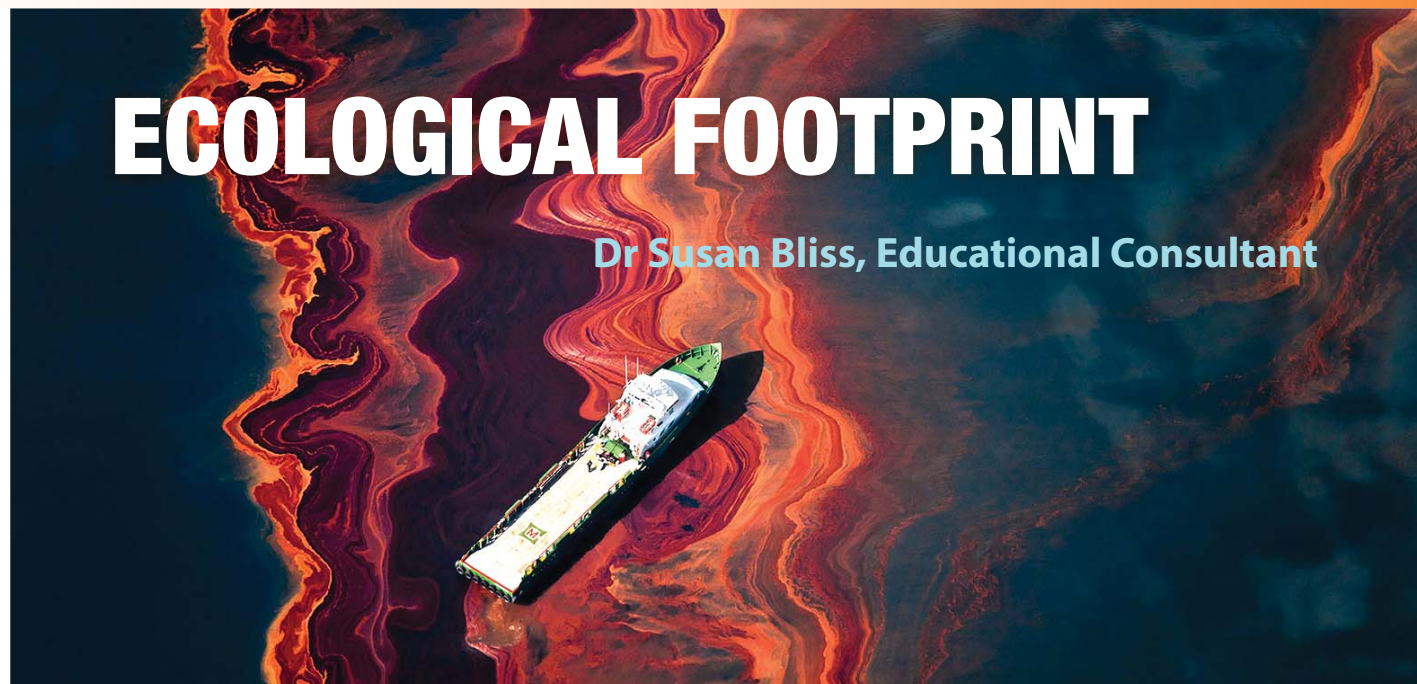


ECOLOGICAL FOOTPRINT

Dr Susan Bliss, Educational Consultant



Ecological Footprint: *Oil Spill #12* by Daniel Beltrá is an aerial image showing the environmental degradation caused by oil spills. His aim, through his work is to protect the environment from further harm.

Source: <https://www.artworksforchange.org/portfolio/daniel-beltra/>

SYLLABUS CONNECTIONS

YEAR 7 TO YEAR 12 (STAGES 4, 5 & 6)

STAGE 4	STAGE 5	STAGE 6
<p>Place and Liveability</p> <ul style="list-style-type: none"> Challenges and strategies to enhance liveability/human wellbeing Future liveability-reducing urban ecological footprints Sustainable places <p>Water in the World</p> <ul style="list-style-type: none"> Availability and access to clean water essential for human wellbeing (water footprint) Water management-towards sustainability-reducing ecological/water footprint <p>Interconnections</p> <ul style="list-style-type: none"> Production and consumption 	<p>Sustainable Biomes</p> <ul style="list-style-type: none"> Urbanisation – consequences and sustainable management to improve human wellbeing and reduce the ecological footprint. Creating sustainable cities-eco-cities <p>Environmental Change and Management-Urban</p> <ul style="list-style-type: none"> Urban management – reduce ecological footprint and improve human wellbeing Sustainable eco-cities <p>Human Wellbeing</p> <ul style="list-style-type: none"> Human wellbeing and ecological footprint Sustainable wellbeing indexes-SSI, WSI, GPI and IWI. Ecological footprint threatens human wellbeing <p>Urban places</p> <ul style="list-style-type: none"> Sustainability 	<p>Global challenges</p> <ul style="list-style-type: none"> Spatial patterns in distribution and consumption of natural resources (bio-capacity) Place and human activity-country; urban/rural; slums versus skyscrapers-human wellbeing and ecological footprint <p>Senior Geography Project</p> <ul style="list-style-type: none"> Ecological footprint at a variety of scales: personal, local, regional, state, national and global. Interactions, challenges, responses Proposing individual and collective action <p>Urban places</p> <ul style="list-style-type: none"> challenges affecting places, and actions for sustainability. Study a large city Megacities

KEY QUESTIONS

At the end of this article students will acquire knowledge and understanding to answer the following Think, Explore and Puzzle questions.

THINK	EXPLORE	PUZZLE
<p>What is the ecological footprint?</p> <p>How do you measure the ecological footprint?</p> <p>What are the connections between the ecological footprint and sustainability?</p> <p>What are the different measurements used to determine human wellbeing?</p> <p>What are the main influences on human wellbeing in your settlement?</p> <p>What are the differences in human wellbeing between urban and rural settlements in different countries?</p> <p>What are the differences in human wellbeing between and within cities in different countries?</p> <p>What are the links between the ecological footprint and GDP?</p> <p>What are the basic environmental human rights which affect human wellbeing?</p> <p>What are the advantages and disadvantages of shrinking cities on human wellbeing?</p> <p>What is the importance of the City Wellbeing Program?</p> <p>Are sustainable cities 'happy cities'?</p> <p>What is the significance of Sustainable Development Goal 11 (2016) concerning sustainable cities and how can it be implemented?</p>	<p>How does a country or city track how much biocapacity it possesses, and how much it uses?</p> <p>What are the connections between the natural environment and human wellbeing?</p> <p>What is the relationship between high liveability and the ecological footprint in different settlements?</p> <p>What settlements have a small ecological footprint and high human wellbeing?</p> <p>What are eco-cities and eco-villages, and how do they combine the ecological footprint with human wellbeing?</p> <p>What indicators are the most suitable measurements combining human and ecosystem wellbeing?</p> <p>Is there a relationship between large megacities and huge ecological footprints in developed and developing countries?</p> <p>How can the benefits of urbanisation improve human wellbeing?</p> <p>Can benefits be equally shared to ensure access to infrastructure and social services, focusing on the needs of the urban poor and vulnerable groups for housing, education, health care, decent work and a safe environment?</p>	<p>How can responsible citizens, organisations and governments reduce the ecological footprint?</p> <p>What measures can be undertaken to reduce inequality in human wellbeing between settlements-in a country?</p> <p>How can the Human Sustainability Index (HSI) and the Sustainability Society Index (SSI) be useful indexes for measuring environmental and human wellbeing?</p> <p>What were the impacts on liveability and human wellbeing from the following incidents on settlements:</p> <ul style="list-style-type: none"> • Cancer villages in Yanglingang China? • Fukushima villages and cities in Japan? • Chernobyl nuclear disaster impacting on farming villages and Pripjat? • Disappearing indigenous fishing villages in coastal Asian countries? <p>Some of the fastest-growing cities have fewer than 1 million inhabitants-many of them located in Asia and Africa. What are some effective sustainable management practices that have been implemented in Asian cities? (Green City Index)</p>

SEE APPENDIX 3 & 4 for student activities in PDF and WORD formats, linked to each of the following content sections

TEACHING RESOURCES

YouTube

- The Ecological Footprint Explained
<https://www.youtube.com/watch?v=fACKb2u1ULY>
- What is Human Development?
https://www.youtube.com/watch?v=HwgZQ1DqG3w&list=PLH1VK0ldT8whMsE_DdL_-XimRjN7_vOH0
- What does Liveability mean?
https://www.youtube.com/watch?v=2n0DUAr_6el
- How to Make Cities Liveable
<https://www.youtube.com/watch?v=u-S5TWkLeyk>
- What Is Sustainability?
<https://www.youtube.com/watch?v=rmQby7adocM>
- Sustainability explained through animation
<https://www.youtube.com/watch?v=B5NiTN0chj0>
- What is sustainable development?
<https://www.youtube.com/watch?v=7V8oFI4GYMY>

Weblinks

- The environment of human settlements human well-being in cities – <https://www.elsevier.com/books/the-environment-of-human-settlements-human-well-being-in-cities/laconte/978-0-08-020978-4>
- Are sustainable cities “happy” cities? Associations between sustainable development and human well-being in urban areas of the United States –

