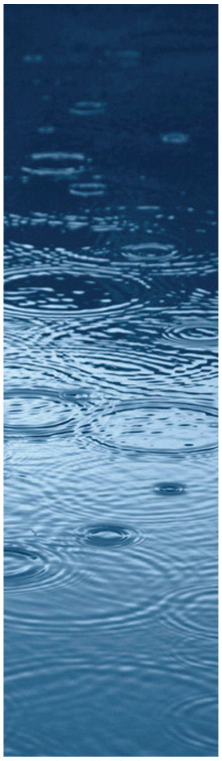

ECOLOGICAL FOOTPRINT ATLAS 2009

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GLOBAL FOOTPRINT NETWORK, RESEARCH AND STANDARDS DEPARTMENT

Global Footprint Network
Advancing the Science of Sustainability

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List of Abbreviations

BC	Biological capacity
CO_2	Carbon dioxide
CLC	CORINE Land Cover
COICOP	Classification of Individual Consumption by Purpose
CORINE	Coordinate Information on the Environment
DG ENV	Directorate General Environment of the European Commission
EE-MRIO	Environmentally Extended Multi-Region Input-Output (analysis/model)
EEA	European Environment Agency
EF	Ecological Footprint
EF_C	Ecological Footprint of consumption
EF_E	Ecological Footprint of exports
EF_I	Ecological Footprint of imports
EF_P	Ecological Footprint of production
EQF	Equivalence Factor
EXIOPOL	Environmental Accouting Framework Using Externality Data and Input-Output Tools for Policy Analysis
GAEZ	Global-Agro Ecological Zones
GDP	Gross Domestic Product
GFN	Global Footprint Network
GNI	Gross National Income
GTAP	Global Trade Analysis Project
HANPP	Human Appropriation of Net Primary Production
HDR	Human Development Report
HDI	Human Development Index
HS	Harmonized System Commodity Classification
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
IO	Input-Output Analysis (analysis/table)
IPCC	Intergovernmental Panel on Climate Change
ISEAL	International Social and Environmental Accreditation and Labelling
LCA	Life Cycle Assessment
MFA	Materal Flow Analysis/Accounting
NAMEA	National Accounting Matrix including Environmental Accounts
NFA	National Footprint Accounts
NPP	Net Primary Production
OECD	Organisation for Economic Cooperation and Development
PIOT	Physical Input-Output Table
PPR	Primary Production Rate
SEEA	System of Economic and Environmental Accounts
SITC	Standard Industrial Trade Classification
SNA	System of National Accounts
UN COMTRADE	United Nations database on the trade of commodities
UN FAO	United Nations Food and Agriculture Organization
YF	Yield factor

Foreword

Rethinking Wealth in a Resource-Constrained World

Competition for ecological services will play a critical role in the 21st century. If we continue business-as-usual, peak energy and climate change will combine with food shortages, biodiversity loss, depleted fisheries, soil erosion and freshwater stress to create a global supply-demand crunch of essential resources. Humanity is already in "overshoot," using more resources than Earth can renew. In a "peak everything" world, if consumption trends in today's wealthy nations and in the emerging economies continue at current rates, overshoot will increase dramatically (Heinberg 2007). This will mean further degradation of the Earth's capacity to generate resources, continuing accumulation of greenhouse gases and other wastes, and the likely collapse of critical ecosystems.

But these issues are not intractable. The good news is that solutions need not wait for a global consensus. While the current climate debate assumes that those who act first may be at a competitive disadvantage, the opposite is often true. Acting aggressively now to implement sustainable solutions will reward the pioneers with lower resource costs, greater resiliency in the face of supply chain perturbations and better positioning to take advantage of opportunities presented by a rapidly changing economy.

Many opinion leaders are trapped in the misconception that advancing sustainability is detrimental to the economy, an expense that will only be affordable at some later date. Unfortunately, later is now, and the consequences of putting off change until later is that countries, and humanity as a whole, will be unprepared for the challenge of living within the limits of our natural resources.

Resource accounting is therefore as vital to the self-interest of any country, state, or city as is financial accounting. Those who prepare for living in a resource-constrained world will fare far better than those who do not. In an age of growing resource scarcity, the wealth of nations increasingly will be defined in terms of who has ecological assets, and who does not. Preparing for this new economic "truth" will take time, making it urgent to begin as quickly as possible. Strategies will need to be simultaneously put in place to better manage and protect ecological reserves while minimizing or reducing a nation's demand on ecosystem services — its "Ecological Footprint". Stimulating and supporting technological innovations and services that promote well-being without draining resources will play a key role in this effort. Cities, regions, or countries that are not able to provide a high quality of life on a low Footprint will be at a disadvantage in a resource-constrained future.

Without significant change, countries that depend extensively upon ecological resources from abroad will become particularly vulnerable to supply chain disruptions, and to rising costs for greenhouse gas emissions and waste disposal. At the same time, countries and states with sufficient ecological reserves to balance their own consumption or even export resources will be at a competitive advantage. This also holds true for cities and communities such as BedZed in the UK and Masdar in the UAE, which can operate on small Ecological Footprints, and are more likely to be able to maintain or even improve the well-being of their residents.

The political challenge is to demonstrate that this is not an "inconvenient truth" to be resisted, but rather a critical issue that demands bold action in the direct self interest of nations. It is a case of pure economics: Prosperity and well-being will not be possible without preserving access to the basic ecological resources and services that sustain our economy, and all of life.

The Role of Metrics

Without a way of comparing the demand on ecological services to the available supply, it is easy for policy makers to ignore the threat of overshoot, and remain entangled in ideological debates over the "affordability of sustainability". Clear metrics are needed to change these ideological debates into discussions based on empirical facts. This will lead to an understanding of what the real risks are, and facilitate building consensus over the actions needed to address them.

Responding to this need for a metric, the Ecological Footprint was developed over 15 years ago. Since that time, it has become an increasingly mature and robust way of capturing human demand on nature. But its evolution is not yet complete. With growing recognition of the value of this metric and its adoption by more governments and businesses, it has become clear that development of the Ecological Footprint needs to be significantly accelerated.

In 2003, Global Footprint Network was established to address this need. In addition to improving the scientific rigor and transparency of the Ecological Footprint methodology, this international NGO works to promote a sustainable economy by making ecological limits central to decision-making. The goal is to assure human well-being by ending overshoot, decreasing pressure on critical ecosystems so they remain robust, while continuing to provide humanity with essential ecological services. Global Footprint Network does this by advancing the Ecological Footprint in collaboration with more than 100 partner organizations that comprise the network. It coordinates research, develops methodological standards, and provides decision makers with extensive resource accounts to help the human economy operate within the Earth's ecological limits. At the heart of this effort are the National Footprint Accounts, which provide a detailed accounting of ecological resource demand and supply for all nations with populations over 1 million. Results of the 2009 Edition of the Accounts are summarized in this report, and some of their implications are explored.

Global Footprint Network and its partners alone cannot bring about the shift to a sustainable economy. All the key stakeholders—especially nations, international agencies, regions and companies—need to engage, for it is they who are at ever-increasing risk if they cannot monitor their ecological performance.

One thing is clear: As natural capital becomes scarcer than financial capital, good governance will depend on resource accounts such as the Ecological Footprint as much as it depends on Gross Domestic Product (GDP) and other financial accounts.

In an increasingly resource-constrained world, it is a government's fiduciary responsibility to know how much ecological capacity it has and how much it is using. Global Footprint Network, therefore, is working to have national governments institutionalize the Ecological Footprint metric, and use it as an indicator for planning and policy decisions in parallel with financial indicators such as GDP. While this effort focuses on nations, the goal will not be achievable without active participation by the business sector, civil society and academic institutions. Therefore, the Network is working with these entities as well.

Use of the Footprint by National Governments

As an initial step in working with a national government, Global Footprint Network invites the country to collaboratively review the underlying data in its National Footprint Accounts for accuracy and completeness. This due diligence helps ensure that the Footprint results for that country are valid and reliable, and also increases the reliability and robustness of the Footprint methodology for all nations. The verified national results can then be put to use by the government for a wide variety of purposes, including to:

- Create an enhanced understanding of the country's Ecological Footprint and biocapacity. Specifically, this can:
    - Identify resource constraints and dependencies;
    - Recognize resource opportunities (e.g. forests).
- Explore policy creation to:
    - Protect national interests and leverage existing opportunities;
    - Bring the economy in line with global limits, including planning for a low-carbon future;
    - Further innovation that maintains or improves quality of life while reducing dependence on ecological capacity.
- Leverage trade opportunities to:
    - Create a strong trade position for exports by better understanding who has ecological reserves and who does not;
    - Minimize and prioritize external resource needs.
- Create a baseline for setting goals and monitoring progress toward lasting and sustainable economic development. In particular, to guide investment in infrastructure that is both efficient in its use of resources, and resilient if supply disruptions materialize.
- Provide a complementary metric to GDP that can help lead to a new way of gauging human progress and development.

