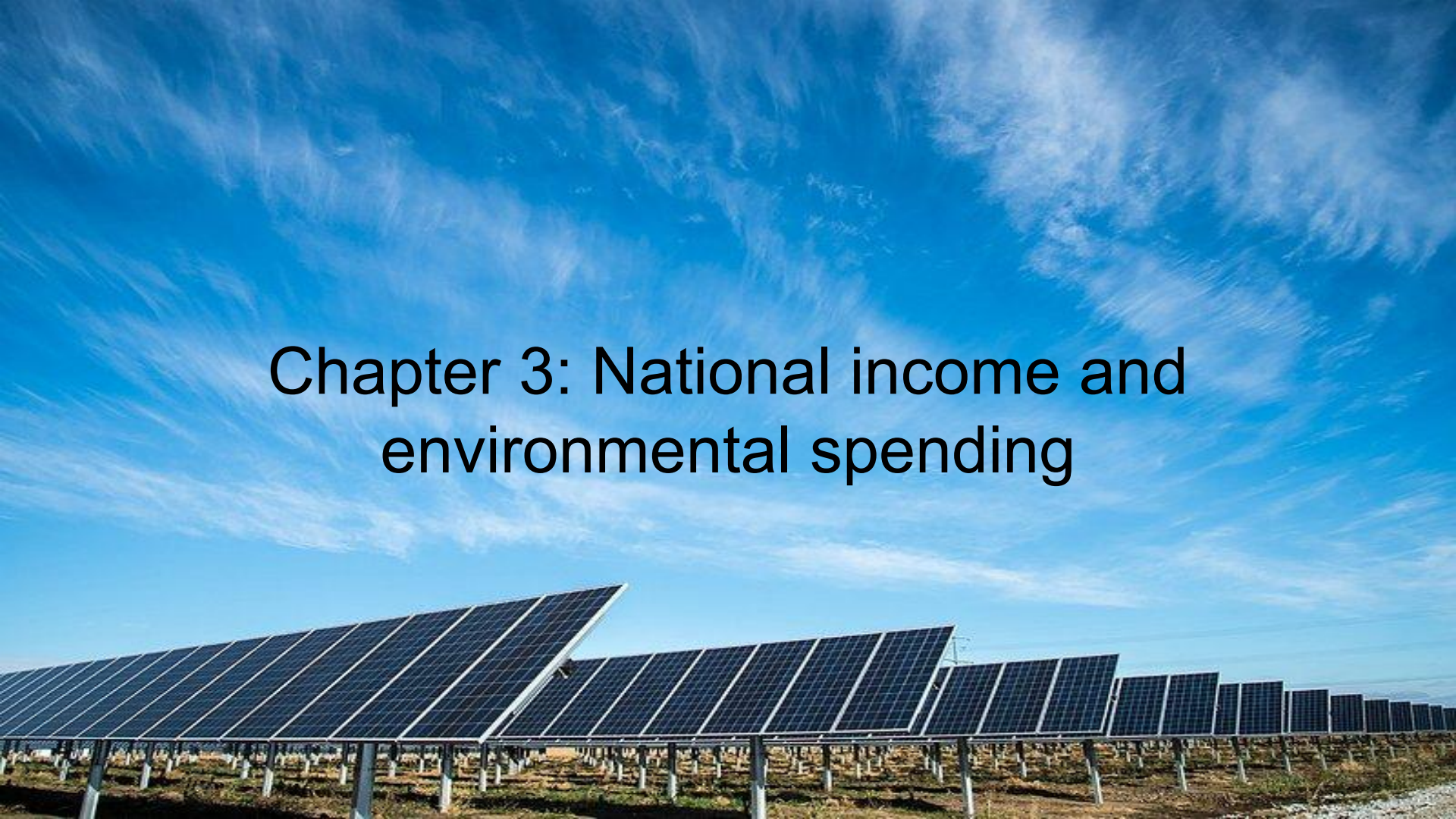

Environment economics
and policies
EC 506

Chapter 3: National income and environmental spending



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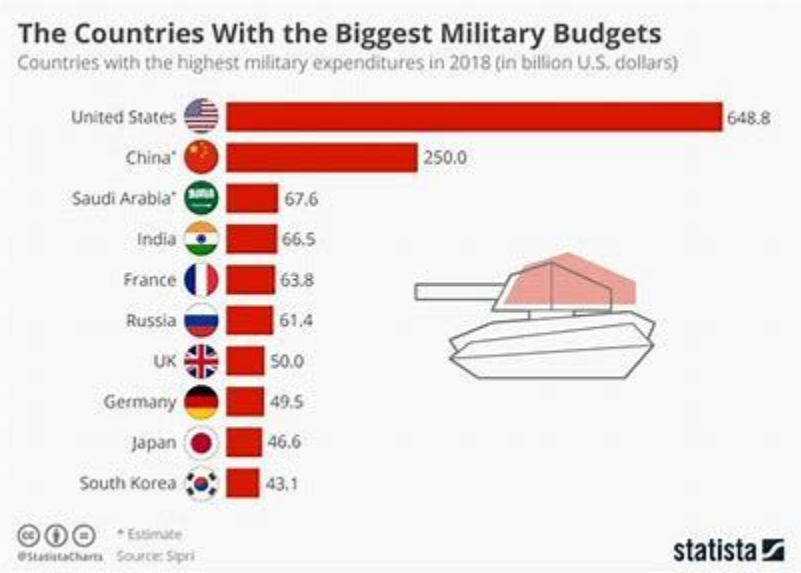