<https://link.springer.com/article/10.1007/s10668-013-9499-0>

- Harnessing urbanisation for human wellbeing and planetary health – [https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196\(17\)30005-0.pdf](https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196(17)30005-0.pdf)
- Projections suggest cities will swell at an astonishing pace – but whether that means our salvation or an eco-disaster is by no means certain? – <https://www.theguardian.com/cities/2018/mar/19/urban-explosion-kinshasa-el-alto-growth-mexico-city-bangalore-lagos>



Stomach contents of a Laysan albatross fledgling, Midway Island, by Chris Jordan

Source: <https://www.artworksforchange.org/portfolio/earth-day-network-featured-tour-2018/>



**ARTWORKS
FOR
CHANGE**

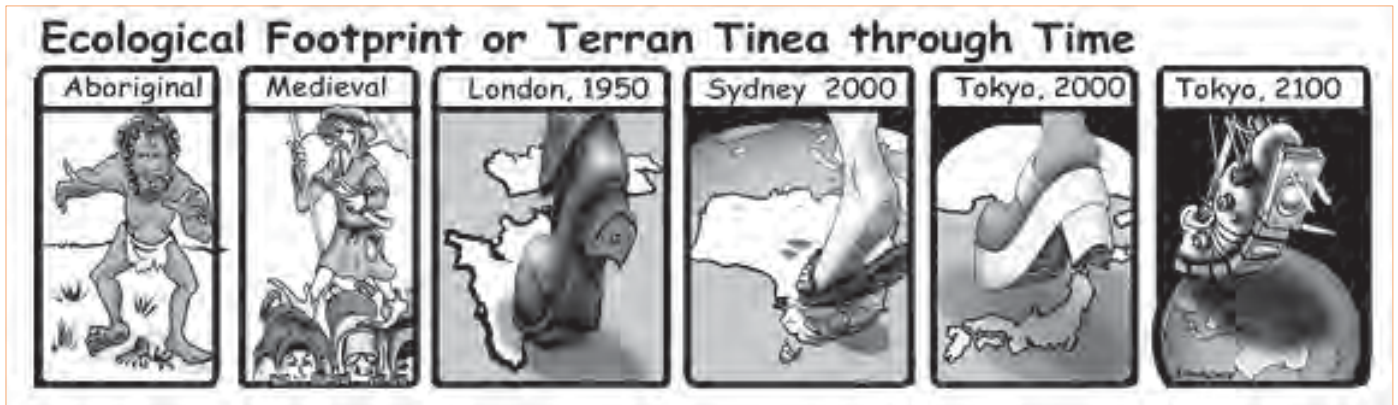
Ecological Footprint: Too Too-Much Much by Thomas Hirschhorn is a symbol of society's big appetite. In our daily lives, we have the luxury of stashing, hiding and discarding things, but in Hirschhorn's world, we are forced to heed the artist's warning about our collective demands on nature.

Source: <https://www.artworksforchange.org/portfolio/thomas-hirschhorn/>

A. WHAT IS THE ECOLOGICAL FOOTPRINT (EF)?

The Ecological Footprint (EF), a widely recognised measure of sustainability, is an account-based system of indicators that tracks the use of natural resources, and its impacts on ecosystems. The EF acknowledges that Earth has a finite amount of biological production that supports all life.

Source: <https://www.footprintnetwork.org/our-work/ecological-footprint/>



Cartoon: Jon Lawrence, Epping Boys' High School (retired)

Archaeologists discovered fossil footprints of humans who walked in the sand near Laetoli in Tanzania Africa, about 3.7 million years ago. These people used rudimentary implements that had a minimal impact on the environment. Their small ecological footprint (EF) was similar to traditional indigenous communities living in the Indonesian, Brazilian and Papua New Guinea rainforests and Namibian deserts, compared to the larger EF of loggers, miners, hunters, agriculturalists and urbanites. Most traditional indigenous communities, demonstrate values that promote conservation and the sustainable use of resources. However the culmination of their nomadic and subsistence lifestyles threatens sustainability.

For at least 60,000 years, traditional Australian Aboriginal and Torres Strait Islander Peoples maintained a special connection to and responsibility for Country, and as a result have a small EF. Their few implements, belongings and clothes were made from rocks, wood, plants and animals. Their intimate knowledge of seasonal patterns secured their ongoing supply of food, medicines and other resources. Scientists and environmental managers increasingly recognise their traditional ecological knowledge and its applications to water resources and land management, as well as their path to low carbon living that meets the global climate challenge.

Humans originally lived by hunting and gathering but major changes occurred that gave humans more energy and new technologies to alter and control more of Earth to meet basic needs and increasing wants. For example:

- Agricultural revolution (about 10,000 –12,000 years ago)
- Industrial revolution (about 275 years ago)
- Information and technology revolution and globalisation (about 50 years ago).

Everything you do from flushing the toilet, buying a mobile phone, watching TV, travelling by car to school and disposing of single use plastic bags – all contribute to your EF.

Over the last century, massive growth in population (83 million a year), high rates of urbanisation, vast technological changes and high consumption of natural resources have increased human's EF, and created an ecological imbalance on Earth, referred to as 'ecological overshoot.'

BELOW: Aboriginal hollow log tombs - National Gallery Canberra

Source: https://upload.wikimedia.org/wikipedia/commons/d/d9/Aboriginal_hollow_log_tombs02.jpg



B. HOW DOES THE EF MEASURE IMPACTS OF HUMANS ON THE ENVIRONMENT?

Ecological Footprint (EF) was defined by (Wackernagel & Rees, 1996) as 'the ecologically productive territory needed to produce the resources used and to assimilate the waste and emissions produced by a population.'

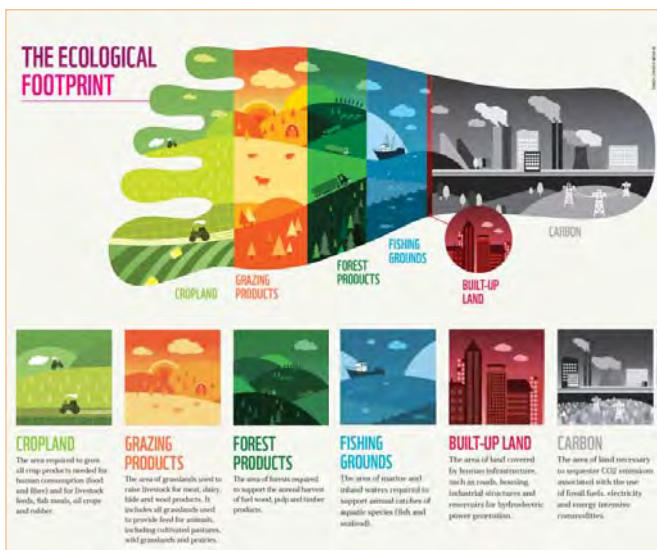
Every human produces an ecological footprint (EF) that is determined largely by their wealth and level of development in the country they live in—more developed countries tend to have a larger footprint but the choices humans make in their daily lives also contribute to the footprint. Running clothes through a dryer and turning on the air conditioning add up to a larger footprint.

Source: <https://www.worldwildlife.org/threats/the-human-footprint>

Measuring the impact of humans on the natural environment is complex and difficult. One measurement applied is the EF calculated in global hectares (gha), at various scales – individuals, corporations, villages, towns, cities, regions and countries. The EF measures the quantity of natural resources the Earth supplies (biocapacity) and the quantity of natural resources consumed.

The EF tracks the use of six productive surface areas—cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land.

1. Six main components of the Ecological Footprint



Source: <https://www.slideshare.net/OliviaSnchezBadini/kefr2016encompressed>

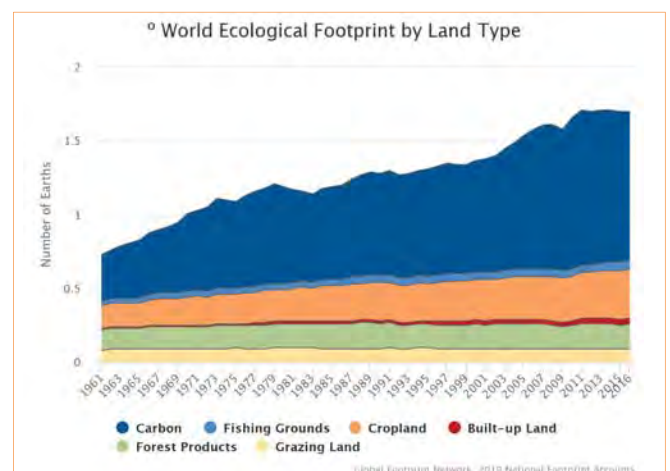
YouTube

- *Mathis Wackernagel: The Ecological Footprint*
Source: https://www.youtube.com/watch?v=94tYMWz_la4
- *6 Questions on the Ecological Footprint of Cities with Mathis Wackernagel (human wellbeing)*
Source: <https://www.youtube.com/watch?v=fFf14HFvpAM>

2. Growing world EF

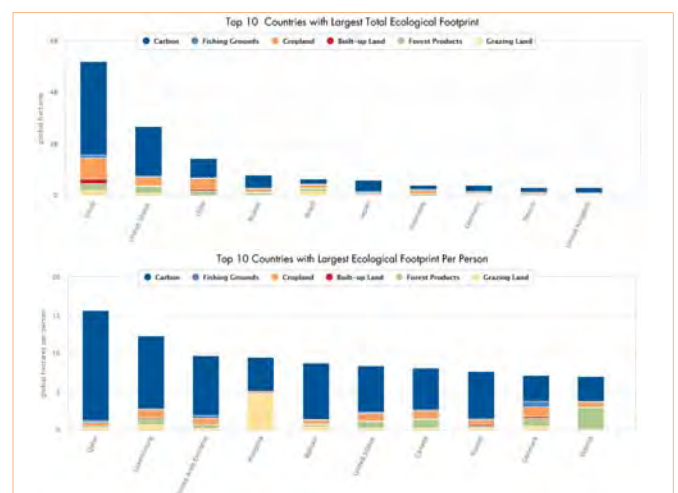
The global EF has grown over the past five decades, due to escalating population and consumption per capita. The largest increase was the carbon component of the EF.