Seizing the Opportunity

All is not gloom and doom. The good news is that with Ecological Footprint accounting, we now know something we did not know before—the extent to which we are overdrawing our ecological accounts, and how far we need to go to rebalance this budget. This information provides a hopeful perspective, suggesting that even working with what we have now, it is well within our ability to secure long-term well-being for all of society. In addition, future-proofing our economies and refocusing our investment efforts can have tremendous payback. Sustainability doesn't simply mean robust ecosystems, it ensures a long-term revenue stream for pioneer investors, those with the foresight to plan and make changes now to prepare for future resource constraints. In fact, if we reverse population trends, improve resource efficiency measures, sufficiently reduce consumption and better manage our ecological assets to increase yields, then demand will no longer exceed supply. If we end overshoot, resource constraints by definition disappear.

This is the message Global Footprint Network is committed to promoting. The Ecological Footprint communicates the challenges of a resource-constrained world. At the same time, it invites people to participate and figure out solutions themselves. Setting collective targets that people and organizations can both understand and invest in has a catalytic effect. Working together, society can pursue its essential self-interests, while ensuring human well-being that is both inclusive and lasting.

Mathis Wackernagel, PhD
President
Global Footprint Network
Oakland, November 2009

Purpose of this Report

In recent years, much of the discussion on finite global resources has focused on the depletion of non-renewable resources, such as petroleum. However, it is increasingly evident that renewable resources, and the ecosystem services they provide, are also at great or even greater risk (UNEP 2007, WRI 2007, UNDP 2008, UNEP 2007, World Bank 2000, Millennium Ecosystem Assessment 2005). Global economies depend on the biosphere for a steady supply of the basic requirements for life: food, energy, fiber, waste sinks, and other life-support services. Any depletion of these services is particularly risky since human demand for them is still growing, which can accelerate the rate at which natural assets are liquidated. Out of this concern, the sustainability proposition emerges. Sustainability is a simple idea. It is based on the recognition that when resources are consumed faster than they are renewed, or wastes emitted faster than they are absorbed, the resources are depleted and eventually exhausted, and wastes are no longer sequestered and converted back into resources fast enough to prevent accumulation in the biosphere.

The elimination of essential renewable resources is fundamentally problematic, as substitution can be expensive or impossible, especially when the problem is global in scale. When humanity's ecological demands in terms of resource consumption and waste absorption exceed what nature can supply, this ecological "overshoot" is a critical threat to society's well-being. Just as constant erosion of business capital weakens an enterprise, ecological overshoot erodes the planet's "natural capital", our ultimate means of livelihood.

The debate over how to make the human enterprise sustainable has accelerated since the widely cited Brundtland Report from the UN World Commission on Environment and Development was released over two decades ago (UN 1987). The Commission defined sustainable development as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN 1987). This definition recognized that the goal of rewarding lives for all on the planet requires that ecosystems be able to continuously supply the resources and waste absorption services necessary for society to flourish.

For sustainable development to go from concept to action, it needs to become specific and accountable. The "ability of future generations to meet their own needs" cannot be directly measured because we cannot know how many people there will be in future generations, and what their needs will be. But some of the underlying conditions that must be met if this development is to become a reality can be specified. If possibilities for future generations are not to be diminished, the most fundamental condition is that we not erode, but rather protect, the ecological wealth of the biosphere.

With natural capital at the foundation of every value chain, tracking the health of ecological assets is critical for sustainable development. Regardless of whether the goal is to maintain existing assets, or to ensure that the loss of one form of assets is compensated by another, we need robust natural capital accounts (Dietz and Neumayer 2007). These Accounts must be able to assess both human demand on ecological assets, as well as the ability of these assets to meet this demand. We cannot make meaningful decisions about where we need to go before we know where we stand. Just as national governments currently use gross domestic product (GDP) as a benchmark to gauge economic performance, natural capital accounts allow governments to gauge their ecological performance (Stiglitz Report, 2009). The National Footprint Accounts provide such accounting, allowing a direct comparison of demand on and supply of ecological assets that identify when limits have been transgressed. The National Footprint Accounts utilize global datasets to measure the biocapacity and Ecological Footprint of 240 countries, territories, and regions from 1961 to 2006. Results in the National Footprint Accounts consist of more than 800,000 data points that are calculated utilizing more than 30 million source data points from databases such as UN FAOSTAT, UN Comtrade, and OECD International Energy Agency. The *Ecological Footprint Atlas 2009* provides an introduction into the methodology behind the Accounts, headline results from the National Footprint Accounts, 2009 Edition, and additional background information on the Committees and Partner Organizations that support these Accounts.

The *Ecological Footprint Atlas 2009* summarizes the Ecological Footprint and biocapacity results from the National Footprint Accounts, 2009 Edition (NFA 2009), which are produced by Global Footprint Network on behalf of its Partner Network, Footprint practitioners, and the broader land use and material flow accounting community. The Atlas describes the research question, basic concepts, the methodology utilized for Ecological Footprint Analysis and the National Footprint Accounts , and describes applications for Ecological Footprint Analysis in a variety of domains. For the technical reader, the Atlas includes detailed notes regarding the source data and results, explains recent advances to enhance the consistency, reliability, and resolution of the National Footprint Accounts, and reviews the evolution of the National Footprint Accounts methodology.

Ecological Footprint and Biocapacity

The Ecological Footprint is a measure of the demand human activity puts on the biosphere. More precisely, it measures the amount of biologically productive land and water area required to produce all the resources an individual, population, or activity consumes, and to absorb the waste they generate, given prevailing technology and resource management practices. This area can then be compared with biological capacity (biocapacity), the amount of productive area that is available to generate these resources and to absorb the waste. If a land or water area provides more than one of these services it is only counted once, so as not to exaggerate the amount of productive area actually available. Land and water area is scaled according to its biological productivity. This scaling makes it possible to compare ecosystems with differing bioproductivity and in different areas of the world in the same unit, a global hectare. A global hectare represents a hectare with world average productivity.

Ecological Footprint and biocapacity accounting is based on six fundamental assumptions (Wackernagel 2002):

1. The majority of the resources people or activities consume and the wastes they generate can be tracked.
2. Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain them. Resource and waste flows that cannot be measured in terms of biologically productive area are excluded from the assessment, leading to a systematic underestimate of the total demand these flows place on ecosystems.
3. By scaling each area in proportion to its bioproductivity, different types of areas can be converted into the common unit of average bioproductivity, the global hectare. This unit is used to express both Footprint and biocapacity.
4. Because a global hectare of demand represents a particular use that excludes any other use tracked by the Footprint, and all global hectares in any single year represent the same amount of bioproductivity, they can be summed. Together, they represent the aggregate demand or Ecological Footprint. In the same way, each hectare of productive area can be scaled according to its bioproductivity and then added up to calculate biocapacity.
5. As both are expressed in global hectares, human demand (as measured by Ecological Footprint accounts) can be directly compared to global, regional, national, or local biocapacity.
6. Area demanded can exceed the area available. If demand on a particular ecosystem exceeds that ecosystem's regenerative capacity, the ecological assets are being diminished. For example, people can temporarily demand resources from forests or fisheries faster than they can be renewed, but the consequences are smaller stocks in that ecosystem. When the human demand exceeds available biocapacity, this is referred to as overshoot.

Ecological Footprint Analysis tracks the regenerative capacity of an ecosystem in terms of historical flows of natural resources. A "flow" corresponds to an amount per time unit, for instance, the number of tonnes of roundwood grown in a given area over a one-year period. A "stock" is the standing balance of resources at any specific time, for instance, the tonnes of roundwood available for harvest in a hectare of forest at the end of a given year. The National Footprint Accounts capture flows rather than stocks, and thus do not specify when overshoot will result in the total depletion of accumulated resources in an ecosystem.

Humanity is using the regenerative capacity of the Earth each year—the flow of resources—while at the same time eating into the standing stock of resources that has been building over time and accumulating waste in the environment. This process reduces our ability to harvest resources at the same rate in the future and leads to ecological overshoot and possible ecosystem collapse.

History of the Ecological Footprint, Biocapacity, and the National Footprint Accounts

The Ecological Footprint concept was created by Mathis Wackernagel and William Rees at the University of British Columbia in the early 1990's (Rees 1992, Wackernagel 1991, Wackernagel 1994, Rees 1996, Wackernagel and Rees 1996). Responding to then-current debates surrounding carrying capacity (e.g., Meadows 1972, Ehrlich 1982, Tiezzi 1984, 1996, Brown and Kane 1994), Ecological Footprint accounting was designed to represent human consumption of biological resources and generation of wastes in terms of appropriated ecosystem area, which could then be compared to the biosphere's productive capacity in a given year. In focusing only on bioproductive area and on resources presently extracted and wastes presently generated, the method provided a focused historical assessment of human demand on the biosphere and the biosphere's ability to meet those specific demands (Wackernagel et al 1999a).

