SUSTAINABILITY MEASUREMENT

SDEE – Sustainable Development, Energy and Environment

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WHAT ARE SUSTAINABILITY INDICATORS?

- Sustainability measurement is the quantitative basis for the informed management of sustainability.

- The metrics used for the measurement of sustainability are still evolving: they include indicators, benchmarks, audits, indexes and accounting, as well as assessment, appraisal and other reporting systems.

- They are applied over a wide range of spatial and temporal scales.

- Can be applied to products and services, to regions, companies and institutions.

REVIEW: SUSTAINABILITY AND INDICATORS

- Sustainable development

Environment
- Issues of scale; environmental limits / maximum limits

Society
- Fairness, distribution and justice (for all, present and future generations)
- Minimum standards for all (food, health, education…)

Economy
- Issues of allocation of resources (how much goes to basic needs, how much goes to other products and services)

REVIEW: SUSTAINABILITY AND INDICATORS

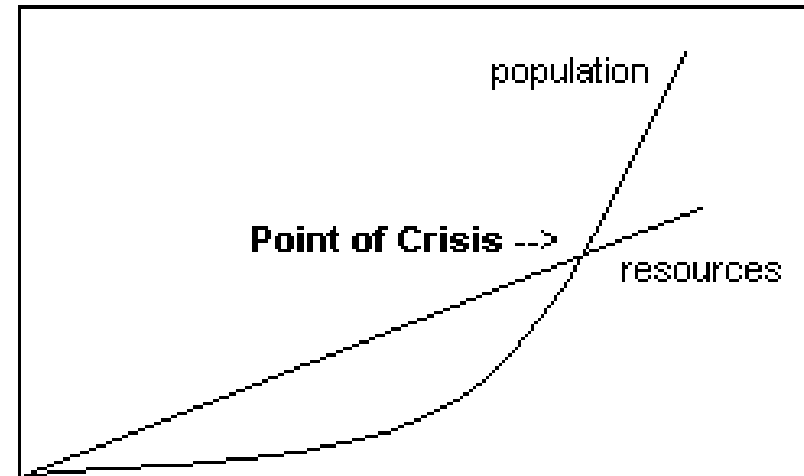- Reviewed some indicators: IPAT

$$I = P \times A \times T$$

total impact — I

population — P

affluence — A

technology — T

REVIEW: SUSTAINABILITY AND INDICATORS

- Reviewed some indicators:
Resource-based indicators

Thomas Malthus and population growth (1798)

- Population increases geometrically (P)
- Consumption per capita remained constant (A)
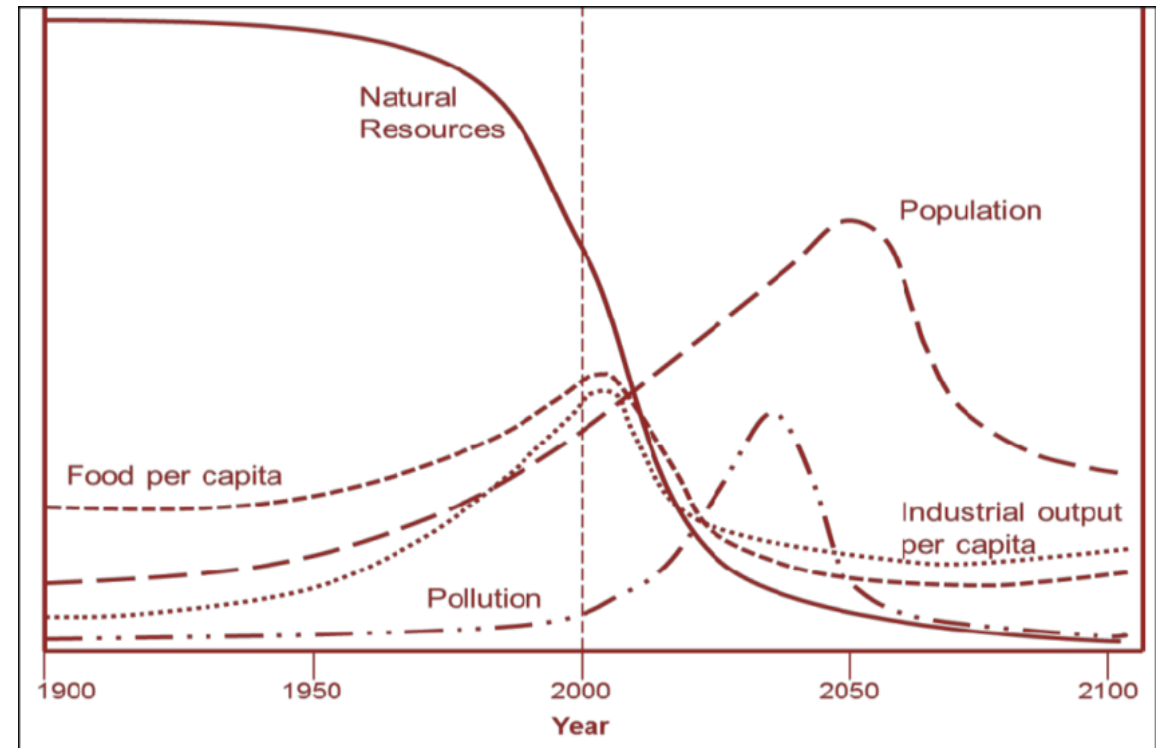- Food increases arithmetically (T)

Malthus' Basic Theory

REVIEW: SUSTAINABILITY AND INDICATORS

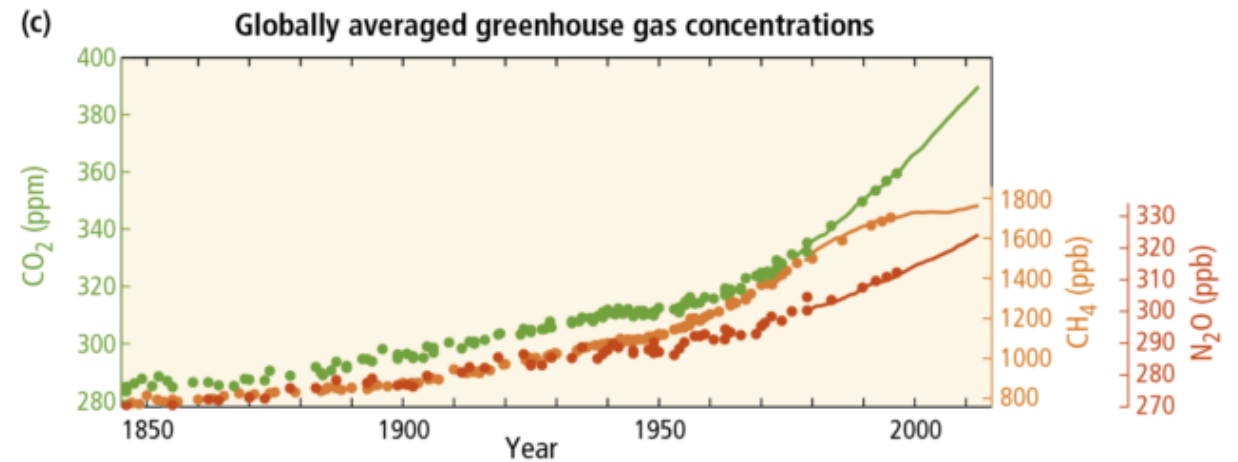- Reviewed some indicators: Resource-based indicators

**Limits to growth,** from Donella Meadows et al. 1972, for the Club of Rome

REVIEW: SUSTAINABILITY AND INDICATORS

- Reviewed some indicators: Environmental indicators

- Human Appropriation of Net Primary Production
- Carbon footprint (GHG emissions)
- Land degradation
- Biodiversity loss indexes

Appropriation of terrestrial vertebrates

Globally averaged greenhouse gas concentrations
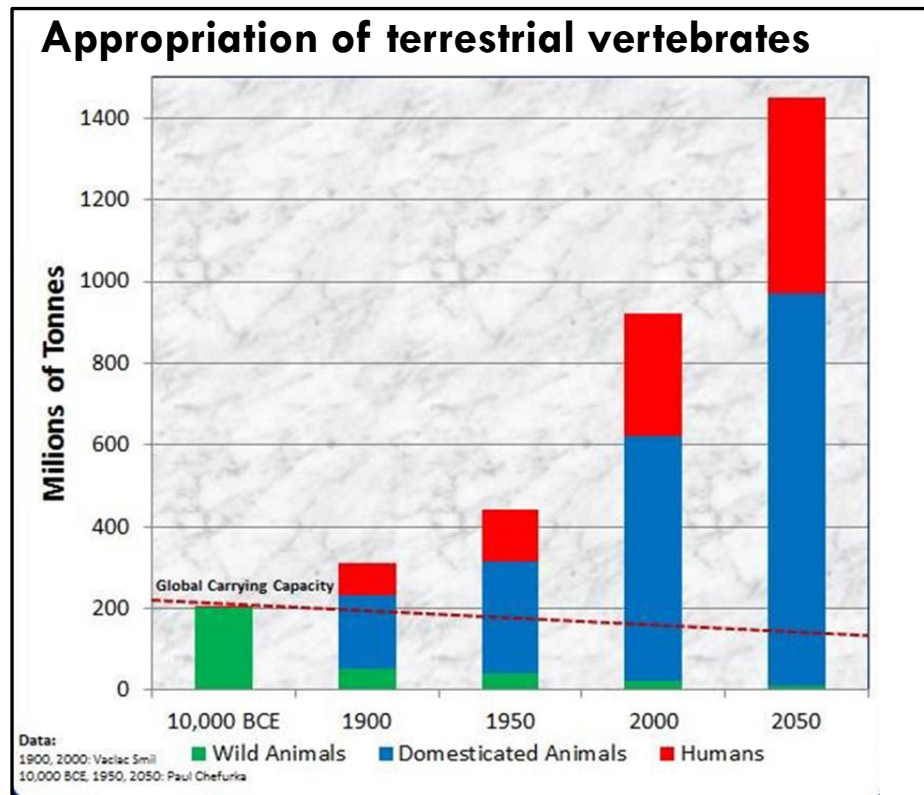
REVIEW: SUSTAINABILITY AND INDICATORS

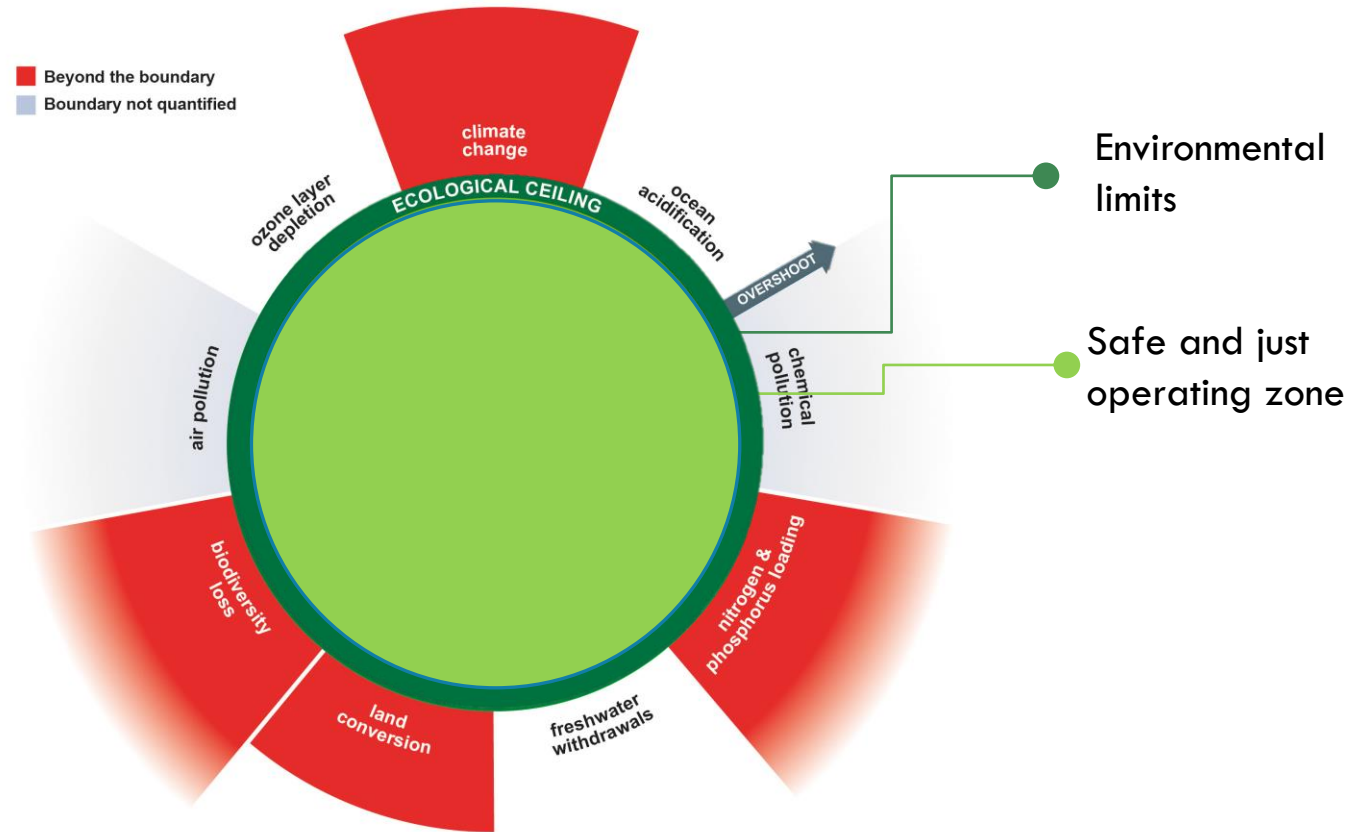- Reviewed some indicators:
  Planetary boundaries
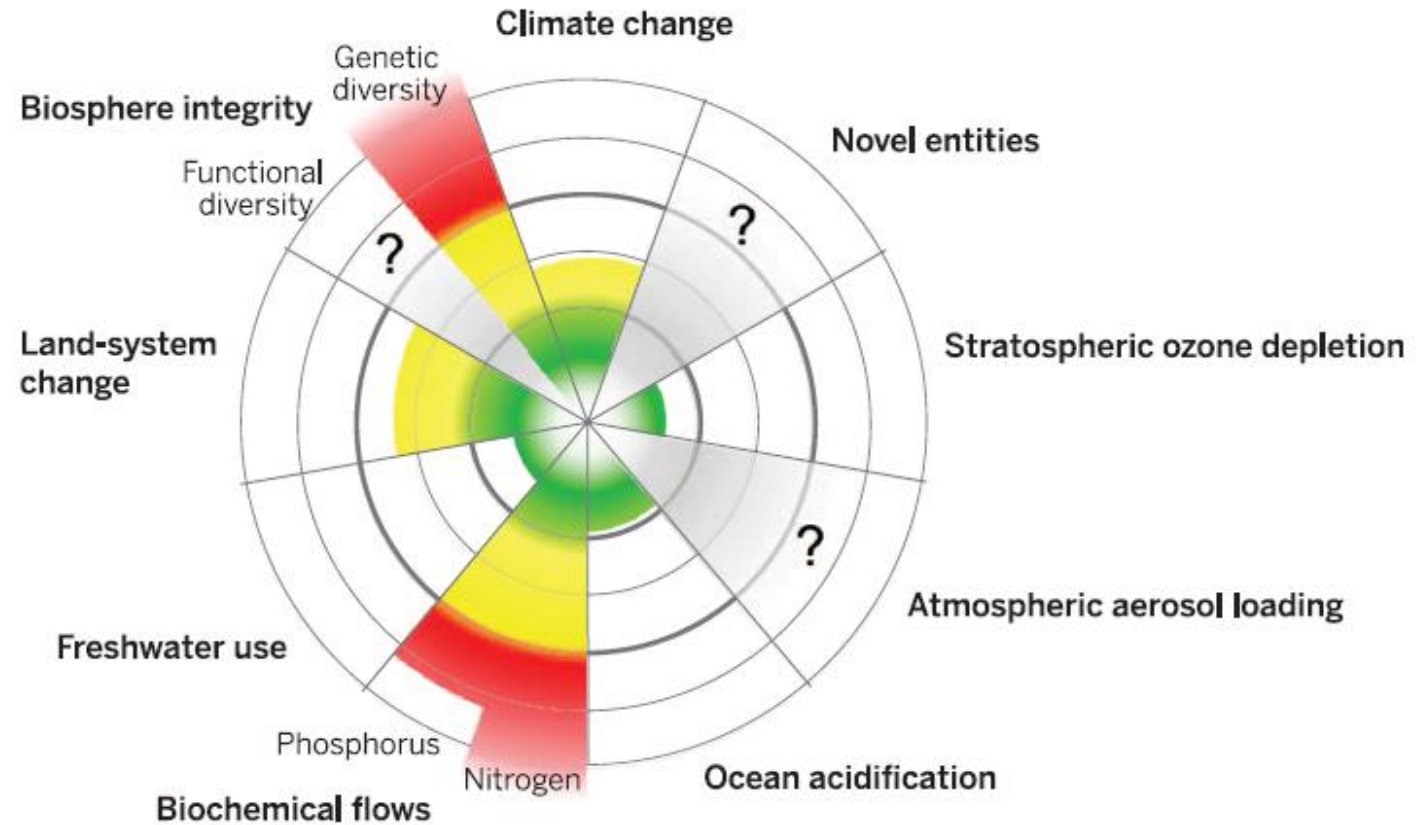
Steffen et al. (2015)

REVIEW: SUSTAINABILITY AND INDICATORS

- Reviewed some indicators:
  Safe and just space

Considers the planetary boundaries

Doughnut economics framework (2017)
https://www.kateraworth.com/doughnut/

REVIEW: SUSTAINABILITY AND INDICATORS

- Reviewed some indicators:
  Safe and just space

… combined with social indicators

11 base social indicators of wellbeing

9 basic needs:

1. Nutrition
2. Sanitation
3. Income
4. Access to energy
5. Education

6. Social support
7. Equality
8. Democratic quality
9. Employment

2 overall measures of wellbeing:

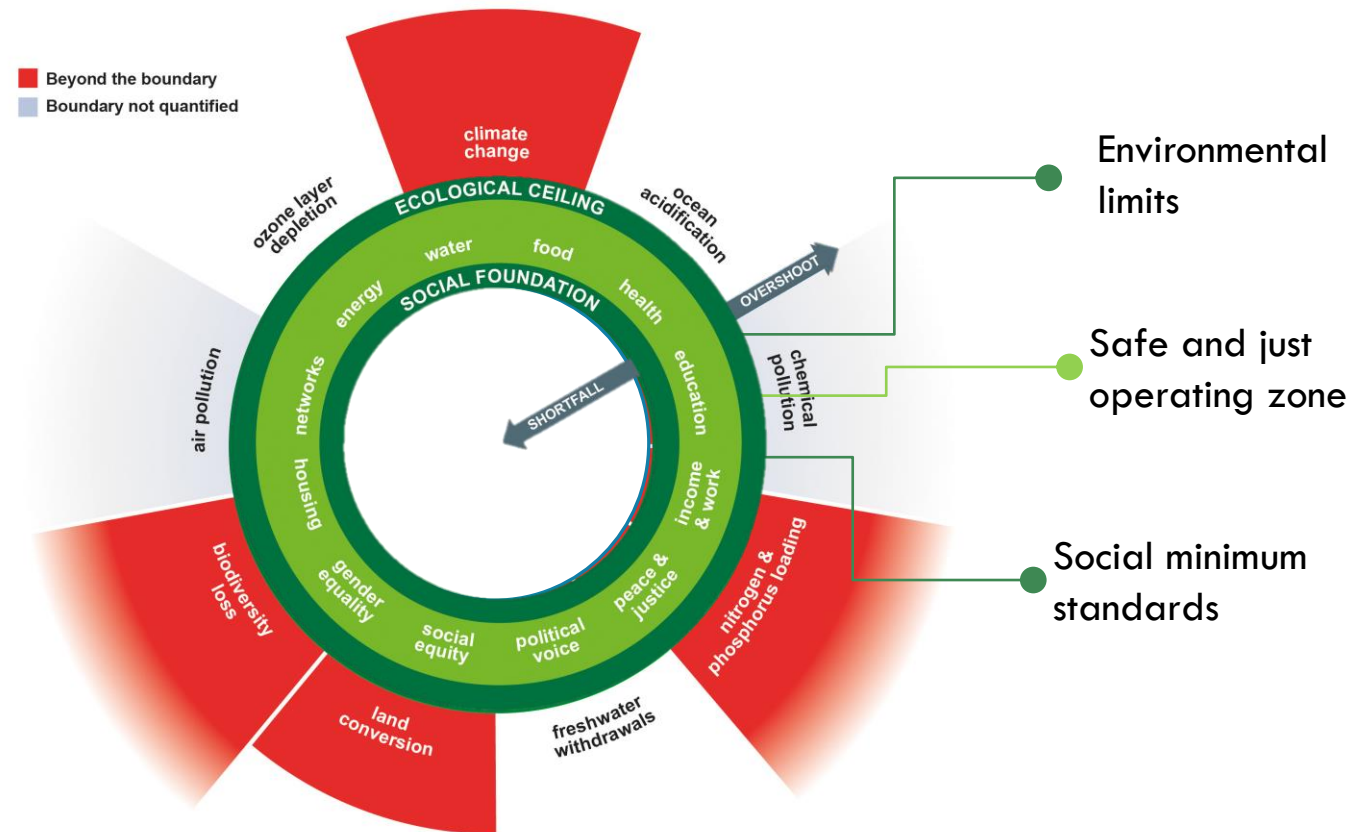10. Self-reported life satisfaction
11. Healthy life expectancy

REVIEW: SUSTAINABILITY AND INDICATORS

- Reviewed some indicators:
  Safe and just space

Doughnut economics framework (2017)
https://www.kateraworth.com/doughnut/

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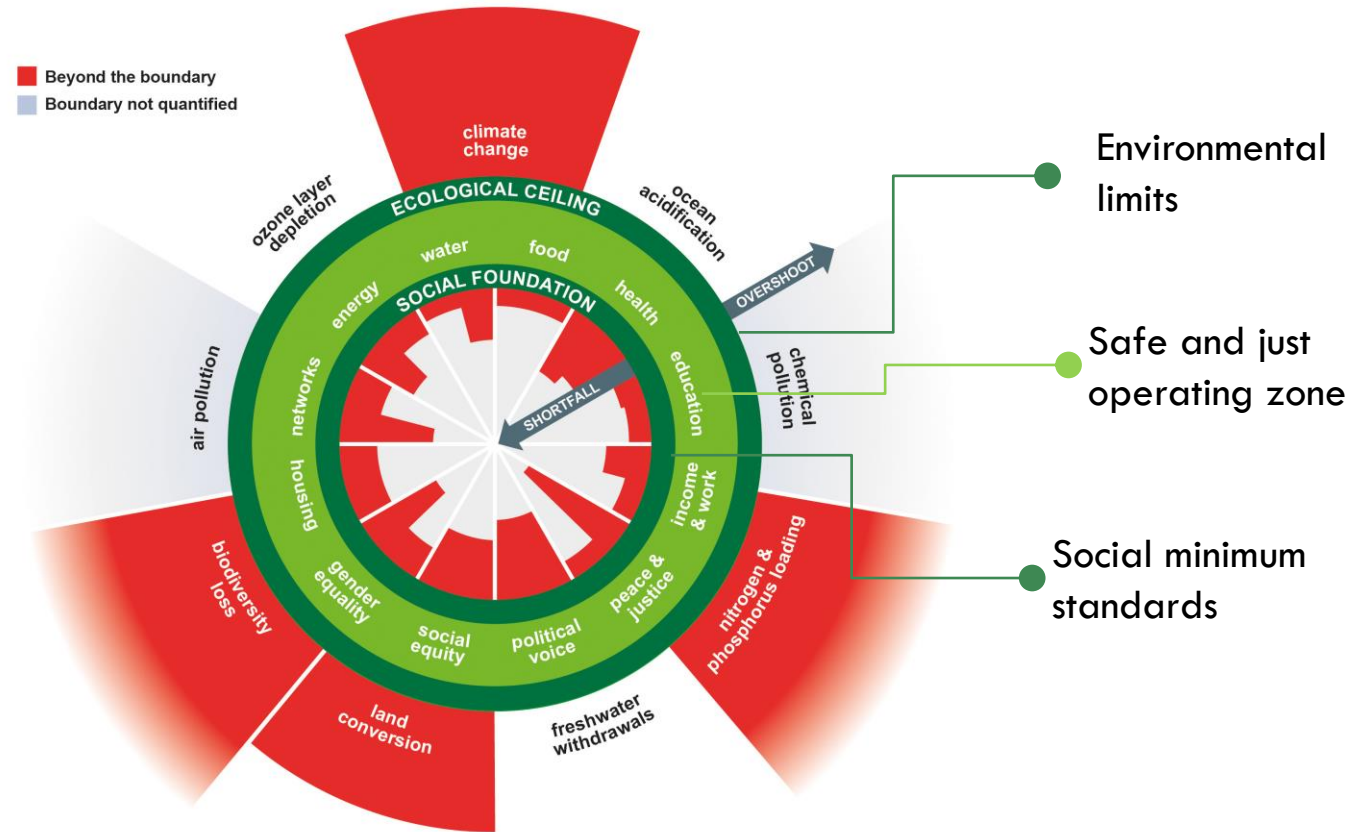
WHY SUSTAINABILITY INDICATORS?

- Systems are particularly sensitive to goals What we aim for, the system will obediently aim to produce it

- If the goals (the indicators of satisfaction of the rules) are defined inaccurately or incompletely, the system may obediently work to produce a result that is not really intended or wanted.

- The need to specify indicators and goals that reflect the real welfare of the system.
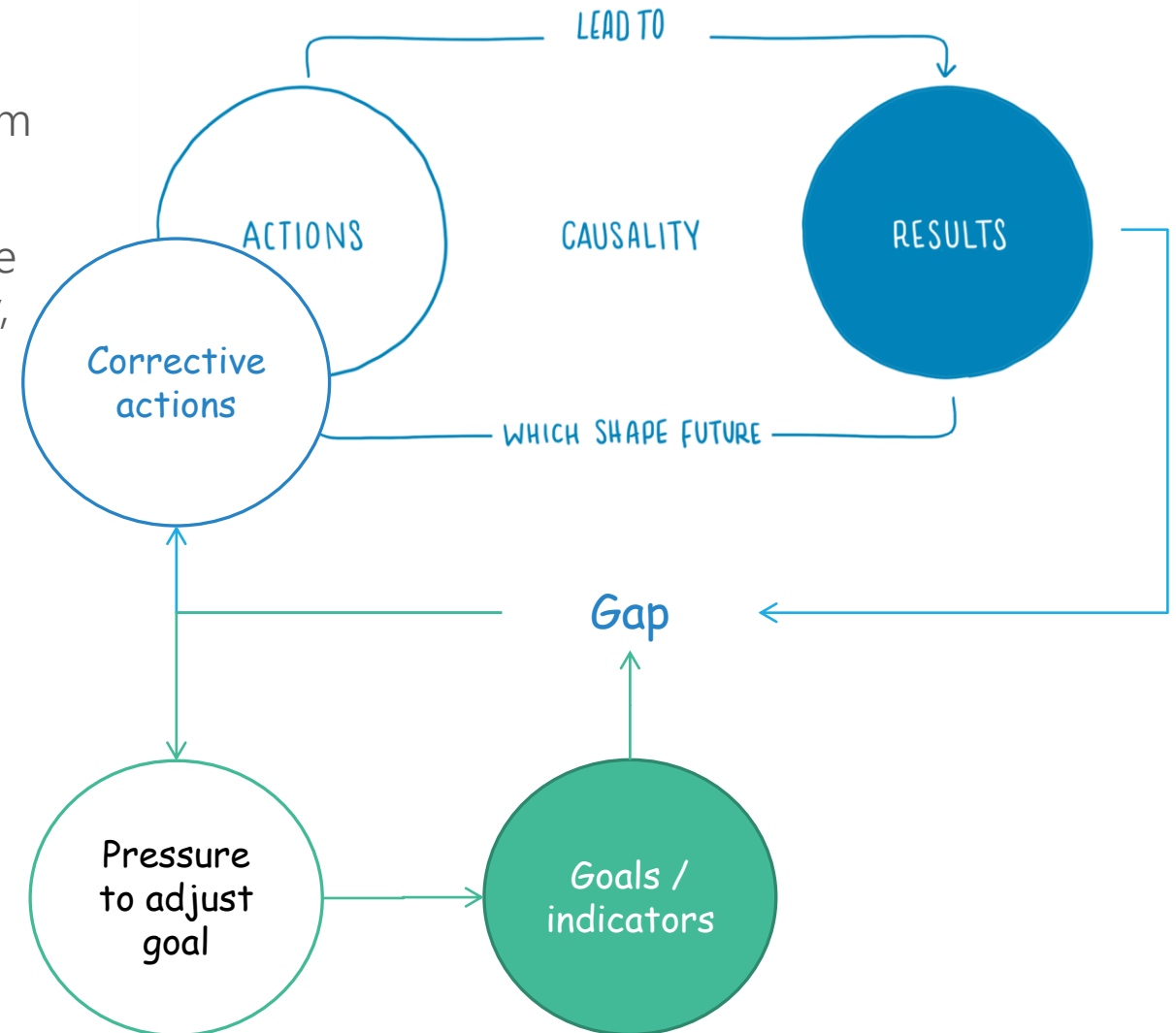
WHY SUSTAINABILITY INDICATORS?

- From the 1950 onwards – focus on economic growth as a way of providing welfare to people

- From the 1970s, environmental and social concerns arose

- In the 1980s and 1990s, UNEP and UNDP defined a new goal: sustainable development
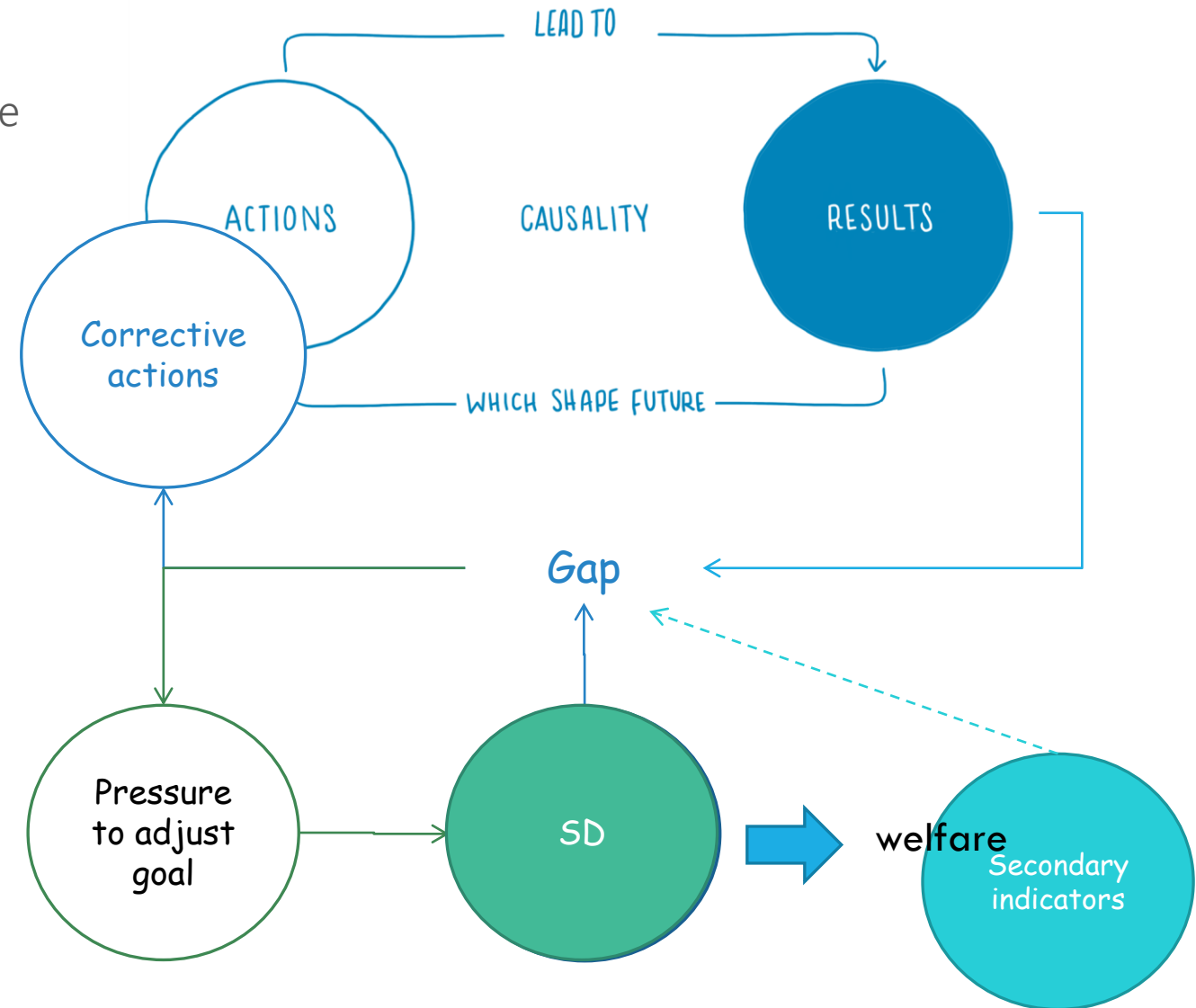
WHICH QUESTIONS WE WANT TO ANSWER?

- Are we in a sustainable development path?

- Can we feed human population within the planetary limits?

- Can we fulfill our basic needs without compromising the environment?

- Which countries are worst and should make more efforts?

- Which sectors we should prioritise action for a sustainable development? Which measures will help directing sectors towards sustainability?

METRICS AT THE GLOBAL SCALE

- **Integrated environmental indicators (indexes)**
  - Ecological footprint, Planetary Boundaries Framework, etc.

- **Partial environmental indicators**
  - Carbon footprints, water footprints, Eutrophication, Biodiversity indexes, HANPP, etc.

- **Social indicators**
  - Human Development Index (HDI), Life satisfaction, Life expectancy, etc.

- **Growth-based economic models**
  - GDP, ISEW, GPI, Green GDP, etc.

- **Integrated sustainability indicators**
  - Happy Planet Index, Safe and just space, etc.

Environment

Society

Economy
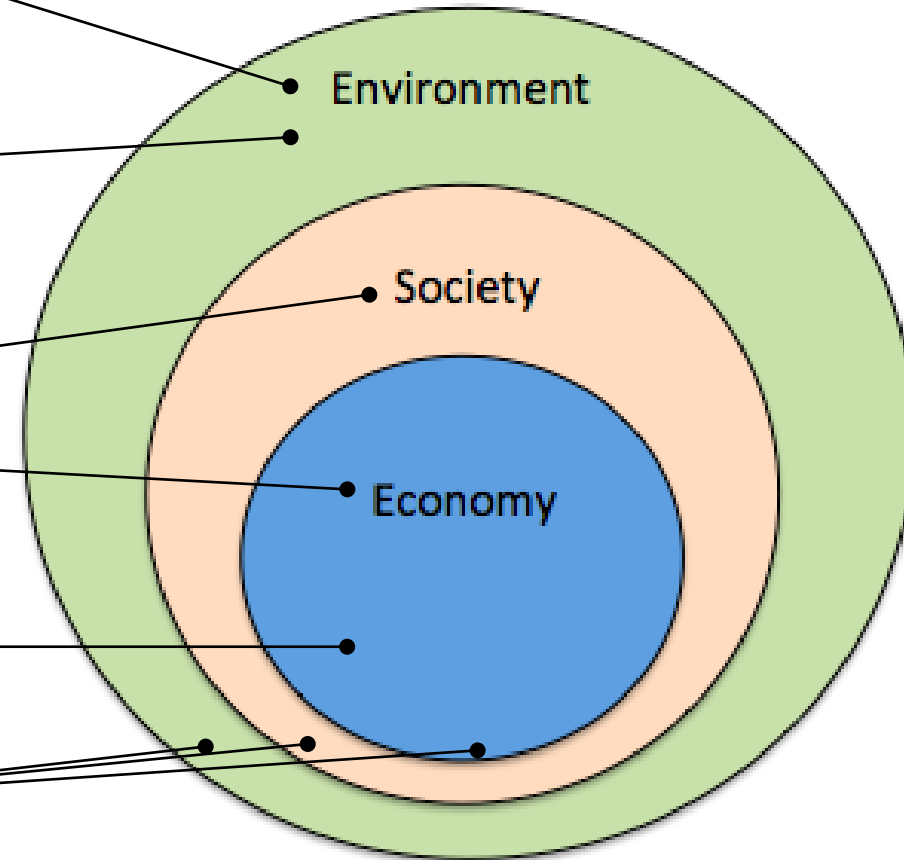
ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Environmental indicators

Indicators can measure one or more of the environmental components.

Relevant environmental issues: Issues of scale; environmental limits

Examples

- Partial environmental indicators:
  - Resource-based indicators/models;
  - Human Appropriation of Net Primary Production (HANPP);
  - Carbon footprints (GHG emissions);
  - Land-degradation;
  - Biodiversity loss indexes;
  - Water footprints, Eutrophication, etc.