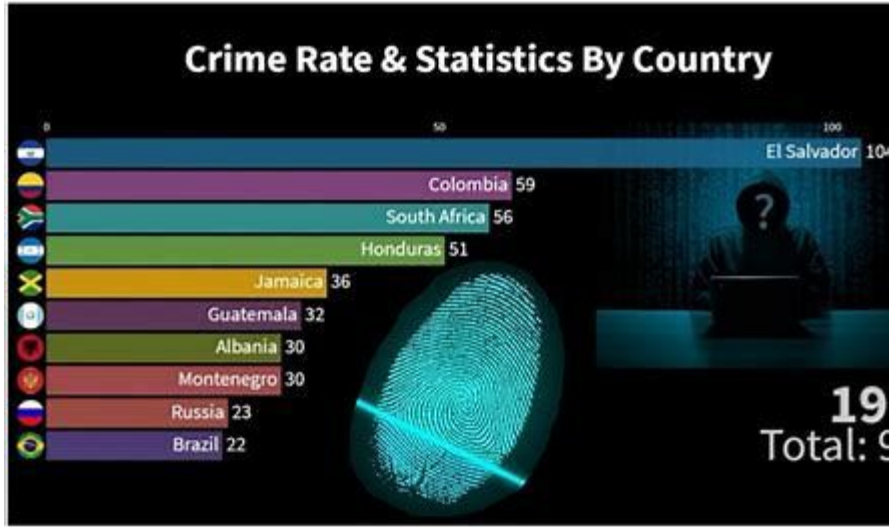

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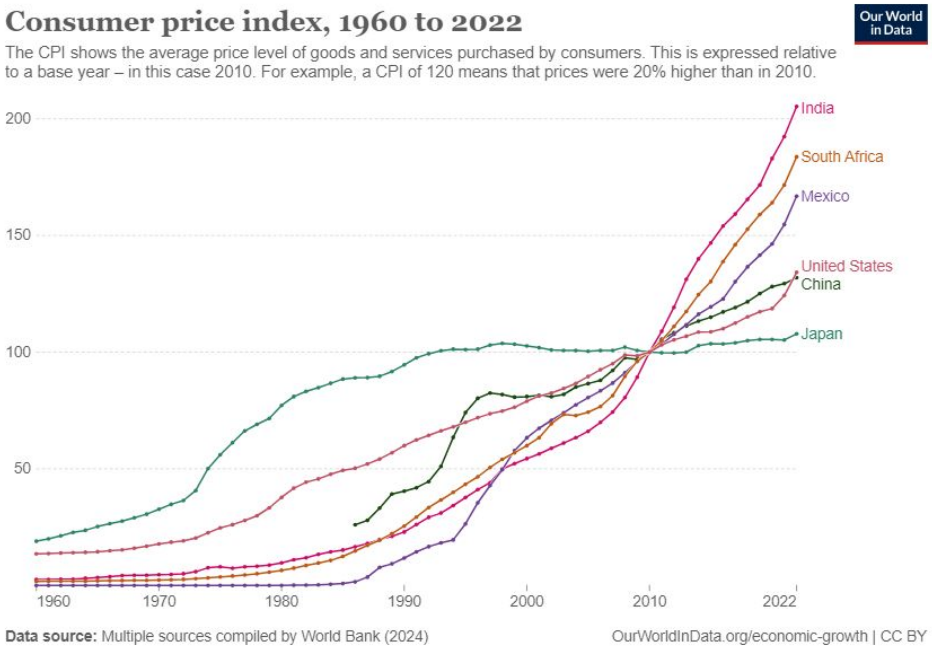
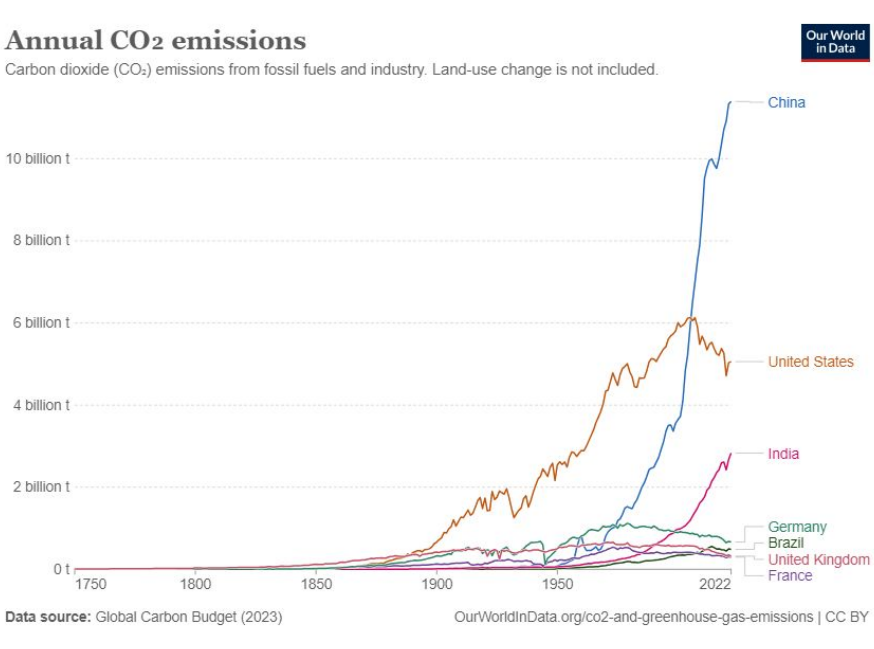
Does GDP reflect overall wellbeing?





Does GDP reflect overall wellbeing?

The economy can contribute to success, but it is a means to an end, not an end itself.

> The welfare of a nation can scarcely be inferred from a measure of national income...
>
> — Simon Kuznets (1934)

Does GDP reflect overall wellbeing?

While GDP accurately reflects the monetary value of marketed goods and services, it fails to provide a broader measure of social welfare.

- Standard measures do not count the benefits of **unpaid volunteer work**, even though such work clearly contributes to social well-being.
- **Unpaid housekeeping and gardening**, these services are not counted.
- No accounting is made for the **loss of leisure time**.
- No consideration is made for the **negative impacts of higher crime rates**.
- **The distribution of income** is not considered.
- No consideration of the **health of a country's citizens, education levels, political participation, or other social and political factors**

Greening the national income accounts

Interest in inclusion of the environment in national accounting began in the 1970s and 1980s, when several European countries began to estimate physical accounts for natural resources, such as forests, water, and land resources.

In 1993 the United Nations published a comprehensive handbook on environmental accounting, which was revised in 2003 and again in 2014. **The 2014 System of Environmental-Economic Accounting (SEEA) framework developed by the United Nations and other international organizations to provide standards for incorporating natural capital and environmental quality into national accounting systems.**

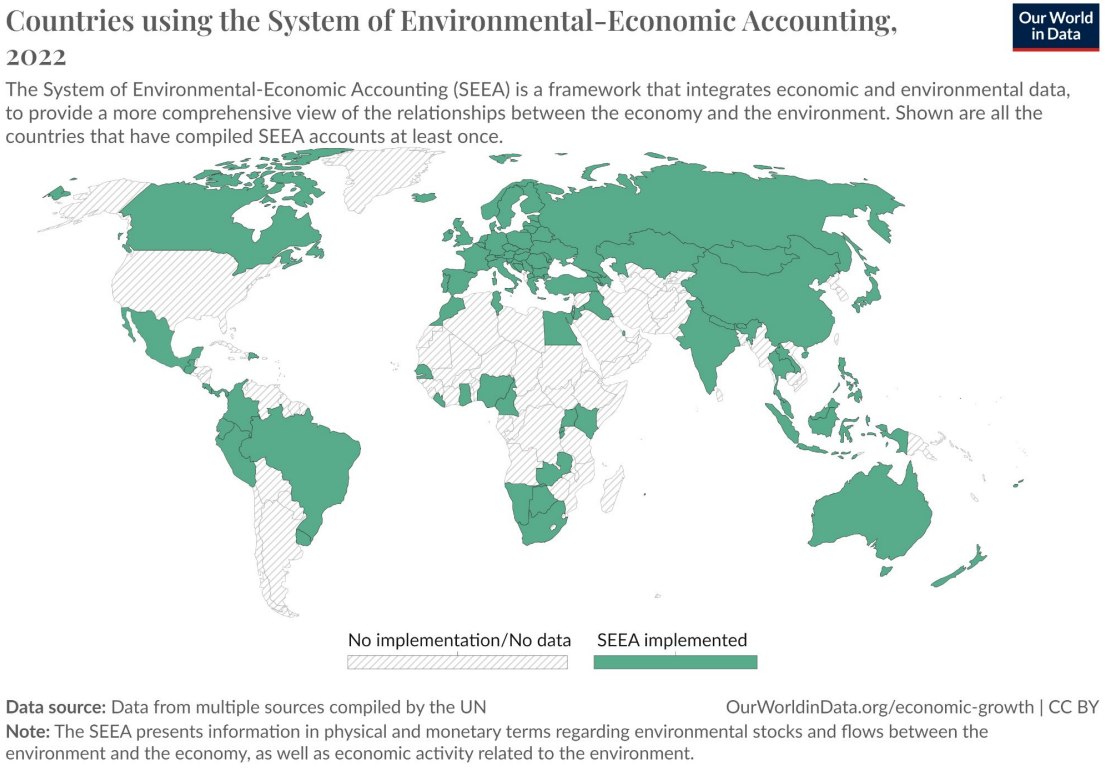
Three basic approaches to environmental accounting:

