



# Ecological Footprint: Its basic concepts

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***Are we running out of planet? Will economies self-correct or self-destruct when operating as if resources are limitless? Can everyone on this planet live like the Chinese? The Costa Ricans? The Canadians? The Ecological Footprint allows decision makers to explore these questions. It also supports business managers in turning the challenges of global competition for limited resources, new environmental regulations, and consumer demand for greener products into business opportunities.***

***This summary introduces the concept. More examples on how to apply the Ecological Footprint are available at: [www.footprintnetwork.org/casestudies](http://www.footprintnetwork.org/casestudies)***

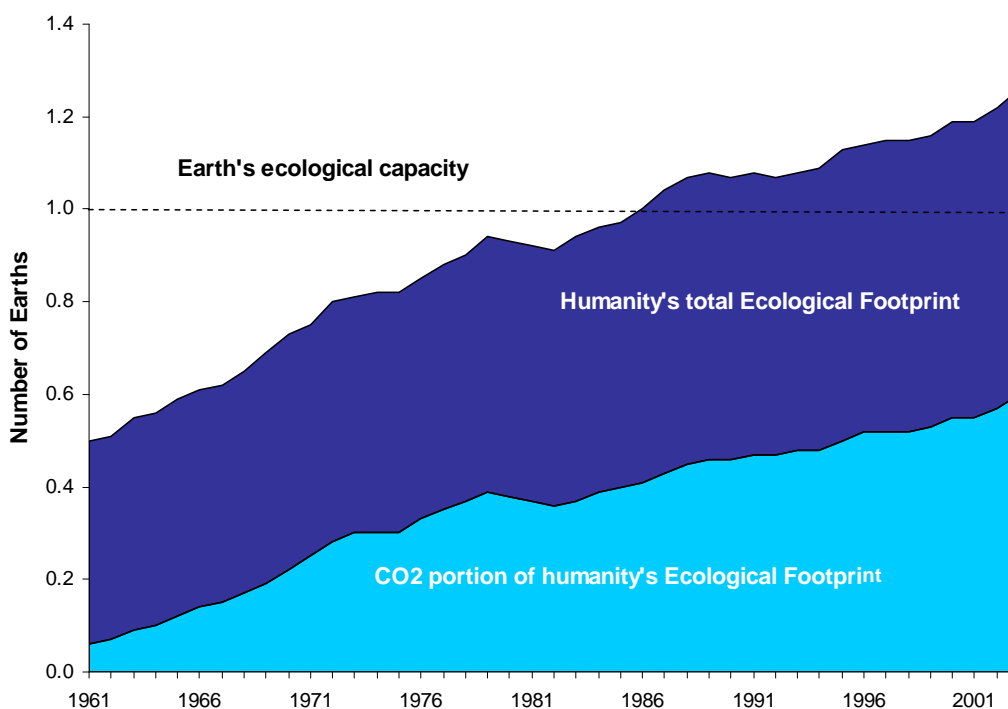
## ***Living Within Our Means?***

The Ecological Footprint tracks **demand on nature** in terms of the area of biologically productive land and water needed to provide natural resources and services to support a population, an individual or an activity. Why area is a good unit to measure demand is explained in box 2 below.

A Footprint generates a measure of total ecological demand by translating each activity's resource use into the biologically productive area necessary to provide this resource flow (e.g., how much area is necessary to produce a given amount of cotton).

The Footprint is then compared to the total amount of biologically productive area on Earth (**supply of nature**) that is available to support that population. This analysis allows us to answer important questions: Who is using how much? Do we all fit on one planet?

### ***Humanity's Ecological Footprint Exceeds the Earth's Biological Capacity***



This accounting tool estimates that for the past 20 years, humanity's demand on ecological resources has exceeded what the Earth can renew. This calculation method suggests that, globally, **it now takes one year and three months to regenerate what we use within one year**. We are in a state of ecological overshoot, on an unsustainable path.

We can **reverse overshoot using the Ecological Footprint**, a practical and scientific tool designed to manage resource supply and demand. Developed over the past 15 years, this tool is now being used by

government agencies, businesses and civil society organizations (NGOs) around the globe. For example, Footprint estimates for each county or municipality are now available in the UK. The European Environment Agency has sponsored national Footprint calculations, and a Swiss government-sponsored Footprint review is under way. And as a barometer of public interest: a Google search finds 1 million websites discussing the Ecological Footprint.