Global EF Trends: Six main categories



3. Countries with the largest EF: Six main categories

Of the 25 countries with the largest EF per person, most are located in high-income countries.



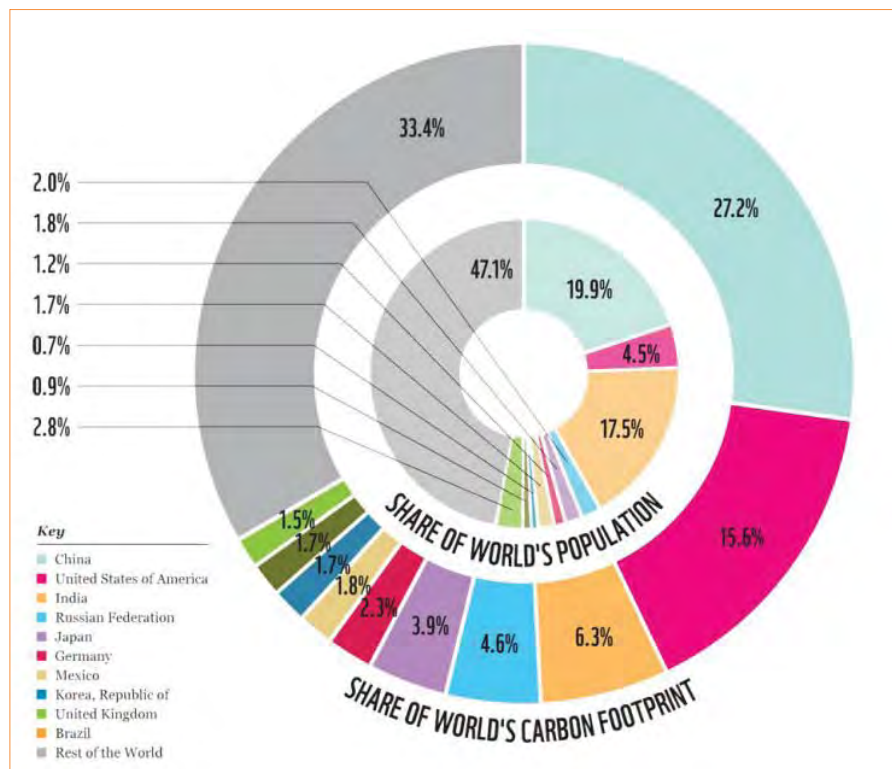
4. Carbon: Main component of EF



The carbon footprint is the amount of carbon dioxide released into the atmosphere as a result of human activities. Where you live (country, urban, rural) and your lifestyle, such as the food you eat, your energy source, and your travel mode, impacts on the size of your carbon footprint.

Carbon is about 60% of the global EF, and the fastest growing component of the EF. In 2018 greenhouse gases (GHG), mainly carbon dioxide CO₂, and methane CH₄, emissions from all human activities (e.g. use of fossil fuels-energy, industry, transport), rose more than 2%.

5. Share of the world's Carbon Footprint



China with 19.9% of the global population produced 27.2% of the world's carbon footprint compared to US with 4.5% of the global population that produced 15.6% of the world's carbon footprint. This large carbon footprint is followed by countries such as India, Russia, Japan, Japan, Mexico and South Korea.

SEE APPENDIX 3 Activities

Weblinks

- Carbon footprints
Source: <https://www.theguardian.com/environment/carbonfootprints>

LEFT: Source: <https://www.footprintnetwork.org/our-work/climate-change/>



6. Running shoes leave a large Carbon Footprint

A typical pair of synthetic trainers generates 30lbs (13.6 kg) of emissions, equivalent to leaving a 100-watt bulb burning for a week

The MIT researchers tracked the emissions associated with the manufacture of the shoe from extracting the raw materials, manufacturing and assembling the product, and use of detergent to clean it by its eventual owner.

The particular shoe was made from 26 different materials, and required 360 different steps to manufacture and assemble. About 68% of the greenhouse gas emissions generated by the shoes tested by the MIT researchers arose during the manufacturing process – not in sourcing the materials or in their actual use.

More than 25bn pairs of shoes are manufactured every year, most of them in developing countries. Sports apparel companies have been leaders in trying to reduce their environmental impact

Source: <https://www.theguardian.com/environment/2013/may/23/running-shoes-carbon-footprint>



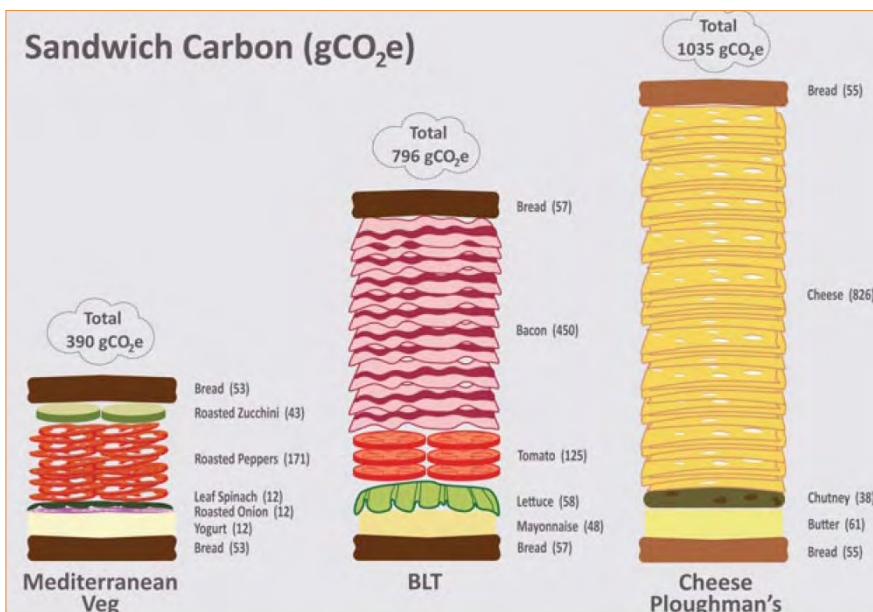
YouTube

- The shoe without a footprint
Source: <https://www.youtube.com/watch?v=a03PbC8UdqQ>

ICT

- Running shoes have large carbon footprint: Most of it comes from the manufacturing process.
Source: <https://www.runnersworld.com/gear/a20845278/running-shoes-have-large-carbon-footprint/>
- How to rock white sneakers without eco-guilt
Source: <https://sydney.edu.au/news-opinion/news/2017/12/14/how-to-rock-white-sneakers-without-eco-guilt.html>

7. Huge Carbon Footprint of a sandwich



Source: <http://visual.ly/community/infographic/food/sandwich-counter-your-lunchtime-sandwich-footprint>

YouTube

- The carbon footprint of a sandwich
Source: <https://www.youtube.com/watch?v=jRQEI-C5GDg>
- Sandwiches have huge carbon footprints
Source: <https://nowthisnews.com/videos/food/sandwiches-have-huge-carbon-footprints>
- How your sandwich changed the world
Source: <https://www.youtube.com/watch?v=jRQEI-C5GDg>

Weblink

- Scientists calculate carbon emissions of your sandwich
Source: <https://www.theguardian.com/lifeandstyle/2018/jan/25/scientists-calculate-carbon-emissions-of-your-sandwich>

C. WHAT IS THE DEMAND SIDE OF THE EF? CONSUMPTION



1. Let's look in your wardrobe!

Humans spend most of their money on housing, food, transport, insurance, entertainment, education, health care, and clothes that have both an ecological footprint (EF) and social footprint (Human Development Index – HDI).

Global clothing production doubled from 2000 to 2014. Unfortunately, people keep their clothing for half as long as they did 15 years ago, and as a result generate a huge amount of waste. Australians buy 27kg of textiles each year, with 23kg thrown into landfill or incinerated.

A cotton shirt uses 2,700 litres of water and 2.1 kg of CO₂. Extra carbon is generated when clothes are transported to distant countries. Additionally, the production of T-shirts sometimes generates a negative social impacts when sweatshop and child labour are used.

Photographs: *Follow the Leader* by Guerra de la Paz, uses repurposed clothing and shoes to emphasise the significance of the human footprint.



2. What do you throw away? Where is the missing plastic?



Source: <https://www.artworksforchange.org/portfolio/fred-tomaselli/>

Photograph: In *Gyre*, Fred Tomaselli depicts trash ingested by a fish. Plastic harms marine species and increases risks to human health risks by introducing toxins into the seafood we consume.

