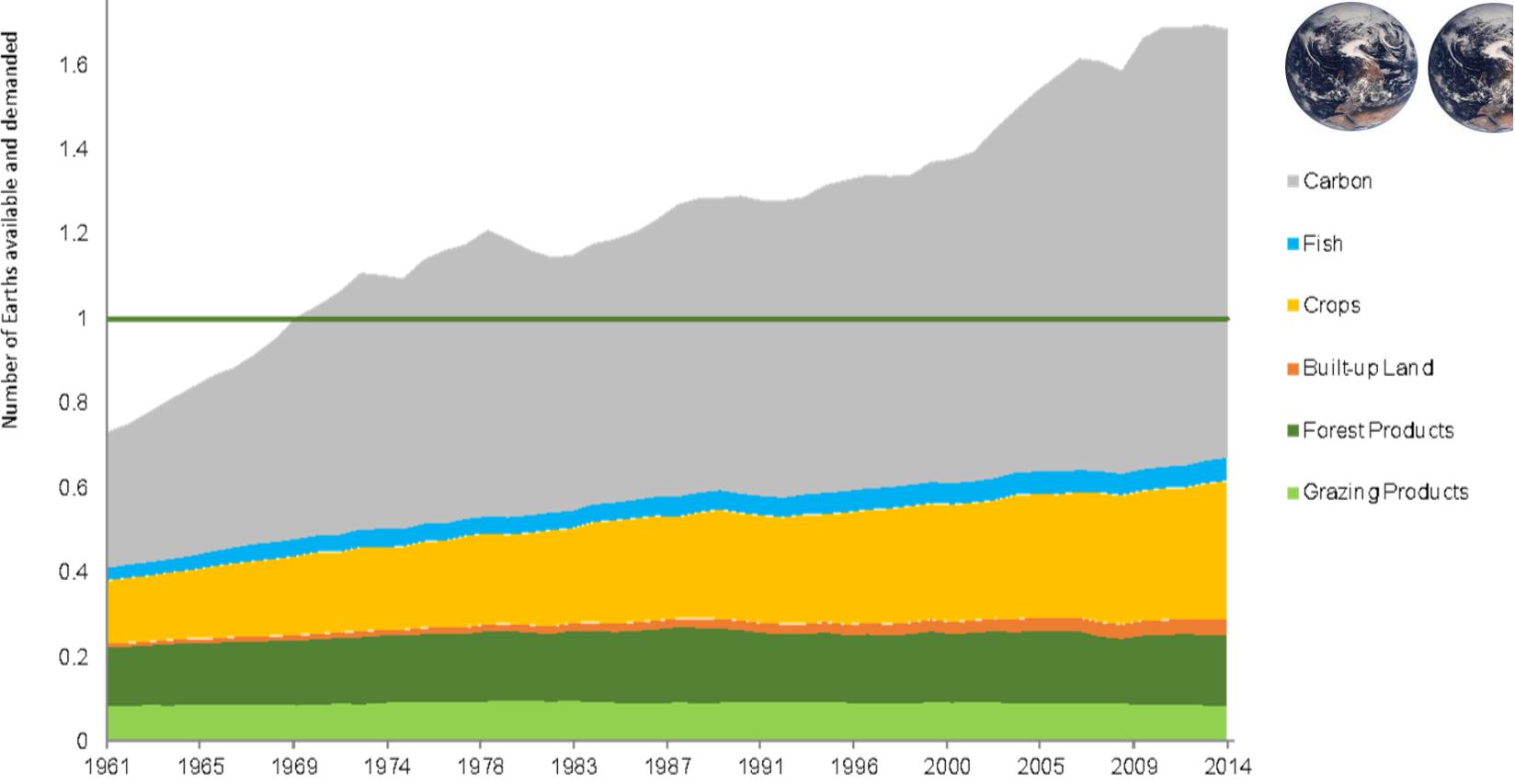


Ecological Footprint allows looking and acting  
locally in the context of the global situation