- **Measuring the physical flows of materials and energy**
- **Measuring the stocks of environmental assets**
- **The measurement of economic activity related to the environment**

These three approaches are not necessarily mutually exclusive—we could theoretically implement all of them simultaneously.

Greening the national income accounts

Natural capital: The available endowment of land and resources including air, water, soil, forests, fisheries, minerals, and ecological life-support systems.



Approaches to environmental accounting: Measuring the physical flows of materials and energy

It looks at physical flows from the environment to the economy—the utilization of natural capital as inputs into production-

- cutting trees
- harvesting fish
- mining metal ores
- drilling for oil

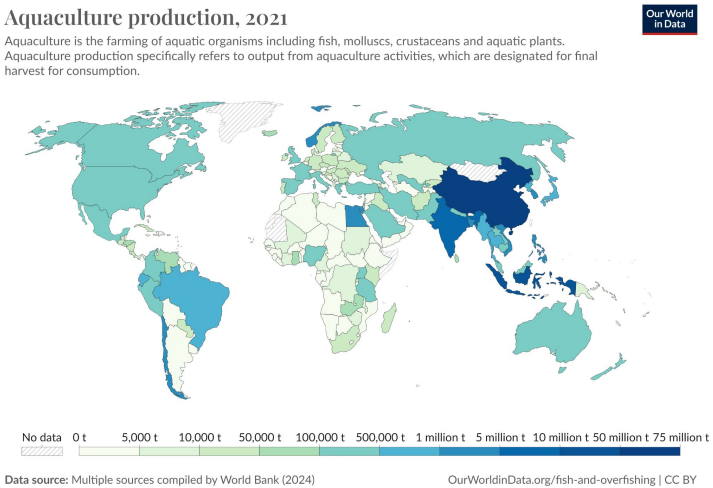
It also looks at flows in the opposite direction, from the economy to the environment-

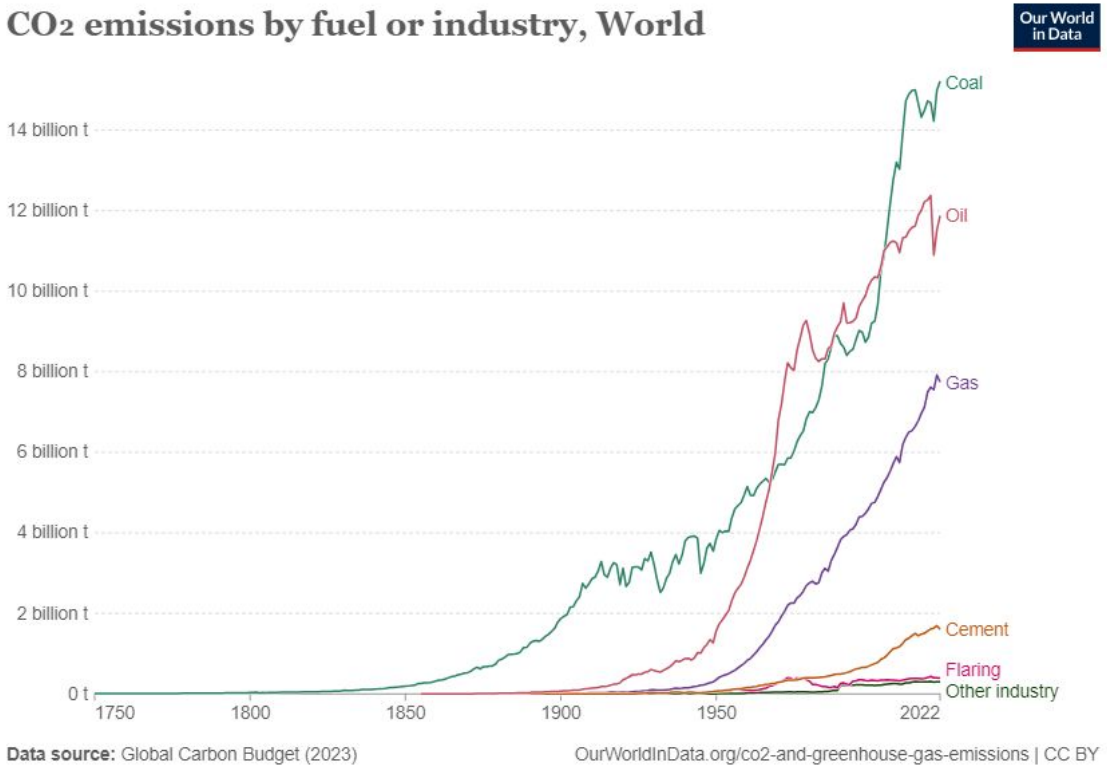
- This includes the disposal of solid wastes
- Emissions of air and water pollutants.

Analysts construct tables that quantify physical flows into, or out of, different sectors of the economy-

- Agriculture
- Mining
- Electricity generation
- Manufacturing.

Approaches to environmental accounting: Measuring the physical flows of materials and energy





Approaches to environmental accounting: Measuring the stocks of environmental assets

The SEEA lists seven categories of environmental assets:

mineral and energy resources, land, soil, timber, water, aquatic resources, and other biological resources.

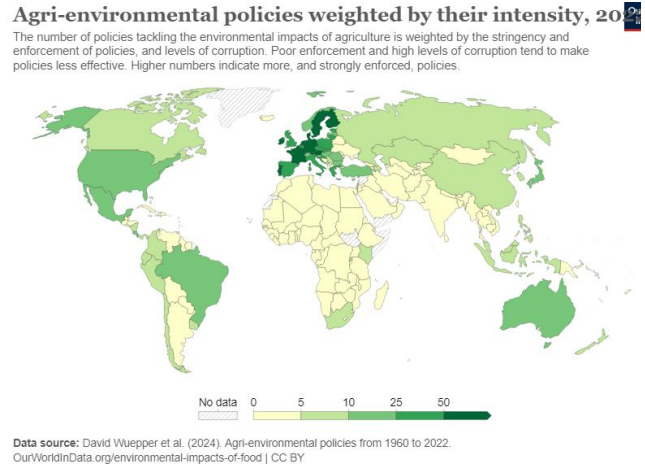
Environmental assets can be measured in both physical and monetary units, e.g., tons of soil, acres of wetlands, or cubic meters of natural gas.