The Footprint has been applied in a wide variety of ways. It can provide a global perspective on the current extent of ecological overshoot, as well as a more localized perspective on city and regional resource issues. Global and national accounts have been reported in headlines worldwide, and over 100 cities or regions have assessed their Ecological Footprint. In the United States, for example, Sonoma County, California's Footprint project "Time to Lighten Up" inspired every city in the county to join the Climate Saver Initiative of the International Council for Local Environmental Initiatives (ICLEI) (Redefining Progress 2002).

At the national level, by 2003 Wales had adopted the Ecological Footprint as its headline indicator for sustainability. The Swiss government has incorporated the Footprint into the nation's sustainable development plan. Japan includes the Footprint as a measure in its Environmental Plan. Among NGOs, WWF International, one of the world's most influential conservation organizations, uses the Ecological Footprint in its communication and policy work for advancing conservation and sustainability. WWF recently established a target of bringing humanity out of overshoot by 2050, and is actively pursuing this goal through its "One Planet" programs.

Country-level Footprint assessments have been completed for many countries, with some countries analyzed multiple times under different methods (Wackernagel and Rees 1996, Bicknell et al. 1998, Fricker 1998, Simpson et al. 2000, van Vuuren and Smeets 2000, Ferng 2001, Haberl et al. 2001, Lenzen and Murray 2001, 2003, McDonald and Patterson 2004, Monfreda et al. 2004, Bagliani et al. 2005, Medved 2006, Venetoulis and Talberth 2007, World Wildlife Fund for Nature, Global Footprint Network, and Zoological Society of London 2006). Since UN agencies collect and publish national data sets and advance the standardization of such reporting across the world, and these data sets form the basis of the National Footprint Accounts, country-level calculations are more directly comparable than assessments at other scales. For instance, only country-level statistics systematically document production, imports, and export. Therefore, the national Ecological Footprint results serve as the basis of all other Footprint analyses .

With a growing number of government agencies, organizations and communities adopting the Ecological Footprint as a core indicator of sustainable resource use, and the number of Ecological Footprint practitioners around the world increasing, different approaches to conducting Footprint studies could lead to fragmentation and divergence of the methodology. This would reduce the ability of the Footprint to produce consistent and comparable results across applications, and could generate confusion.

The value of the Footprint as a sustainability metric depends not only on the scientific integrity of the methodology, but also on consistent application of this methodology across analyses. It also depends on results of analyses being communicated in a manner that does not distort or misrepresent findings. To address these needs, Global Footprint Network initiated a consensus, committee-based process for ongoing scientific review of the methodology, and for the development of standards governing Footprint applications.

The National Footprint Accounts Review Committee supports continual improvement of the scientific basis of the National Footprint Accounts. The Ecological Footprint Standards Committee, comprised of representatives from Global Footprint Network Partner Organizations and representing academia, government, NGOs, and consulting firms, issued the *Ecological Footprint Standards 2009* (Global Footprint Network, 2009). The Standards build on the *Ecological Footprint Standards 2006* and are designed to ensure that Footprint assessments are produced consistently and according to community-proposed best practices. They aim to ensure that assessments are conducted and communicated in a way that is accurate and transparent, by providing standards and guidelines on such issues as use of source data, derivation of conversion factors, establishment of study boundaries, and communication of findings. The Standards are applicable to all Footprint studies, including sub-national populations, products, and organizations.

Calculation Methodology: National Footprint Accounts

The National Footprint Accounts track countries' use of ecological services and resources as well as the biocapacity available in each country. As with any resource accounts, they are static, quantitative descriptions of outcomes, for any given year in the past for which data exist. The detailed calculation methodology of the most updated Accounts, are described in *Calculation Methodology for the National Footprint Accounts, 2009 Edition* (Ewing et al. 2009). The implementation of the National Footprint Accounts through database-supported templates is described in the *Guidebook to the National Footprint Accounts 2009* (Kitzes et al. 2009).

The National Footprint Accounts aim to:

- Provide a scientifically robust and transparent calculation of the demands placed by different nations on the regenerative capacity of the biosphere;
- Build a reliable and consistent method that allows for international comparisons of nations' demands on global regenerative capacity;
- Produce information in a format that is useful for developing policies and strategies for living within biophysical limits; and
- Generate a core dataset that can be used as the basis of sub-national Ecological Footprint analyses, such as those for provinces, states, businesses, or products.

The National Footprint Accounts, 2009 Edition calculate the Ecological Footprint and biocapacity for 240 countries, territories, and regions, from 1961 to 2006. Of these 240 countries, territories, and regions, 126 were covered consistently by the UN statistical system and other source datasets. Data for the latter countries, territories, and regions are included in this report.

Ecological Footprint Assessment

The National Footprint Accounts, 2009 Edition track human demand for ecological services in terms of six major land use types (cropland, grazing land, forest land, carbon Footprint, fishing grounds, and built-up land). With the exception of built-up land and forest for carbon dioxide uptake, the Ecological Footprint of each major land use type is calculated by summing the contributions of a variety of specific products. Built-up land reflects the bioproductivity compromised by infrastructure and hydropower and forest land for carbon dioxide uptake represents the waste absorption of a world average hectare of forest needed to absorb human induced carbon dioxide emissions, after having considered the ocean sequestration capacity.

The Ecological Footprint calculates the combined demand for ecological resources wherever they are located and presents them as the global average area needed to support a specific human activity. This quantity is expressed in units of global hectares, defined as hectares of bioproductive area with world average bioproductivity. By expressing all results in a common unit, biocapacity and Footprints can be directly compared across land use types and countries.

Demand for resource production and waste assimilation are translated into global hectares by dividing the total amount of a resource consumed by the yield per hectare, or dividing the waste emitted by the absorptive capacity per hectare. Yields are calculated based on various international statistics, primarily those from the United Nations Food and Agriculture Organization (FAO ResourceSTAT Statistical Databases). Yields are mutually exclusive: If two crops are grown at the same time on the same hectare, one portion of the hectare is assigned to one crop, and the remainder to the other. This avoids double counting. This follows the same logic as measuring the size of a farm: Each hectare is only counted once, even though it might provide multiple services.

The Ecological Footprint, in its most basic form, is calculated by the following equation:

$$EF = \frac{D_{ANNUAL}}{Y_{ANNUAL}}$$

where D is the annual demand of a product and Y is the annual yield of the same product. Yield is expressed in global hectares. The way global hectares are calculated is explained in more detail below after the various area types are introduced. But in essence, global hectares are estimated with the help of two factors: the yield factors (that compare national average yield per hectare to world average yield in the same land category) and the equivalence factors (which capture the relative productivity among the various land and sea area types).

Therefore, the formula of the Ecological Footprint becomes:

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

where P is the amount of a product harvested or waste emitted (equal to D_{ANNUAL} above), YN is the national average yield for P, and YF and EQF are the yield factor and equivalence factor, respectively, for the country and land use type in question. The yield factor is the ratio of national-to world-average yields. It is calculated as the annual availability of usable products and varies by country and year. Equivalence factors trasnlate the area supplied or demanded of a specific land use type (e.g. world average cropland, grazing land, etc.) into units of world average biologically productive area: global hectares and varies by land use type and year.

Annual demand for manufactured or derivative products (e.g. flour or wood pulp), is converted into primary product equivalents (e.g. wheat or roundwood) through the use of extraction rates. These quantities of primary product equivalents are then translated into an Ecological Footprint. The Ecological Footprint also embodies the energy required for the manufacturing process.

Consumption, Production, and Trade

The National Footprint Accounts calculate the Footprint of a population from a number of perspectives. Most commonly reported is the Ecological Footprint of consumption of a population, typically just called Ecological Footprint. The Ecological Footprint of consumption for a given country measures the biocapacity demanded by the final consumption of all the residents of the country. This includes their household consumption as well as their collective consumption, such as schools, roads, fire brigades, etc., which serve the household, but may not be directly paid for by the households.

In contrast, a country's primary production Ecological Footprint is the sum of the Footprints for all resources harvested and all waste generated within the country's geographical borders. This includes all the area within a country necessary for supporting the actual harvest of primary products (cropland, grazing land, forest land, and fishing grounds), the country's infrastructure and hydropower (built-up land), and the area needed to absorb fossil fuel carbon dioxide emissions generated within the country (carbon Footprint).

The difference between the production and consumption Footprint is trade, shown by the following equation:

$$EF_C = EF_P + EF_I - EF_E$$

where EF_C is the Ecological Footprint of consumption, EF_P is the Ecological Footprint of production, and EF_I and EF_E are the Footprints of imported and exported commodity flows, respectively.

In order to measure the Footprint of imports and exports, one needs to know both the amounts traded as well as the embodied resources (including carbon dioxide emissions) in all categories. The embodied Footprint is measured as the number of global hectares required to make a tonne per year of a given product. The Footprint intensity of any primary product is by definition the same anywhere in the world since it is expressed in global hectares. However, the embodied Footprint of secondary products will depend on transformation efficiencies ("extraction rates"), and these vary between countries.