# Looking at the Earth as a single system: Showing our society's overall direction



# Humanity's Ecological Footprint and biocapacity, 1961 – 2014



- Carbon
- Fish
- Crops
- Built-up Land
- Forest Products
- Grazing Products



**EF<sub>P</sub>**

**Production Activities:**

- Agriculture
- Silviculture
- Farming
- Fishing
- Manufacturing
- etc



**EF<sub>I</sub>**

**EF<sub>C</sub>**

**EF<sub>P</sub>**

**EF<sub>I</sub>**

**EF<sub>E</sub>**

$$EF_C = EF_P + (EF_I - EF_E)$$

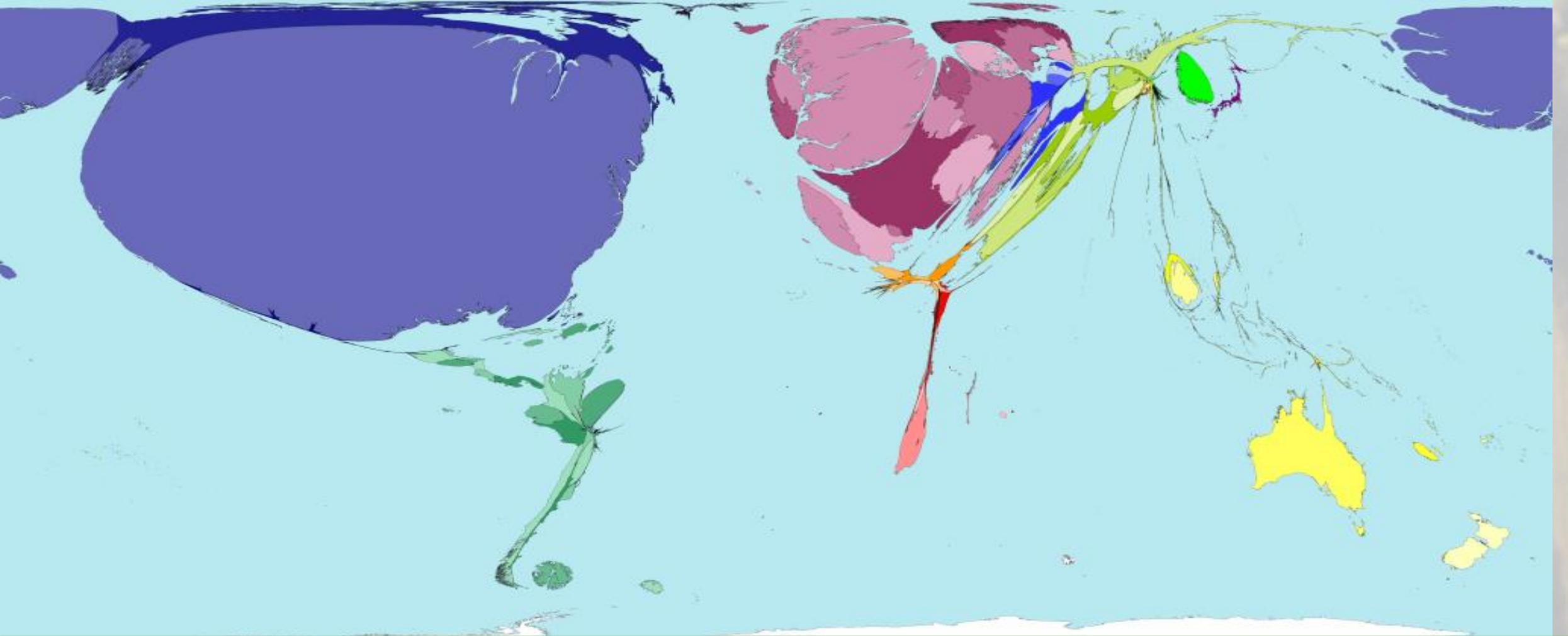


**BIOCAPACITY**

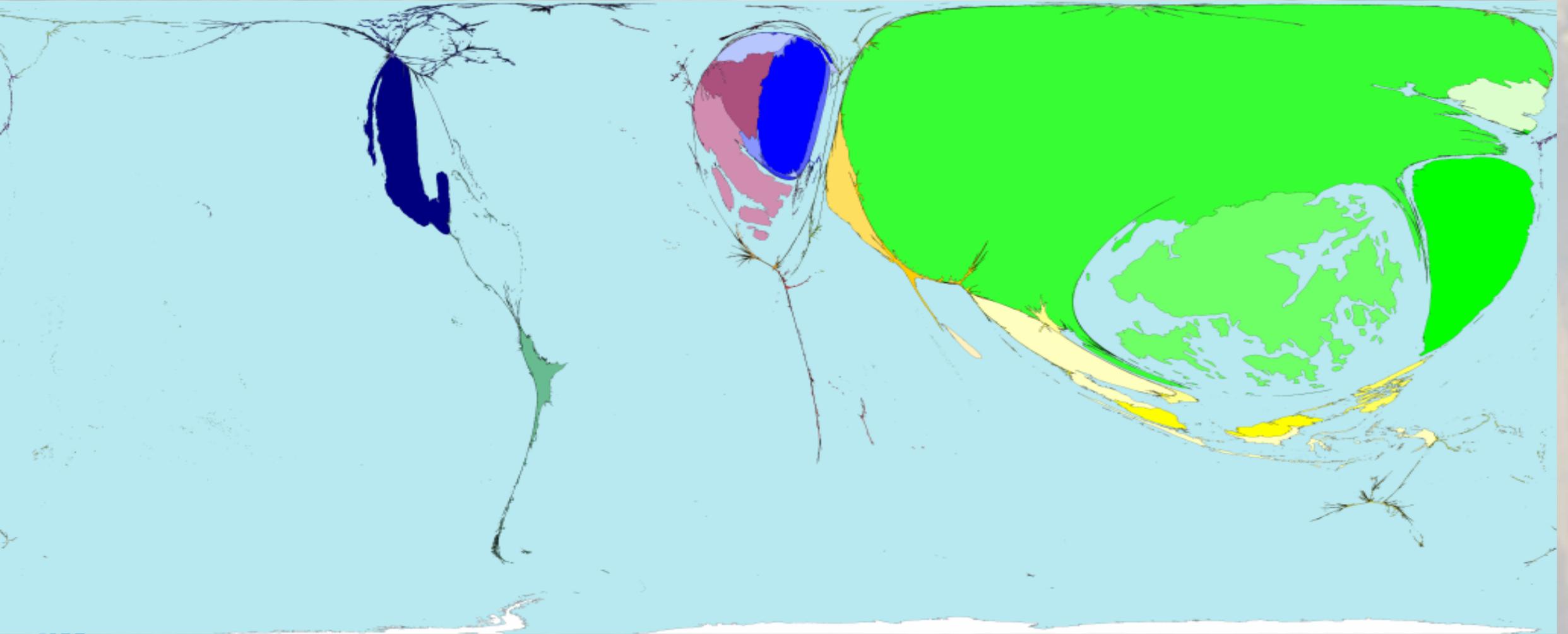
**EF<sub>E</sub>**  
Exports

## Why using a consumer approach?

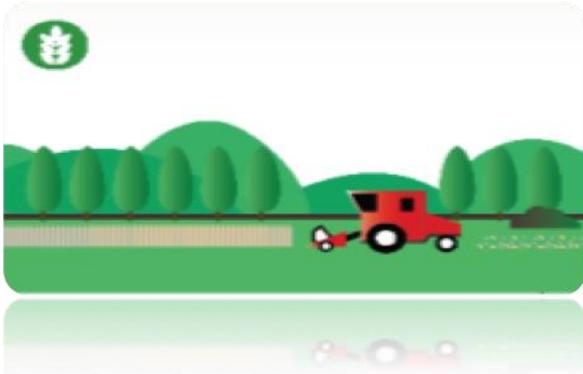
Not everything that is consumed in the West...



**... is being produced in the West.** Environmental impacts are often manifesting far away from the places in which their root causes (i.e., their drivers) are taking place.



## Ecological Footprint: input data



### **CROPLAND FOOTPRINT**

Represents the area required to grow all crop products, including livestock feeds, fish feed, oil crops and rubber.

It is calculated by using data on production, import and export of  $\approx 400$  primary and derived agricultural products.

Source data is FAO