Around 7 billion kilograms of rubbish such as cardboard, plastic bottles and cans are dumped into the ocean every year. Plastic made from the non-renewable resource petroleum:

- is a major cause of ocean, land, groundwater and air pollution
- upsets food chains
- kills marine species

About 8% of the world's annual oil production is used to produce and manufacture plastic. Due to its low cost and ease of manufacture 33% of plastic is a 'single life product'. However plastic has a large carbon footprint, that is about 6 kg CO₂ per kg of plastic. Humans produce 20 times more plastic than 50 years ago. Asia accounts for 30% of the global consumption followed by North America (26%) and Western Europe (23%).

The Pacific, Atlantic and Indian Oceans, are important environmental resources but are threatened by floating

garbage of which 90% is plastic. The Great Pacific Garbage Patch, located in the North Pacific Ocean, was formed by slow swirling ocean currents called gyres. These currents move garbage from the coasts of Asia and North America towards the centre of the Ocean, referred to as the 'patch'. Micro-plastics a major component of the patch are virtually non-biodegradable.

3. What do you do with the waste from consumption?

Photograph: *Mobro – High Seas Drifter* by Scott Greene.



Source: <https://www.artworksforchange.org/portfolio/scott-greene/>

A barge carried over 3,000 tons of garbage on a 6,000-mile journey that ended where it began. The barge set out in 1987, filled with garbage from New York that was headed for a landfill in North Carolina. The barge was turned away. It travelled to Belize before returning to New York, where its cargo was incinerated. This incident raised awareness about our growing waste problem and propelled the recycling effort throughout the US.

4. Do you think this is over-consumption of natural resources?

Diagram: Average lifetime resource consumption in the USA



Source: <http://css.umich.edu/factsheets/us-environmental-footprint-factsheet>

Weblink

- US cult of greed is now a global environmental threat.
Source: <https://www.theguardian.com/environment/2010/jan/12/climate-change-greed-environment-threat>

5. Is over-consumption of 'stuff' causing a sick environment?

The Story of Stuff creator Annie Leonard's book examines the high price of the western world's obsession with all things material

Source: <https://www.theguardian.com/environment/2010/jun/21/overconsumption-environment-relationships-annie-leonard>


The film "The Story of Stuff"

Every product has its own story. It begins with the removal of raw materials and continues through an entire manufacturing process, including distribution of the finished product. Every product story peaks when we make our decision to buy it, and then consume it – but it certainly doesn't end when the packaging is thrown away.

Annie Leonard gives us a behind-the-scenes look of product stories in her fast-paced short film *The Story of Stuff*. The film, which is full of both humor and facts, gives us a chance to understand the social and ecological consequences of our purchasing decisions. The English language version is available on the accompanying DVD or can be downloaded at these Web sites:

THE STORY OF STUFF

- www.storyofstuff.com
(Original English version)
- www.storyofstuff.com/international/
(Original English version with subtitles)
- www.utopia.de/wissen/bildungsuecken/the-story-of-stuff (dubbed in German)



Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf



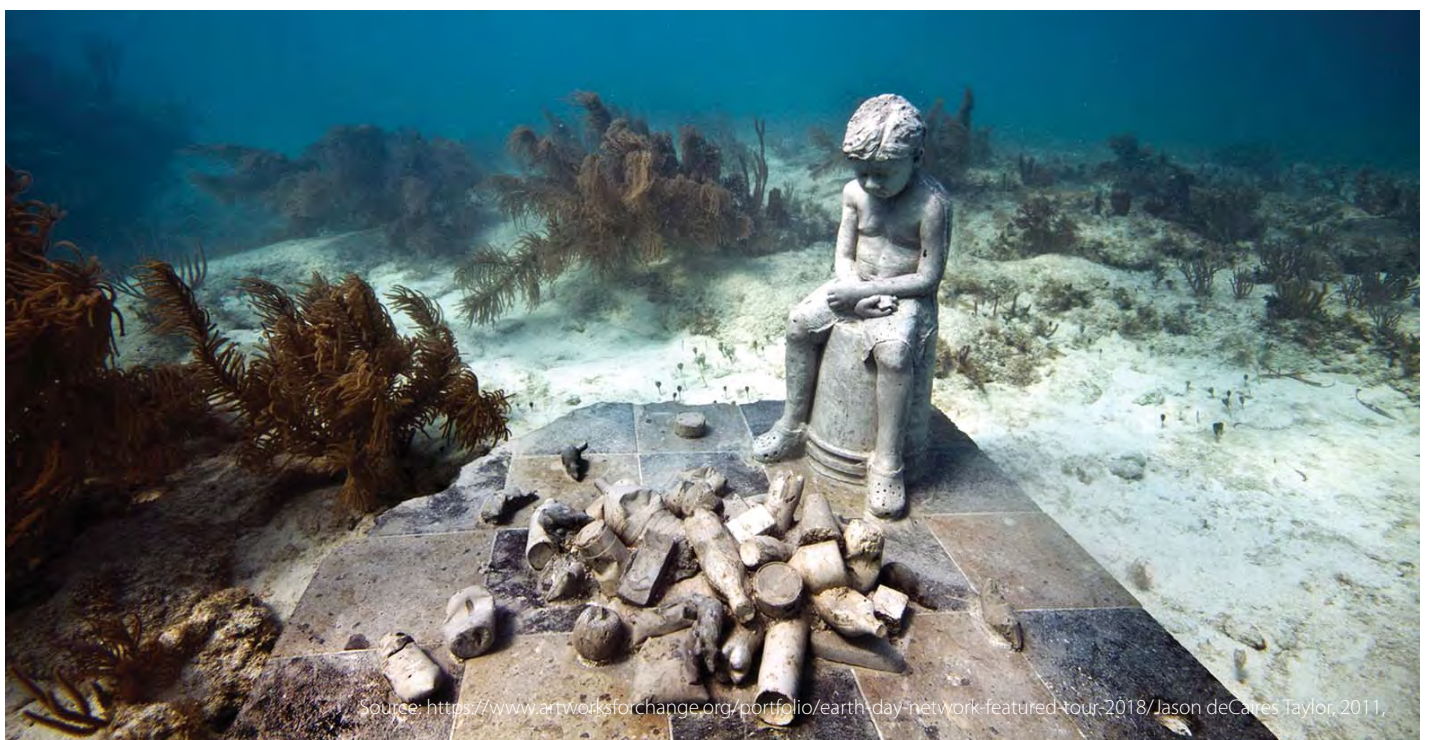
Source: https://upload.wikimedia.org/wikipedia/commons/6/65/Electronic_waste.jpg

Weblink

- Consumption dwarfs population as main environmental threat
Source: <https://www.theguardian.com/environment/2009/apr/15/consumption-versus-population-environmental-impact>

6. Will this be our inheritance if we continue on this unsustainable path?

Photograph: *Inheritance*, an underwater sculpture by Jason deCaires Taylor. Why is it referred to as inheritance?



Source: <https://www.artworkforchange.org/portfolio/earth-day-network-featured-tour-2018/Jason-deCaires-Taylor-2011>

D. WHAT IS THE SUPPLY SIDE OF THE EF? BIOCAPACITY

We also need to calculate the planet's total biocapacity. In other words, Earth's ability to produce natural resources, provide land for humans to build on, and absorb waste such as carbon emissions.

Biocapacity measured in global hectares (gha), calculates the area of biologically productive land (for crops, grazing, forests and built-up areas) and sea (fishing grounds), that provides the resources a population requires for consumption, and the assimilation of its wastes.

Ecological resources are at the core of a country's long term wealth. However, population growth and high consumption are placing pressure on limited natural

resources' (GFN). For example the world's average citizen has an EF of 2.8gha per person but the world's biocapacity is 1.7gha per person. This led to an ecological deficit of 0.11ha per person. About 86% of the world's population lives in countries with an ecological deficit.

Countries are endowed with different resources and consume resources at different rates. In a globalised world, countries meet their demand for resources through trade.

What is the difference between Surplus and Deficit?



BIOCAPACITY SURPLUS

EF is smaller than biocapacity e.g. Suriname, Congo, Bolivia and Namibia.
14% of the world lives in countries with more biocapacity than footprint



BIOCAPACITY DEFICIT

EF is larger than biocapacity e.g. Bermuda, Israel, Bahrain, Saudi Arabia and Qatar.
Residents demand more from nature than the country's ecosystems can generate.

BIOCAPACITY DEFICIT COUNTRIES

Percentage that EF exceeds biocapacity:

Singapore 9,890%
Bermuda 4,810%
Réunion 2,820%
Barbados 2,070%
Cayman Islands 1,670%
United Arab Emirates 1,650%
Israel 1,640%
Bahrain 1,530%
Saudi Arabia 1,350%
Cyprus 1,260%
Qatar 1,230%
Kuwait 1,150%

BIOCAPACITY SURPLUS COUNTRIES

Percentage that biocapacity exceeds EF:

French Guiana 3,860%
Suriname 2,330%
Guyana 2,300%
Gabon 846%
Congo 763%
Central African Republic 555%
Bolivia 436%
Congo 255%
Uruguay 246%
Namibia 212%
Eritrea 209%
Timor-Leste 199%

Adapted <http://data.footprintnetwork.org/#/>

E. WHAT IS THE ENVIRONMENTAL PROBLEM?



Source: <https://www.thegef.org/blog/environmental-challenges-need-integrated-solutions>

How much nature do we use (DEMAND – ECOLOGICAL FOOTPRINT)?