The National Footprint Accounts, 2009 Edition track the embodied Ecological Footprint of over 700 categories of traded crop, forest, livestock, and fish products. The embodied carbon dioxide emissions in 625 categories of products is used with trade flows from the United Nation's COMTRADE database (UN Commodity Trade Statistics Database 2007) to calculate the embodied carbon Footprint in traded goods.

Throughout the National Footprint Accounts, the embodied Footprint of trade is calculated assuming world average Footprint intensities for all products. Using world-average efficiencies for all traded goods is an overestimate of the Footprint of exports for countries with higher-than-average production efficiency. In turn, it underestimates that country's Footprint of consumption. For countries with below-average transformation efficiencies for secondary products, the opposite is true: An underestimate of the embodied Footprint of exports yields an exaggerated Footprint of consumption.

Biocapacity Assessment

A national biocapacity calculation starts with the total amount of bioproductive land available. "Bioproductive" refers to land and water that supports significant photosynthetic activity and accumulation of biomass, ignoring barren areas of low, dispersed productivity. This is not to say that areas such as the Sahara Desert, Antarctica, or Alpine mountaintops do not support life; their production is simply too widespread to be directly harvestable by humans. Biocapacity is an aggregated measure of the amount of land available, weighted by the productivity of that land. It represents the ability of the biosphere to produce crops, livestock (pasture), timber products (forest), and fish, as well as to uptake carbon dioxide in forests. It also includes how much of this regenerative capacity is occupied by infrastructure (built-up land). In short, it measures the ability of available terrestrial and aquatic areas to provide ecological services. A country's biocapacity for any land use type is calculated as

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

where BC is the biocapacity, A is the area available for a given land use type, and YF and EQF are the yield factor and equivalence factor, respectively, for the country land use type in question. The yield factor is the ratio of national-to world-average yields. It is calculated as the annual availability of usable products and varies by country and year. Equivalence factors trasnlate the area supplied or demanded of a specific land use type (e.g. world average cropland, grazing land, etc.) into units of world average biologically productive area: global hectares and varies by land use type and year.

Land Area types of the National Footprint Accounts

The National Footprint Accounts include six main land use types: cropland, grazing land, fishing ground, forests for timber and fuelwood, forests for carbon dioxide uptake, and built-up land. For all land use types there is a demand on the area, as well as a supply of such an area.

In 2006, the area of biologically productive land and water on Earth was approximately 11.9 billion hectares. World biocapacity is also 11.9 billion global hectares, since the total number of average hectares equals the total number of actual hectares. But the relative area of each land type expressed in global hectares differs from the distribution in

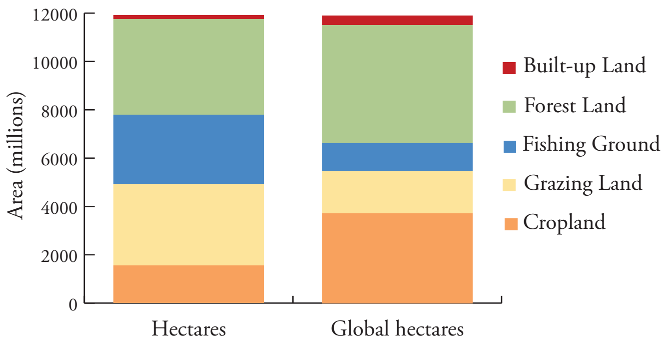


Figure 1. Relative area of land use types world-wide in global hectares and hectares, 2006

actual hectares as shown in Figure 1.

In 2006, the world had 3.7 billion global hectares of cropland biocapacity as compared to 1.6 billion hectares of cropland area (Figure 1). This difference is due to the relatively high productivity of cropland compared to other land use types. This is not surprising since cropland typically uses the most suitable and productive land areas, unless they have been urbanized. Thus, cropland affords more biologically productive services to humans than the same physical area of other land use types.

Cropland

Cropland is the most bioproductive of all the land use types and consists of areas used to produce food and fiber for human consumption, feed for livestock, oil crops, and rubber. Worldwide in 2006 there were 1.6 billion hectares designated as cropland (FAO ResourceSTAT Statistical Database 2007); the National Footprint Accounts calculate the cropland Footprint according to the production quantities of 164 different crop categories. Cropland Footprint calculations do not take into account the extent to which farming techniques or unsustainable agricultural practices cause long-term degradation of soil.

Grazing land

Globally in 2006, there were 3.4 billion hectares of land classified as grazing land. Grazing land is used to raise livestock for meat, dairy, hide, and wool products. The grazing land Footprint is calculated by comparing the amount of livestock feed available in a country with the amount of feed required for the livestock produced in that year, with the remainder of feed demand assumed to come from grazing land. Since the yield of grazing land represents the amount of above-ground primary production available in a year, overshoot is not physically possible over extended periods of time for this land use type. For this reason, a country's grazing land Footprint of production is capped at its biocapacity.

Forest for timber and fuelwood

The forest Footprint is calculated based on the amount of lumber, pulp, timber products, and fuelwood consumed by a country on a yearly basis. FAO ResourceSTAT places the total area of world forests at 3.9 billion hectares (FAO ResourceSTAT Statistical Database 2007). Estimates of timber productivity are derived from the UNEC and FAO "Temperate and Boreal Forest Resource Assessment," the FAO "Global Fiber Supply Model" and the Intergovernmental Panel on Climate Change (UNEC, 2000, FAO 2000, FAO 1998, IPCC 2006), and give a world average yield of 1.81 m^3 of harvestable underbark per hectare per year. These sources also provide information on plantation type, coverage, timber yield, and areas of protected and economically inaccessible forest.

Fishing ground

The fishing grounds Footprint is calculated using estimates of the maximum sustainable catch for a variety of fish species (Gulland 1971). These sustainable catch estimates are converted into an equivalent mass of primary production based on the various species' trophic levels. This estimate of maximum harvestable primary production is then divided amongst the continental shelf areas of the world. Globally, there were 2.4 billion hectares of continental shelf and 433 million hectares of inland water areas in 2006 (World Resources Institute and FAO ResourceSTAT Statistical Database 2007). The fishing grounds Footprint is calculated based on the estimated primary production required to support the fish caught. This primary production requirement (PPR) is calculated from the average trophic level of the species in question. Fish that feed higher on the food chain (at higher trophic levels) require more primary production input and as such are associated with a higher Footprint of consumption. The National Footprint Accounts includes primary production requirement estimates for 1,439 different marine species and more than 268 freshwater species.

Built-up land

The built-up land Footprint is calculated based on the area of land covered by human infrastructure — transportation, housing, industrial structures, and reservoirs for hydropower. Built-up land occupied 167 million hectares of land worldwide in 2006, according to satellite imaging and research data sets (FAO 2005 and IIASA Global Agro-Ecological Zones 2000). Built-up land presumably occupies what would previously have been cropland. This assumption is based on the theory that human settlements are generally situated in highly fertile areas. For lack of data on the types of land inundated, all hydroelectric dams are assumed to flood land with global average productivity.

Forest for carbon dioxide uptake

Carbon dioxide emissions, primarily from burning fossil fuels, are the only waste product included in the National Footprint Accounts. On the demand side, the carbon Footprint is calculated as the amount of forest land required to absorb given carbon emissions. It is the largest portion of humanity's current Footprint – in some countries though, it is a minor contribution to their overall Footprint.

The first step in calculating the carbon Footprint is to sum the atmospheric emissions of carbon dioxide from burning fossil fuels, land use change (deforestation, for example), and emissions from the international transport of passengers and freight. This total is the amount of anthropogenic emissions of carbon dioxide into the global atmosphere in a given year. Second, after subtracting the amount of carbon dioxide absorbed by the world's oceans each year from the anthropogenic total, the remaining carbon dioxide is translated into the amount of bioproductive forest that would be needed to store it that year. Since timber harvest leads to a release of the stocked carbon, using forest land for carbon uptake and using it for timber or fuel-wood provision are considered to be mutually exclusive activities (see forest area for timber and fuelwood).

Normalizing Bioproductive Areas – From Hectares to Global Hectares

Ecological Footprint results are expressed in a single measurement unit, the global hectare. To achieve this, Ecological Footprint accounting scales different types of areas to account for productivity differences among land and water use types. Equivalence factors and yield factors are used to convert actual areas of different land use types (in hectares) into their global hectare equivalents. Equivalence and yield factors are applied to both Footprint and biocapacity calculations.

Yield factors account for differences in productivity of a given land use type between a country and the global average in this area type. A hectare of grazing land in New Zealand, for example, produces more grass on average than a world average grazing land hectare. Inversely, a hectare of grazing land in Jordan produces less. Hence, the New Zealand hectare is potentially capable of supporting more meat production than the global average hectare of grazing land. These differences are driven by natural factors, such as precipitation or soil quality, as well as by management practices. To account for these differences, the yield factor compares the production of a specific land use type in a country to a world average hectare of the same land use type. Each country and each year has its own set of yield factors. For example, Table 1 shows that New Zealand's grazing land is on average 2.5 times as productive as world average grazing land. The yield factor for built-up land is assumed to be equal that for cropland since urban areas are typically built on or near the most productive cropland areas.