- Planetary Boundaries Framework,

- Ecological footprint

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

The Ecological Footprint

- Its an environmental indicator that tries to capture the amount of biologically productive land and sea area a population required to produce the resources it consumes and absorb the waste it generates, using prevailing technology and resource management practices (Borucke et al. 2013)

- Allows to assess "sustainability" of a region – Biocapacity: the available productive area

- The ecological footprint is the sum of 6 components:
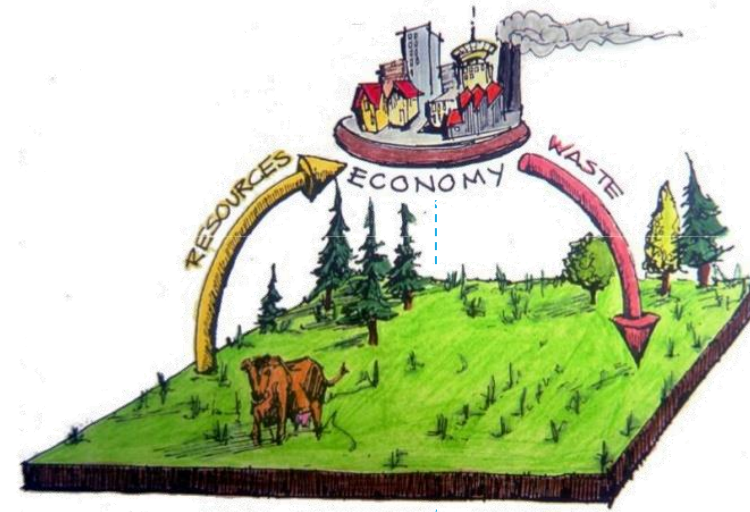
1. Grazing land
2. Forest products land
3. Fishing grounds
4. Cropland
5. Built-up land
6. Carbon land

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

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- Allows to assess "sustainability" of a region – Biocapacity: The available productive area

- The ecological footprint is the sum of 6 components

- Allows to compare products and services, institutions and regions, individual lifestyles
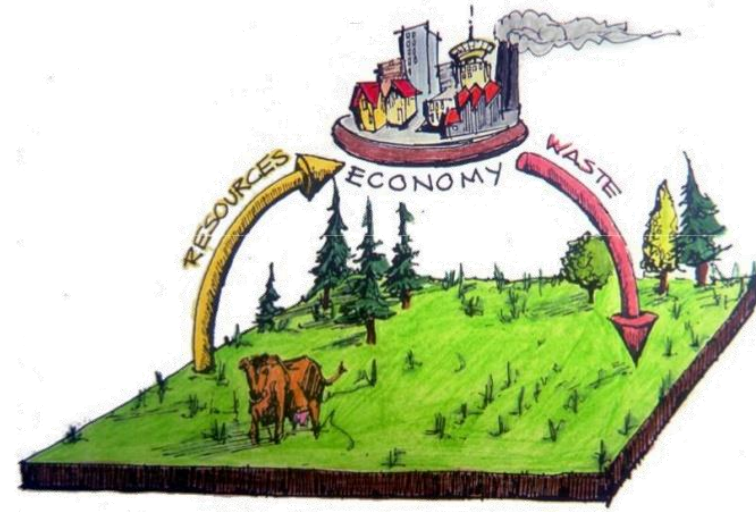
ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

The Ecological Footprint

Some critics …

- Good communication indicator (issues of scale and the environment)

- Poor in terms of:
  - Providing detailed information for action
  - Providing little account of the environmental impacts of wastes and emissions
  - Approaches taken for GHG gases (climate change) is debatable

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE
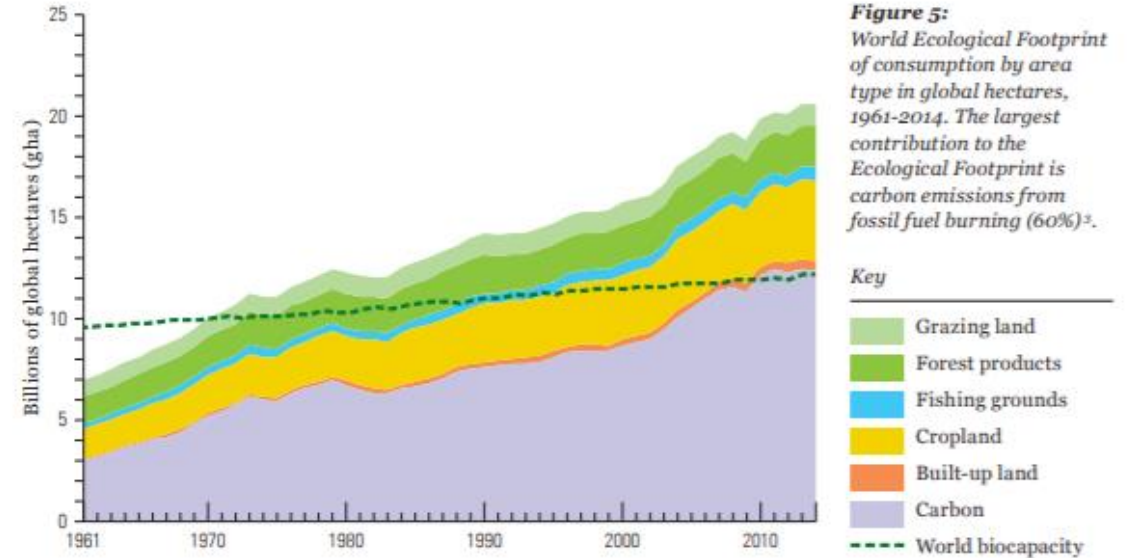
- Boundaries, biocapacity, thresholds, limits

We cannot transgress the boundaries.

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Boundaries, biocapacity, thresholds, limits:

Example: Ecological footprint

- Defines and estimates a biocapacity

- Biocapacity is the available productive area

Figure 5:
World Ecological Footprint of consumption by area type in global hectares, 1961-2014. The largest contribution to the Ecological Footprint is carbon emissions from fossil fuel burning (60%)[2].

Key

- Grazing land
- Forest products
- Fishing grounds
- Cropland
- Built-up land
- Carbon
- - - World biocapacity

World average footprint is 2.65 global hectares (gha) of land per capita, which is 50% above global biocapacity of 1.7 gha per capita
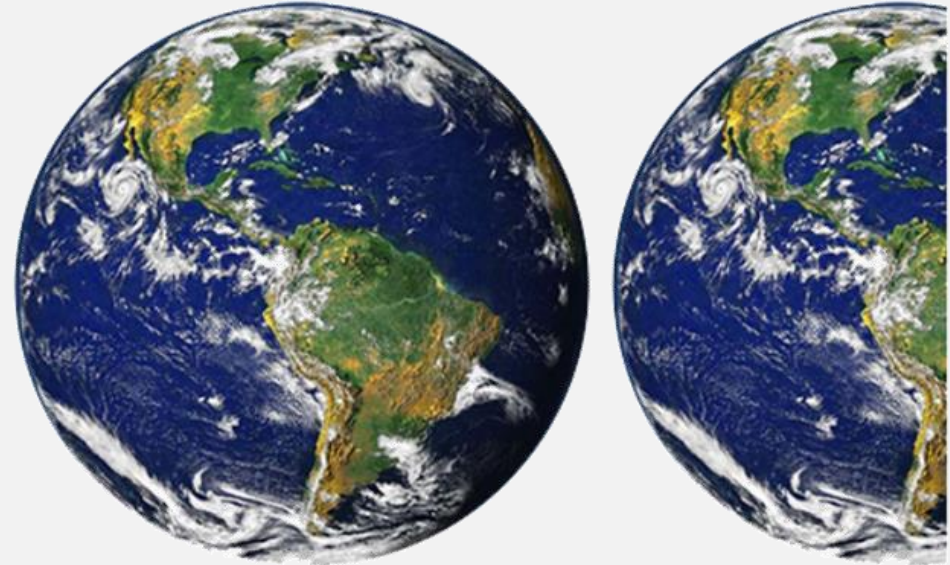
Source: Living Planet Report 2018

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Boundaries, biocapacity, thresholds, limits:

Example: Ecological footprint

- Defines and estimates a biocapacity

- Based on the amount of resources the planet produces per year

In 2018, humanity was using 1.75 Earths to provide the resources and absorb CO_2 emissions
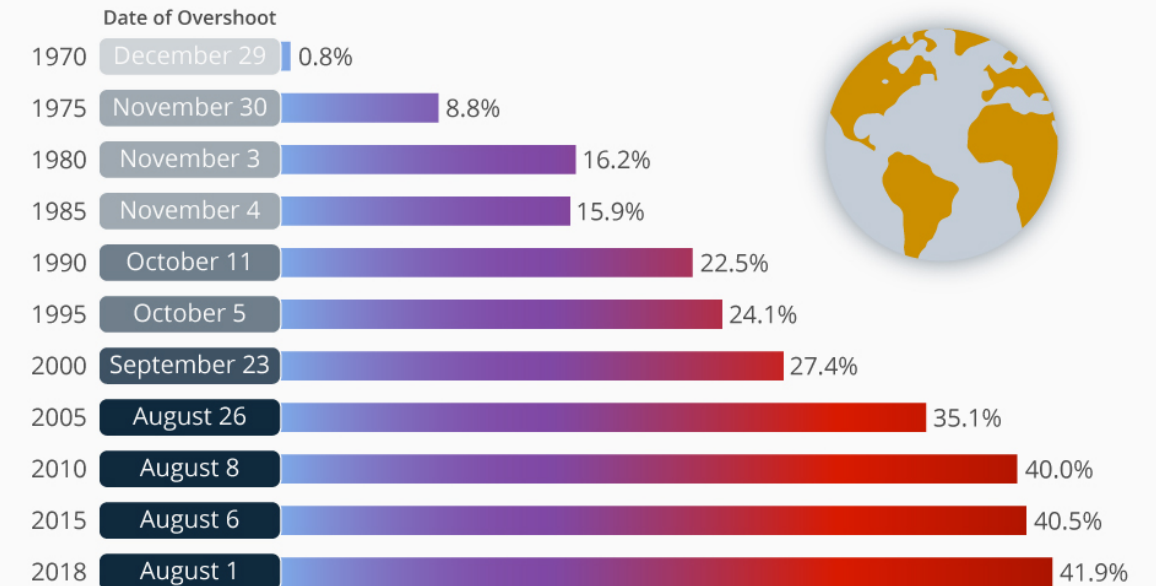
ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Boundaries, biocapacity, thresholds, limits:

Example: Ecological footprint

- Defines and estimates a biocapacity

- Based on the amount of resources the planet produces per year

- Global ecological overshoot is when the annual demand on resources exceeds what Earth can regenerate each year – ecological deficit

- Overshoot day – the day when humanity's demand for resources and waste assimilation equals the annual capacity of the Earth to produce those resources

Earth Overshoot Day Comes Sooner Every Year

Share of year remaining after Earth Overshoot Day (1970–2018)

Date of Overshoot

Year	Date of Overshoot	Share
1970	December 29	0.8%
1975	November 30	8.8%
1980	November 3	16.2%
1985	November 4	15.9%
1990	October 11	22.5%
1995	October 5	24.1%
2000	September 23	27.4%
2005	August 26	35.1%
2010	August 8	40.0%
2015	August 6	40.5%
2018	August 1	41.9%

@StatistaCharts   Source: Earth Overshoot Day

statista

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Boundaries, biocapacity, thresholds, limits

Example: Planetary Boundaries

- Defines and estimates a boundaries per each of 9 environmental indicators:
  1. Climate change,
  2. biosphere integrity,
  3. land-system change,
  4. freshwater use,
  5. biogeochemical flows,
  6. ocean acidification,
  7. atmospheric aerosol loading,
  8. stratospheric ozone depletion and
  9. novel entities

- Limits are established making sure there are no damage for the species in the planet

Example of a boundary: climate change

- Maximum concentration of CO_2 in the atmosphere of 350 ppm - a value that would likely preserve the climate in a Holocene-like state (Steffen et al. 2015)

- As an alternative boundary to 350 ppm, the 2°C temperature stabilisation goal emphasised in the Paris Agreement. approximately 1.61 t CO_2 per capita (O'Neill et al. 2018)

ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

- Boundaries, biocapacity, thresholds, limits

Example: Planetary Boundaries

- Defines and estimates a boundaries per each of 9 environmental indicators

- Limits are established making sure there are no damage for the species in the planet
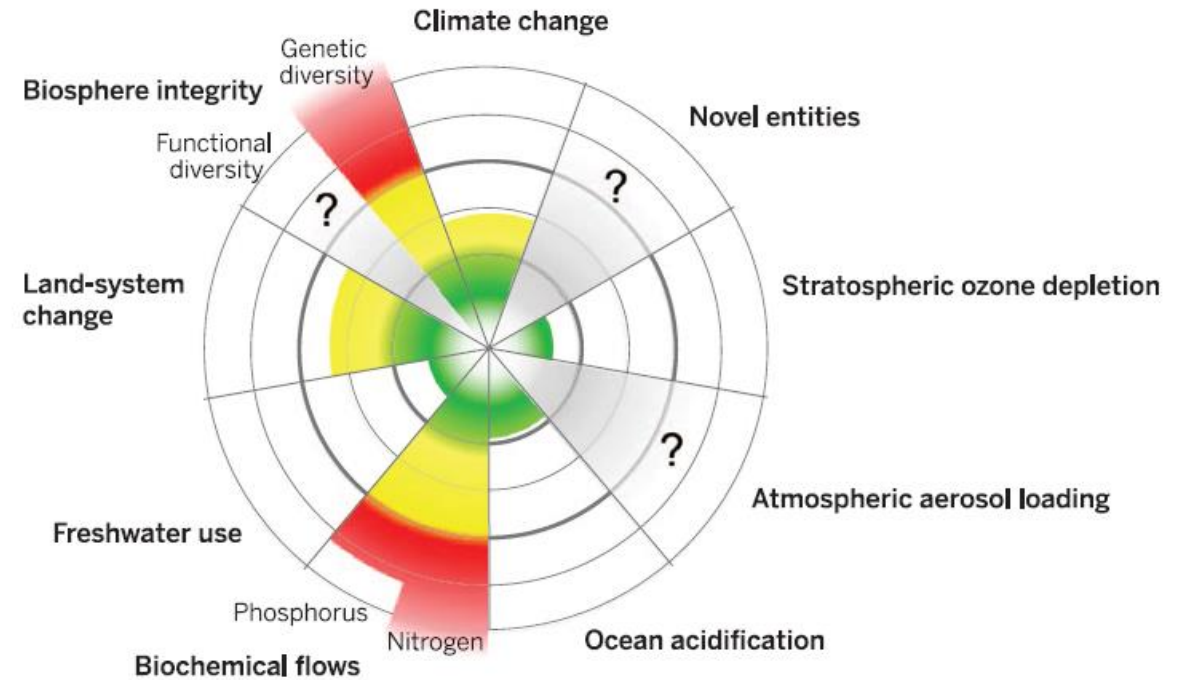
- Boundaries as intervals
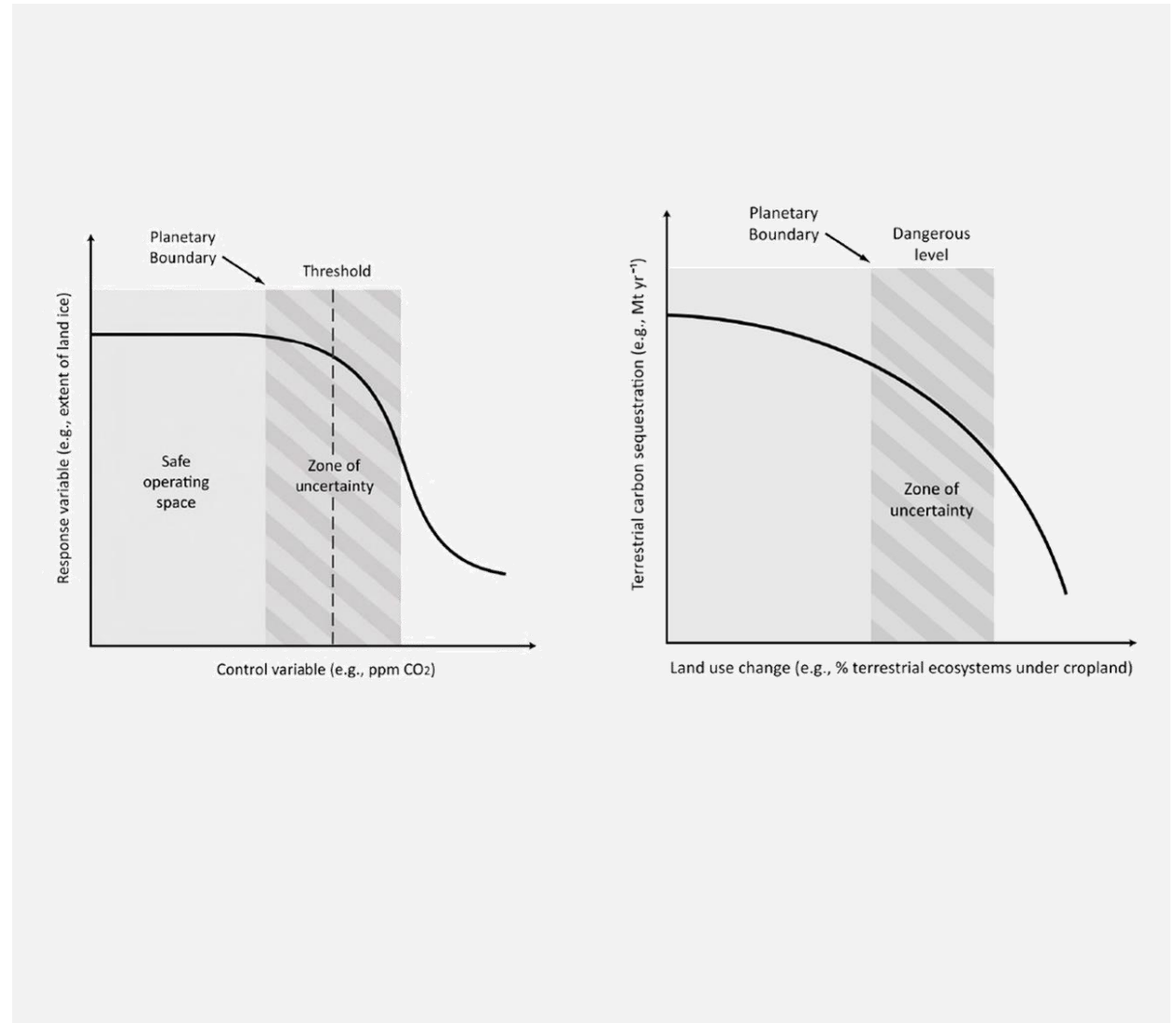
ENVIRONMENTAL METRICS AT THE GLOBAL SCALE

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Example: Planetary Boundaries

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- Boundaries as intervals

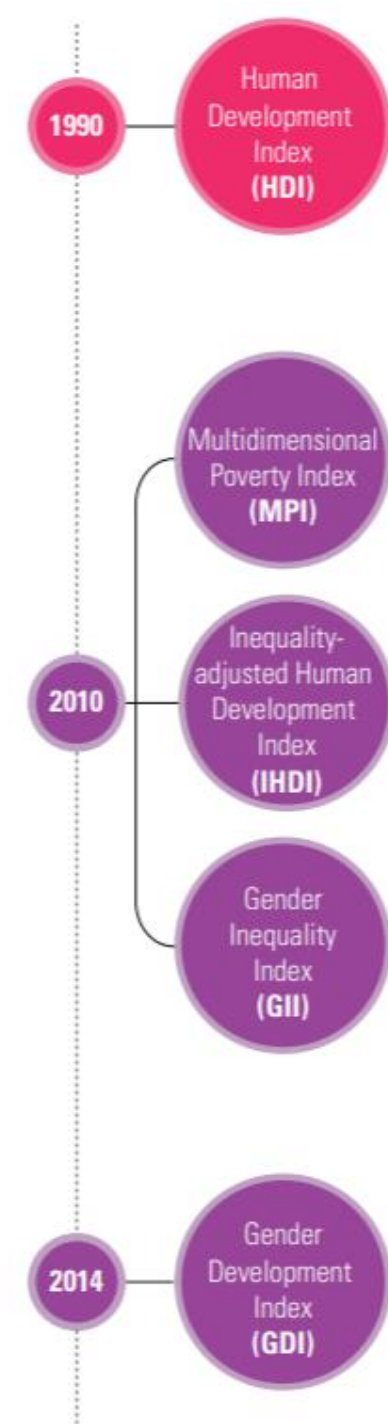# SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators

- Human Development Index (HDI),
- Life satisfaction,
- Life expectancy

SOCIAL METRICS AT THE GLOBAL SCALE
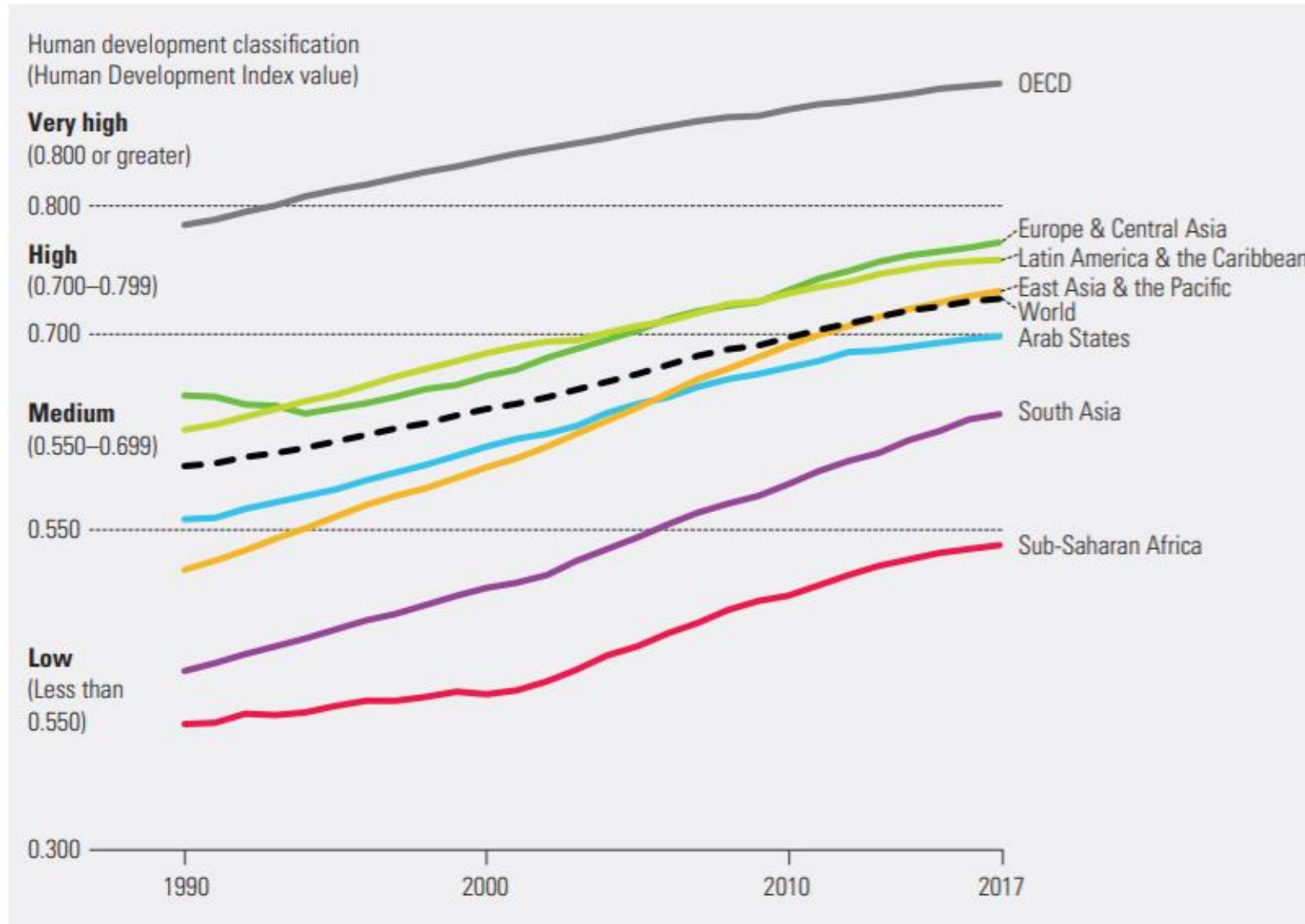
Human Development Index (HDI)

The HDI was created in 1990 (by the UNDP), and accounts three dimensions:

1. **Long and healthy life**, assessed by life expectancy at birth,

2. **Knowledge**, measured by (1) expected years of schooling (for children entering school age); and (2) mean years of schooling for adults aged 25.

3. **Standard of living**, measured by gross national income per capita. The HDI uses the logarithm of income, to reflect the diminishing importance of income with increasing GNI.

1990 — Human Development Index (HDI)

2010 — Multidimensional Poverty Index (MPI)

Inequality-adjusted Human Development Index (IHDI)

Gender Inequality Index (GII)

2014 — Gender Development Index (GDI)

SOCIAL METRICS AT THE GLOBAL SCALE

Human Development Index values, by country grouping, 1990–2017

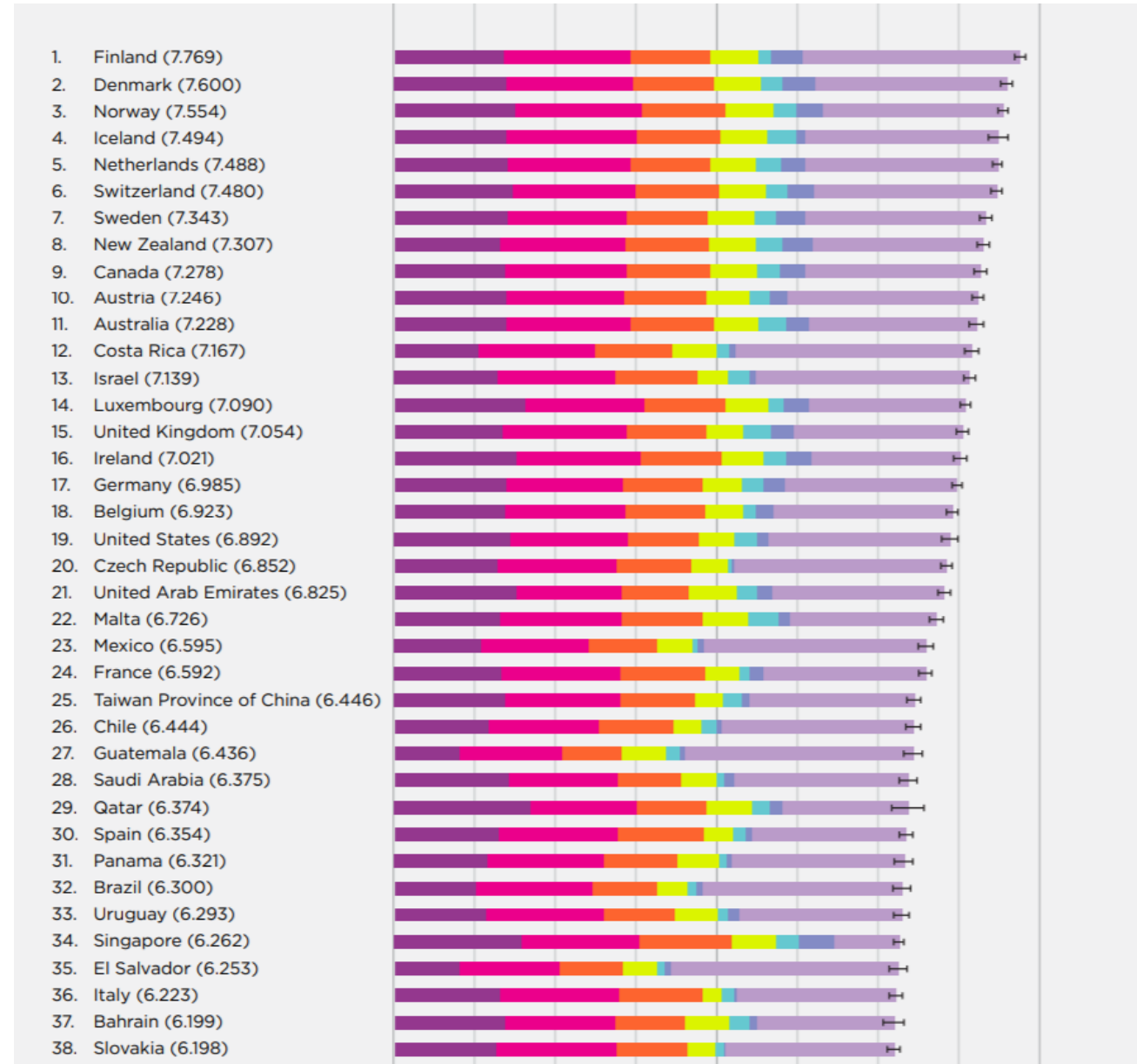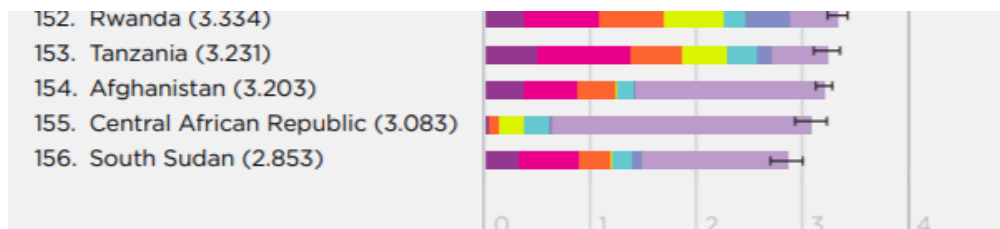
Source: Human Development Report Office.
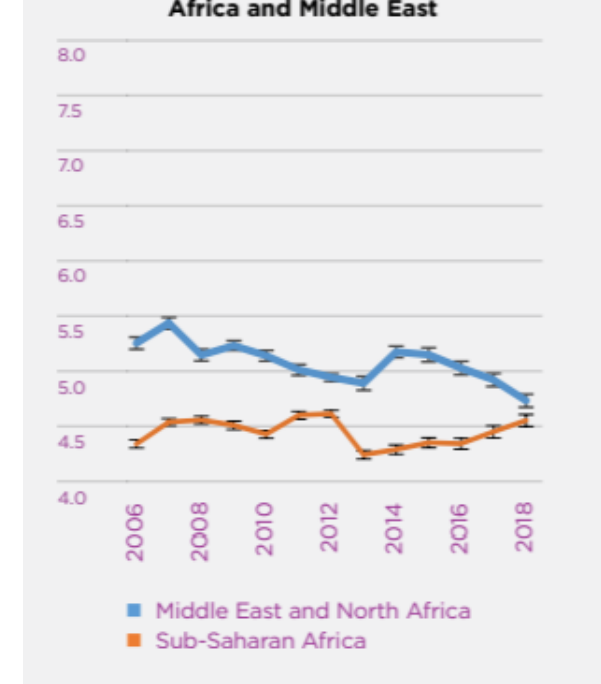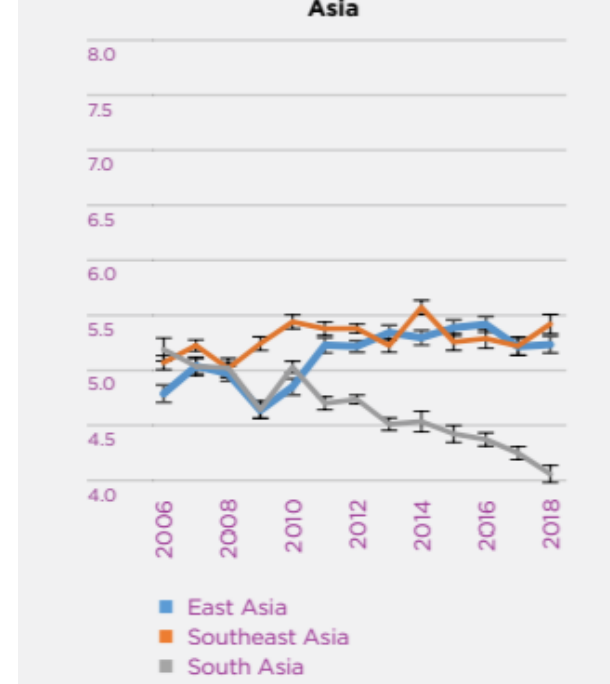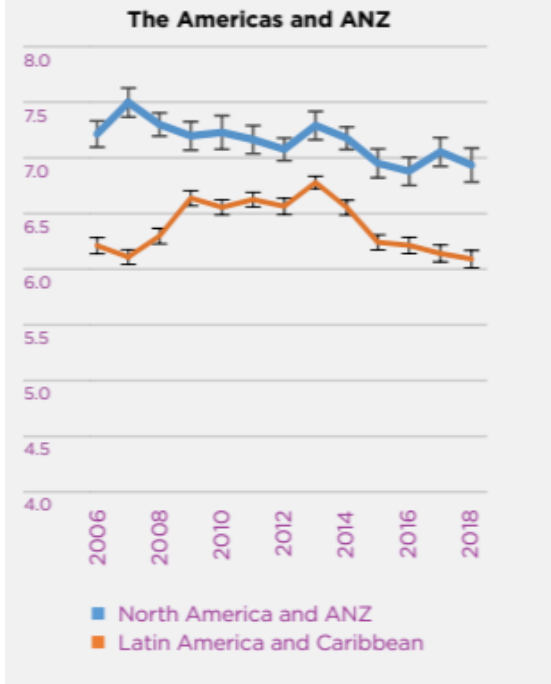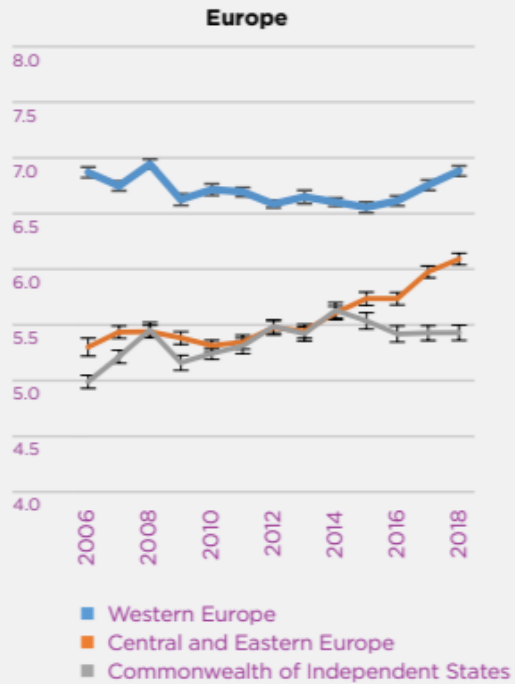
SOCIAL METRICS AT THE GLOBAL SCALE

Life satisfaction indexes

- Also known as happiness indicators

- They measure life satisfaction, using evidence from emerging science of happiness.

- Measurement: surveys
  Cantril Self-Anchoring Scale or the Ladder of Life, has been used in surveys since the 1960s, and its validity has been demonstrated in a range of different contexts around the world

1. Finland (7.769)
2. Denmark (7.600)
3. Norway (7.554)
4. Iceland (7.494)
5. Netherlands (7.488)
6. Switzerland (7.480)
7. Sweden (7.343)
8. New Zealand (7.307)
9. Canada (7.278)
10. Austria (7.246)
11. Australia (7.228)
12. Costa Rica (7.167)
13. Israel (7.139)
14. Luxembourg (7.090)
15. United Kingdom (7.054)
16. Ireland (7.021)
17. Germany (6.985)
18. Belgium (6.923)
19. United States (6.892)
20. Czech Republic (6.852)
21. United Arab Emirates (6.825)
22. Malta (6.726)
23. Mexico (6.595)
24. France (6.592)
25. Taiwan Province of China (6.446)
26. Chile (6.444)
27. Guatemala (6.436)
28. Saudi Arabia (6.375)
29. Qatar (6.374)
30. Spain (6.354)
31. Panama (6.321)
32. Brazil (6.300)
33. Uruguay (6.293)
34. Singapore (6.262)
35. El Salvador (6.253)
36. Italy (6.223)
37. Bahrain (6.199)
38. Slovakia (6.198)

152. Rwanda (3.334)
153. Tanzania (3.231)
154. Afghanistan (3.203)
155. Central African Republic (3.083)
156. South Sudan (2.853)

SOCIAL METRICS AT THE GLOBAL SCALE

Life satisfaction indexes

World Happiness Report, 2019

SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators

- **Minimum Standards**

Environmental indicators: Boundaries, thresholds, biocapacity that we cannot transgress
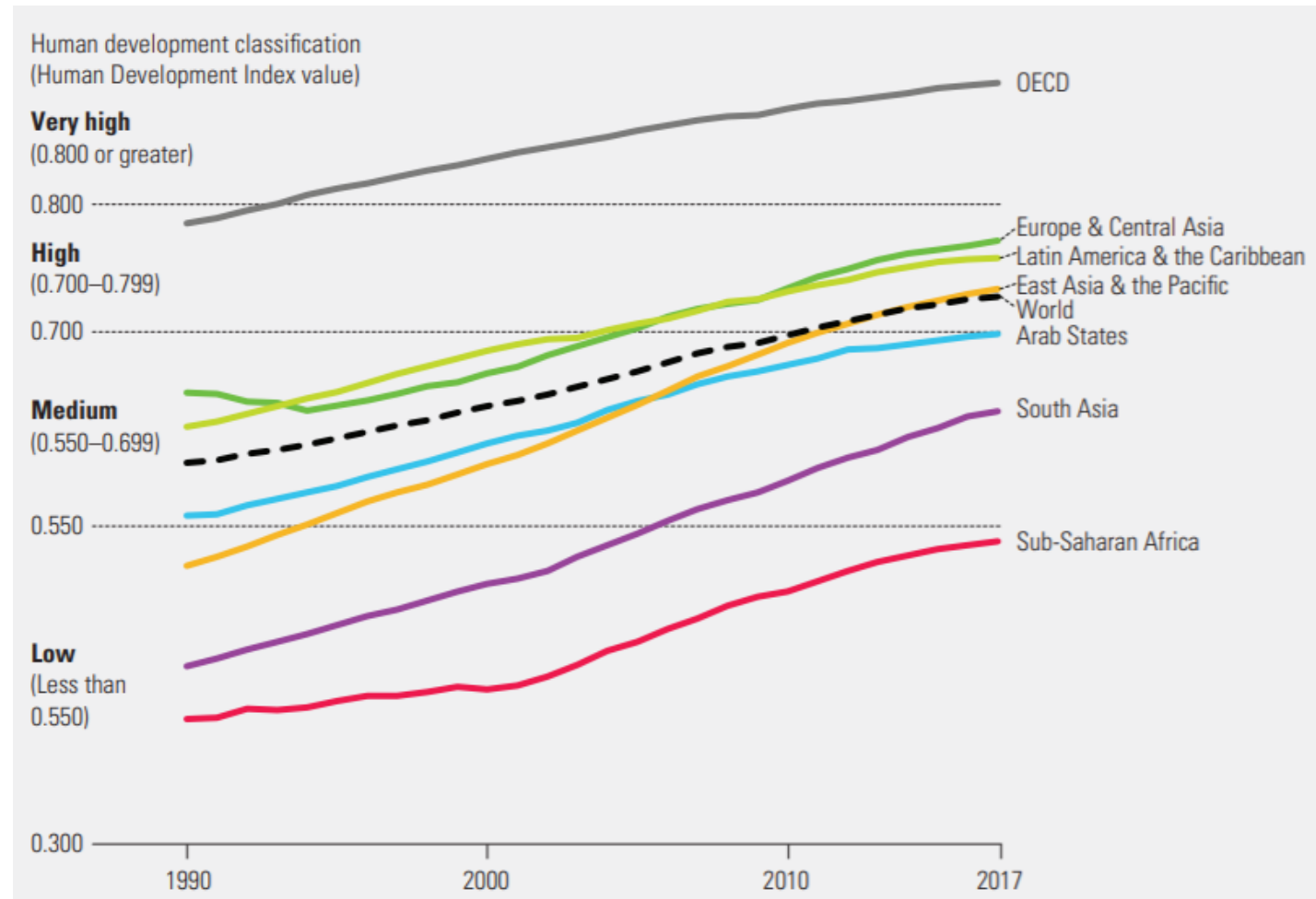
Social: Minimum standards, basic needs, where we need to ensure the minimum is satisfied

SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators
- Minimum Standards

HDI: 4 threshold levels

Human development classification
(Human Development Index value)

Very high
(0.800 or greater)

0.800

High
(0.700–0.799)

0.700

Medium
(0.550–0.699)

0.550

Low
(Less than
0.550)

0.300

1990   2000   2010   2017

OECD
Europe & Central Asia
Latin America & the Caribbean
East Asia & the Pacific
World
Arab States
South Asia
Sub-Saharan Africa

SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators

- Minimum Standards

United Nations Sustainable Development Goals

SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators

- Minimum Standards

United Nations Sustainable Development Goals

5 goals for 2030
1 Eradicate extreme poverty for all people everywhere
2 Reduce at least by half the proportion of men, women and children of all ages living in poverty
3 Implement nationally appropriate social protection systems and measures and achieve substantial coverage of the poor and the vulnerable
4 Ensure that all men and women, have equal rights to economic resources, access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services
5 Build the resilience of the poor and those in vulnerable situations

SOCIAL METRICS AT THE GLOBAL SCALE

- Social indicators

- Minimum Standards

- Aspects that sustainability social indicators need to cover:
  - Fairness, distribution and justice
  - Intragenerations and intergenerations

Ensuring all present populations have access to water, food, employment, etc

Future generations are able to satisfy their needs

ECONOMIC METRICS AT THE GLOBAL SCALE

- Economic indicators

- GDP

- ISEW, GPI, Green GDP

ECONOMIC METRICS AT THE GLOBAL SCALE

- Economic indicators

GDP – Gross Domestic Product

- It's the economic indicator.