How much nature do we have (SUPPLY – BIOCAPACITY)?

Demand is greater than supply!

DEMAND ECOLOGICAL FOOTPRINT

Ecological Footprint measures resource consumption of human activities across the lifecycle of a product or service and converts this to the amount of land required to supply the resources consumed and assimilate the wastes generated.

Source: <http://www.foodchoices.com.au/samples/resource%20sheet%2056.pdf>

Consumption indicators such as the Ecological Footprint provides a picture of overall resource use. The products we consume, supply chains behind them, materials used and how these are extracted and manufactured, have myriad impacts on Earth.

Source: https://c402277.ssl.cf1.rackcdn.com/publications/1187/files/original/LPR2018_Full_Report_Spreads.pdf?1540487589

ECOLOGICAL FOOTPRINT =

Population X Per capita consumption X Resource intensity

SUPPLY BIOCAPACITY

Biocapacity refers to the capacity of a given biologically productive area (global hectares) to supply resources and absorb its wastes.

Source: <https://www.greenfacts.org/glossary/abc/biocapacity.htm>

Ecological resources are at the core of a country's long-term wealth.

Source: <https://www.footprintnetwork.org/our-work/countries/>

Population, growth and consumption (EF), already exceeds Earth's biocapacity. This is unsustainable

BIOCAPACITY =

Biocapacity X Productive Area

UNBALANCED

HUMAN IMPACT: ECOLOGICAL FOOTPRINT

As population and consumption increased, humans have placed greater demands on ecosystems essential for our survival

1. Top Countries – Ecological Demand and Supply

When placing demand and supply together, the problem becomes obvious. It takes a year and a half to generate the resources (supply) that the human population uses (demands) in only a year. This is not a sustainable path for our planet's future.

DEMAND

- 51% of Ecological Footprint is attributed to five countries: China, USA, India, Russia and Japan

SUPPLY

- 62% of the world's biocapacity is located in ten countries. Forests comprise the largest proportion of total biocapacity in Brazil, China, US, Russia, India, Canada, Australia, Indonesia, Argentina and Congo

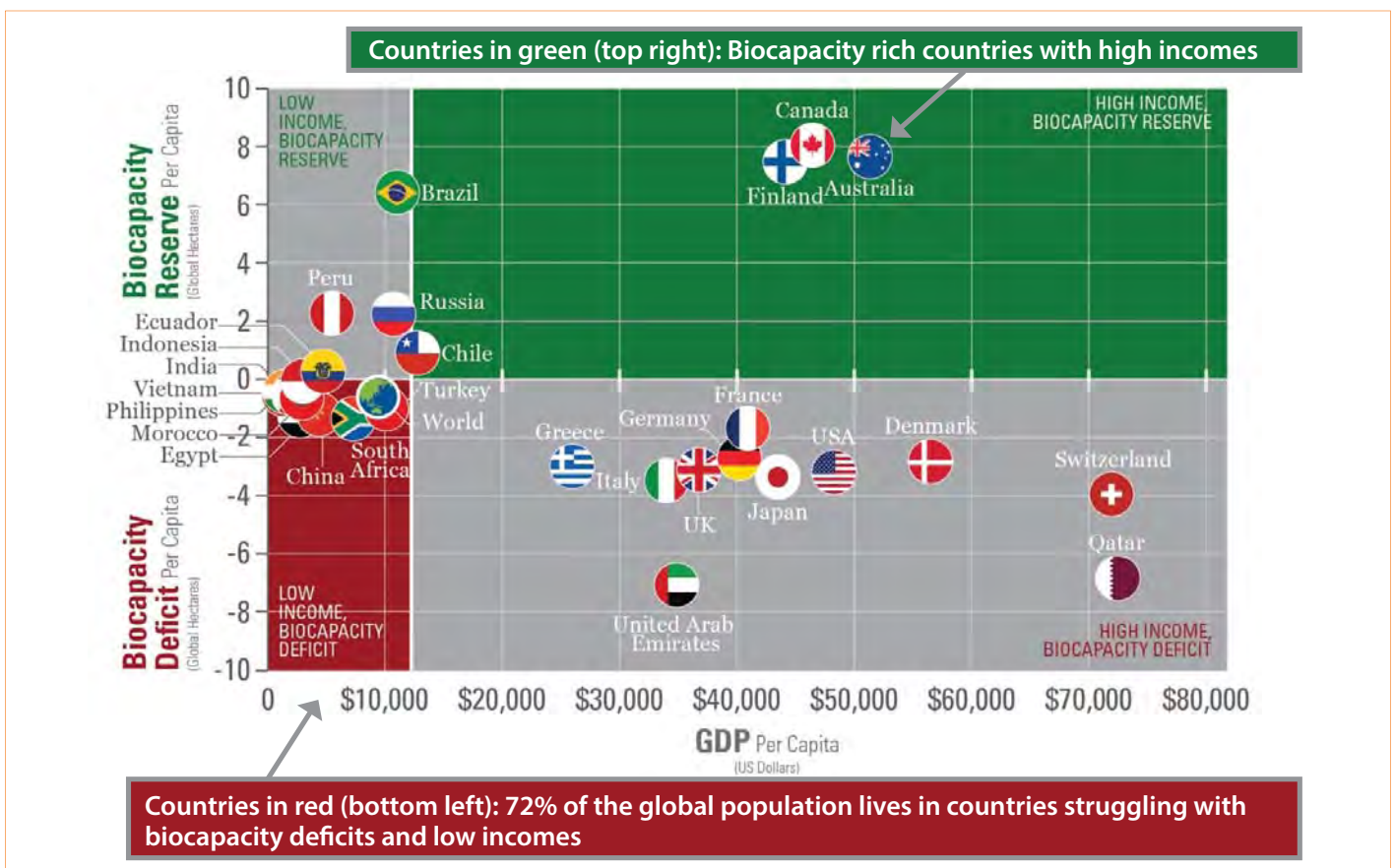


Photograph: Aerial monitoring of illegal mining in Jamanxim and Rio Novo national parks in Pará, Brazil

Source: https://upload.wikimedia.org/wikipedia/commons/b/bc/Parques_Nacionais_do_Jamanxim_e_do_Rio_Novo%2C_Par%C3%A1_%2831181653127%29.jpg

2. EF and Biocapacity of countries versus GDP per capita

Gross Domestic Product (GDP) per capita is directly connected to the EF. A wealthy country possesses greater opportunities for spending its money, and the use of more natural resources.



<https://www.eco-business.com/news/earths-annual-ecological-budget-blown-just-8-months/>

Wealthy countries such as UAE and Qatar have the highest ecological deficits, while Brazil, Canada, Finland and Australia have the highest biocapacity reserves.

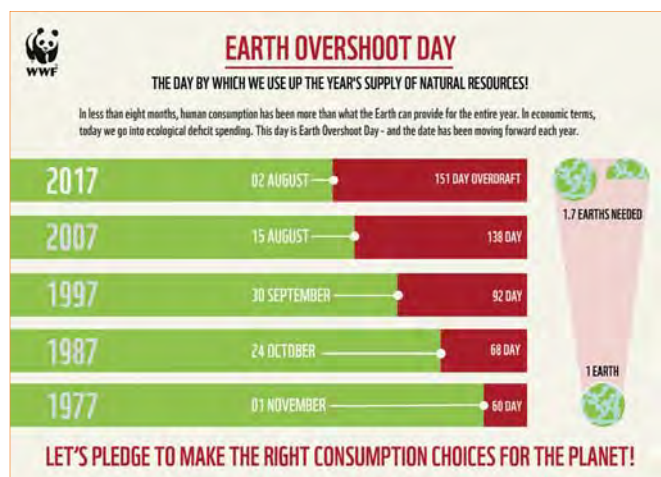
F. WHAT IS MEANT BY ECOLOGICAL OVERSHOOT? IS THIS A PROBLEM?

Ecological Overshoot is the shortfall in Earth's biological capacity to meet humanity's consumption demands.

'The costs of this global ecological overspending are evident around the world, in the form of deforestation; scarce fresh-water; soil erosion; biodiversity loss; and the build-up of carbon dioxide in the atmosphere, leading to climate change and more severe droughts, wildfires and cyclones.'

Source: <https://www.footprintnetwork.org/2018/06/13/earth-overshoot-day-2018-is-august-1-the-earliest-date-since-ecological-overshoot-started-in-the-early-1970s/>

Since the 1970s, humans are consuming more energy and other resources than nature can provide, as well as produce more wastes than nature can assimilate, in a year. This referred to as "ecological overshoot", has continued to grow. By August 1 2018, more of the Earth's resources had been consumed than it could regenerate in one year. In fact humans had used a year's worth of resources in only seven months.



Source: <https://www.wwfndia.org/?16661/Earth-Overshoot-Day-2017-is-August-2>

In a globalised world, countries meet their population's demand for resources by firstly using their own biocapacity, then secondly using the biocapacity of other countries via trade, and so called land grabs in other countries, such as Saudi Arabia in Ethiopia.