### **GRAZING LAND FOOTPRINT**

Measures the area of grassland used in addition to crop feeds to provide feed for livestock, including cultivated pastures, wild grasslands and prairies.

It is calculated by using data on production, import and export of  $\approx 150$  animal and dairy products (including live animals).

Source data is FAO

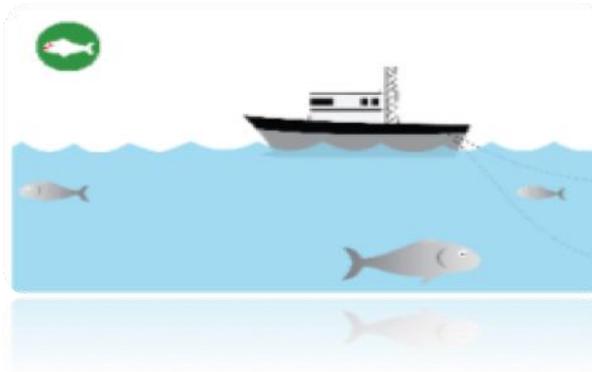


## FOREST FOOTPRINT

Measures the annual harvest of fuel wood and timber to supply forest products.

It is calculated by using data on production, import and export of  $\approx 30$  in between timber and wood fuel products.

Source data is FAO

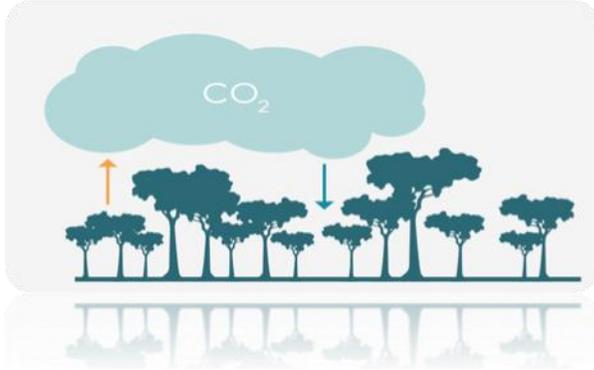


## FISHING GROUNDS FOOTPRINT

Measures the area of marine and inland water used to provide the primary production needed to sustain aquatic species (including fish meals).

It is calculated by using data on production, import and export of  $\approx 1500$  fish products.

Source data is FAO



## CARBON FOOTPRINT

Measures the uptake land to accommodate the carbon dioxide emissions due to consumption of fossil fuels, electricity and energy intensive products

It is calculated by using data on emissions from  $\approx 45$  industrial sectors as well as import and export of  $\approx 625$  manufactured commodities.