- It measures how much is produced by a country of region or how much a country or region earned – used as a **measure of welfare**.

- It does not include:
  - Economic aspects such as unpaid household labour
  - Social aspects such as: social costs, income distribution
  - Environmental damage

- Includes negative aspects such as negative human health effects, loss of leisure time

ECONOMIC METRICS AT THE GLOBAL SCALE

- Economic indicators

Alternatives

- ISEW – Index of Sustainable Economic Welfare

- GPI – Genuine Progress Indicator

- Green GDP

- Try to include:
  - Economic aspects such as unpaid household labour
  - Social aspects such as: social costs, income distribution
  - Environmental damage

- Try to eliminate: negative human health effects, loss of leisure time

ECONOMIC METRICS AT THE GLOBAL SCALE

- Economic indicators

- Should be able to tell how to allocate resources
(how much goes to basic needs, how much goes to other products and services)

METRICS AT THE GLOBAL SCALE

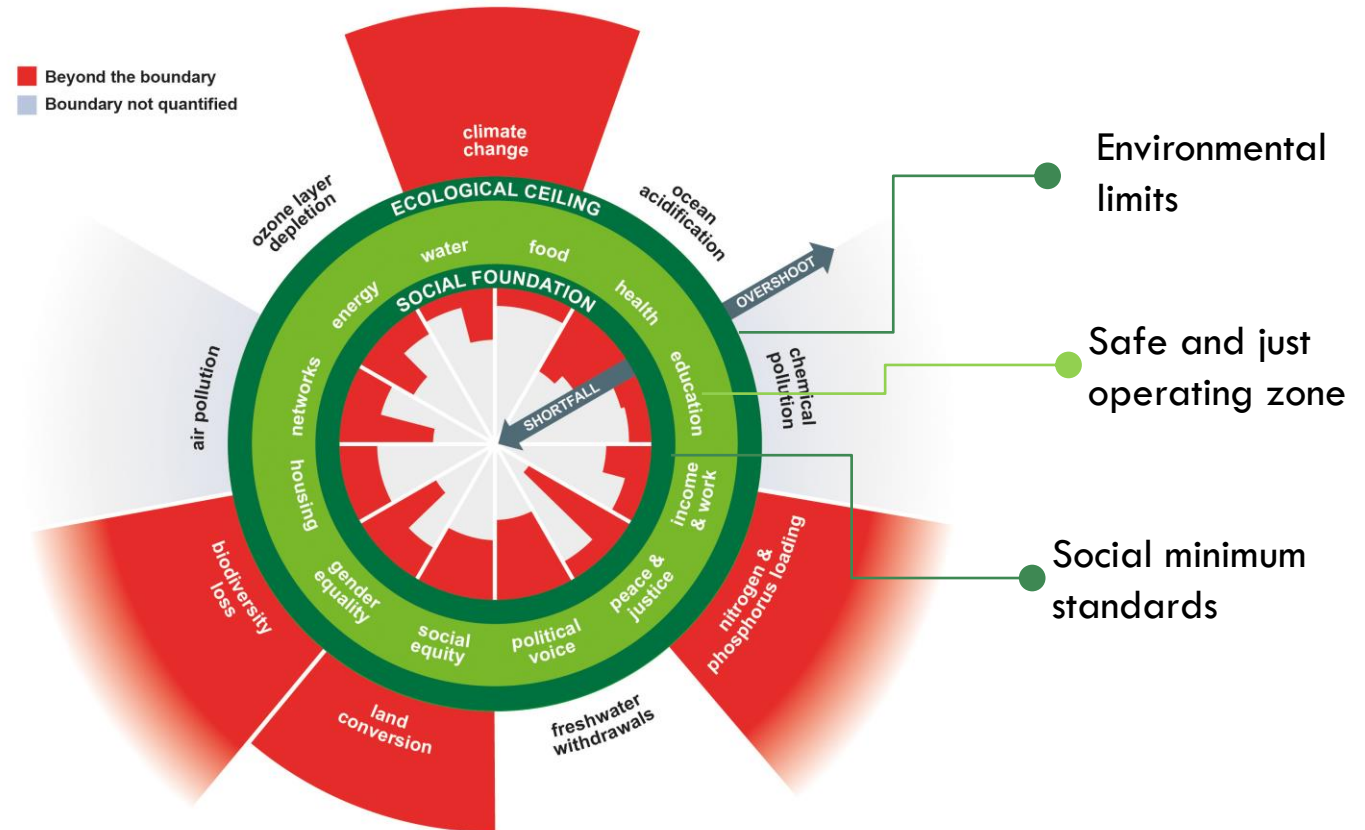- Indicators that combine two or more SD dimensions

Why is it relevant?

- Maximise more than one goal

- Consider trade-offs
  - Things can be good economically, but not good socially or environmentally

Examples

- Increasing GDP means little in terms of:
  - Income distribution
  - Environment protection

METRICS AT THE GLOBAL SCALE

- Indicators that combine two or more SD dimensions

Why is it relevant?

- Maximise more than one goal

- Consider trade-offs
    - Things can be good economically, but not good socially or environmentally
    - Things that are good socially might not be good environmentally

Examples

- Fossil fuel-based transport (e.g., road, aviation)

- Food products globalized and out-of-season production available all year round

- Intensive farming (produce food surpluses, produces higher environmental impacts than other alternatives)

- Excessive consumerism

- Excessive tourism

METRICS AT THE GLOBAL SCALE

- Indicators that combine two or more SD dimensions

Why is it relevant?

- Maximise more than one goal
- Consider trade-offs
  - Things can be good economically, but not good socially or environmentally
  - Things that are good socially might not be good environmentally
  - Within the environment, some aspects may be good in some environmental aspects and not so good in others

Examples

- Dishwasher vs handwashing (water vs. energy)
- Large dams (good for climate change, not so good for land and biodiversity)
- Diesel vs gasoline (air pollution vs climate change)

METRICS AT THE GLOBAL SCALE

- Indicators that combine two or more SD dimensions

- Ex.: Safe and just space

Doughnut economics framework (2017)
https://www.kateraworth.com/doughnut/

METRICS AT THE GLOBAL SCALE

- Indicators that combine two or more SD dimensions

- Examples:
  - Safe and just space
  - Happy Planet Index
  - Other combined frameworks

METRICS AT THE REGIONAL SCALE

- Territorial, Consumption and Income based indicators

METRICS AT THE REGIONAL SCALE
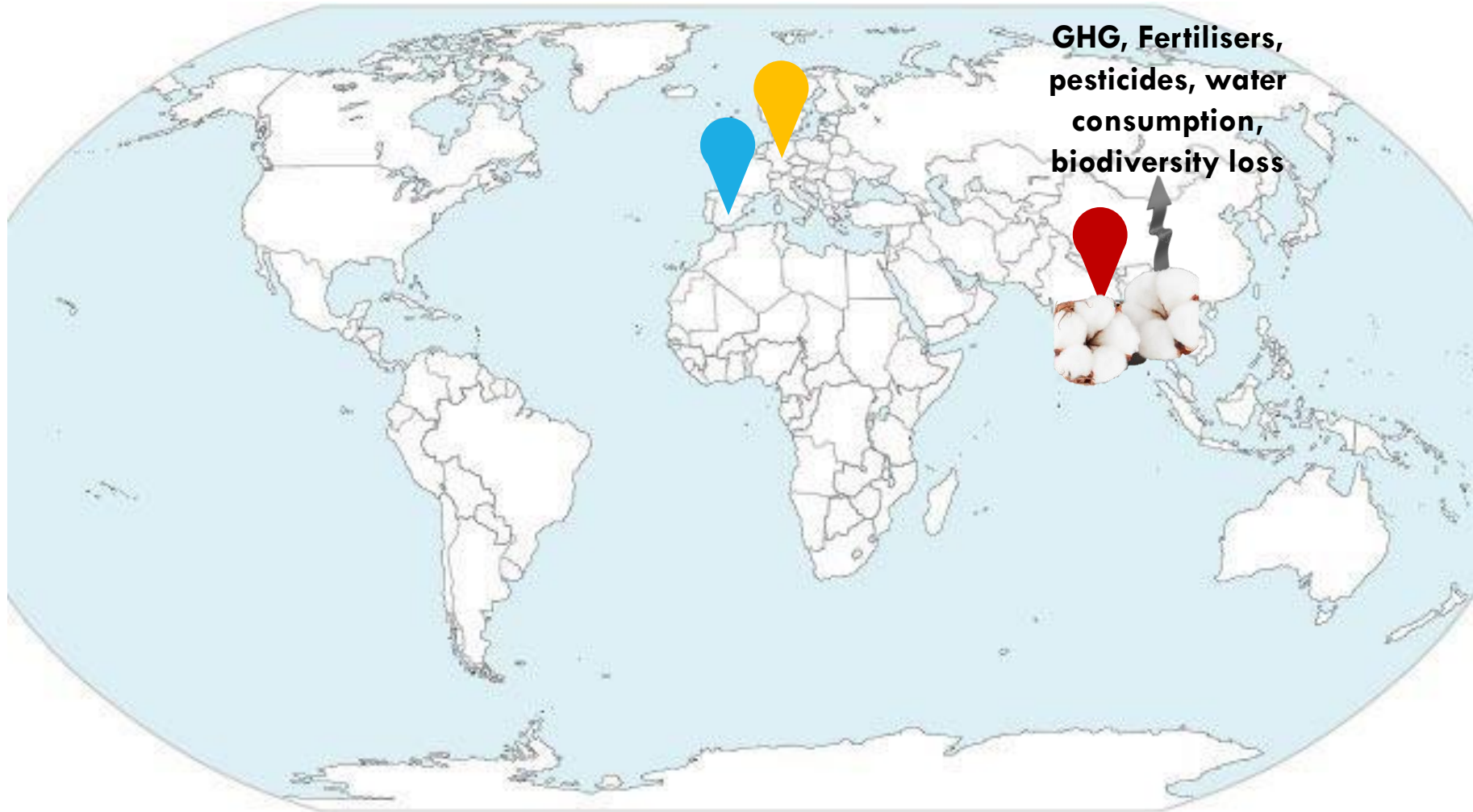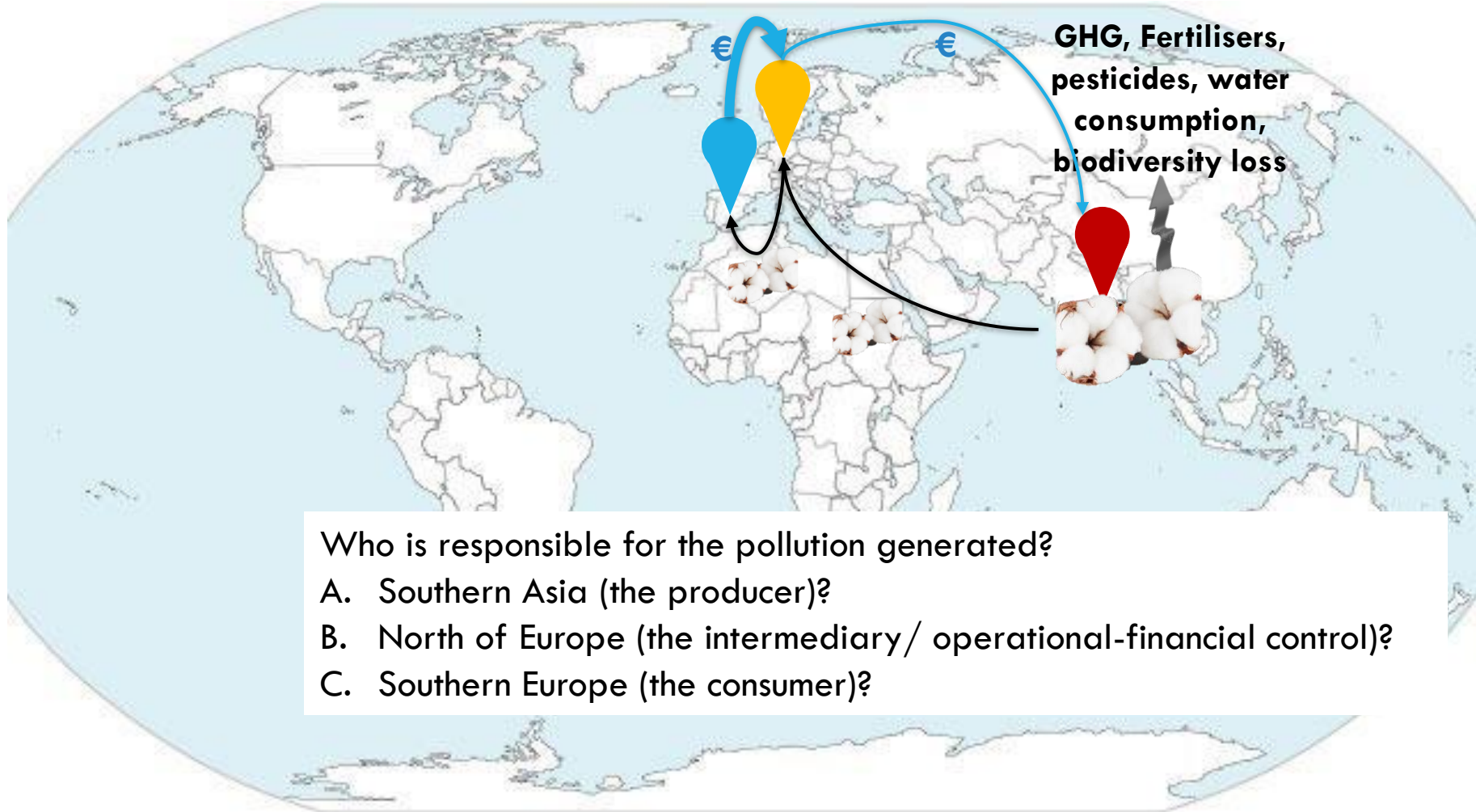
- Territorial, Consumption and Income based indicators