As wealth grows and consumption patterns change humans need to adopt innovative technology and sustainable lifestyles to preserve this planet. *'All hope is not lost if we can reverse the trend. Living within the means of one planet is technologically possible, financially beneficial, and our only chance for a prosperous future,'* said Wackernagel

Source: <https://www.wwfndia.org/?16661/Earth-Overshoot-Day-2017-is-August-2>



1. Why should we be concerned with overshoot?

A digression: Looking back – an example of overshoot in early civilisation

The first evidence of the destruction of an ecosystem comes from the Sumerians about 2400 BCE. The geology of the valley between the Tigris and Euphrates made food production especially difficult. In spring both rivers were swollen with large amounts of water; between August and October, the period when farms most need water, the rivers shrank into tiny rivulets. The Sumerians developed one of the world's first artificial irrigation systems. The productivity of the ecosystems rose as did grain harvests. During summer it is extremely hot in this latitude, around 40 °C. The irrigation water quickly evaporated on the fields, leaving deposits of salt behind. Beginning in 2000 BCE reports grew of the earth "turning white". Ultimately, grain production collapsed due to salinisation of the soil – a chief problem with irrigation even today. The case of the Sumerians reveals the basic pattern of overshoot:

- Growth occurs and events accelerate (artificial irrigation increases the productivity in the Tigris and Euphrates valley).
- Limits are exceeded whereby the system is decisively destroyed (after a certain degree of soil salinisation, plants reacted negatively and yields sank).
- Learning processes start too late to correct the problem (the Sumerians were unaware of the problem of salinisation and may have never fully understood what caused the collapse).

This example shows how overshoot is a problem that often creeps up slowly; this is what makes it so dangerous. The fate of the Sumerians as a result of their unintentional mismanagement and overuse of ecosystems has repeated itself innumerable times, be it in Biblical times with the destruction of the forests on the hills of Lebanon, Roman times with extensive erosion around the Mediterranean, right up to the present day. Ecosystems are sensitive; when they lose their balance, a collapse is often not far away.

Ponting, C. (2007): *A New Green History of the World. The Environment and the Collapse of Great Civilisations*. Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf



Do you understand the importance of overshoot?

Suggestions for further work: Have you understood the principle of overshoot?

Imagine, for example, you take a second job in a bakery. You must get up every morning at 3 am. After a certain amount of time, your ability to perform your day job really begins to suffer, probably because you are much too tired. Is this overshoot?

Consider other situations from your everyday life, your family, your community, or on a global level in which overshoot can occur (even when we don't call it that in everyday conversation).

Let's look a bit into the future: humankind realises that it cannot overdraw its natural capital account any longer because it is endangering its own basis for survival. Imagine that you are a minister of the environment, a mayor, or an automobile manufacturer – what do you think the basic approaches for solutions would look like in order to encourage better, more intelligent and fairer dealings with natural resources? What ideas occur to you in the face of such complex challenges? What would the different arguments look like from the perspectives of the interested parties mentioned above (or others)? For example:

- What if every person, every city, every country or business could buy or sell their "personal consumption units" similar to the trading of greenhouse gas emissions? How would this impact people's daily lives? Do you think that this approach would reduce consumption? Why, or why not? Who would likely oppose such an idea and who would

support it? How could such an idea be implemented – which institution or organisation would have the capability to handle such a challenging task? Where do you see risks and / or potential negative consequences?

- Some suggest that we should consider giving everybody equal access rights to global biocapacity – Is this fair? Or does biocapacity belong to the various countries? Or should we get access according to our purchasing power?
- If we lived within the means of the planet, would we all go hungry from October onwards, after the annual Overshoot Day because we had already used up our resources for the year?
- Germany's "green tax" (which, among other things, contains electricity taxes and leads to an increase in petroleum taxes) makes environmentally damaging behavior more expensive. Should this regulatory instrument be extended to other consumption sectors? Do you see ways of expand it to include biocapacity? Might it be a good model for other countries?
- What other solutions can you think of?

Sustainability Has Many Faces. A big foot on a small planet? A brochure series with accompanying materials on development cooperation for the UN Decade of Education for Sustainable Development

Source: https://conservation-development.net/Projekte/Nachhaltigkeit/DVD_10_Footprint/Material/pdf_Serie_Nachhaltigkeit/10_Footprint_en.pdf

SEE APPENDIX 3 and 4 activities

G. WHAT ARE THE INEQUALITIES BETWEEN EF AT A VARIETY OF SCALES?

The world's 7.7 billion people consume varying amounts of the planet's resources and production of wastes. Consumption varies between and within:

- REGIONS (Asia, Europe, North America, Africa and South America)
- COUNTRIES (developed and developing)
- SETTLEMENTS (rural – urban)
- PEOPLE (rich and poor)

a. REGIONS

EF per person: North America has the highest EF per person, followed by Europe. The most rapid increase in EF is in the Asia region which is primarily driven by China. The EF of Africa and West Asia/Central Asia region are increasing. All other regions are characterised by relatively minor increases in per capita EF (8% Africa, 16% South America)

Source: <https://www.mdpi.com/2079-9276/7/3/58/htm>

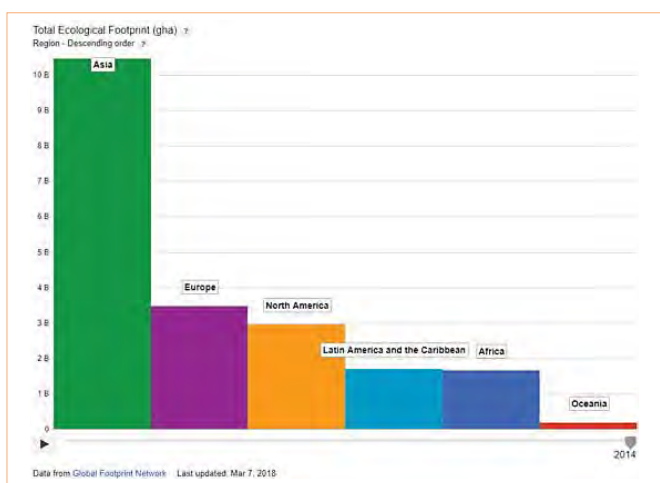
Total EF: However, the story differs when measuring the total EF. Asia has the highest with large populations, followed by Europe and North America. Asia's large population (60% of global population) creates 40% of the world's EF.

From 1961 to 2007 Asia's population doubled, total EF increased 340% to about 5.1 billion gha, and per capita EF increased by 30%.

Within Asia there are variations: For example, the United Arab Emirates (UAE) has a per capita EF of 10.3gha, the highest in the world, whilst Pakistan's per capita EF is only 0.75gha.

Currently, Asia's EF is around 2.5 times that of its biocapacity.

Comparative column graph: EF of Regions: EF of Regions



Source: <https://www.footprintnetwork.org/our-work/climate-change/>

b. COUNTRIES

Countries demand and supply of natural resources varies over time. Generally richer more developed countries have a higher EF per person than poorer less developed countries. For example developed Luxembourg (15.82) in contrast to developing Pakistan (0.79) and India (1.16).

Inequalities in EF per person in some Asian countries

Rank	Country	EF per person
8	Singapore	7.97
20	Mongolia	6.08
27	South Korea	5.69
42	Japan	5.02
64	Malaysia	3.71
71	China	3.38
98	Thailand	2.66
133	Vietnam	1.65
135	Indonesia	1.58
143	Myanmar	1.43
163	North Korea	1.17
164	India	1.16
167	Phillipines	1.10
175	Nepal	0.98
184	Pakistan	0.79
185	Bangladesh	0.72

Adapted: https://en.wikipedia.org/wiki/List_of_countries_by_ecological_footprint

Bangladesh

Bangladesh is a poor developing country, with a small population than lives without many luxuries. Hence, the EF per person of a Bangladeshi is small. This is mainly due to low per capita income which means Bangladesh does not possess a large consumer society. Moreover, it has a low carbon footprint as it possesses few industries resulting in emitting only 0.44 tonnes of CO₂ per person compared to 14.4 tonnes of CO₂ per person in the US.

Producer:

- Less production in Bangladesh means less ecological damage – reduced consumption of biocapacity and the productio of waste.

Consumer:

- Lower incomes in Bangladesh means less consumption of resources that leads to smaller EF.

This contrasts with United Arab Emirates (UAE) that has a very large EF because it is the world's third-largest oil exporter country. As a result, this country has one of the highest per capita carbon footprints in the world.

India

India's EF has doubled since 1961 with India now demanding the biocapacity of two India's to provide for its consumption and absorb its wastes. While India demands a significant percent of the world's biocapacity, its per-capita EF of 0.8 gha, is well below the world average of 2.2 global hectares

On a global scale, India has the fourth-largest carbon footprint from tourism in the world. *Have you ever wondered if your vacation to exotic India may have played a role in global carbon pollution?*

c. SETTLEMENTS WITHIN COUNTRIES

The wellbeing of a subsistence farmer living in an isolated village in a developing country contrasts with a wealthy city-dweller in a developed country. More land is required to grow the city dweller's food, more materials are used to build the city dweller's home and workplace, and more energy is required for transport, heating and cooling.