Yield	Cropland	Forest	Grazing Land	Fishing Grounds
World Average	**1.0**	**1.0**	**1.0**	**1.0**
Algeria	0.6	0.4	0.7	0.9
Germany	2.1	4.1	2.2	3.0
Hungary	1.4	2.6	1.9	0.0
Japan	1.5	1.4	2.2	0.8
Jordan	1.0	1.5	0.4	0.7
New Zealand	1.9	2.0	2.5	1.0
Zambia	0.5	0.2	1.5	0.0

Table 1*:* Sample Yield Factors for Selected Countries, 2006.

Equivalence factors translate a specific land use type (i.e. world average cropland, pasture, forest, fishing ground) into a universal unit of biologically productive area, a global hectare. In 2006, for example, cropland had an equivalence factor of 2.39 (Table 2), indicating that world-average cropland productivity was more than double the average productivity for all land combined. This same year, grazing land had an equivalence factor of 0.51, showing that grazing land was, on average, half as productive as the world-average bioproductive hectare. The equivalence factor for built-up land is set equal to that for cropland. Equivalence factors are calculated for every year, and are identical for every country in a given year.

Area Type	Equivalence Factor [global hectares per hectare]
Primary Cropland	2.39
Forest	1.24
Grazing Land	0.51
Marine	0.41
Inland Water	0.41
Built-up Land	2.39

Table 2*:* Equivalence Factors, 2006.

Methodology Updates between the 2008 and 2009 Edition of National Footprint Accounts

A formal process is in place to assure continuous improvement of the National Footprint Accounts (NFA) methodology. Coordinated by Global Footprint Network, this process is supported by its partners and by the National Footprint Accounts Committee, as well as other stakeholders.

There have been two primary motivations for revisions to the calculation method of the National Footprint Accounts: to adapt to changes in the organization of the source data, and to increase the specificity and accuracy of the NFA calculations. Many of the changes in the latter category focus on incorporating country specific information in determining the Footprint intensities of traded goods.

This section describes each of the calculation method changes implemented since the 2008 Edition of the National Footprint Accounts.

General Updates

Since the release of the 2008 National Footprint Accounts, there have been substantial revisions to some of the FAO datasets the NFA rely on. The product classifications have changed, and in some instances the extended HS codes used previously have been replaced entirely by the FAO's own system of commodity classification.

In many of the datasets used to calculate the NFA Belgium and Luxembourg are reported as an aggregate for most of the time series, and are only reported separately after 2000. In past editions, we have scaled the 2000 values for the two countries according to the change in their combined Footprint and biocapacity to approximate a time series for each prior to 2000. In the 2009 Edition of the NFA we have split the reported production and trade amounts in the raw data where Belgium and Luxembourg are reported as an aggregate, using the ratio of their quantities in the most recent year where the two are reported separately.

Cropland Updates

The product lists for crop production and trade have been changed to match changes in the categories reported in FAOSTAT.

Previously, the FAO TradeSTAT database reported the sum of trade and food aid shipments. Food aid is now reported separately from other trade, necessitating the addition of several worksheets to explicitly calculate the embodied EF of food aid flows. Since food aid quantities are reported only for aggregate categories, the composition of each country's domestic production is used to determine the intensity of food aid exports.

A country specific unharvested cropland percentage has been calculated, and applied to the production of each country. Imports are assumed to embody the world average unharvested percentage, while the percentage for exports is calculated as the weighted average of those for production and imports.

Previously, a world average unharvested percentage was simply applied to each country's consumption quantity. This led to each country's cropland Footprint of production not necessarily equaling its cropland biocapacity as it should, as well as a mismatch between production, trade quantities and consumption.

Grazing Land/Livestock Updates

The biggest change in the grazing land and livestock sections is the modification of export intensities to reflect a country's domestic feed mix. Previously, all traded livestock products were assumed to embody world average cropland and grazing land demand. In the 2009 Edition of the NFA, these intensities are modified according to domestic mix and intensity of feed to estimate a country specific Footprint intensity of livestock. The exports intensity for livestock and livestock products is then calculated as the weighted average of production and imports intensities.

There have also been several smaller changes:

The list of livestock for which feed demand is calculated has been expanded, providing a more comprehensive picture of each country's livestock populations and feed intensity.

The aggregate crop amounts used to determine residue feed availability are now explicitly calculated from production quantities of each aggregate category's constituent products. This eliminates some potential for double-counting.

A conversion factor between wet and dry weight for cropped grass feed has been removed after a review of reported yields in the ProdSTAT database indicated that no such conversion is necessary.

It is worth noting that the removal of the "Other Wooded Land" category described below affects the grazing land Footprint by reducing many countries' grazing land Footprints of production.

Fishing Grounds Updates

The FAO FishSTAT database does not report trade in fish commodities prior to 1976. In previous editions, trade in fish commodities prior to 1976 was simply omitted. In the 2009 Edition of the NFA, we have used COMTRADE data to extrapolate these trade flows back to the start of our time series.

The list of fish species considered in the Footprint of production calculation has grown somewhat, as the number of reported species has grown, and estimates of average trophic level have been collected for more species.

The exports yield for each fish commodity is calculated as the weighted average of domestic catch and imports. The catch intensity for each commodity is now based on the effective trophic level across a country's catch of several species, rather than global constants based on the trophic levels of individual species. The formula for effective trophic level has also been revised to reflect the exponential relation between fish trophic levels and Footprint intensities.

Forest Land Updates

The calculation of national net annual increments was refined for the 2009 Edition of the National Footprint Accounts. Where possible, regional rather than global averages were used for countries where explicit NAI estimates are lacking. The global average NAI is now calculated from national figures, rather than being reported independently. This has brought greater consistency between countries' forest biocapacity and Footprint estimates.

Carbon Uptake Land Updates

There have been two minor adjustments to the carbon Footprint calculation: the CO2 intensity time series estimation has been refined, and the list of traded commodities is now somewhat more comprehensive.

World average heat and electricity CO2 intensity prior to 1991 has been recalculated, using the change in intensity for those individual countries that do have historical data available as a proxy for the change in global intensity.

Traded goods which are reported in units other than mass (e.g. number or volume) are now included in the embodied carbon import and export calculations, since for these items a traded mass is usually provided as a secondary measure.

Land Cover Updates

For European countries, the 2008 Edition of the NFA used the CLC 2000 dataset for areas under various land cover. In the 2009 Edition, CLC data for 1990 has been added, with areas interpolated between 1990 and 2000. For years outside this range, the change in area reported in the FAO data has been used to scale the CLC reported areas.

The equivalence factor calculation has been improved slightly. In previous editions, the equivalence factors shifted abruptly between 1991 and 1992, primarily due to a difference in various land cover areas reported by the USSR and those reported by former Soviet countries. To address this, the 1991 USSR areas have been scaled to match the aggregate areas reported by all former Soviet countries in 1992. The percent change in reported USSR areas is then applied to the USSR 1991 estimate to create a consistent time series. In addition, the distribution of GAEZ suitability indices in the USSR was calculated, based on the distributions reported for the former Soviet countries. This leads greater interannual consistency in the equivalence factors.

The land cover category "Other Wooded Land," previously included as a subcategory of grazing land, has been removed. This category is no longer reported in any available FAO dataset, and in at least some cases it appears to be double counting areas already reported in other FAO land use categories.

Overall, despite the changes in methodology, the 2008 and 2009 editions of the National Footprint Accounts provide very similar results. This can be seen in Figure 2, which shows the extent of global overshoot calculated using the 2008 Accounts and the 2009 Accounts.

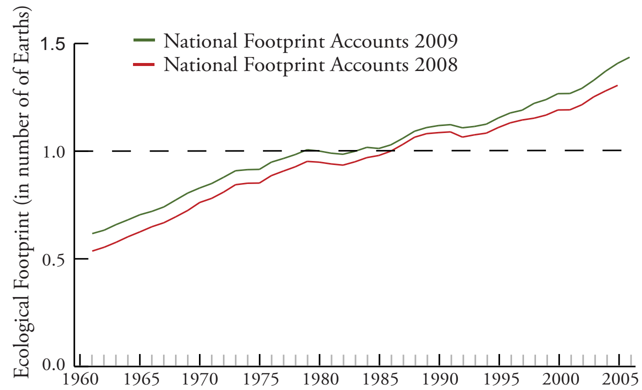


Figure 2. Comparison of global results 2006

Global Results from the National Footprint Accounts

The Global Context

Natural resource wealth and material consumption are not evenly distributed worldwide. Some countries and regions have a net demand on the planet greater than their respective biocapacity, while others use less than their available capacity. Humanity as a whole, however, is not living within the means of the planet. In 2006, humanity's total Ecological Footprint worldwide was 17.1 billion global hectares (gha); with world population at 6.6 billion people, the average person's Footprint was 2.6 global hectares. But there were only 11.9 billion gha of biocapacity available that year, or 1.8 gha per person. This overshoot of approximately 40 percent means that in 2006 humanity used the equivalent of 1.4 Earths to support its consumption (Figure 3). It took the Earth approximately a year and four months to regenerate the resources used by humanity in that year.