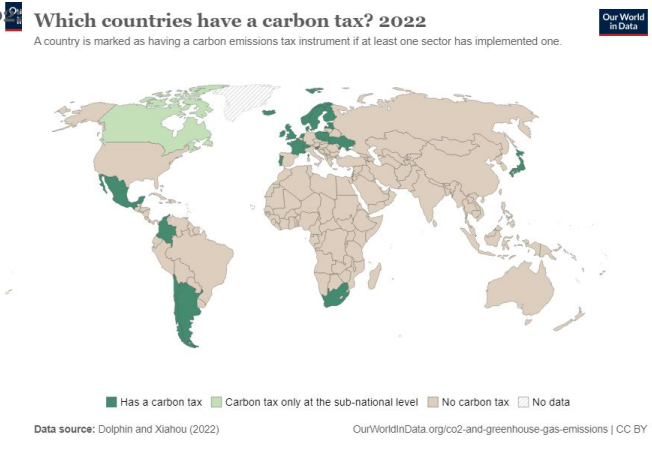
Approaches to environmental accounting: The measurement of economic activity related to the environment

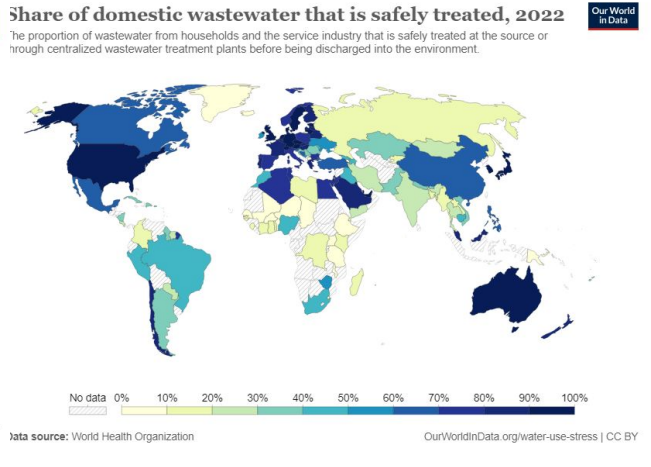
This approach tabulates environmentally related monetary transactions-

- **the amount of spending on environmental protection and resource management**
- **the collection of environmental taxes, and the quantity of subsidies**
- **the production of environmental goods and services, e.g., pollution-control equipment and “environmentally friendly” products**

Approaches to environmental accounting: The measurement of economic activity related to the environment







Green GDP

Green GDP a national accounting measure that deducts a monetary value from GDP or NDP to account for natural capital depreciation and other environmental damages.

The net annual change in the value of natural capital in a country can simply be added or subtracted from GDP or NDP to obtain what is often called Green GDP.

$$\text{Green GDP} = \text{GDP} - Dm - Dn$$

where, Dn is the depreciation of natural capital.

A deduction in national accounting for loss of natural capital, such as a reduction in the supply of timber, wildlife habitat, or mineral resources, or environmental degradation such as pollution.

Each year the value of natural capital may depreciate as a result of resource extraction or environmental degradation.

In some cases, the value of natural capital would increase as well if environmental quality improves.

Green GDP

A pioneering 1989 analysis estimated the value of depreciation in Indonesia for three categories of natural capital: oil, forests, and soil.9 The analysis found that ***accounting for natural capital depreciation could reduce GDP by 25% or more.***

A 2001 analysis in Sweden looked at a broader set of natural resource categories, including soil erosion, recreation values, metal ores, and water quality. The results found that ***accounting for these factors would reduce GDP in Sweden by about 1–2% for 1993 and 1997.***

A 2020 journal article estimated ***China's Green GDP in 2017 to be 4% less than traditional GDP when accounting for environmental pollution and resource depletion****.*

A 2019 analysis calculated Green GDP for 44 countries, making adjustments for carbon emissions, waste generation, and natural resource depletion. The study found that ***Green GDP was lower than standard GDP in all cases, by amounts varying from less than 1% to as much as 10%. Countries with the highest environmental impacts included China (5.0%), Chile (8.9%), Norway (6.6%), Mexico (4.3%), and Australia (3.0%).***

Green GDP

Estimating Green GDP reveals three important points:

1. **Natural capital depreciation and environmental damages can amount to a significant portion of GDP.** Green GDP can be significantly lower than GDP, by perhaps 10% or more in some countries, particularly developing countries.

2. **Measuring the growth of GDP to illustrate changes in social welfare may not produce accurate results.** Based on GDP growth alone, China is commonly touted as an economic development success story. But annual GDP growth in China appears to be largely or fully offset by environmental damages.

3. **Monetization of natural capital needs to be approached carefully. Monetary estimates of natural capital, based on market prices, can fail to detect trends in physical stocks.** As discussed in the SEEA, it is the physical stocks of natural resources that we are ultimately interested in measuring and tracking. Similarly, economists may disagree about the monetary damages from carbon emissions.

Green GDP

A study estimated the value of changes in forest resources in India in 2003.11 Based on timber and firewood market prices, the results indicated that while the overall physical stock of timber decreased, the value of timber resources actually increased due to higher prices. This illustrates the potential distortionary effect of looking at natural capital in monetary, rather than physical, terms. If we measure the value of natural capital at market prices, we can lose important information regarding the actual physical stock of those resources.

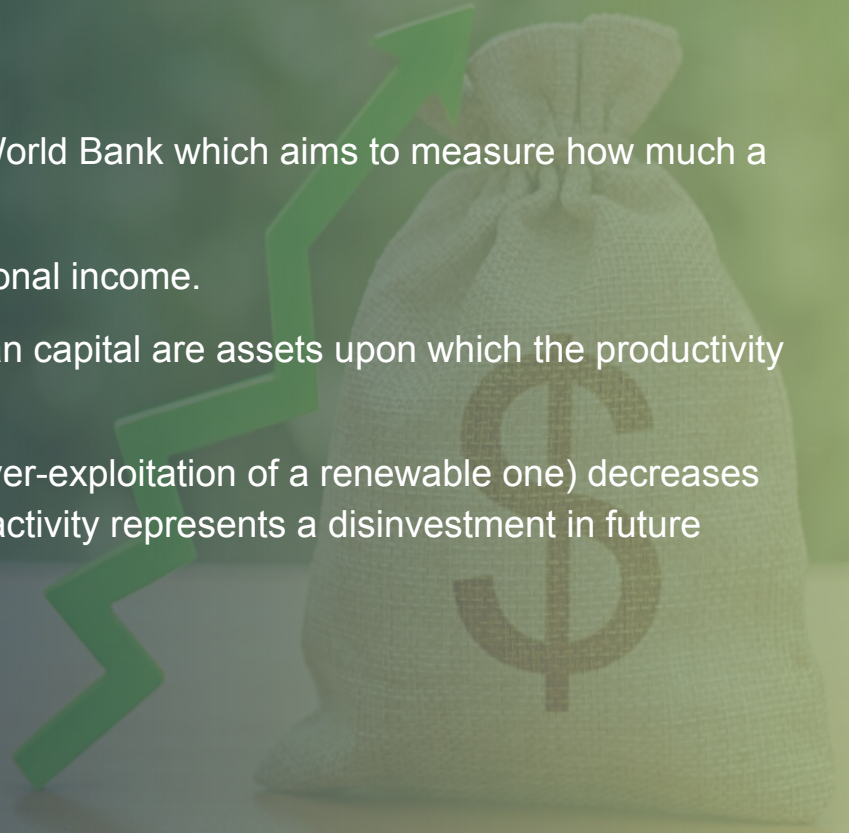
Adjusted Net Saving (ANS)

A national accounting measure developed by the World Bank which aims to measure how much a country is actually saving for its future.