Clearly, the Footprint does not cover all aspects of sustainability, just one key question: to what extent human activities fit within the regenerative capacity of planet Earth. Therefore the Footprint needs to be, and is, complemented by other measures. For example, a comparative study on the application of Ecological Footprinting to sustainability, completed in 2001 and produced for the European parliament, was supervised by the Directorate General for Research, Division Industry, Research, Energy, Environment, and Scientific and Technological Options Assessment (STOA).<sup>1</sup> A more in-depth study on the applicability of the Footprint for European Policy is being conducted now by DG Environment (to be published in March 2008). Another study by Global Footprint Network was published in *Ecological Economics* and discussed in the *New Scientist* which cross tabulates the Human Development Index of 93 countries against their Footprint and describes the countries path over time.<sup>2</sup> Another study explains the link between Ecological Footprinting and sustainable development.<sup>3</sup> Finally, a study commissioned by the OECD Roundtable on Sustainable Development compared the complementarity between the Genuine Savings approach from the World Bank and the Ecological Footprint.<sup>4</sup>

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<sup>1</sup> Ecotec-UK, "Ecological Footprinting: A Technical Report to the STOA Panel" March 2001, published by European Parliament, Directorate General for Research, Directorate A, The STOA Programme. [http://www.europarl.europa.eu/stoa/publications/studies/20000903\\_en.pdf](http://www.europarl.europa.eu/stoa/publications/studies/20000903_en.pdf)

<sup>2</sup> Daniel D. Moran, Mathis Wackernagel, Justin A. Kitzes, Steven H. Goldfinger, Aurélien Boutaud, 2007, "Measuring Sustainable Development – Nation by Nation", *Ecological Economics*.

<sup>3</sup> Wackernagel, M. Sahm White, Dan Moran, 2004. Using Ecological Footprint Accounts: From Analysis to Applications, *Int. J. Environment and Sustainable Development*, Vol. 3, Nos. 3/4, 2004, 293-315.

<sup>4</sup> Wackernagel, M., Kirk Hamilton, Jonathan Loh, and Jerome Sayre, 2002, "Accounting for Sustainable Development: Complementary Monetary and Biophysical Approaches," *Redefining Progress and Environment Department of World Bank*, Prepared for the OECD Roundtable on Sustainable Development, Version 2.0, June 15, 2002.

## Comparisons, Nation by Nation

Latest Footprint calculations show that the average Swede requires 6 global average hectares (gha)<sup>5</sup> to provide for his or her consumption. If everyone on Earth consumed at this level, we would need about three additional planets. The average Italian lives on a Footprint two thirds that size (4 global hectares). The average Mexican occupies 2.5 global hectares, the average Indian lives on about 1/3 of that. **The global average demand is 2.2 global hectares per person. Yet there are only 1.8 global hectares available per person worldwide**, not taking into account areas needed for wild species. (See table below – or for more results visit [www.footprintnetwork.org](http://www.footprintnetwork.org)).

	Population	Ecological Footprint	Biological Capacity	Ecological Deficit (-) or Reserve (+)
	[millions]	[global ha/cap]	[global ha/cap]	[global ha/cap]
<b>WORLD</b>	<b>6301.5</b>	<b>2.2</b>	<b>1.8</b>	<b>-0.5</b>
Brazil	178.5	2.1	9.1	7.8
Canada	31.5	7.6	14.5	6.9
China	1311.7	1.6	0.8	-0.9
Costa Rica	4.2	2.0	1.5	-0.5
Denmark	5.4	5.8	3.5	-2.2
France	60.1	5.6	3.0	-2.6
India	106.5	0.8	0.4	-0.4
Italy	57.4	4.2	1.0	-3.1
Norway	4.5	5.8	6.8	0.9
Switzerland	7.2	5.1	1.5	-3.6
Sweden	8.9	6.1	9.6	3.5
United Kingdom	59.5	5.6	1.6	-4.0
United States	294.0	9.6	4.7	-4.8

In the last column, negative numbers indicate an ecological *deficit*, positive numbers an ecological *reserve*. All results are expressed in global hectares of biologically productive space with world-average productivity. Note: 1 hectare = 2.5 acres.