Source data is IEA and UN COMTADE



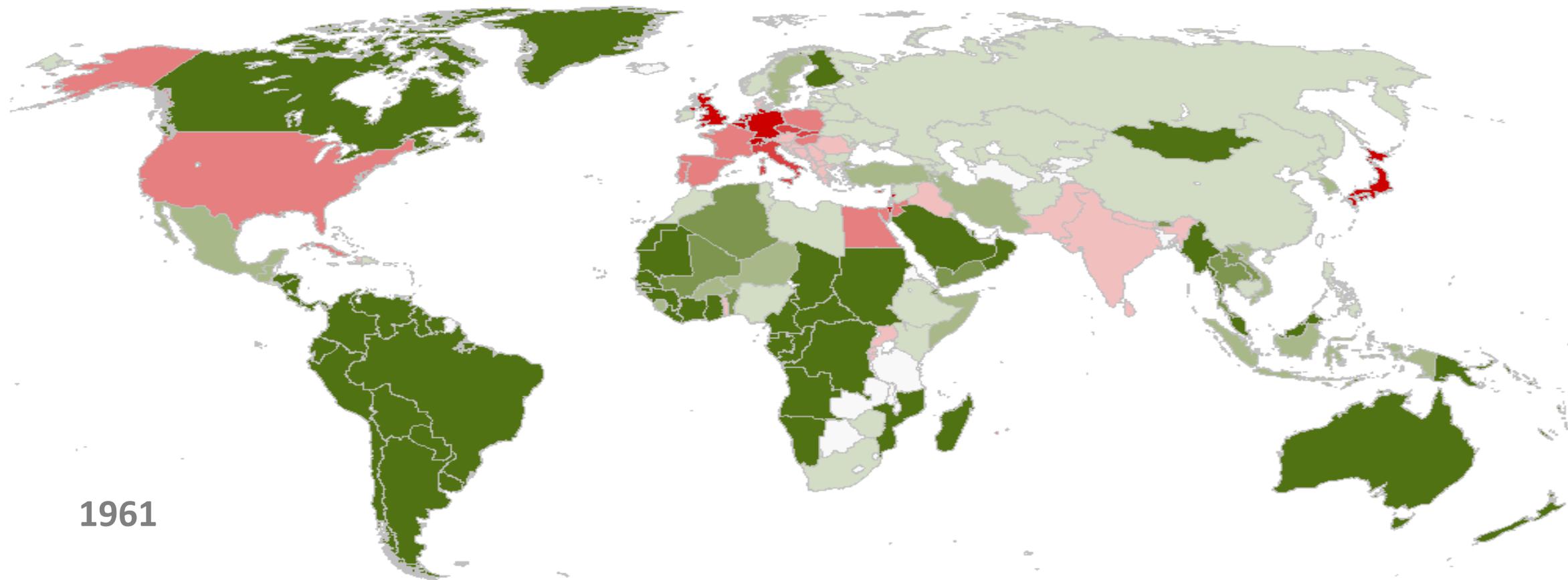
## BUILT-UP LAND FOOTPRINT

Measures the area of land covered by human infrastructure: transportation, housing, industrial structures and reservoirs for hydroelectric power generation.

Source data is CORINE, GLC, SAGE, etc

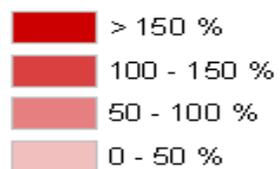
## Outcomes: National Footprint Accounts - NFA

- **Every year** Global Footprint Network releases an updated version of the NFA, which is based on the most up-to-date Footprint methodology
- **Each edition** of the NFA tracks EF and BC values for almost 200 countries (and the World), over five decades (1961-2014) and with different level of aggregation:
  1. Aggregate national EF and BC values (most known)
  2. EF and BC values by land type
  3. EF values by variable
  4. EF values for all individual products
  5. Values are provided both per capita and total
  6. Results in both ha and gha (not for totals)