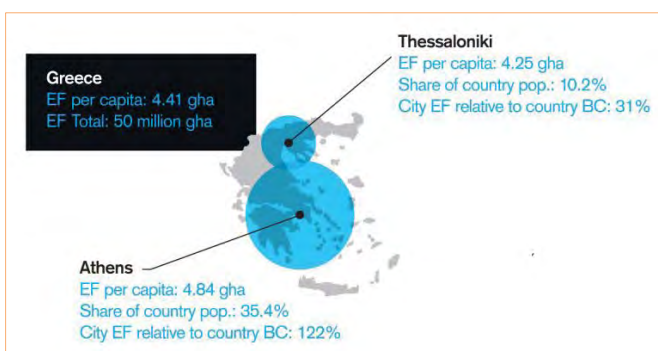
Source: <https://www.bbc.com/news/magazine-33133712>

In many countries, one or two major urban centres are major contributors to the country's EF and also runs higher per capita EF than the average for their country. For instance, the resource demands of citizens in Athens exceeds the biocapacity of all of Greece.

Source: <https://www.footprintnetwork.org/our-work/cities/>

Greece compared to its two cities – Athens and Thessaloniki

Both cities have a larger EF per person than Greece



Source: <https://www.footprintnetwork.org/our-work/cities/>

Two per cent (2%) of the world's land surface, which the cities currently occupy, consumes 75% of the world's natural resources and discharges an equal amount of waste, causing huge EF.

- *Will we have enough resources to consume and survive if 60% of the world's population becomes urbanised by 2030?*
- *Are our cities self-sufficient entities?*
- *How are we going to satisfy the huge appetite of the growing cities and still be able to leave a liveable world for our future?*

Source: <https://www.smartcitiesdive.com/ex/sustainablecitiescollective/ecological-footprint-and-liveable-future/118866/>

In a globalised world, cities regions and countries, depend on resources and ecological services from distant ecosystems. The wellbeing of residents is affected by both the health and availability of diverse ecosystems, and that the supply of natural capital meets human demand.

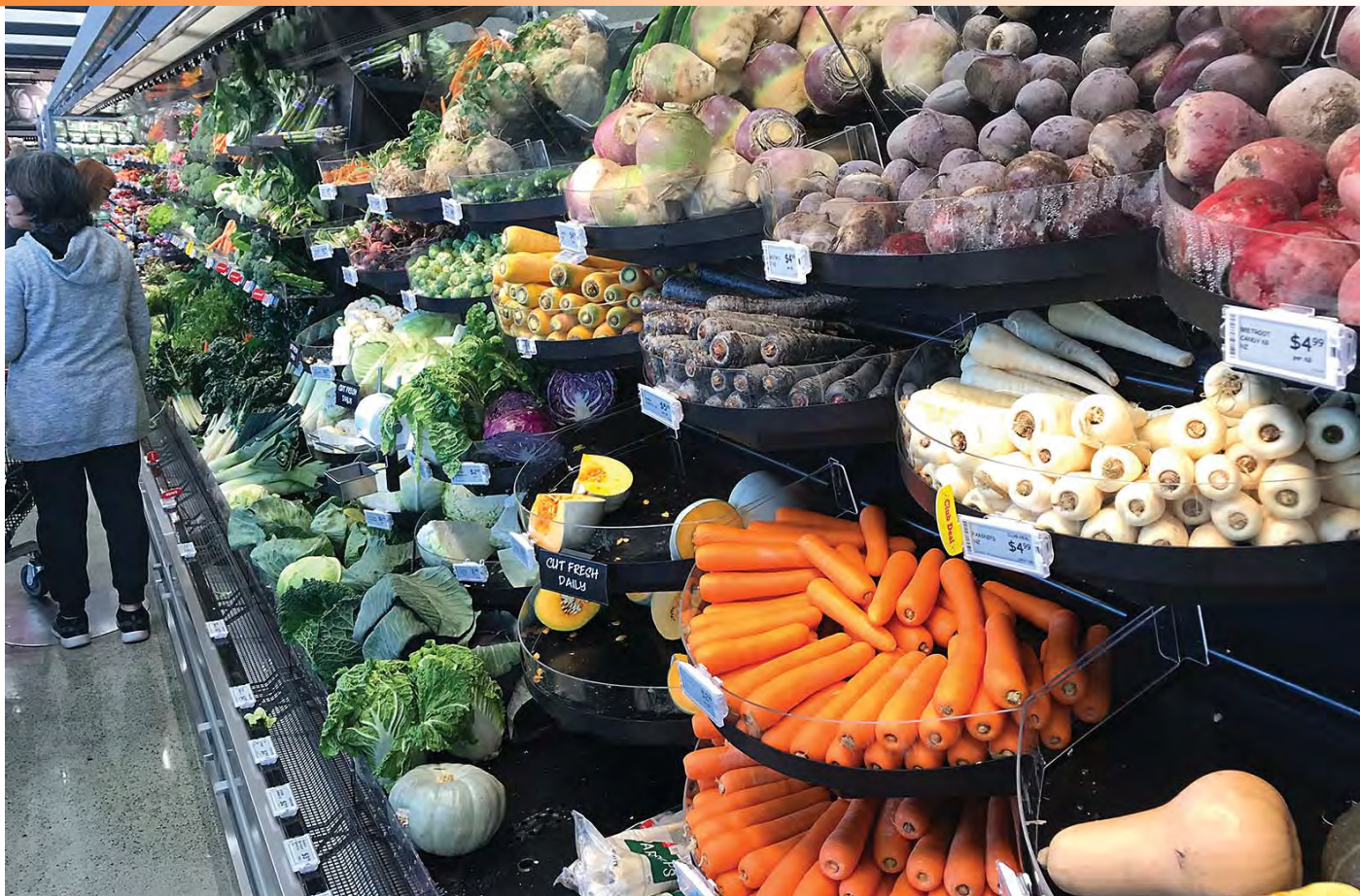
d. PEOPLE

Every person on Earth from birth to death is responsible for the EF. However, the size of a person's EF depends on what country they live in, where they live in that country, and their wealth (income and assets).

- A person's per-capita share of the country's services and infrastructure such as hospitals, roads and schools, tends to be higher in urban compared to rural settlements.
- The size of a person's EF depends on income, assets and lifestyle such as the choices individuals make on what they eat, what products they purchase and how they travel.
- Wealthier people tend to have a larger EF produce more carbon pollution, and waste more energy e.g. heat homes, drive cars, take more flights and require more cement to construct their large homes, while buying and throwing away more items.

Decisions undertaken by governments and businesses have a substantial influence on the EF. For example, individuals generally have no direct control over the size of the built-up land footprint. The same is true for the way in which a country produces its electricity or the intensity of its agricultural production. Governments and businesses therefore play an important role in increasing or reducing the EF of each person.

Source: https://www.panda.org/knowledge_hub/all_publications/living_planet_report_timeline/lpr_2012/demands_on_our_planet/footprint_income/



Source: https://upload.wikimedia.org/wikipedia/commons/c/c1/Naked_food_279.jpg

1. Comparing people who live in USA with those living in India

Globally, half the CO₂ emissions associated with individual lifestyles are due to the actions of the richest 10% of humanity, who live in the world's most affluent 25 countries.

Source: <https://newint.org/features/2017/07/01-equality-environment>

CATEGORIES	AVERAGE US/INDIAN PERSON
Average per capita consumption expenditure	US: US\$33,469; India: US\$900
Consumption of:	US consumes more than India by:
– food and beverages	15 times
– housing and household goods and services	50 times
– recreation	6,000 times
– health	200 times
The richest 5% of Indians consume less than the poorest 20% of people living in US.	

Adapted: <https://www.downtoearth.org.in/news/climate-change/consumption-and-emissions-rich-indians-v-s-rich-and-poor-americans-61805>

The Human Development Report stated that the richest one-fifth of the world's people consume/possess:

- 45% of fish and meat (poorest fifth 5%)
- 58% of world's energy (poorest fifth 4%)
- 74% of telephone lines (poorest fifth 1.1%).

Developed countries have 25% of the world's population but consume 75% of energy, 85% of wood products and 72% of steel products, and are able to use 84% of all manufactured products.

Is this fair? Who should pay?

Egalitarianism:

All humans should be entitled to an equal share of the global commons (air, water, land and resources).

Historical Responsibility:

Those who caused global warming and environmental degradation, should bear the burden (ecological debt).

H. HOW CAN YOU REDUCE THE EF? ACTIVE CITIZENSHIP

'How shall we learn to tread more lightly on the face of the Earth? One answer is to calculate our "ecological footprint", being the impact that each and every one of us makes through our daily lifestyles.'

Professor Norman Myers

Today the EF is 30% larger than what the world possesses as we are overusing and misusing the Earth's resources leading to deforestation, disappearing species, global warming, air pollution, declining water quality and quantity, and soil degradation. If the global population continues to grow and the emerging middle class, demand more goods and services, it will impact adversely on human wellbeing, and threaten the sustainability of our civilisation. As informed, responsible active local-global citizens the stewardship of the world and the wellbeing of its people are our collective responsibility.