GHG, Fertilisers, pesticides, water consumption, biodiversity loss

METRICS AT THE REGIONAL SCALE

- Territorial, Consumption and Income based indicators

GHG, Fertilisers, pesticides, water consumption, biodiversity loss

Who is responsible for the pollution generated?
A. Southern Asia (the producer)?
B. North of Europe (the intermediary/ operational-financial control)?
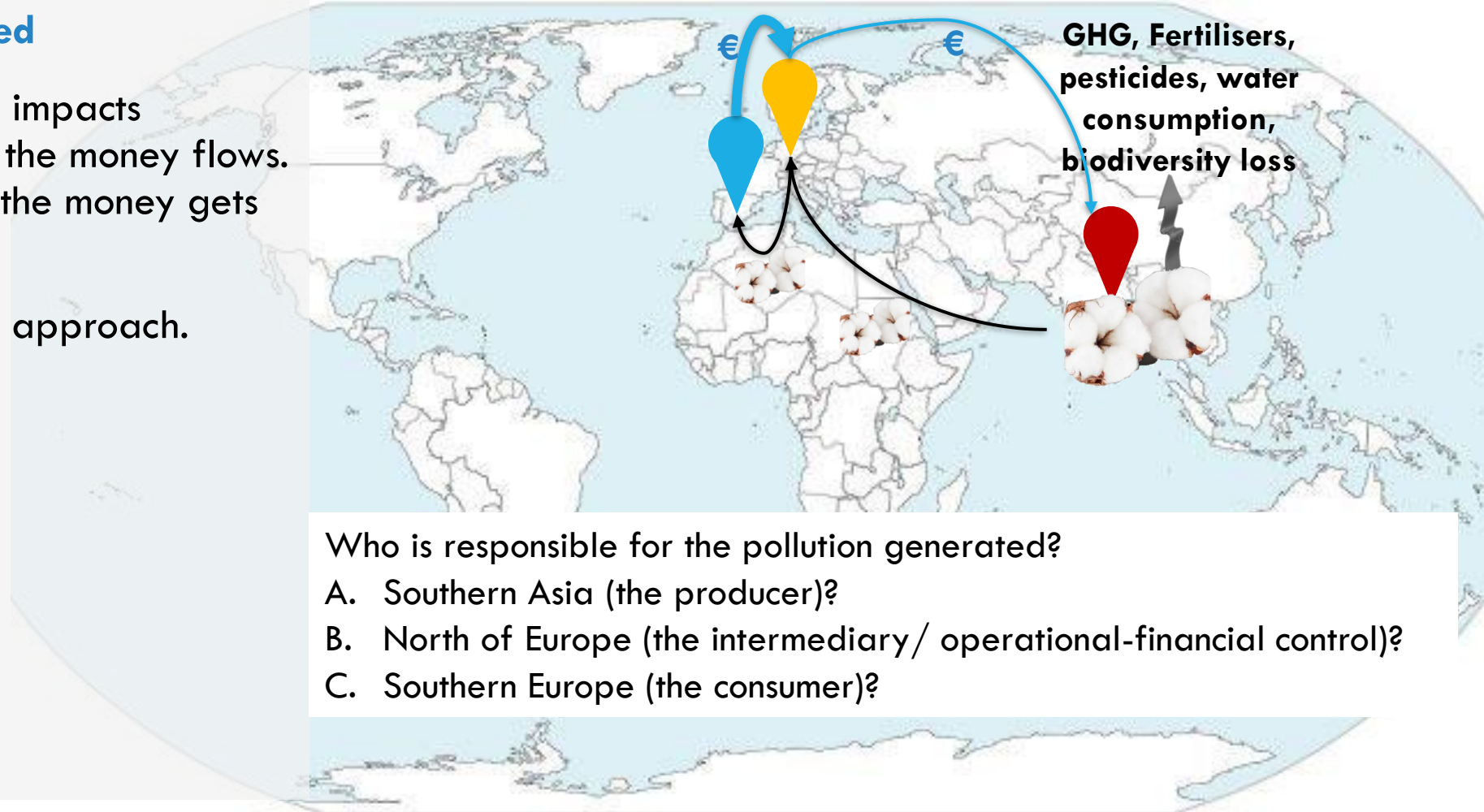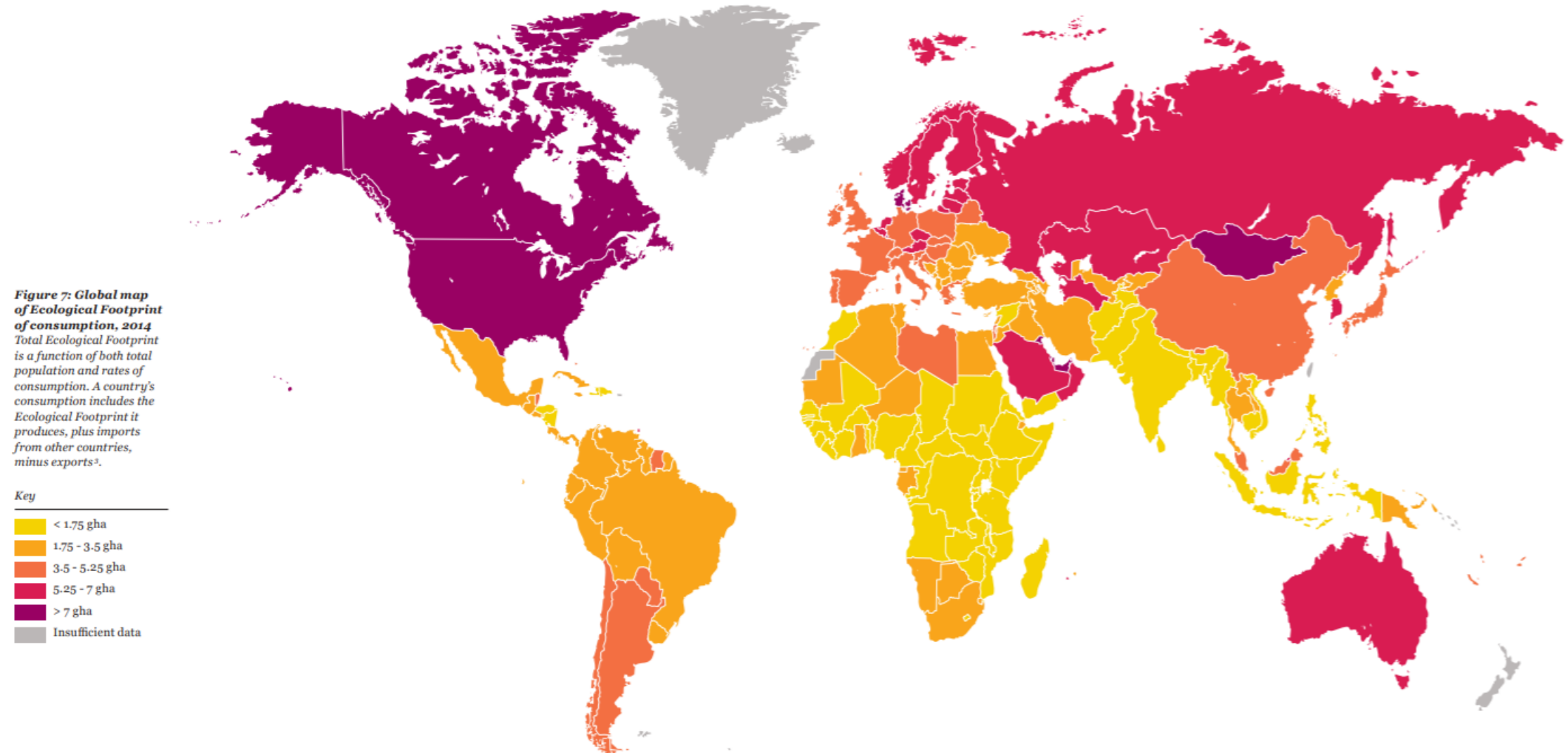C. Southern Europe (the consumer)?

METRICS AT THE REGIONAL SCALE

- Territorial, Consumption and Income based indicators

Territorial based

Consider only the activities that happen within the territorial borders. Excludes imports and exports.

Most environmental accounting.

Answer: A.

GHG, Fertilisers, pesticides, water consumption, biodiversity loss

Who is responsible for the pollution generated?
A. Southern Asia (the producer)?
B. North of Europe (the intermediary/ operational-financial control)?
C. Southern Europe (the consumer)?
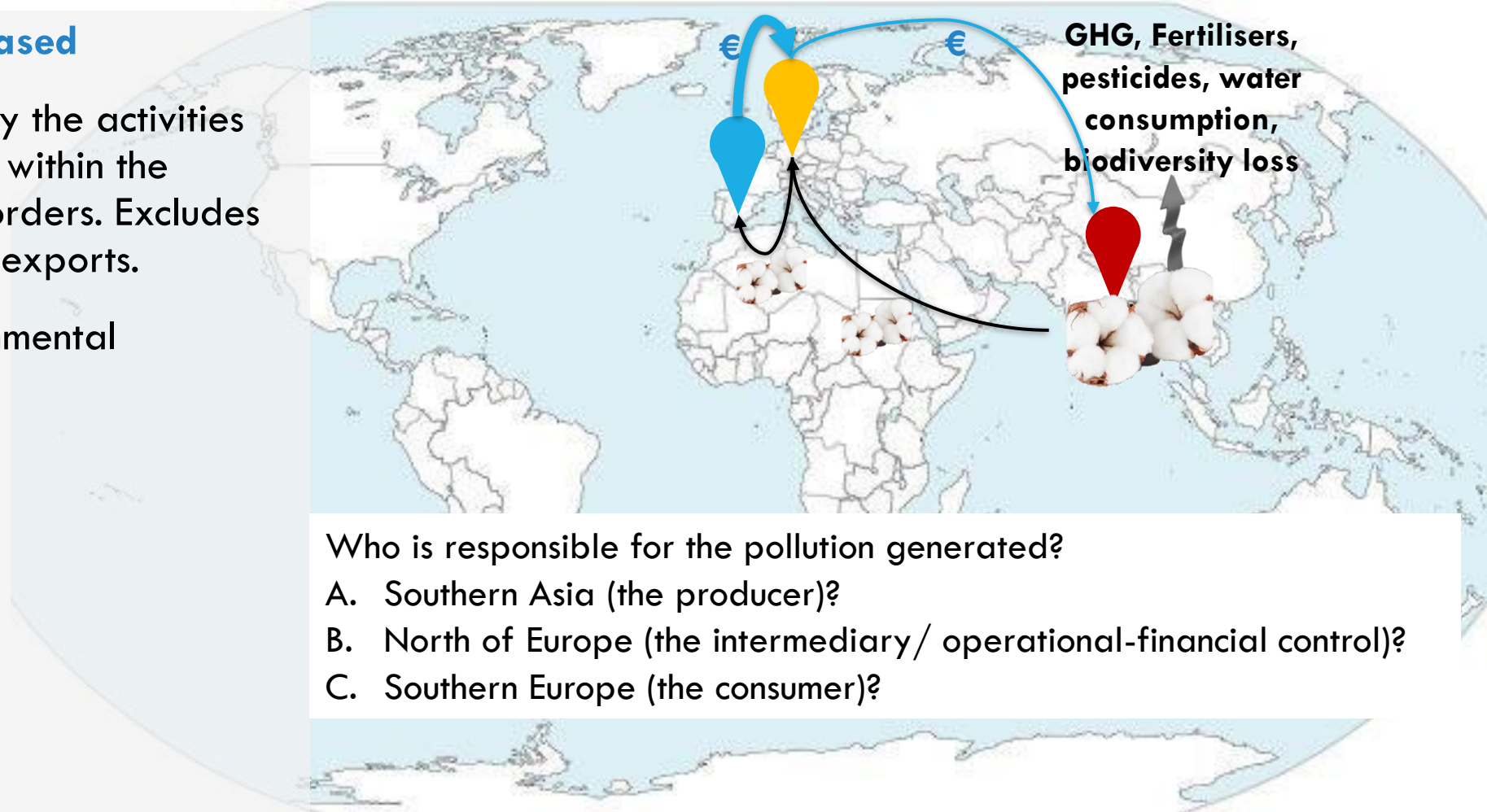
METRICS AT THE REGIONAL SCALE

- Territorial, Consumption and Income based indicators

Consumption based

Consider the impacts of the production activities associated with the products consumed, no matter where they occur. Accounts for imports and exports.

This is the case of national economic accounts.

Answer: C.

GHG, Fertilisers, pesticides, water consumption, biodiversity loss

Who is responsible for the pollution generated?
A. Southern Asia (the producer)?
B. North of Europe (the intermediary/ operational-financial control)?
C. Southern Europe (the consumer)?
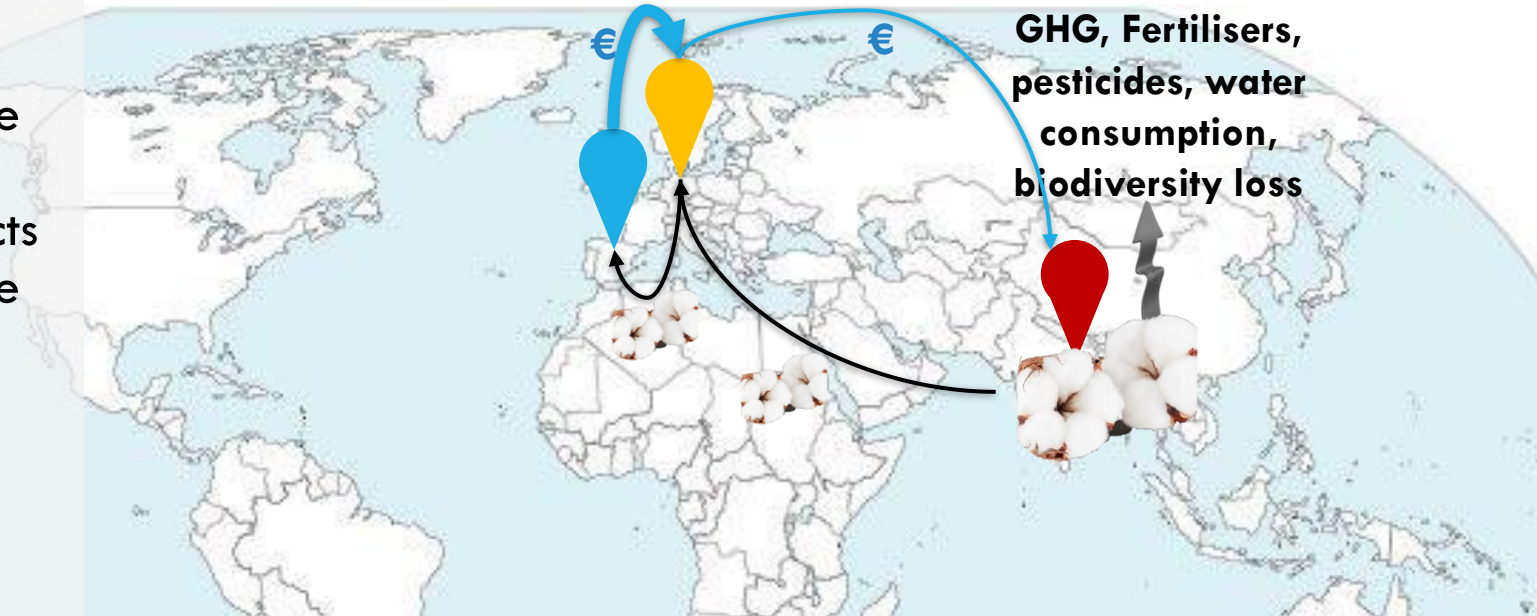
METRICS AT THE REGIONAL SCALE

- Territorial, Consumption and Income based indicators

Income based

Consider the impacts allocated to the money flows. Who makes the money gets penalized.

This is a new approach.

Answer: B.

GHG, Fertilisers, pesticides, water consumption, biodiversity loss

Who is responsible for the pollution generated?
A. Southern Asia (the producer)?
B. North of Europe (the intermediary/ operational-financial control)?
C. Southern Europe (the consumer)?

METRICS AT THE REGIONAL SCALE

- What do the indicators tell us about regional sustainability?

- Who is sustainable and who is not?

METRICS AT THE REGIONAL SCALE

- Ecological Footprint – consumption base

Figure 7: Global map of Ecological Footprint of consumption, 2014
Total Ecological Footprint is a function of both total population and rates of consumption. A country's consumption includes the Ecological Footprint it produces, plus imports from other countries, minus exports[3].

Key

- < 1.75 gha
- 1.75 - 3.5 gha
- 3.5 - 5.25 gha
- 5.25 - 7 gha
- > 7 gha
- Insufficient data

METRICS AT THE REGIONAL SCALE

- Planetary Boundaries Framework – consumption base

METRICS AT THE REGIONAL SCALE

- Safe and just Space – Social component – territorial-based

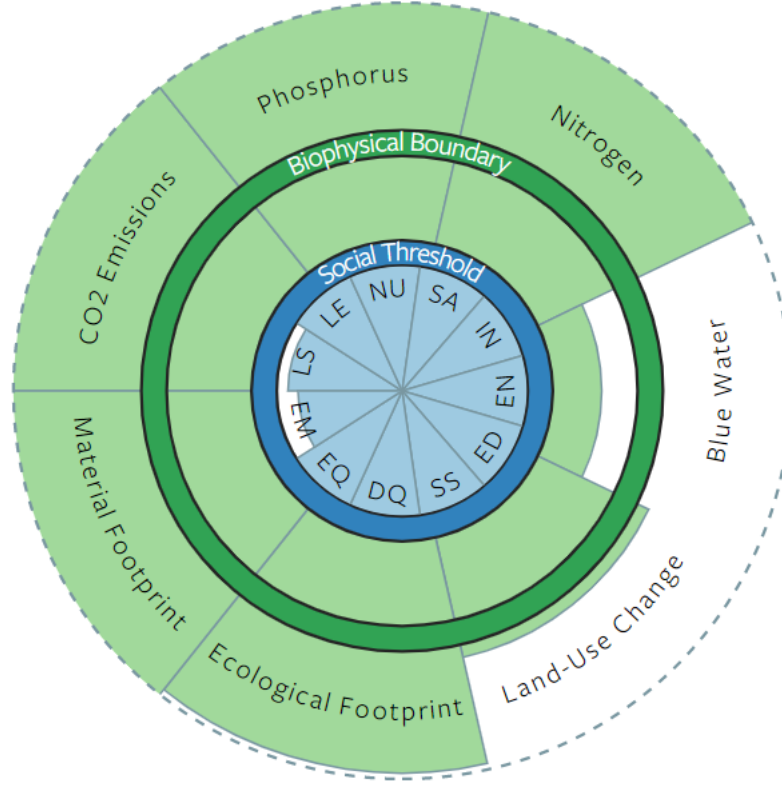Source: O'Neill et al. 2018
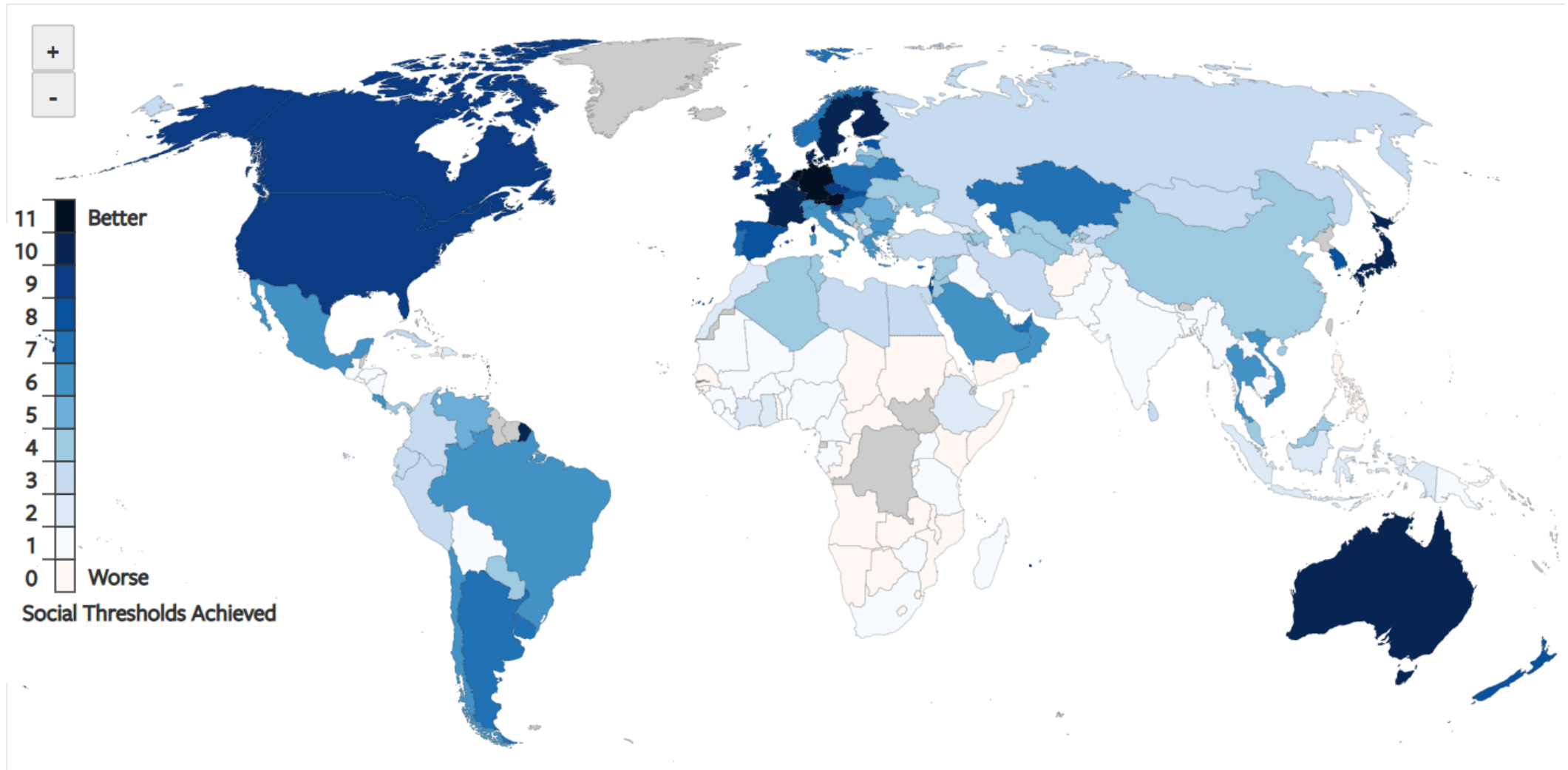
METRICS AT THE REGIONAL SCALE