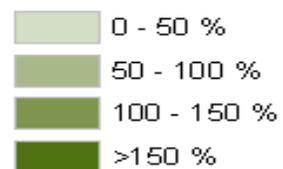


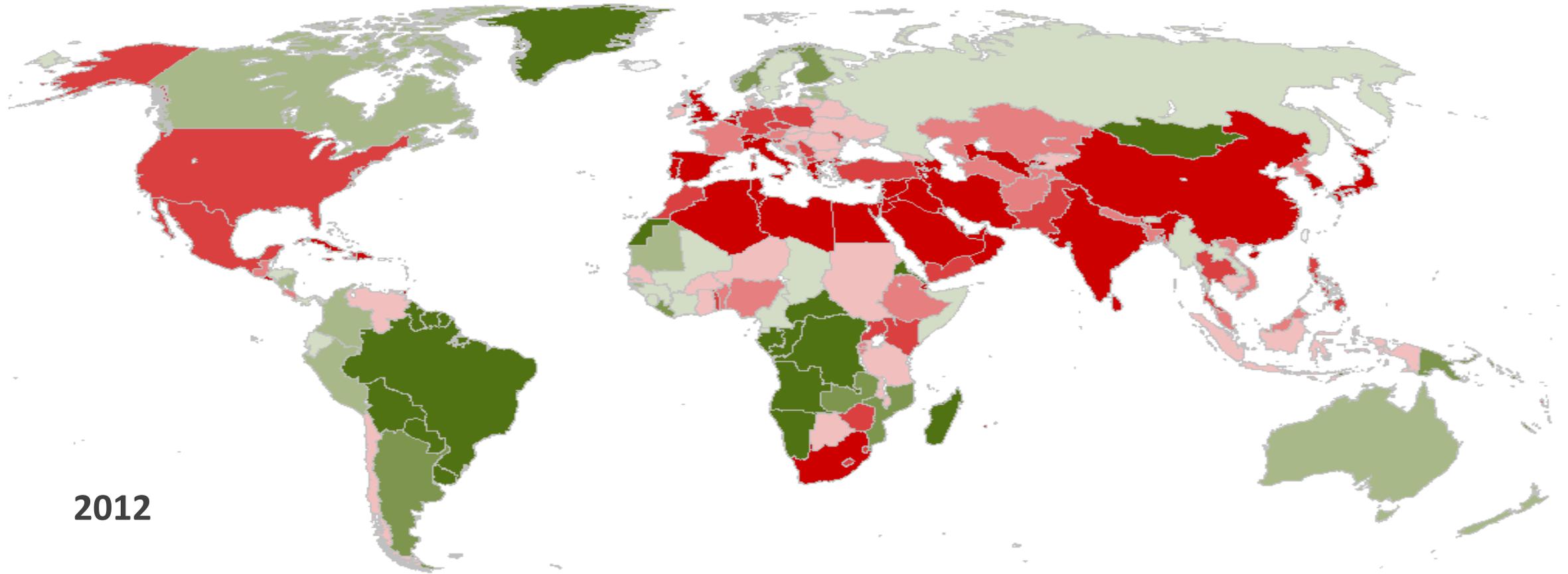
1961

**Ecological Footprint of consumption exceeds biocapacity**



**Biocapacity exceeds Ecological Footprint of consumption**





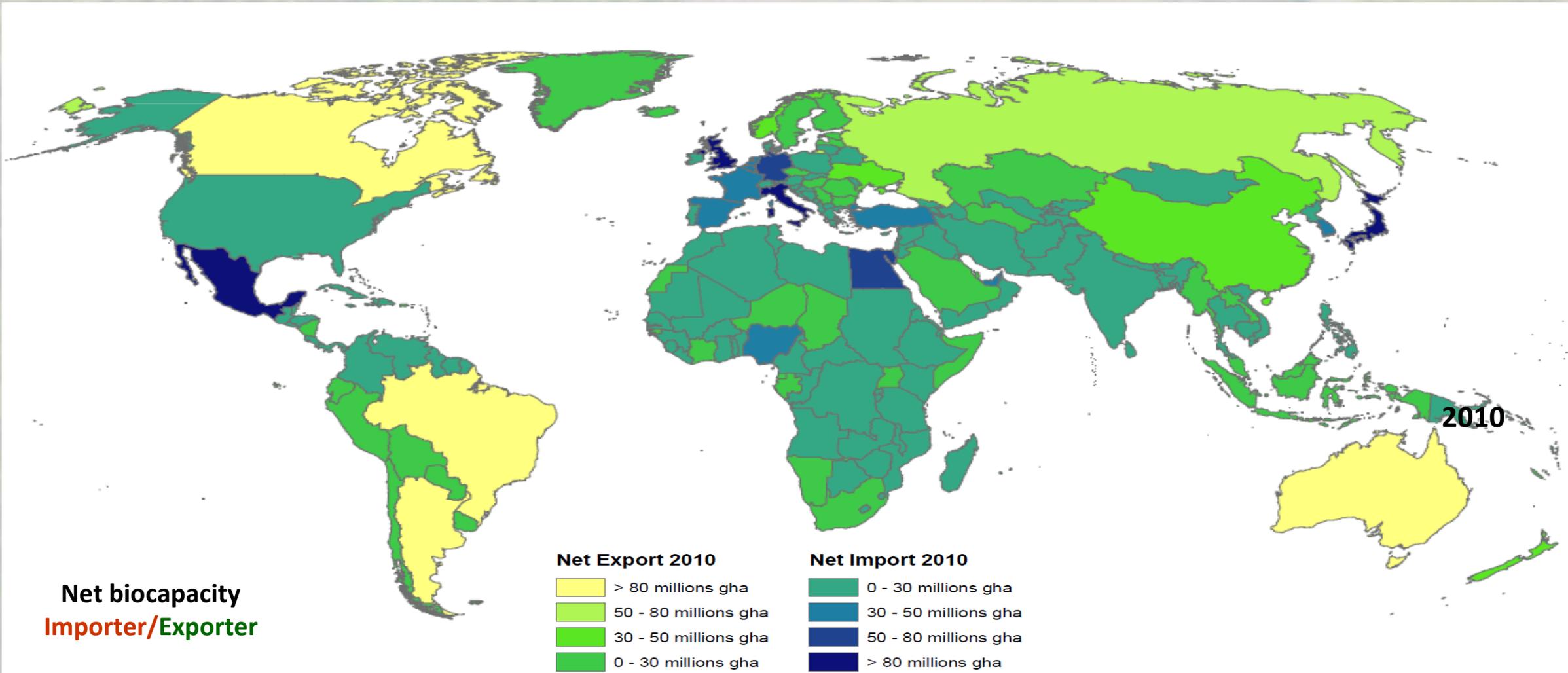