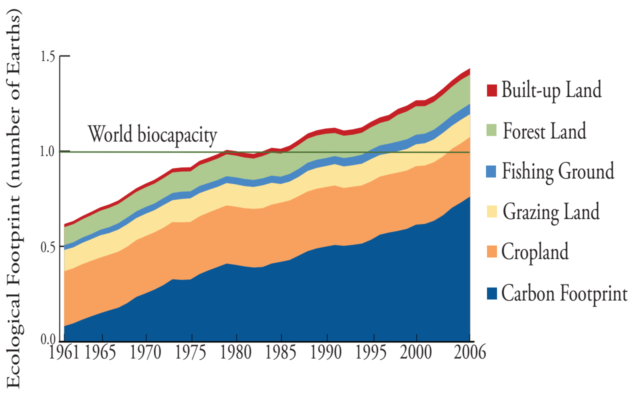


Figure 3. Humanity's Ecological Footprint, 1961-2006

In 1961, the first year for which National Footprint Accounts are available, humanity's Footprint was about half of what the Earth could supply—humanity was living off the planet's annual ecological interest, not drawing down its principal. Human demand first exceeded the planet's ability to meet this demand around 1980, and this state of overshoot has characterized every year since.

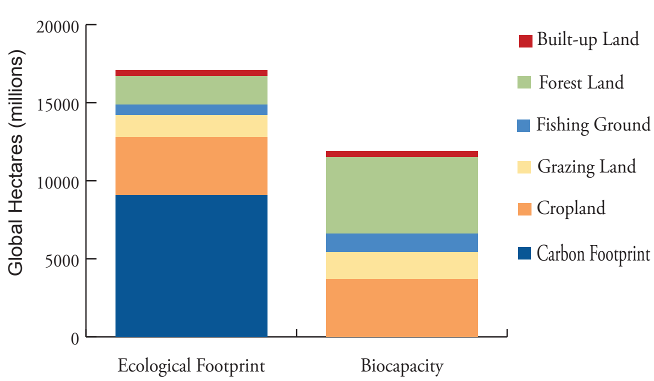


Figure 1. Total Ecological Footprint and biocapacity by land type, 2006

Figure 4 compares Ecological Footprint and biocapacity by land use type for the world. For components other than carbon Footprint, where a region's Footprint exceeds its biocapacity the net deficit, is made up by depleting its own ecosystem resource stocks, or by importing resources from elsewhere. At a national level, this latter option is less available to countries with fewer financial resources.

Half of the global Footprint was attributable in 2006 to just 10 countries (Figure 5), with the United States of America and China alone each using 23 and 21 percent, respectively, of the Earth's biocapacity.

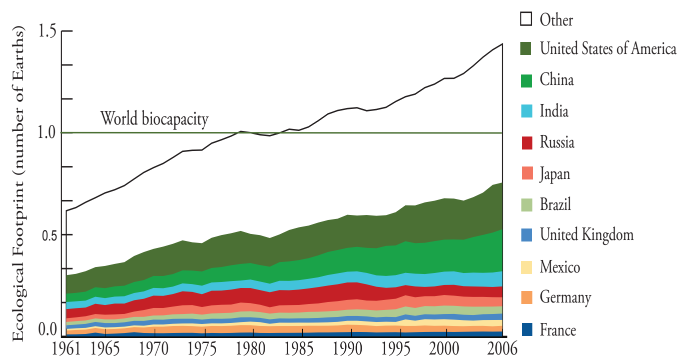


Figure 5. Humanity's Ecological Footprint by country, 1961-2006

Figure 6 below shows the top 10 countries in terms of total available biocapacity. Brazil has the most biocapacity of any country, followed in decreasing order by United States of America, China, Russian Federation, Canada, India, Australia, Indonesia, Argentina, and Bolivia. Half the world's biocapacity is found within the borders of just eight countries.