- Happy Planet Index

METRICS AT THE REGIONAL SCALE

- Happy Planet Index – territorial based
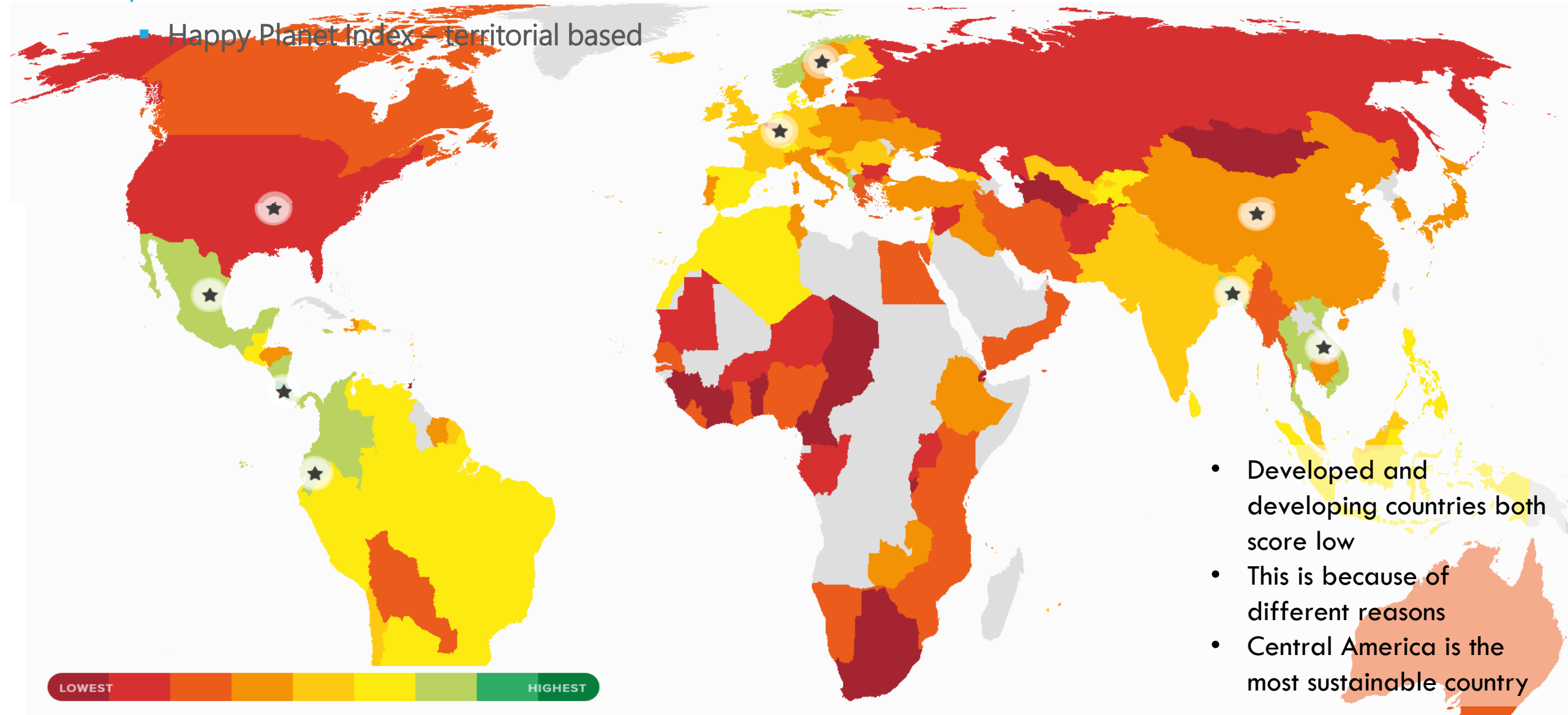
- Developed and developing countries both score low
- This is because of different reasons
- Central America is the most sustainable country

LOWEST   HIGHEST

METRICS AT THE REGIONAL SCALE

- HDI and EF – Territorial based

Human Welfare and Ecological Footprints compared

METRICS AT THE REGIONAL SCALE

- Safe and just Space – Social component (territorial-based)

METRICS AT THE REGIONAL SCALE

- Safe and just Space

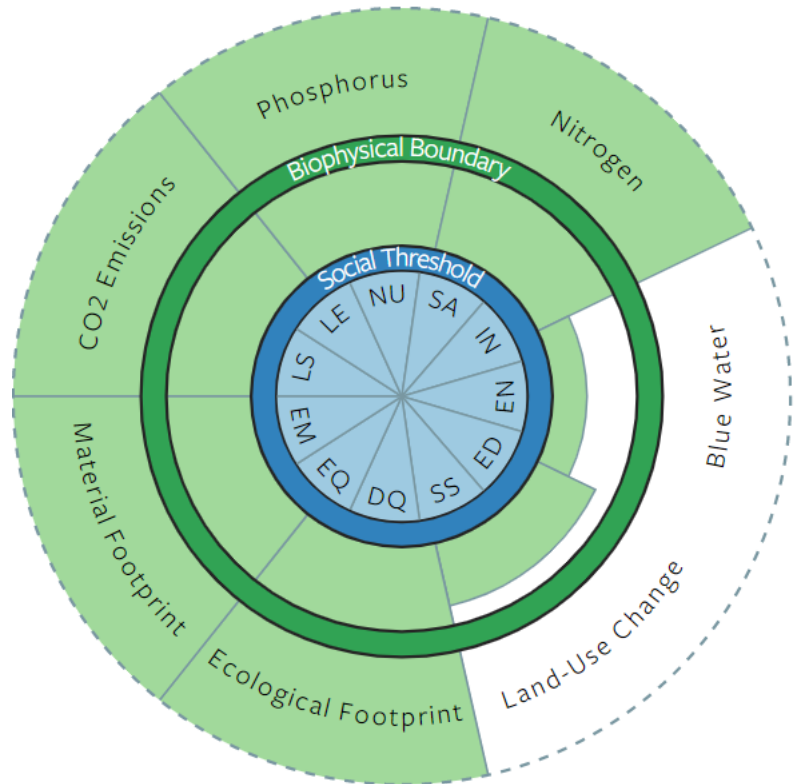| LS - Life Satisfaction	ED - Education
LE - Healthy Life Expect.	SS - Social Support
NU - Nutrition	DQ - Democratic Quality
SA - Sanitation	EQ - Equality
IN - Income	EM - Employment
EN - Access to Energy	

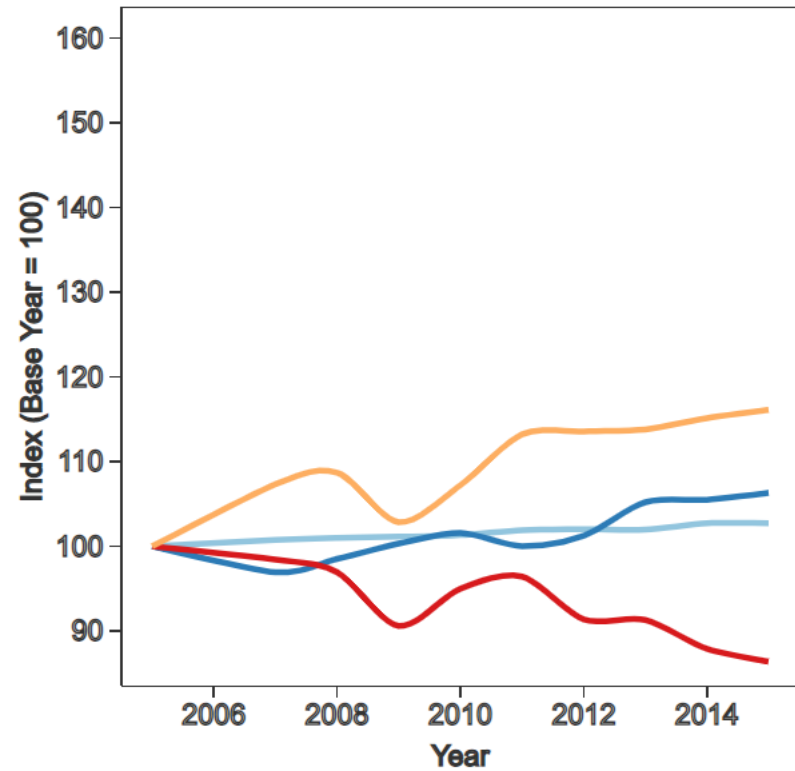# METRICS AT THE REGIONAL SCALE

- Safe and just Space

LS - Life Satisfaction   ED - Education
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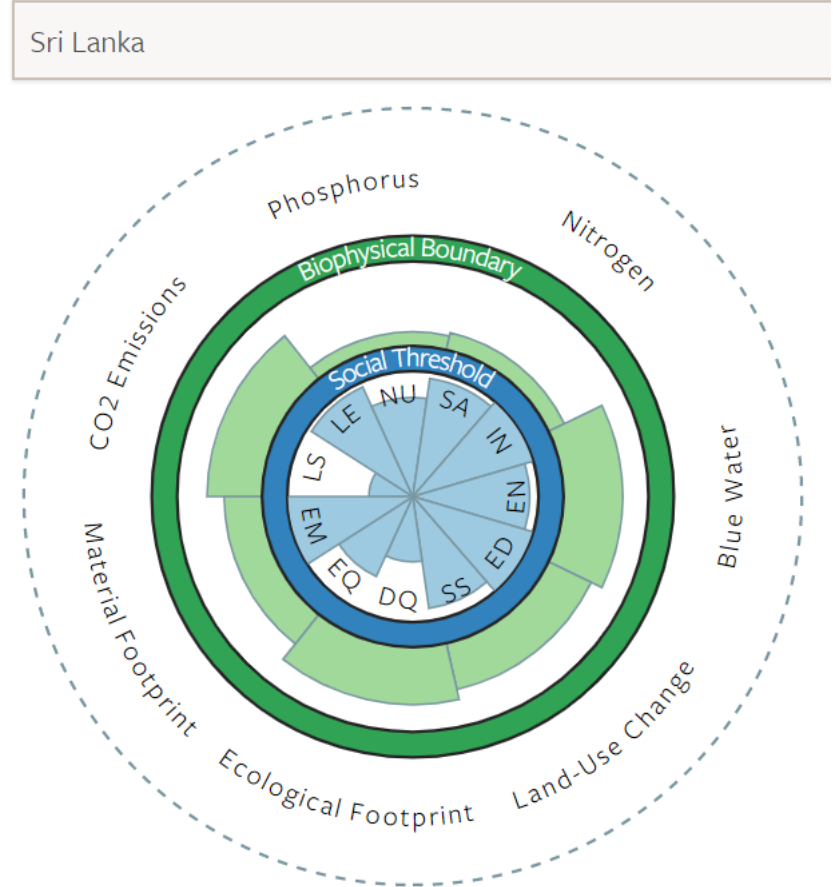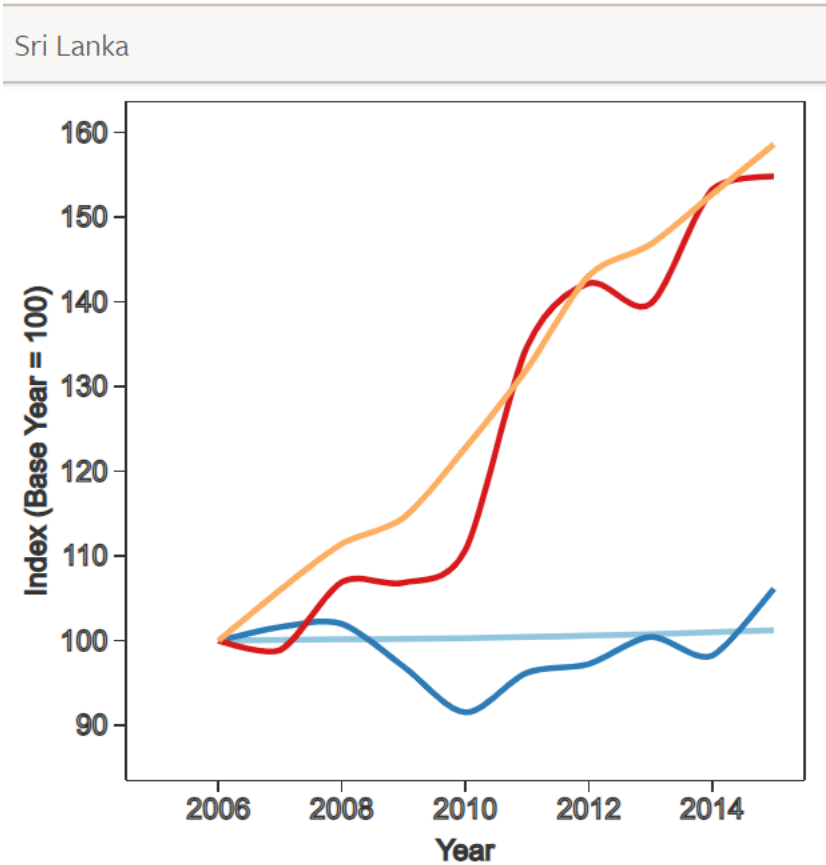IN - Income   EM - Employment
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METRICS AT THE REGIONAL SCALE

- Safe and just Space

METRICS AT THE REGIONAL SCALE
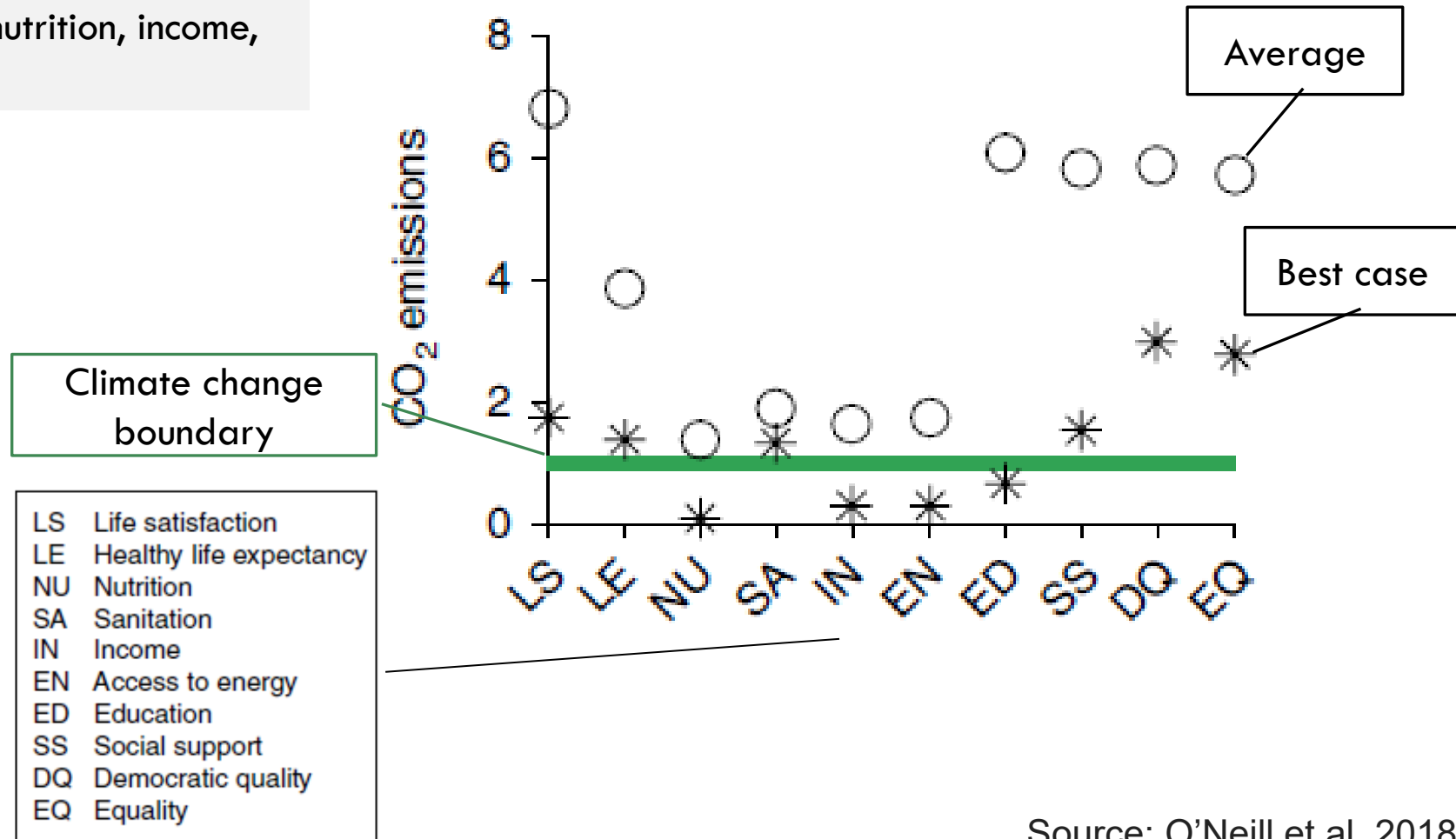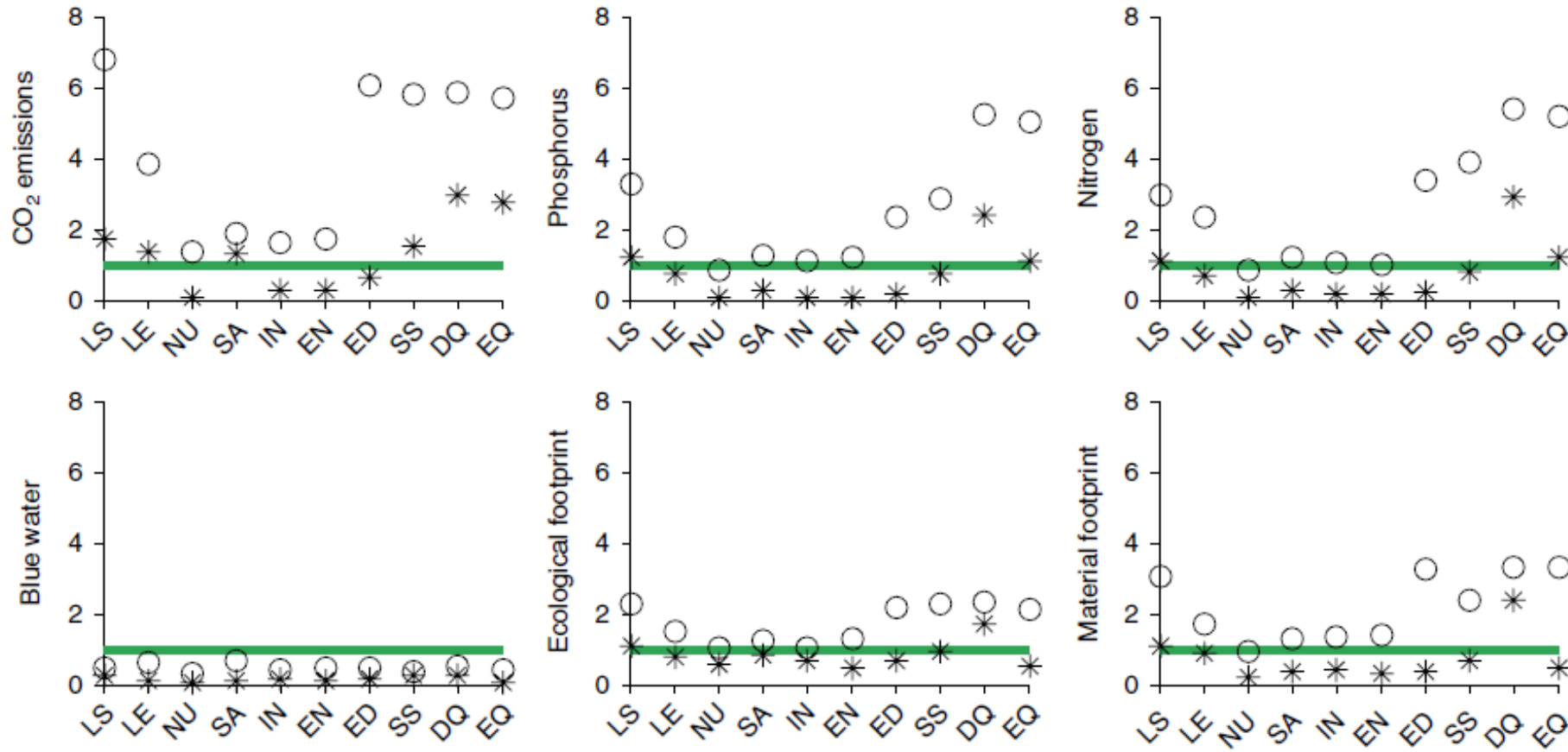
- Safe and just Space

HOW MANY RESOURCES WE NEED TO FULFILL OUR NEEDS?