2012

**Ecological Footprint of consumption exceeds biocapacity**

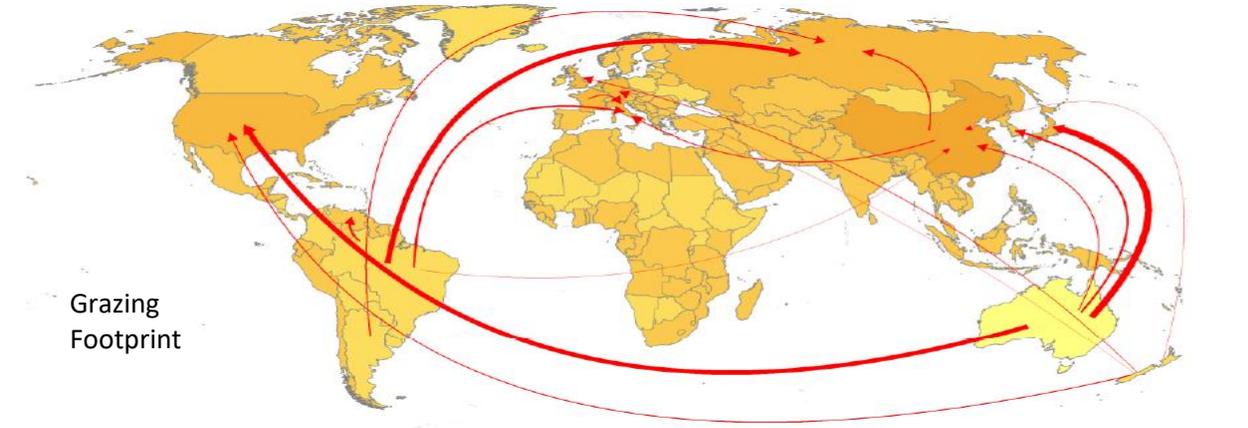
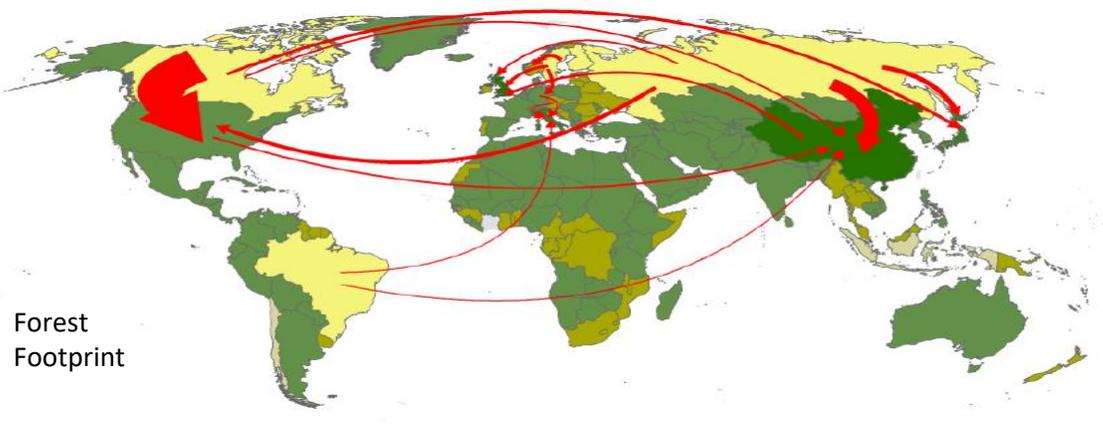
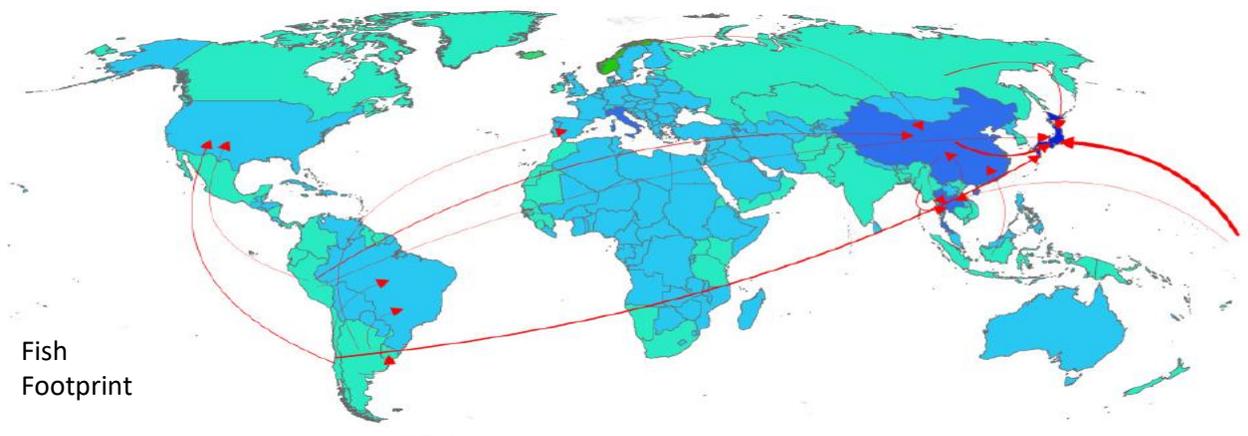
- > 150 %
- 100 - 150 %
- 50 - 100 %
- 0 - 50 %