Note that numbers may not always add up due to rounding. These Ecological Footprint results are based on 2003 data. For details check [www.footprintnetwork.org](http://www.footprintnetwork.org) or results on the website of the European Environment Agency (<http://org.eea.europa.eu/news/Ann1132753060>)

<sup>5</sup> A global hectare is a bioproductive hectare with world average biological productivity (in a given year). One hectare is about 2.47 acres.

### ***How do National Footprint calculations work?***

Each national Footprint calculates the supply and demand of a country's biocapacity, based on about 5,000 data points per country per year. A country's demand is calculated by adding imports and subtracting exports from production. Each resource flow is translated into the bioproductive area necessary to provide this flow. This method captures demands on the biosphere, but does not include impacts on human health, or depletion of non-renewable stocks.

The calculation method is continuously being refined and reviewed to increase the detail and accuracy of the data. This is done through a committee process hosted by Global Footprint Network to ensure a consensus based, steady improvement process. At the same time, the method faces clear limitations (see Box 1). For more detail on the approach, see the methodology paper at [www.footprintnetwork.org](http://www.footprintnetwork.org). Reviewers include academic institutions, independent research institutes and government agencies.

Many governments recognize the benefits of accessing reliable ecological asset accounts, because National Footprints allow the populations, organizations and individuals within their borders to make informed environmental decisions. Like any responsible business that tracks its spending and income to protect its financial assets, we need ecological accounts to manage and protect our natural assets – our ultimate wealth. The Ecological Footprint enables states, countries, provinces, cities, regions, businesses, communities and individuals to track their Footprints and make informed decisions based on the results.

Governments and their research agencies are encouraged to participate in Footprint calculation reviews, to verify that information about our “ecological balance sheet” is robust and trustworthy. For instance, we had a research collaboration with the government of Switzerland, which resulted in a report issued by the Swiss Statistical Offices.

<http://www.bfs.admin.ch/bfs/portal/en/index/themen/21/03/blank/blank/01.html> (report exists in English, French, German and Italian, plus a more technical background report only in English). We are now also working with Japan, and have just started with the United Arab Emirates and Belgium. France, Ecuador and Mozambique are in discussion with us. We are also

collaborating with the Indian Confederation of Indian Industry (<http://www.greenbusinesscentre.com>) one of India's leading green business think-tanks.

Because consistent application of the tool is needed to produce comparable results, the Global Footprint Network community has developed standards to ensure that analyses will translate across applications. Please visit ([www.footprintstandards.org](http://www.footprintstandards.org)) for more information on the Ecological Footprint standards.

### ***Generating Measurable Business Results***

The Ecological Footprint is used around the world to help corporations improve their market foresight, set strategic direction, manage performance and communicate their strengths. Unlike other impact assessments, the Ecological Footprint is a comprehensive, standardized resource accounting system that links resource use to global limits. The Footprint not only measures an organization's environmental impact, but also compares it against the planet's ecological limits. This helps companies find openings for innovation and new markets, test their long-term strategies, and identify potential resource constraints. As a result, businesses can find new opportunities, identify risks, and avoid costly surprises.

Another practical element of the Ecological Footprint is its intuitively simple method for communicating results. Because Footprints are expressed in units of biologically productive area, they are easy to understand and communicate to a broad set of stakeholders.

Using the Ecological Footprint, businesses can:

- Assess their sustainability performance
- Identify implications of policy choices by comparing scenarios
- Set realistic targets
- Monitor projects and programs, and
- Communicate successes

For examples of Footprint applications please visit:

[www.footprintnetwork.org/casestudies](http://www.footprintnetwork.org/casestudies), for answers to common questions visit: [www.footprintnetwork.org/faq](http://www.footprintnetwork.org/faq).

## ***Becoming Footprint Neutral***

Footprint neutrality, an exciting new idea which emerged from Swiss Reinsurance, is gaining popularity within the business community. Companies often begin by offering Footprint Neutral goods and services, and eventually become Footprint Neutral themselves. This means that Footprint Neutral goods and services are satisfying clients while reducing humanity's overall Footprint. While companies continue to improve their production and distribution efficiencies, they simultaneously invest in high quality offsets to address any remaining Footprint balance. Simply stated, Footprint offsets are measurable Footprint reductions: such as replacing a kWh of coal powered electricity with one that is wind generated, or increasing the energy efficiency of a building by using less energy for the same service.