ANS is normally calculated as a percentage of national income.

ANS: takes the broader view that natural and human capital are assets upon which the productivity and therefore the well-being of a nation rest.

Since depletion of a non-renewable resource (or over-exploitation of a renewable one) decreases the value of that resource stock as an asset, such activity represents a disinvestment in future productivity and well-being.

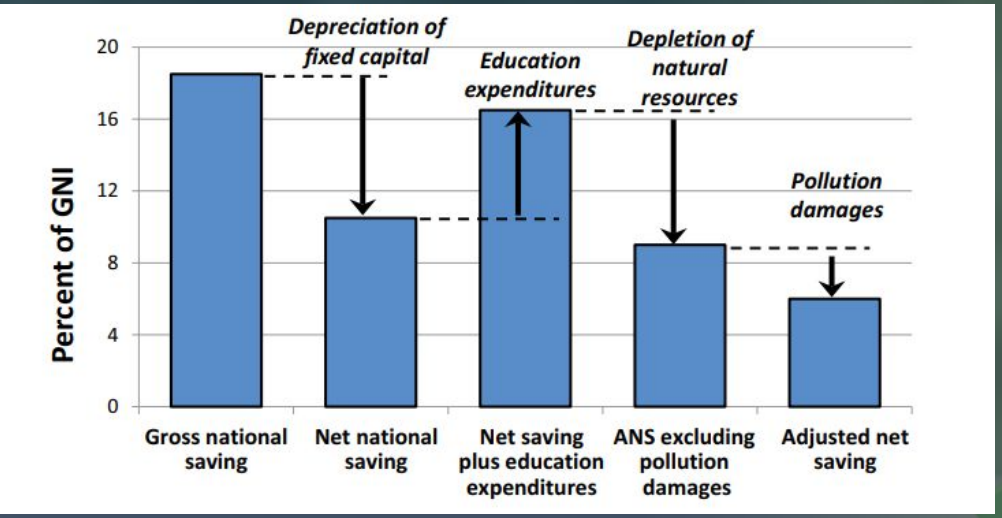


Adjusted Net Saving (ANS)

ANS is obtained using the following steps:

- **Start with gross national savings.**
- **Make a deduction to account for the depreciation of fixed capital to obtain net national savings.**
- **Adjust for education expenditures (**to reflect investment in human capital)
- **Adjust for natural resources depletion (**total market value of the resource minus its extraction cost)
- **Adjust for pollution damages (CO2 and PM)**

Adjusted Net Saving (ANS)



Country	NNS + Education	Forest Depletion	Mineral Depletion	Energy Depletion	Carbon Damage	Particulate Matter Damage	ANS
Brazil	7.02	–0.14	–0.75	–1.72	–0.94	–0.16	3.31
Chile	8.92	0.00	–7.19	–0.01	–1.08	–0.11	0.53
China	25.03	0.00	–0.24	–0.71	–2.66	–0.29	21.13
Ethiopia	15.03	–5.20	–0.28	–0.00	–0.74	–0.44	8.37
Germany	15.17	0.00	0.00	–0.03	–0.63	–0.08	14.44
India	22.97	–0.12	–0.31	–0.58	–3.51	–0.80	17.66
Nigeria	8.35	–0.93	–0.01	–4.54	–1.10	–1.72	0.05
Russia	20.82	0.00	–0.55	–8.02	–3.81	–0.21	8.23
Saudi Arabia	29.20	0.00	–0.05	–9.28	–2.54	–0.16	17.16
Uganda	3.56	–7.47	–0.12	0.00	–0.71	–0.67	–5.41
United States	6.96	0.00	–0.05	–0.32	–0.83	–0.11	5.64
Uzbekistan	45.05	0.00	–5.03	–7.25	–5.62	–0.41	26.74

Source: World Bank, World Development Indicators database.

Problem with Green GDP and Adjusted Net Savings

Green GDP and ANS adjust traditional national accounting measures to account for natural capital depreciation and environmental damage

But as with GDP, neither of these alternatives appear to measure social welfare. Perhaps the most ambitious attempt to date to design a replacement to GDP is the **genuine progress indicator (GPI).**

Genuine Progress Indicator

GPI is a national accounting measure that includes the monetary value of goods and services that contribute to well-being, such as volunteer work and higher education, and deducts impacts that detract from well-being, such as the loss of leisure time, pollution, and commuting.

The GPI is measured in monetary units. The starting point of the GPI is personal consumption, based on the rationale that consumption directly contributes to current welfare.

Genuine Progress Indicator

Steps to calculate GPI:

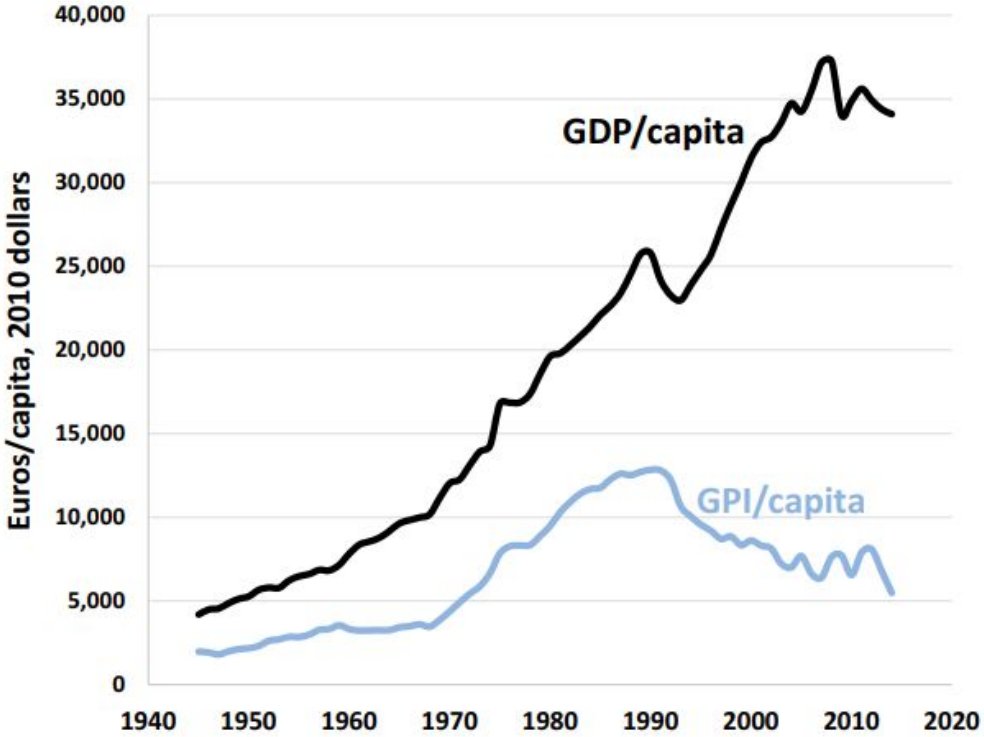
- Start with personal consumption adjusted by income inequality. (*Weighted personal consumption is personal consumption divided by index of distributional inequality multiplied by 100*)
- Add in the value of household labor, parenting, higher education, and volunteer work. *(The GPI estimates the market value of unpaid household labor and parenting)*
- Add the net benefits from transportation and consumer durables. *(An estimate is included for the value people derive from using highways and streets. The annual benefits consumers obtain from long-lasting goods, such as motor vehicles, appliances, and furniture, are also positive contributions to the GPI.)*
- Subtract the cost of crime and underemployment. *(The cost of crime includes the costs of prisons and defensive expenditures such as buying locks and alarms. Underemployed people include those who have become discouraged and given up looking for a job, people working part-time who would prefer a full-time job, and people who are willing but unable to work because of circumstances such as an inability to afford child care.)*