**Biocapacity exceeds Ecological Footprint of consumption**

- 0 - 50 %
- 50 - 100 %
- 100 - 150 %
- >150 %



**Countries are highly interconnected and depend on each other**



Source: Lazarus et al, 2015

# HOW MANY EARTHS?

If everybody lived like Argentinians, it would take 1.6 Earths.

If everybody had a Footprint like a quarter-finalist nation in the World Cup, how many Earths would it take to meet our demand on nature?



# On the Usefulness of Ecological Footprint Accounting

## WHAT WE LEARN FROM THIS? WHAT CAN WE DO?

- Globally, the human metabolism has become “faster” than the planet capacity to regenerate key resources and ecosystem services.
- This affects the health of ecosystems and biodiversity and puts at risk human well-being
- Countries around the world are telecoupled and overconsumption in a country causes resource depletion somewhere else
- As such, local resource management and governance cannot be blind to such global teleconnections and their consequences

**What do you think is the link between Ecological Footprint and the SDGs, if any?**

# Ecological Footprint and Multilateral Environmental Agreements (MEAs)



**Indicator description**

The Ecological Footprint compares human demand on nature against nature supply. Demand is measured in terms of the biologically productive areas – also called ecological assets – that a population requires for producing all the renewable resources it consumes and absorbing its waste. The availability of nature, called biocapacity, is also measured in surface area, and represents the availability of ecological assets and their regenerative capacity for such resources and waste. An increase in a nation's Ecological Footprint stands for an increase in its population's pressure on biodiversity and a greater risk of biodiversity loss.

## Related SDGs

Expand ▼



GOAL 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.



GOAL 12 - Ensure sustainable consumption and production patterns.

## Related Aichi Targets

Expand ▼

Primary target



### Target 4:

By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

## Other related MEAs and processes

Expand ▼



IPBES Global Assessment Chapters



IPBES Regional Assessment Chapters

# 12 RESPONSIBLE CONSUMPTION AND PRODUCTION



## Conclusions: how EF informs progresses on SDG12

- EF allows comparing the impact of a country's production and consumption activities vs. the ecological budget available (globally or nationally).
- It offers a framework to assess the **appropriation of ecological assets** due to both **production and consumption (PC) activities** thus offering a way to track progresses on **SDG12**
- It also allows comparing the impact of PC activities against the regeneration of the planet thus **complementing** the **"efficiency"** side of human PC activities with the **"one-planet-consistency"** side (whether they fit within planetary limits)
- EF clearly shows that **overall, the human enterprise is operating well beyond safe planetary limits**