Footprint neutrality goes beyond environmental compliance and eco-efficiency. A Footprint Neutral good or service is not just "less damaging" than an average product. This is a systems approach that acts as a driver to reduce humanity's Ecological Footprint. Footprint neutrality becomes a quantifiable, global solution to improve the economic and environmental bottom line.

## ***Learning More about the Ecological Footprint***

Fully committed to advancing human well-being, Global Footprint Network's mission is to end overshoot. We do this by further developing the Ecological Footprint and making the reality of planetary limits relevant to decision-makers throughout the world. Global Footprint Network is a non-profit research organization, with 75 partner institutions around the world. Together with its corporate, nonprofit and government partners, Global Footprint Network continuously strengthens and improves the Ecological Footprint by coordinating research, developing methodological standards and providing robust national resource accounts. The network offers a variety of tools and services designed to quantify and improve the economic and environmental bottom line.

For more on human development and the Ecological Footprint, consult the "Africa Fact Book" available at [www.footprintnetwork.org/africa](http://www.footprintnetwork.org/africa)

A number of government organizations have active Footprint initiatives, for instance EPA Victoria in Australia (<http://www.epa.vic.gov.au/ecologicalfootprint>), the city of Calgary (<http://www.calgary.ca/footprint>), Wales (through a coalition of government agencies and civil society organizations ([www.footprintwales.org](http://www.footprintwales.org)) or Scotland (<http://www.scotlandsfootprint.org>).

For more information about partners, methods or case studies, please visit [www.footprintnetwork.org](http://www.footprintnetwork.org).

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## Box 1: What the Footprint Does **Not** Capture

The Ecological Footprint is designed to answer one particular research question: *how much of the biosphere's regenerative capacity is occupied by human activities?*

Hence, the method is limited in two ways: some aspects of sustainability are excluded from its scope, and some aspects of demand are hard to quantify.

a) *What the Footprint does not measure:*

- **Non-ecological aspects of sustainability.** The Footprint is, by design, not a complete sustainability measure. A single metric that includes all aspects of sustainability, even if possible, would produce results that would have little utilitarian value. Having a Footprint smaller than the biosphere is a necessary minimum condition for humanity's sustainability, but is far from sufficient. For instance, while social well-being also needs to be tracked, the Footprint does not measure it. The Ecological Footprint also makes no attempt to evaluate the long-term viability of social structures, economic viability, or political systems. Neither does it identify the drivers – it merely documents the ecological outcome, the demand on nature resulting from human activities that occurred at a given time.
- **Depletion of non-renewable resources.** The Footprint does not track the amount of non-renewable resource stocks, such as oil, natural gas, coal, or metal deposits.
- **Inherently unsustainable activities.** Activities that are inherently unsustainable, such as the release of heavy metals, radioactive materials and persistent synthetic compounds (chlordane, PCBs, CFCs, PVCs, dioxins, etc.) do not enter into Footprint calculations. Nature does not have any significant capacity to break down and process these compounds, so the recycling of these materials cannot be associated with a land area. Because the biosphere cannot assimilate any of these materials within human timescales, integration of these factors into Footprint calculations would result in infinitely large and therefore meaningless values.
- **Ecological degradation.** The Footprint does not directly measure ecological degradation, such as increased soil salinity from irrigation, that could affect future productivity. However, if degradation leads to reductions in biological productivity, this loss is captured in future measures of biocapacity. The Footprint it is not predictive in this sense, but documents effects as they occur. This avoids making Footprint assessments speculative.
- **Resilience of ecosystems.** Footprint accounts do not identify where and in what way the capacity of ecosystems is vulnerable or resilient. The Footprint is merely an outcome measure documenting how much of the biosphere is being used compared to how productive it was. Lisa Deutsch et al are correctly pointing out that “when trying to answer questions on how to manage ecosystems in a