Genuine Progress Indicator

Steps to calculate GPI:

- Subtract the loss of leisure time. *(a deduction is included in the GPI if people are losing leisure time.)*
- Subtract the costs of pollution *(air, water, and noise) and environmental defensive expenditures. (the GPI estimates the economic damage from each type of pollution. Also, the cost of such products as air filters and water purification systems do not increase welfare but simply serve to compensate for existing pollution.)*
- Subtract the value of lost wetlands, farmlands, and forests. *(The GPI subtracts for losses of natural capital, including reductions in ecosystem services, lost recreation opportunities, and declining nonuse values.)*
- Subtract the costs of depleting non-renewable energy sources. *(A diminishing stock of resources imposes a cost on future generations. The GPI attempts to estimate this implied cost.)*
- Subtract the damages from carbon dioxide emissions and ozone depletion. *(Attempt to estimate the damage associated with carbon emissions.)*

Genuine Progress Indicator



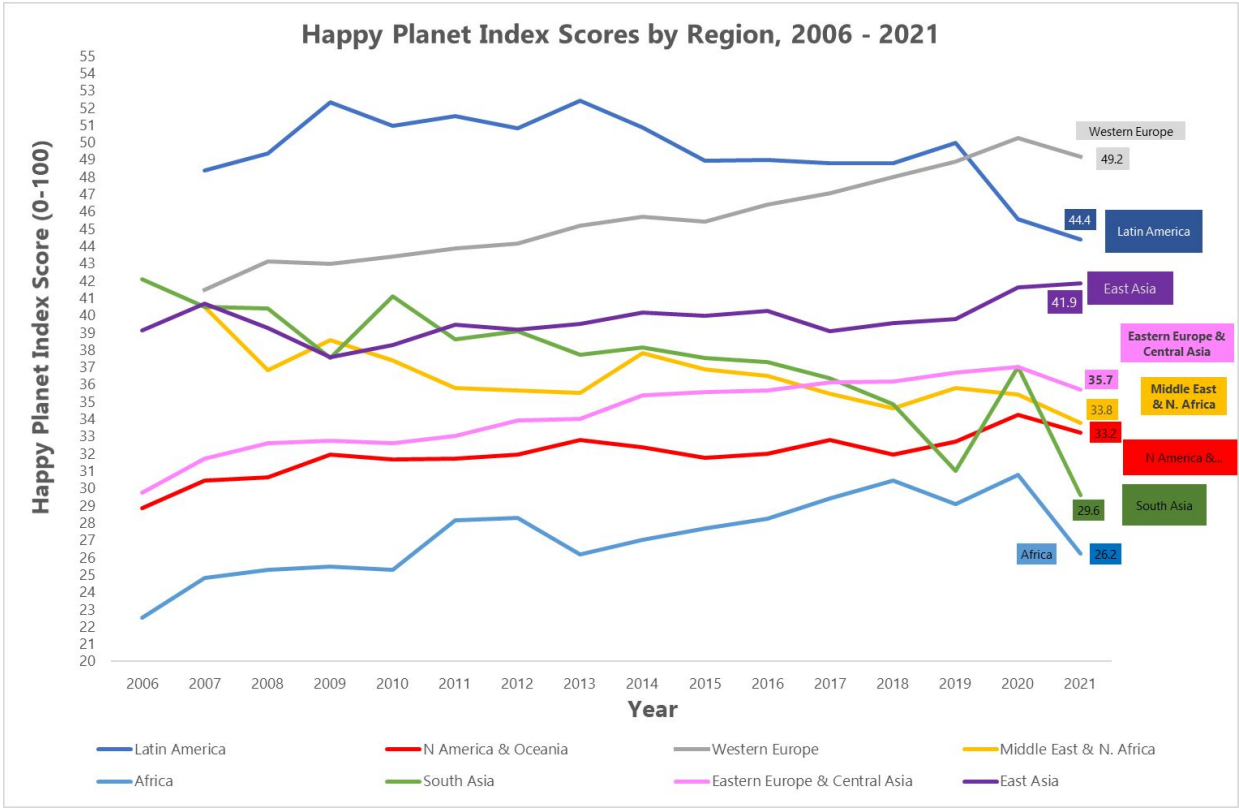
Comparison of GDP per Capita and GPI per Capita, Finland, 1945–2014

Class exercise

- Suppose GDP of country A in 2023 was $460billion. A household spends 5 hours for household work and loses 5 hours of leisure time everyday. Minimum hourly wage is $1.50 and total working days are 240. Total number of households is 35 million. Calculate GPI of the country.

- GDP of a country is $10trillion and GPI amounts to $9.5trillion. What does this scenario indicate?

Happy Planet Index



Happy Planet Index

RANK	COUNTRY	Life expectancy	Wellbeing	Carbon footprint	HPI SCORE and change since 2019	
1st	Vanuatu	70.4 years	7.10/10	2.62 tCO2e	57.9	(+2.6)
2nd	Sweden	83.0 years	7.40/10	8.70 tCO2e	55.9	(+1.9)
3rd	El Salvador	70.7 years	6.40/10	2.03 tCO2e	54.7	(-2.5)
4th	Costa Rica	77.0 years	6.40/10	4.37 tCO2e	54.1	(-7.6)
5th	Nicaragua	73.8 years	6.10/10	2.61 tCO2e	53.6	(-0.3)
143rd	Chad	52.5 years	4.40/10	3.88 tCO2e	18.3	(+0.3)
144th	Afghanistan	62.0 years	2.40/10	1.14 tCO2e	16.2	(-0.7)
145th	Lesotho	53.1 years	3.70/10	3.04 tCO2e	15.6	(+0.1)
146th	Botswana	61.1 years	3.50/10	10.28 tCO2e	14.7	(-2.3)
147th	Central African Republic	53.9 years	3.10/10	1.83 tCO2e	13.7	—