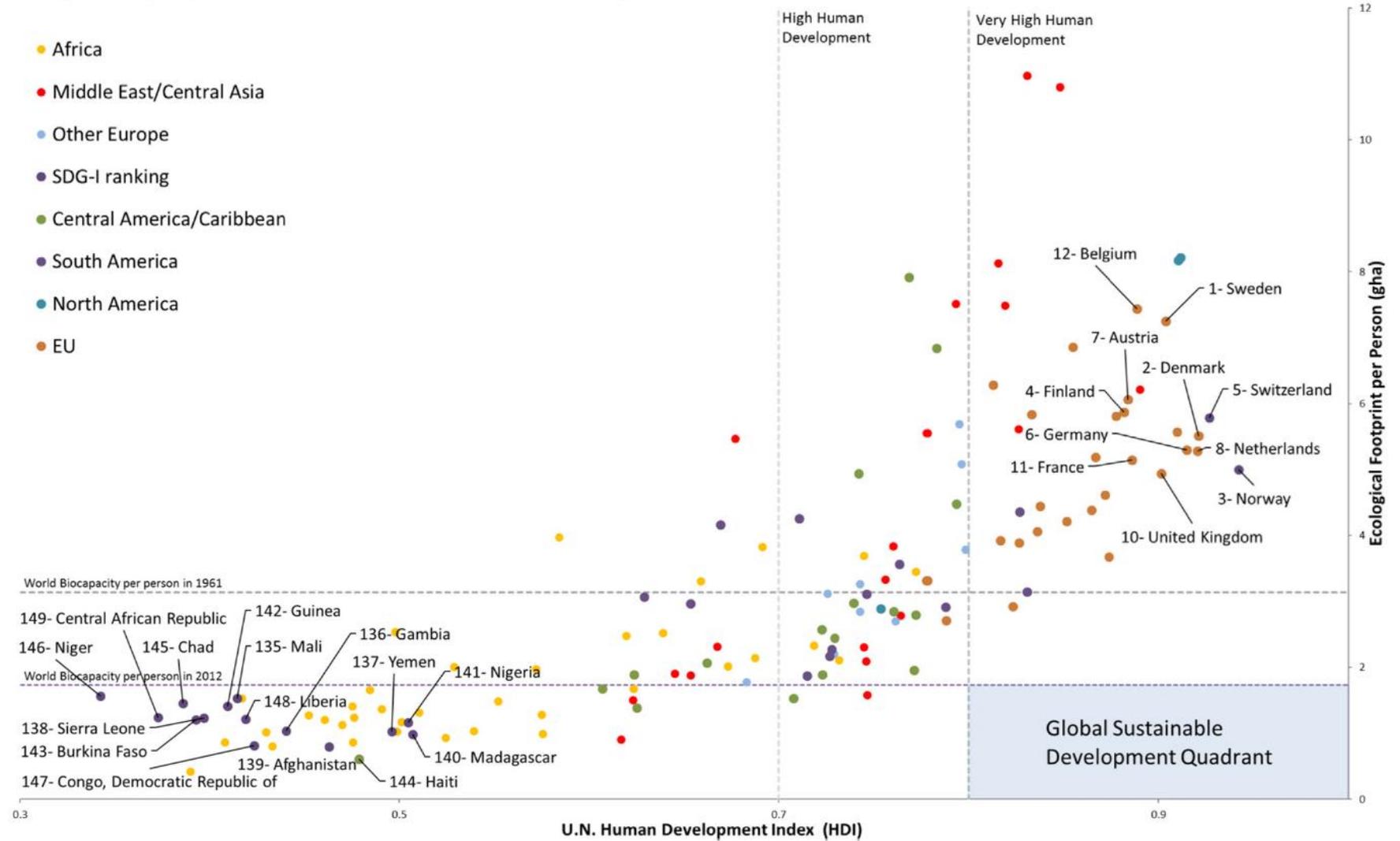


## Conclusions: how EF informs progresses on SDG12

- At country level, EF accounting allows connecting the location of resource consumption to those of resource production thus shedding light on the **teleconnections of our economies** and their **associated environmental externalities**.
  - Comparing production Footprint vs. local biocapacity tells us about the extra pressure that economic activities place on the ecosystems of a country, thus representing an **indicator of direct (anthropogenic) drivers** of change in the state of biodiversity and ecosystems functioning (**IPBES Core Indicator**)
  - Ecological Footprint helps track the underlying drivers of biodiversity loss (**C indicator for the Aichi Target 4**)



### Ecological Footprint per Person and HDI of Nations with SDG-I Ranking



**FIGURE 1** | Ecological Footprint per person and HDI by country indicate how close each country is to basic global sustainable development criteria (high human development, within resource requirements that are globally replicable). Each number indicates the country's ranking on the sustainable development goal (SDG) index (only top and bottom 10 are marked here).

## Suggestions for further reading:

- Borucke, M., Moore, D., Cranston, G., Gracey, K., Iha, K., Larson, J., Lazarus, E., Morales, J. C., Wackernagel, M., & Galli, A. (2013). Accounting for demand and supply of the biosphere's regenerative capacity: The National Footprint Accounts' underlying methodology and framework. *Ecological Indicators*, 24, 518–533. <https://doi.org/10.1016/j.ecolind.2012.08.005>. **(Mandatory)**
- Ecological Footprint Explorer - GFN (<http://data.footprintnetwork.org/#/>) **(Optional)**
- Kitzes, J., & Wackernagel, M. (2009). Answers to common questions in Ecological Footprint accounting. *Ecological Indicators*, 9(4), 812–817. <https://doi.org/10.1016/j.ecolind.2008.09.014>. **(Optional)**
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"The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflect the views of the authors only. The Commission, along with the National Authority (IKY), cannot be held responsible for any use which may be made of the information contained therein."

Co-funded by the  
Erasmus+ Programme  
of the European Union



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