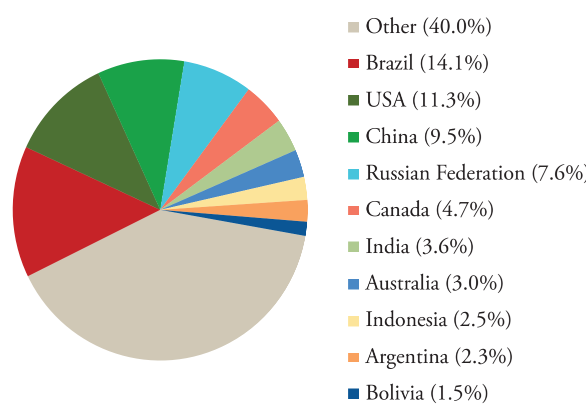


Figure 6. Top ten national biocapacities, 2006

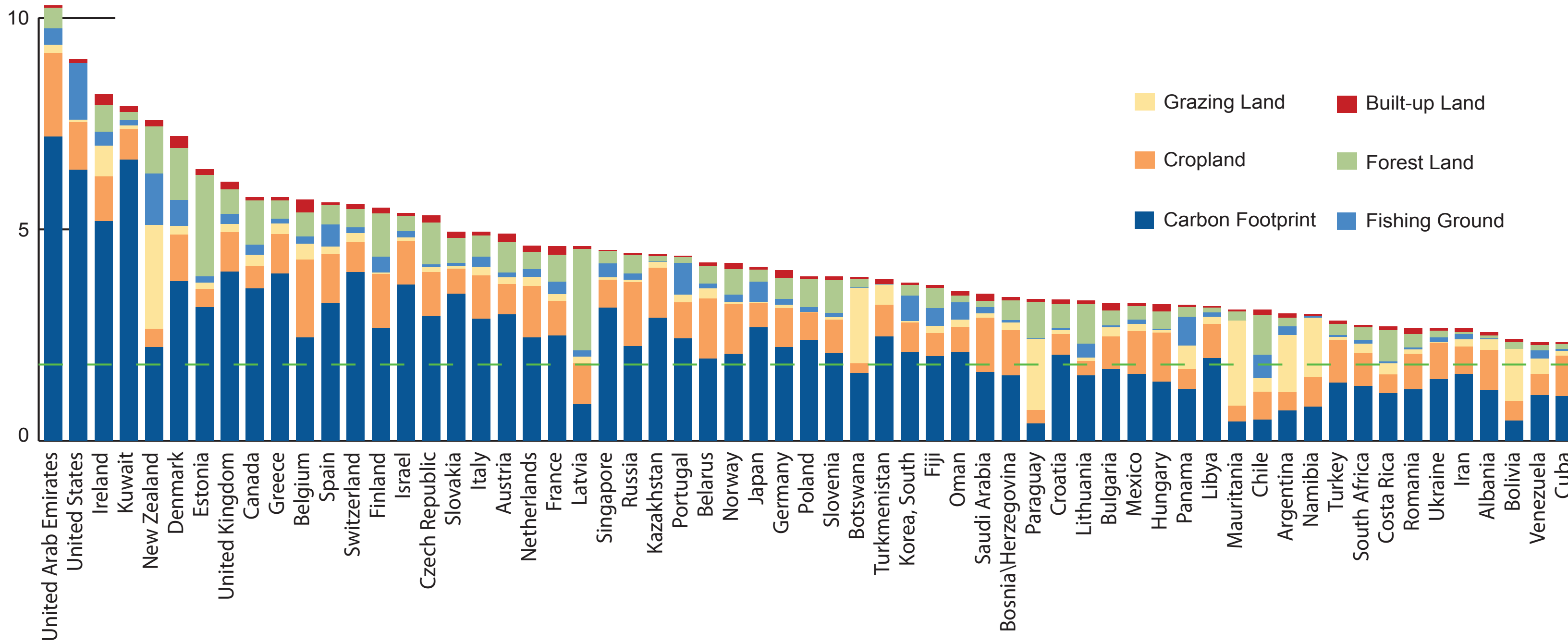


Figure 7. Ecological Footprint by Country, 2006

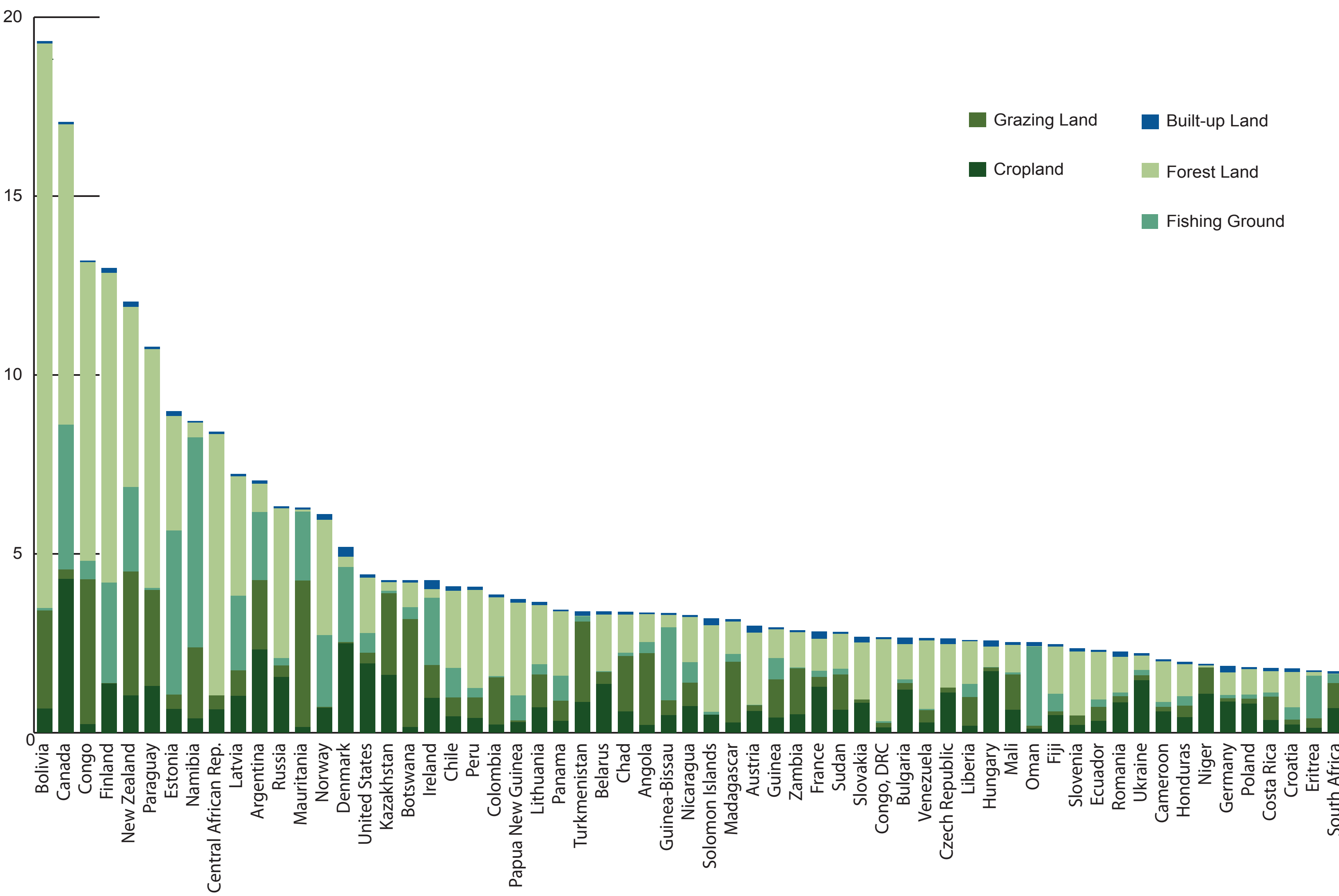
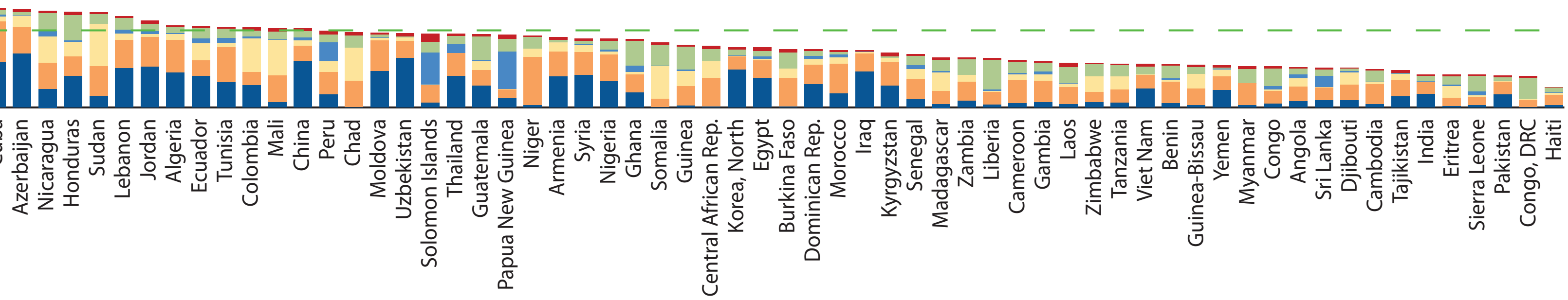
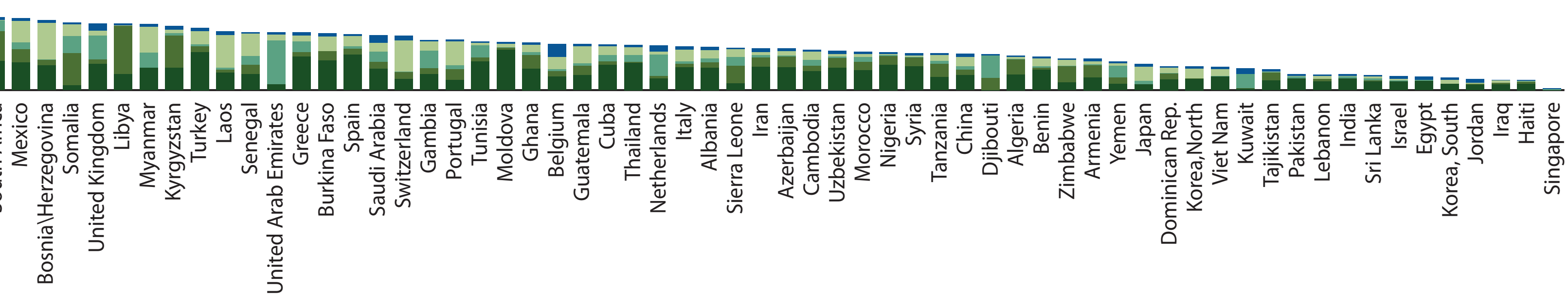


Figure 8. Biocapacity by Country, 2006

Figure 7 shows the average Ecological Footprint of consumption per person in 2006 for 126 of the 241 countries covered in the National Footprint Accounts. Of the 10 countries with the highest Ecological Footprints per person, only Australia, New Zealand, Estonia and Canada had more biocapacity than they were using. Figure 8 shows the average biocapacity available per person for these same countries. While having high availability of biocapacity is not a pre-requisite for a large average Ecological Footprint, the converse is also true. Bolivia, for example, has the most biocapacity per person of any country, while its Ecological Footprint per person is less than half the global average.





Human Development and the Ecological Footprint

Many low-income countries have an abundance of natural resources, yet their populations often suffer first and most tragically when humanity's demand on the biosphere exceeds what the biosphere can renewably provide. Countries in Africa, Latin America, and South East Asia have some of the lowest per capita Ecological Footprints in the world--in many cases the flow of usable resources from these Ecological Footprints is too small to meet basic needs for food, shelter, health, and sanitation. For these regions to reduce poverty, hunger, and disease, their access to natural resources must increase. Yet the growing population and the rest of the world's escalating resource consumption are making this increasingly difficult to manage in a sustainable manner. If low-income countries are to make advances in human development that can persist, they will need to find approaches that work within the Earth's ecological budget.

When utilizing moderate projections of UN agencies for 2050, based on slow population growth and slight improvements of people's diet, human demand would be twice of what Earth could provide. Moving energy systems away from dependancy on fossil fuels, preserving bioproductive areas, and restoring unproductive areas would go a long way to reducing this demand, but even optimistic forecasts are still not sufficient to bring demand within the biological capacity of the Earth. Therefore, relying on a growing level of consumption to attain sustainable well-being for all is unrealistic, especially given the increasing global population. While technological improvements can certainly help alleviate the strain placed on the environment, placing complete reliance on continued improvements in the future does not represent good planning. Worse, the accumulated ecological debt from decades of ecological overspending is likely to start decreasing the biosphere's regenerative capacity at the same time we are increasing our demands on it. Realizing the "right to develop" of all countries, which is the principle underlying this publication, requires constructing new development pathways that place much less strain on the global environment than have historically been the case.

The challenge of reaching a high level of human well-being while ensuring long-term resource availability is illustrated in the graph below. The United Nations Development Programme (UNDP) defines a high level of development as an HDI score of 0.8 or above, while 1.8 global hectares is the average productive area available for each person on the planet. Countries with an HDI score of 0.8 or higher, and a Footprint of 1.8 global hectares per person or lower, meet two minimum criteria for global sustainable development: a high level of development and an Ecological Footprint per person that could be globally replicated to a level less than global biocapacity. Any countries that meet both criteria are shown in the lower right quadrant. Despite growing adoption of sustainable development as an explicit policy goal, all countries do not meet both minimum conditions.