Happy Planet Index

RANK	COUNTRY	Life expectancy	Wellbeing	Carbon footprint	HPI SCORE and change since 2019	
102nd	United States of America	77.2 years	7.00/10	19.59 tCO2e	32.1	(+0.3)
79th	Canada	82.7 years	6.90/10	17.87 tCO2e	37.2	(+1)
66th	Australia	84.5 years	7.10/10	17.70 tCO2e	39.5	(+2.4)
68th	Bangladesh	72.4 years	4.10/10	1.22 tCO2e	39.2	(-9.2)

Happy Planet Index

The Happy Planet Index (HPI) is perhaps the most novel attempt to devise an entirely new approach to measuring national welfare in the context of environmental sustainability. The HPI, created by the British New Economics Foundation (NEF), asserts that the goal of society is to enable long and happy lives for all its members in an environmentally sustainable manner. **The HPI is calculated for 140 countries.**

The HPI consists of four variables to reflect these concepts:

1. Average life expectancy. This measures whether a society's members lead long lives.

2. Average subjective well-being. This measures whether a society's members lead happy lives. The data are obtained from surveys that ask people how satisfied they are with their lives.

3. Equality of outcomes. This measures the distribution of well-being and life expectancy across a given society.

4. Ecological footprint. This measures a society's overall ecological impact.

$$HPI = \frac{Well-Being \times Life\ Expectancy \times Equality}{Ecological\ Footprint}$$

Happy Planet Index

Strengths

- It considers the ends of economic activity, namely, happiness and life expectancy.
- The innovative way that it combines well-being and environmental factors.
- Its calculations are easy to understand.
- Data can be easily compared across countries.

Weaknesses

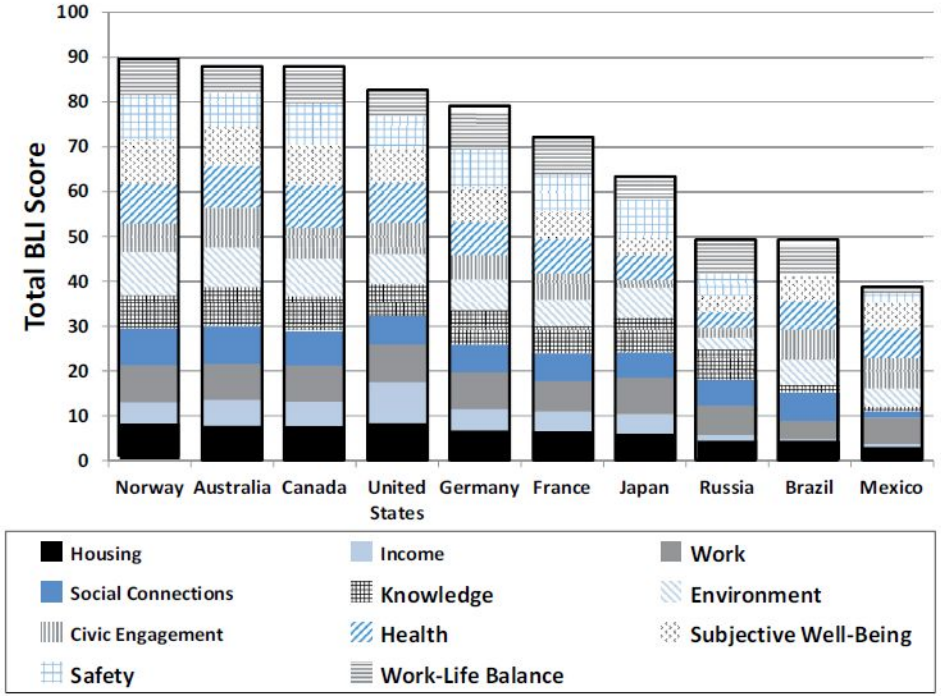
- The interpretation and policy implications of the HPI are unclear.
- Whether a country's policies can affect happiness levels, that may be more a construction of inherent social and cultural factors rather than policy choices.

The Better Life Index

An index developed by the OECD to measure national welfare using 11 well-being dimensions.

The BLI's 11 dimensions are:

1. Income and Wealth
2. Work and Job Quality
3. Housing
4. Health
5. Work–Life Balance
6. Knowledge and Skills
7. Social Connections
8. Civic Engagement
9. Environmental Quality
10. Safety
11. Subjective Well-Being