sustainable way, or how to best distribute the goods and services generated by ecosystems, there are other methods better suited for the task.”<sup>6</sup> Footprint accounts are not able to guide where to put investments for removing vulnerability or enhance resilience.<sup>7</sup>

b) *What the Footprint does not measure well:*

- **Waste flows.** For many waste flows, inadequate datasets exist for Footprint calculations. For example, SO<sub>x</sub> emissions from fossil fuel-based power plants contribute to the acidification of rainwater, which has detrimental effects on forests, fish and wildlife. However, at this time globally comparable data on the relationship between SO<sub>x</sub> concentration and biocapacity are lacking. Acid rain does not yet enter into Footprint calculations, but may in the future if better data become available.
- **Freshwater use.** Freshwater use is only indirectly included in the Footprint due to lack of data that link freshwater use with loss in bioproductivity. Some local Footprint assessments have included freshwater use, but national assessments do not yet do so. Freshwater shortages which do result in declining bioproductivity are reflected in biocapacity measurements.
- **Nuclear power.** Nuclear waste is inherently unsustainable since ecosystems have no inherent capacity to deal with them. However, not including a nuclear energy Footprint could be misinterpreted as nuclear energy having no ecological impact, and would also ignore the extent to which nuclear accidents have compromised biocapacity. Therefore, we count each thermal unit of nuclear energy as equal to a unit from fossil energy.
- **Aspects for which data are sparse.** Most of the underlying datasets used to calculate national Footprints and biocapacities come from the United Nations (to a large extent from the UN Food and Agriculture Organization). These datasets do not include assessments of their data uncertainty or reliability. Accordingly, Footprint results must be interpreted with the proviso that the underlying data is assumed to be correct. When there is doubt about data values, Footprint calculations exclude impacts or use lower estimates for demand on nature, and use optimistic biocapacity accounts. This is done in order not to exaggerate ecological deficits. Results therefore most likely underestimate the extent of humanity’s ecological overshoot.

For additional discussion of the quality and reliability of Footprint data, see the technical supplement to this report.

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<sup>6</sup> Lisa Deutsch, Asa Jansson, Max Troell, Patrik Rönnbäcka, Carl Folke, Nils Kautsky, 2000, “The ‘ecological footprint’: communicating human dependence on nature’s work” *Ecological Economics* Vol. 32 (2000) pages 351–355.

<sup>7</sup> Carl Folke, S. Carpenter, T. Elmqvist, L. Gunderson, C.S. Holling, B. Walker, J. et al. 2002. *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*. Report for the Swedish Environmental Advisory Council 2002:1. Ministry of the Environment, Stockholm, [www.mvb.gov.se](http://www.mvb.gov.se), also published in the ICSU Series on Science for Sustainable Development No. 3, 2002. International Council for Science, Paris

## Box 2: Why surface area?

Some wonder about the scientific rationale of taking land surface as a common measure for any impact. They argue that apprehending the climate change issue through the sole capability of biological carbon sinks would be a strongly restricted approach that does not make justice of real policy options. Why then stick to areas?

The answer is simple. Life happens on surfaces. The surface of the planet is the biggest solar collector we have at our disposition. Hence measuring ecosystems in terms of surface areas makes sense. Like framers and land owners, we are competing for space. And this is what the Footprint is measuring. Possibly, the calculation could also be explained in energy flows. However, this would create more confusion, since the energy flows are characterized by a significant quality cascade: Sun beams 175,000 TW onto the planet which the biosphere turns into about 100-400 TW of biomass. Further, humanity occupies about 40 percent of the biosphere to generate 0.7 TW of food calories. So TW can mean quite different things according to where in the energy cascade the TW is being measured. Hence using energy as the unit of analysis and communication can produce confusion in both analysis and communication. Therefore, surface is a better measurement unit than energy – and what the Footprint uses is standardized surface – global hectares, representing each the same, average productivity of a world average bioproductive hectare in a given year. Also note that for carbon, no information about the tones of carbon is lost in Footprint accounting. The area accounts merely translate tones into the area necessary to provide the sequestration service. Also note that Footprints only include the carbon that was not sequestered elsewhere. So for instance, carbon that is being removed from the atmosphere through human sequestration machines (which do not yet exist in any significant amount) this carbon will not enter the Footprint equation.

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