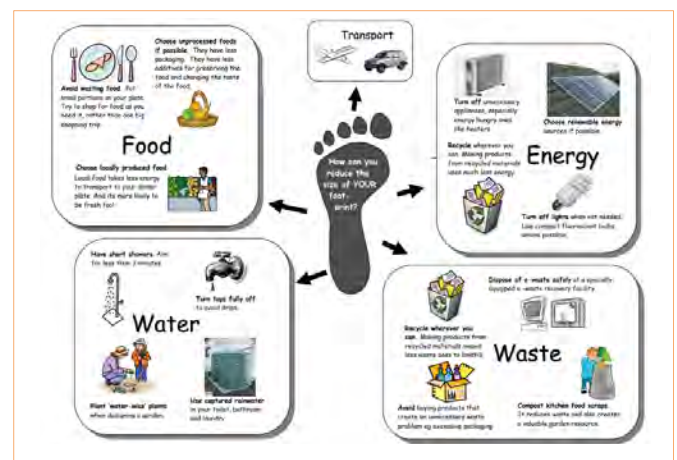
Sustainability is creeping into our lives. Olympic Games and World Cups are becoming more environmentally aware in the design of buildings and products. Ecuador requested the international community pledge \$3.6 billion to a United Nations Development Fund (UNDF) instead of mining 850 million barrels of oil in the Yasuni National Park which is one of the most biologically biodiverse regions on Earth. The fashion industry uses organic fibres, recycles plastic into clothes and eco-friendly upcycled clothing is creative.

WHAT CAN YOU DO AS AN INFORMED, RESPONSIBLE ACTIVE CITIZEN?

1. Plant native species
2. Mulch the garden
3. Use less water e.g. turn off tap while brushing teeth
4. Avoid using plastic bags.
5. Choose cleaning products that are environmentally friendly.
6. Use energy smart light globes and whitegoods
7. When buying food:
 - buy local: saves cost on transport
 - Buy organic: saves costs of pesticides and fertilisers on the land and bioaccumulation in the body.
 - preserve biological diversity
 - buy bulk or in large quantities: saves cost of packaging and reduces landfill
 - buy food in season: saves costs of transport, glasshouses and cool stores
8. Recycle and reuse resources
9. Turn off computer, lights and equipment not in use.

10. Cycle to school, utilise public transport or car pool
11. Purchase products that support fair and ethical trade, and recycled
12. Visit parks and gardens: take nothing but photographs
13. Obtain permission from traditional landowners or land manager to visit sensitive areas.

Suggested solutions – Food, water, energy, waste



Source: http://www.arbурpark.sa.edu.au/docs/ecological_footprint_poster.pdf

Suggested solutions – Recycle, green waste, trash



Source: <http://shopannies.blogspot.com/2016/11/america-recycles-day.html>

I. IS THERE PROGRESS TOWARDS A LIVEABLE FUTURE?



Has the world reached peak EF? Interestingly the EF for some high income countries have declined since 2000 (e.g. Singapore and Denmark). Mathis Wackernagel, the network's founder and chief executive, said *"We may have reached peak eco-footprint, after years of expansion. For example, China underwent a rapid expansion of its footprint, and now it has flattened. This could be a real trend."*

Source: <https://www.thefifthstate.com.au/urbanism/climate-change-news/has-the-world-reached-peak-ecological-footprint/>

1. Mahim Nature Park in Mumbai

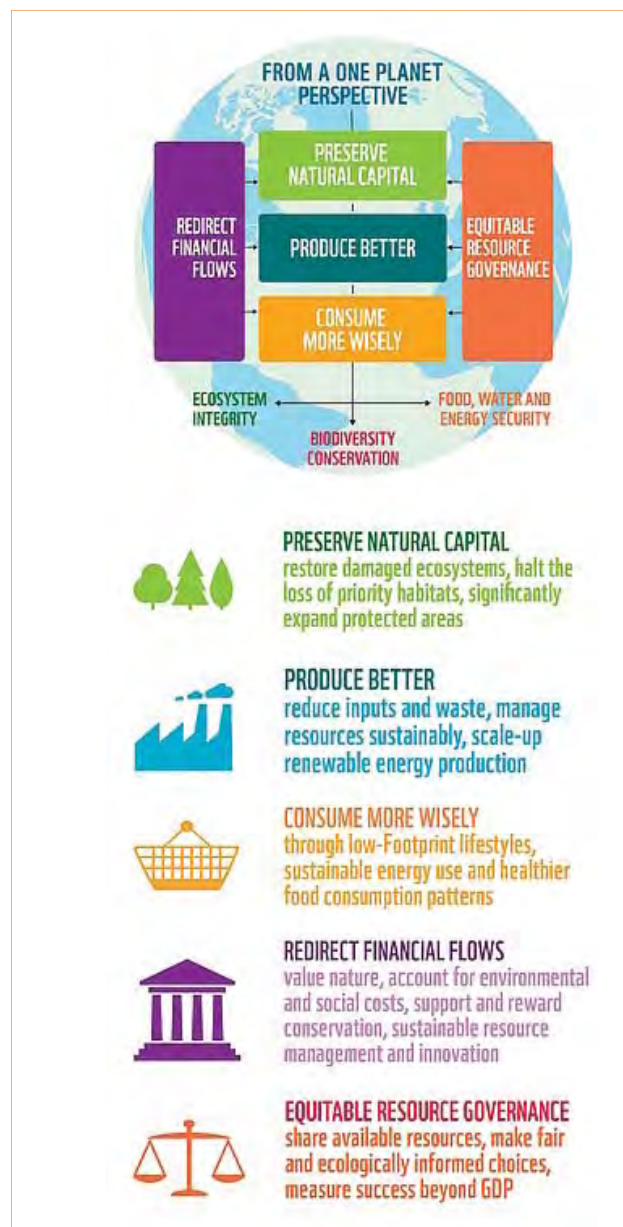
India covers an area of 37 acres. The park is situated next to India's largest slum, Dharavi. Over time the slum has been transformed into a green lung for the city, by the Mumbai Metropolitan Region Development Authority (MMRDA) and World Wildlife Fund (WWF India). The lush green forest replaced the five-metre deep garbage dump. The area now boasts 18,000 trees that attracts thousands of varieties of species-butterflies, birds, insects, reptiles and amphibians. Instead of shifting all the garbage to another city or place and damaging more ecosystems, the project improved the biocapacity of Mumbai.

2. WWF 'One Planet Perspective'

This project outlines better choices for managing, using and sharing natural resources within the planet's capacity.

Source: https://www.footprintnetwork.org/content/documents/2016_Korea_EF_

The One Planet Perspective Goals



J. QUOTATIONS

The Global Footprint Network (GFN) predicts that if we continue with business as usual, by 2050 humanity's EF will be 100% larger than the planet's biocapacity – that is, it would take two years for the planet to regenerate what we use in one year.

The GFN finds that almost no country today meets the sustainable development challenge—to have both a high quality of life (wellbeing), defined here by the United Nations Human Development Index (HDI), and an average Footprint (EF) that doesn't exceed the biological capacity available per person on the planet. It also shows that ending overshoot does not condemn us to a low standard of living or low human wellbeing standards

Source: https://www.footprintnetwork.org/content/documents/LPR06_media_Backgrounder.pdf

"Our data shows that we use as much from nature as if we lived on 1.75 Earths, yet we only have one. This is not a judgement, just a measurement. In this context, bringing human activity back within the ecological budget of our one planet is not about doing the noble thing or easing our guilty conscience. It is about choosing self-interest and what works. We will move out of ecological overshoot. Why choose to get there by disaster rather than by design?"

Mathis Wackernagel, Founder and President of Global Footprint Network
Source: [https://www.footprintnetwork.org/2019/04/24/humanitys-](https://www.footprintnetwork.org/2019/04/24/humanitys-ecological-footprint-contracted-between-2014-and-2016/)



https://upload.wikimedia.org/wikipedia/commons/d/d4/Trash_in_Venice_%2833966463004%29.jpg

[ecological-footprint-contracted-between-2014-and-2016/](https://www.footprintnetwork.org/2019/04/24/humanitys-ecological-footprint-contracted-between-2014-and-2016/)

"We are in serious ecological overshoot, consuming resources faster than the Earth can replace them. The consequences of this are predictable and dire. It is time to make some vital choices. Change that improves living standards while reducing our impact on the natural world will not be easy. The cities, power plants and homes we build today will either lock society into damaging over consumption beyond our lifetimes, or begin to propel this and future generations towards sustainable living."

James Leape, Director General, WWF

Source: <https://www.footprintnetwork.org/2019/04/24/humanitys-ecological-footprint-contracted-between-2014-and-2016/>

"For twenty years we've lived our lives in a way that far exceeds the carrying capacity of the Earth. The choices we make today will shape the possibilities for the generations which follow us. The fact that we live beyond our means in our use of natural resources will surely limit opportunities for future generations that follow."

Carter Roberts, President and CEO of WWF US

"The most precious resources in the 21st century will be natural resources, particularly in a finite world with rapidly growing populations and consumption. Every day we make decisions about where to invest our money, what kind of policies we demand from our political system and how we live our lives. These decisions will determine our resource demand into the future, and whether or not there will be natural resources to meet it."

Carter Roberts, President and CEO of WWF US

But we only have one Earth. The only thing we can do is create more sustainable consumption models and lifestyles and, as a result, enable humans and nature to live in harmony.

Source: https://www.footprintnetwork.org/content/images/article_uploads/China_EF_Sustainable_Consumption_2014_English.pdf



Source: https://upload.wikimedia.org/wikipedia/commons/9/94/Greater_adjutant_stork_garbage_dump_Guwahati_AJTJ_DSCN7659.JPG