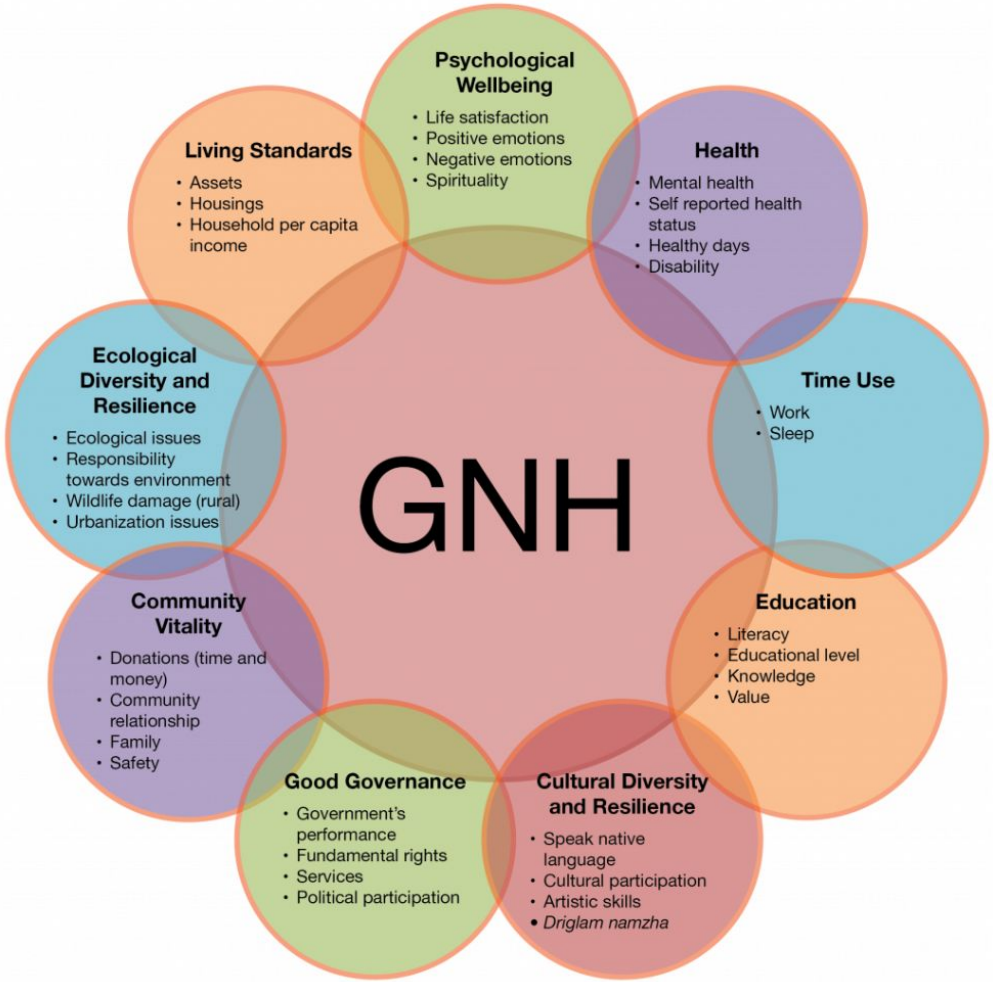
The Better Life Index

1. Income and Wealth- *household net wealth*, *Household net adjusted disposable income after taxes and transfers*
2. Work and Job Quality- *job security, personal earnings, long term unemployment rate, employment rate*
3. Housing- *rooms per person, dwellings with basic facilities, housing expenditure share in gross income*
4. Health- *self reported health, life expectancy*
5. Work–Life Balance- *time devoted to leisure and personal care, employees working very long hours*
6. Knowledge and Skills- *years in education, student skills, educational attainment*
7. Social Connections- *social support network*
8. Civic Engagement- *stakeholder engagement for developing regulations, voter turnout*
9. Environmental Quality- *water quality, air pollution*
10. Safety- *homicide rate, feeling safe walking alone at night*
11. Subjective Well-Being- *life satisfaction*

Gross National Happiness

Originating in Bhutan, where a society and its policies should seek to improve the welfare of its citizens, as opposed to maximizing GDP, by focusing on **four policy objectives: equitable economic development, environmental preservation, cultural resilience, and good governance.** The Centre for Bhutan Studies (CBS) has sought to operationalize GNH. The Centre has defined GNH as encompassing nine domains:

- **Psychological well-being**
- **Standard of living**
- **Good governance**
- **Health**
- **Education**
- **Community vitality**
- **Cultural diversity and resilience**
- **Time use**
- **Ecological diversity and resilience**

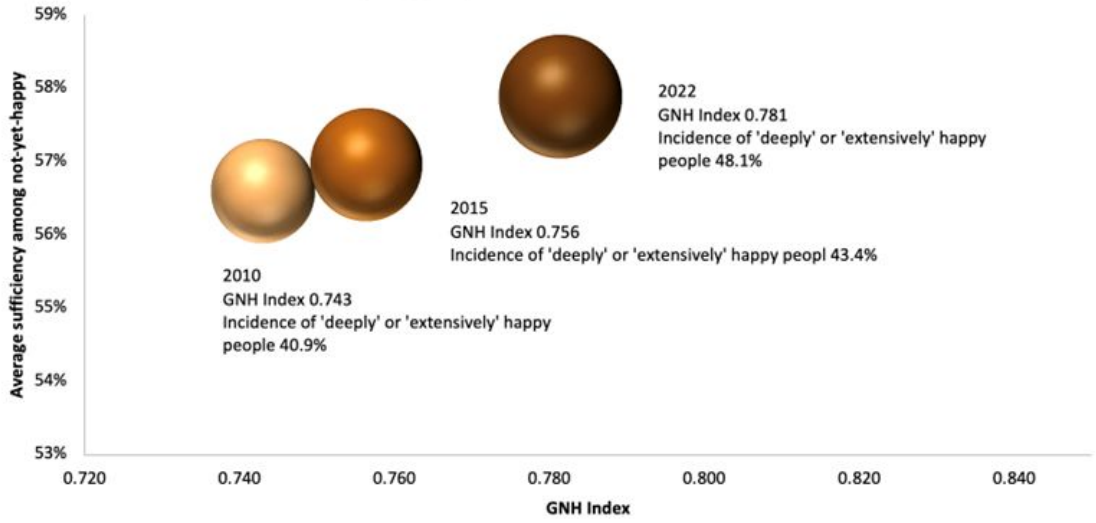

GNH
Psychological Wellbeing
• Life satisfaction
• Positive emotions
• Negative emotions
• Spirituality
Health
• Mental health
• Self reported health status
• Healthy days
• Disability
Time Use
• Work
• Sleep
Education
• Literacy
• Educational level
• Knowledge
• Value
Cultural Diversity and Resilience
• Speak native language
• Cultural participation
• Artistic skills
• Driglam namzha
Good Governance
• Government's performance
• Fundamental rights
• Services
• Political participation
Community Vitality
• Donations (time and money)
• Community relationship
• Family
• Safety
Ecological Diversity and Resilience
• Ecological issues
• Responsibility towards environment
• Wildlife damage (rural)
• Urbanization issues
Living Standards
• Assets
• Housings
• Household per capita income

Gross National Happiness

The phrase ‘gross national happiness’ was first coined by the 4th King of Bhutan, King Jigme Singye Wangchuck, in the late 1970s when He stated, **“Gross National Happiness is more important than Gross Domestic Product.”** The concept implies that sustainable development should take a holistic approach towards notions of progress and give equal importance to non-economic aspects of wellbeing and happiness.

GNH 2022

Figure 16: *National GNH Index and share of happy people, 2010–22*[21]



Environmental asset accounting

Another approach is to maintain environmental asset accounts, tracking environmental indicators separately from GDP, either in monetary or physical units.

Environmental asset accounts are particularly useful if one is interested in whether a society is achieving strong sustainability, focusing exclusively on natural capital.

Weak sustainability
The view that natural capital depletion is justified as long as it is compensated for with increases in human-made capital; assumes that human-made capital can substitute for most types of natural capital.

Strong sustainability
The view that natural and human-made capital are generally not substitutable and, therefore, natural capital levels should be maintained.

Environmental asset accounting

The two main strengths of measuring environmental asset accounts in physical units are:

- They provide a detailed picture of a country’s natural capital levels and trends over time. A particular focus can be on ensuring that levels of critical natural capital are maintained.

- They provide a means for assessing very strong sustainability. Since each category of natural capital is quantified in a separate account, policy makers can determine whether the levels of each are being maintained.

Environmental asset accounting

Example of environmental asset accounting

	Year 1		Year 2
Forest Resources		Decrease in Capital Stock	
Board-Feet of Timber	500,000		400,000
Price per Board-Foot	$5.00		$5.00
Timber Asset Value	$2,500,000		$2,000,000
Agricultural Land Resources		Increase in Capital Stock	
Hectares of Land	6,000		7,000
Price per Hectare	$1,000		$1,000
Agricultural Asset Value	$6,000,000		$7,000,000
Total Environmental Asset Value	$8,500,000		$9,000,000

Environmental asset accounting

Table 10.2 Economic Asset Value of Ecosystem Services in the United Kingdom

Type of Ecosystem Service	*Asset Value (billion 2018 US$)*
Provisioning Services	
Agricultural production	165
Water supplies	96
Fossil fuels	77
Renewable energy	12
Timber	12
Fisheries	10
Minerals	8
Regulating Services	
Carbon sequestration	136
Air purification	56
Urban cooling	17
Noise mitigation	1
Cultural Services	
Recreation	545
Green space	12

In Sweden, categories of environmental indicators include:

- **Material flow statistics.**
- **Energy accounts.**
- **Environmental goods and services.**
- **Environmental impacts from households.**
- **Environmentally related taxes and subsidies.**
- **Emissions to air.**
- **Chemical indicators.**

Food for thought

Which alternative is the best you think?