On average, no country can fulfill basic needs respecting climate change
There are exceptional cases for nutrition, income, access to energy, equality

How many CO_2 emissions we need to fulfill the world's basic needs

Average

Best case

Climate change boundary

LS Life satisfaction
LE Healthy life expectancy
NU Nutrition
SA Sanitation
IN Income
EN Access to energy
ED Education
SS Social support
DQ Democratic quality
EQ Equality

Source: O'Neill et al. 2018

HOW MANY RESOURCES WE NEED TO FULFILL OUR NEEDS?

Source: O'Neill et al. 2018

IPAT

- How important is affluence compared to population?

IPAT

- IPAT – the weight of Affluence

Biogeochemical flows – Nitrogen flows:
8.9 Tg N .person^{-1}.yr^{-1}

Canada	15.16	Ghana, Cameroon and Malawi	0.11
Norway	12.13	Mozambique	0.09
Finland	10.82	Nigeria and Madagascar	0.08
Sweden	10.68	Côte d'Ivoire	0.07
Lithuania	10.37	Tanzania, Uganda and Somalia	0.05

(Portugal: 5.42)

44% countries are living below Earth's biocapacity

IPAT

- IPAT – the weight of Affluence

Biogeochemical flows – Nitrogen flows: *We have crossed the boundary*
8.9 Tg N .person^{-1}.yr^{-1} *worldwide*

Canada	15.16	Ghana, Cameroon and Malawi	0.11
Norway	12.13	Mozambique	0.09
Finland	10.82	Nigeria and Madagascar	0.08
Sweden	10.68	Côte d'Ivoire	0.07
Lithuania	10.37	Tanzania, Uganda and Somalia	0.05

(Portugal: 5.42)

44% countries are living below
Earth's biocapacity

IPAT

- IPAT – the weight of Affluence

Climate change – GHG emissions:
1.61 $tCO_2.person^{-1}.yr^{-1}$

Qatar	20.75	Central African Republic, Liberia and Mali	0.08
Singapore	19.19	Niger	0.07
Kuwait	18.22	Côte d'Ivoire	0.06
United Arab Emirates	14.51	Somalia	0.05
United States of America	13.14	Chad	0.04

34% countries are living below Earth's biocapacity

IPAT

- IPAT – the weight of Affluence

Ecological footprint:
1.7 gha.person^{-1}.yr^{-1}

Kuwait	5.15	Bangladesh	0.38
Australia	4.84	Afghanistan	0.37
United Arab Emirates	4.73	Haiti	0.31
Qatar	4.05	Eritrea	0.25
United States	3.93	East Timor	0.20

Portugal - 1.94 gha.person^{-1}.yr^{-1}
(47th)

43% countries are living below Earth's biocapacity

IPAT

- IPAT – the weight of Affluence

Affluence and Population size have both a major role in the global environmental impacts.

METRICS AT THE SECTORAL SCALE

Just a quick note of measuring sustainability in sectors of the economy

- Many indicators can be applied at the sectoral scale (e.g., Life Cycle Assessment)

- It is not simple to define boundaries. Lack of boundaries for sectors means care needs to be made for:

    - Cross sectoral impacts
    - Relative importance of sectors and the availability of resources

METRICS AT THE SECTORAL SCALE

- Many indicators can be applied at the sectoral scale (e.g., Life Cycle Assessment)

- It is not simple to define boundaries.

- **Minimum standards – services provided by sectors**

STRONG AND WEAK SUSTAINABILITY

Sustainability

Weak	Strong
Substitutability between natural capital and manufactured capital	**Complementarity** between natural capital and manufactured capital - there is a minimum level of natural capital (critical natural capital) that cannot be substituted by manufactured capital

STRONG AND WEAK SUSTAINABILITY

Which indicators are from a Strong or Weak Sustainability perspectives?

STRONG AND WEAK SUSTAINABILITY

Which indicators are from a Strong or Weak Sustainability perspectives?

Strong S.	Weak S.	
		GDP
		ISEW, GPI, Green GDP
		Happy Planet Index
		Safe and Just Space (and the Planetary Boundaries Framework)
		Ecological Footprint and the Human Development Index

STRONG AND WEAK SUSTAINABILITY

Examples of indicators:

- Planetary boundaries and Safe and just space
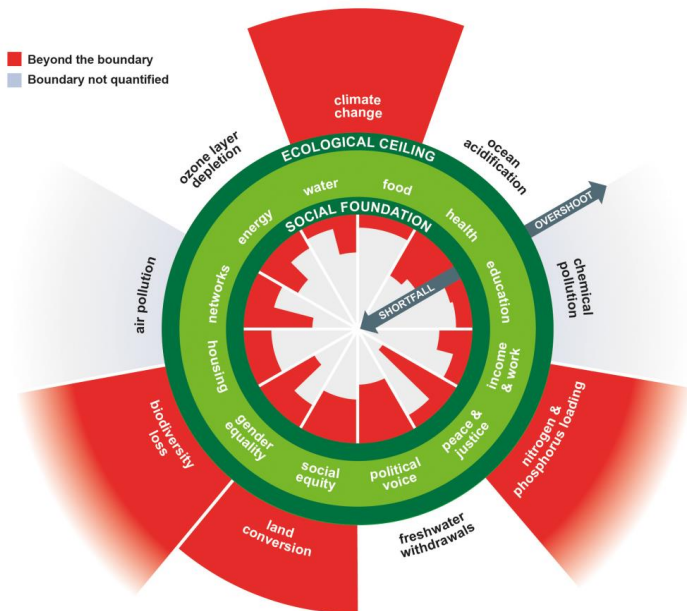
Strong

Complementarity between natural capital and manufactured capital
- there is a minimum level of natural capital (critical natural capital) that cannot be substituted by manufactured capital

Separate environmental and social aspects
Consider boundaries

STRONG AND WEAK SUSTAINABILITY

Examples of indicators:

- Ecological footprint and the human development index
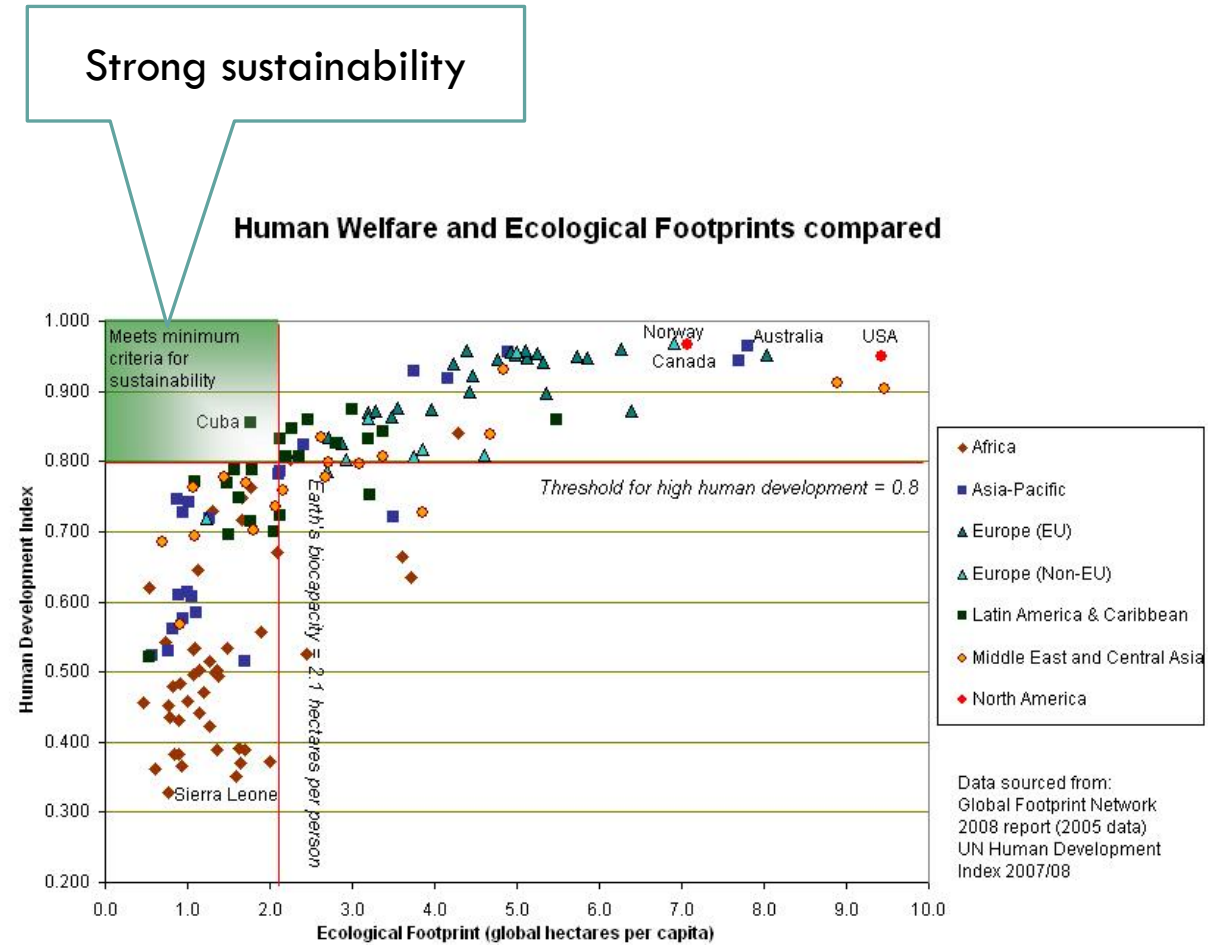
STRONG AND WEAK SUSTAINABILITY

Weak

Substitutability between natural capital and manufactured capital

Indicators under this perspective will consider substitutability by compiling economic, social and environmental dimensions into a single index

Examples of indicators:

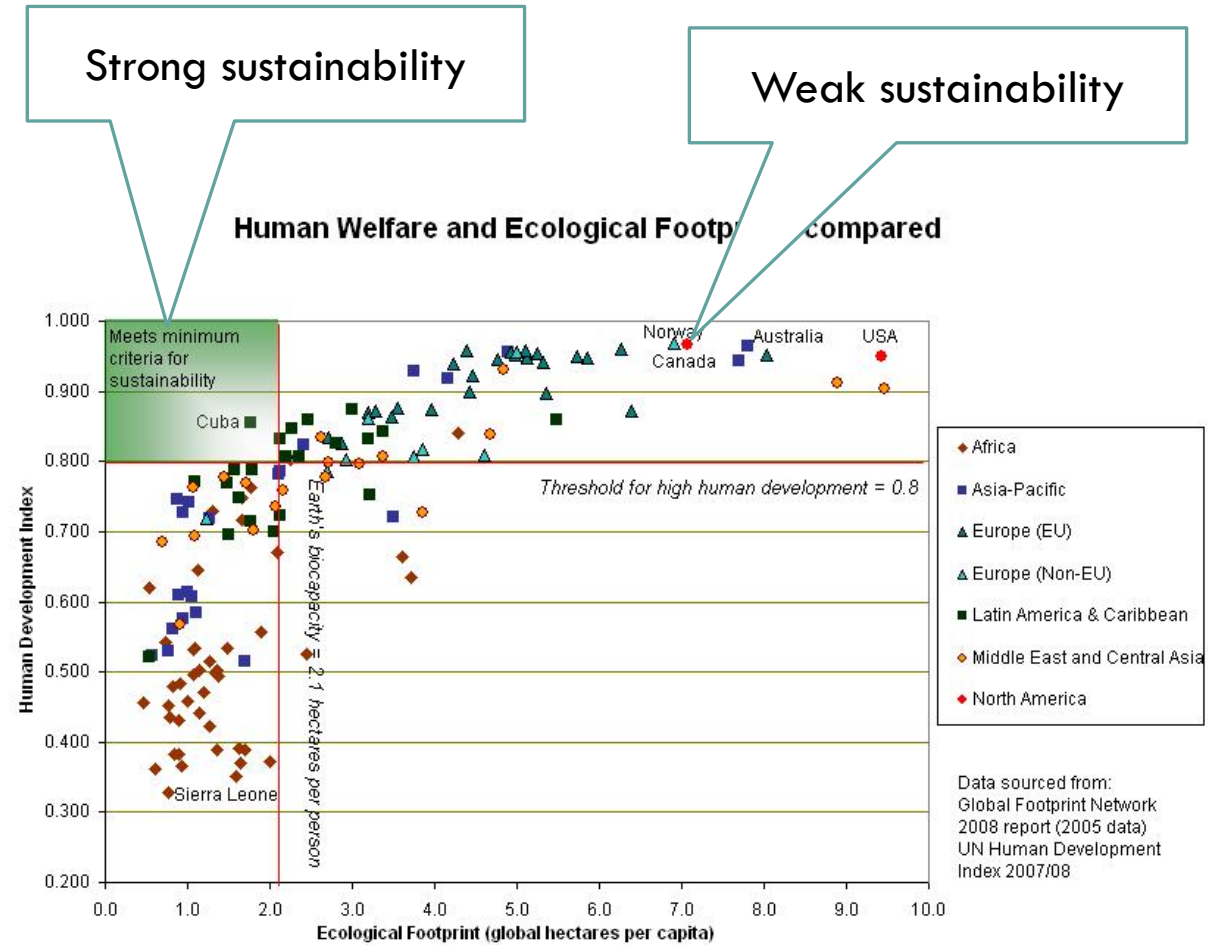- GDP, ISEW and GPI
- Happy Planet Index

STRONG AND WEAK SUSTAINABILITY

Weak

Substitutability between natural capital and manufactured capital

Indicators under this perspective will consider substitutability by compiling economic, social and environmental dimensions into a single index

Strong sustainability

Weak sustainability

Human Welfare and Ecological Footprint compared

STRONG AND WEAK SUSTAINABILITY

Weak

Substitutability between natural capital and manufactured capital

Indicators under this perspective will consider substitutability by compiling economic, social and environmental dimensions into a single index
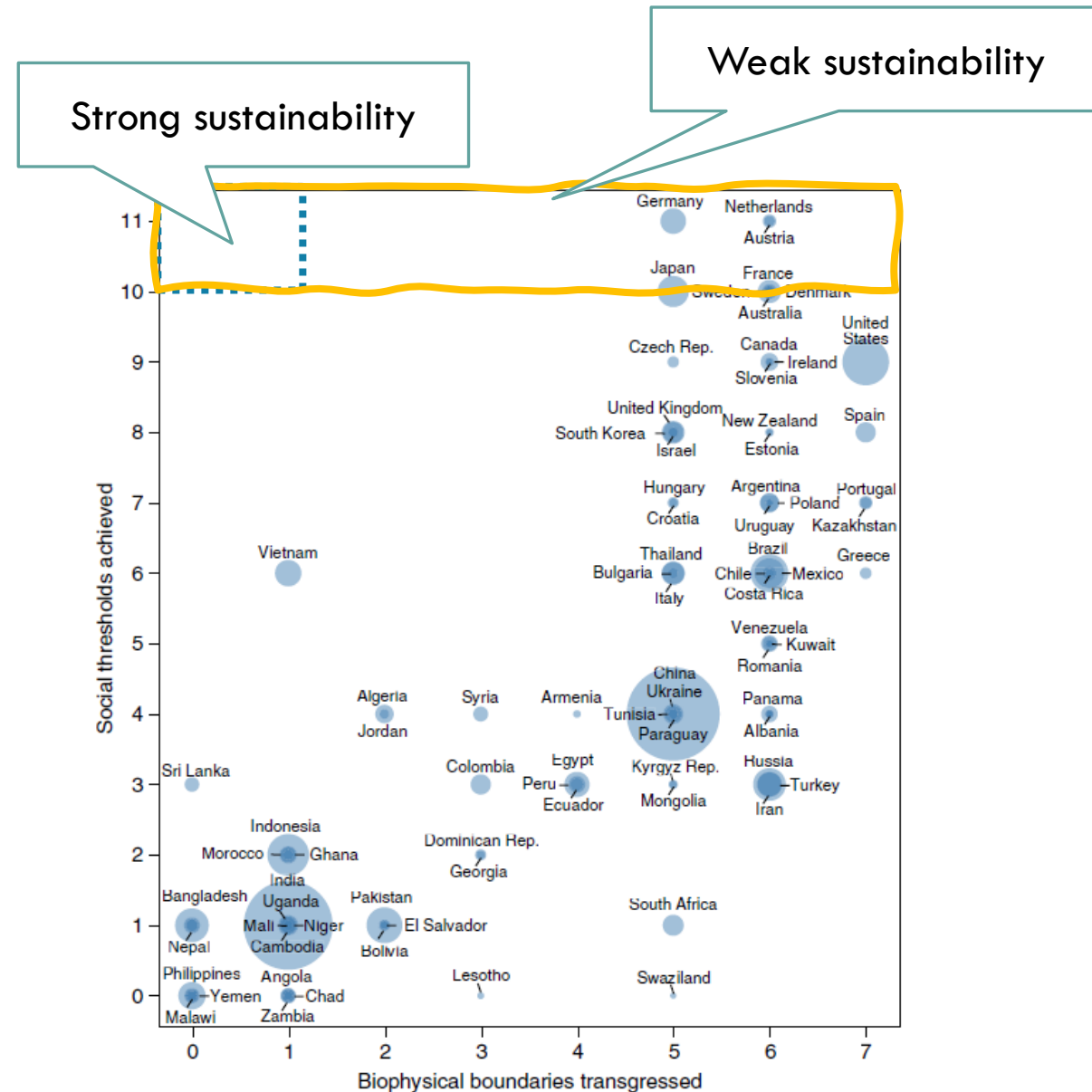
SUMMARY

We have reviewed a series of sustainability indicators:

- Ecological Footprint
- Planetary Boundaries and the Safe and Just Space
- Life satisfaction indicators
- Happy Planet Index
- IPAT
- Economic based indicators (GDP, ISEW, GPI)
- UN Sustainable Development Goals

We have reviewed a few properties sustainability indicators need to consider:

- Environmental boundaries and social minimum standards
- Territorial, consumption and income-based perspectives
- Strong and weak sustainability indicators

SUSTAINABILITY MEASUREMENT

SDEE — Sustainable Development, Energy and Environment

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