The well-being of human society is intricately linked to the biological capital on which it depends. Accounting for the biological capacity available to, and used by, a society can help identify opportunities and challenges in meeting human development goals. The loss in human well-being due to ecological degradation often comes after a significant time delay, and is difficult to reverse once the stock of resources has been significantly depleted. Short-term methods to improve human lives – such as water purification, basic medicine, and electricity for hospitals – must be complemented by effective long-term resource management in order to address and reverse humanity's cumulative ecological degradation.

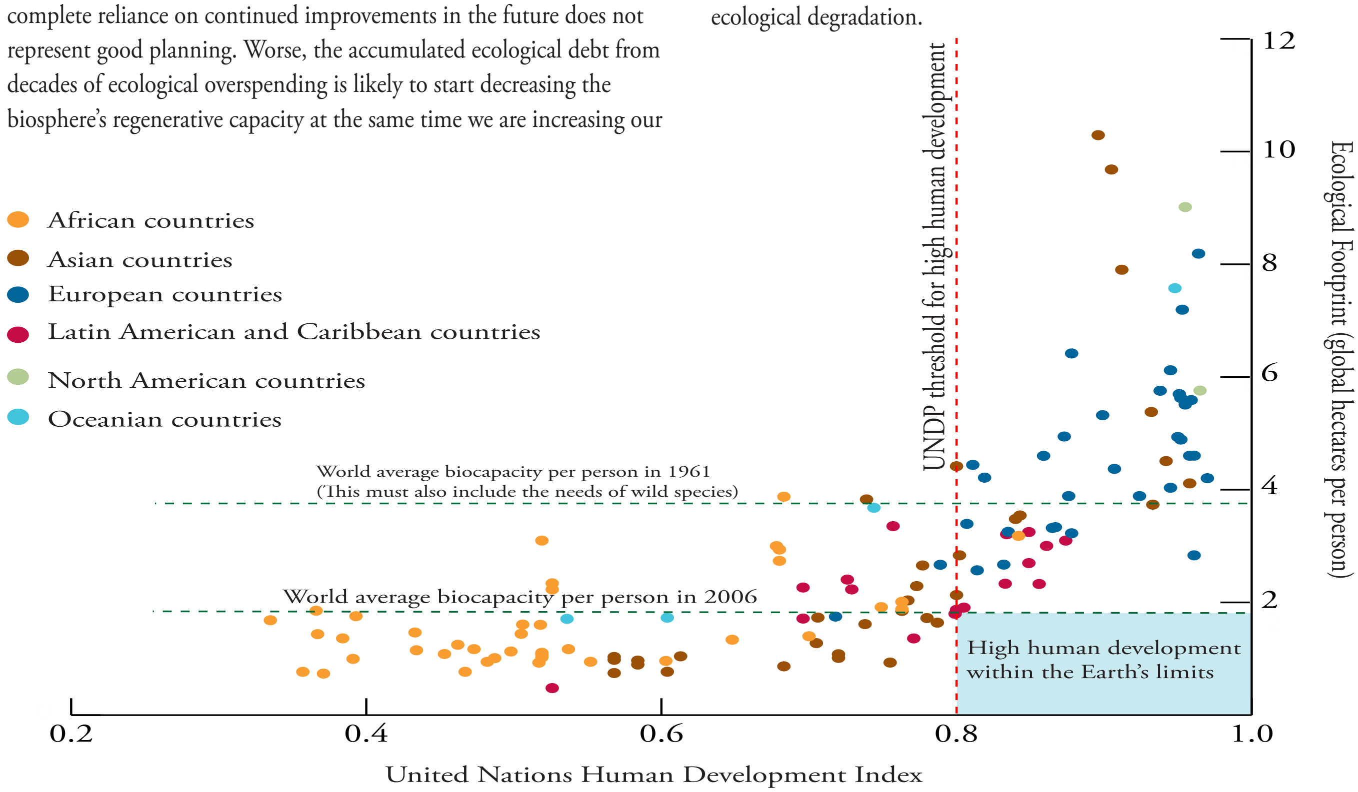


Figure 9. Human Development Index and Ecological Footprint, 2006

Ecological resources will play a crucial role in the success or failure to reduce poverty, hunger, and disease in the future. Global Footprint Network's Human Development Initiative aims to address the question: How can enduring human development be achieved, given a world of increasing resource constraints?

In an effort to explore the answer to this question, Global Footprint Network collaborates with a wide range of partners in countries throughout Latin America, Africa and South East Asia. In 2006 Global Footprint Network and the Swiss Agency for Development and Cooperation (SDC) published the Africa Ecological Footprint Atlas; a document examining indicators for human well-being and ecological health in 34 sub-Saharan African countries. This document served as the basis for discussion at workshops in Senegal, South Africa, and Kenya, where local and regional environmental leaders gathered to discuss the impacts of natural resource constraints on development in Africa. A 2008 report "Africa: Ecological Footprint and Well-being" was subsequently published to capture the ideas generated at the workshops, while highlighting case study examples of how countries have achieved advances in human development within their country's ecological limits. In 2008, Global Footprint Network worked together with Camfed International to implement an environmental-business training programme for 200 female secondary school graduates in northern Zambia. Recently, the 2006 Africa Atlas was revised to become the 2009 Africa Footprint Factbook. This new edition included perspectives of local natural resource experts in each of the countries featured.

In India, Global Footprint Network partnered with the Green Business Centre of the Confederation of Indian Industry (CII) and the World Wide Fund for Nature - India (WWF-India) to publish "India's Ecological Footprint; A Business Perspective in 2008." This report examined India's Ecological Footprint and biocapacity in the context of India's rapidly growing industrial sector. It highlighted business opportunities for specific industries, in light of India's ecological challenges.

On the Latin American continent, Global Footprint Network has built a strong relationship with the Community of Andean Nations (CAN) to begin a dialog on the growing significance of biocapacity levels in developing countries. This partnership has yielded the publication of two important documents; the Huella Ecologica y Biocapacidad en la Comunidad Andina, which presents the Ecological Footprint and biocapacity data for the four CAN member nations, Ecuador, Peru, Bolivia, and Colombia and "The Ecological Power of Nations: The Earths Biocapacity" as a new framework for international cooperation.

In the future, Global Footprint Network's Human Development Initiative will continue to explore how the Ecological Footprint can be used as a tool to make sustainable investments in human development. By working side-by-side with governments, institutions, and innovators, we will work to better understand how to provide increases in human well-being while preserving, and even replenishing, the world's natural capital.

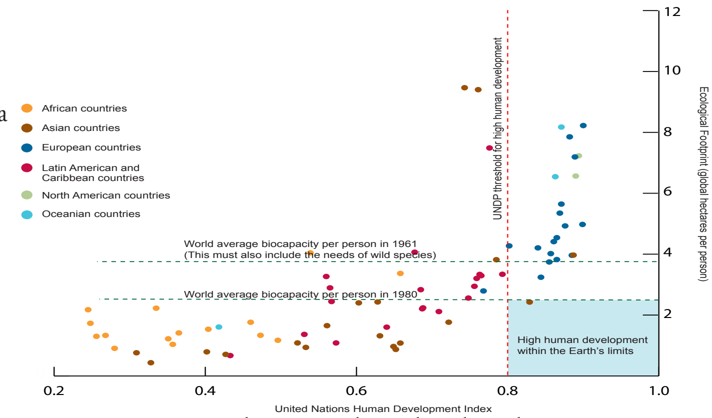


Figure 9a: Human Development Index and Ecological Footprint , 1980

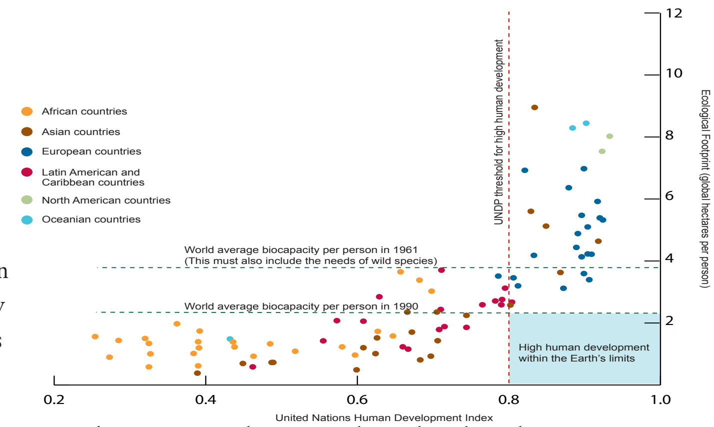


Figure 9b: Human Development Index and Ecological Footprint , 1990

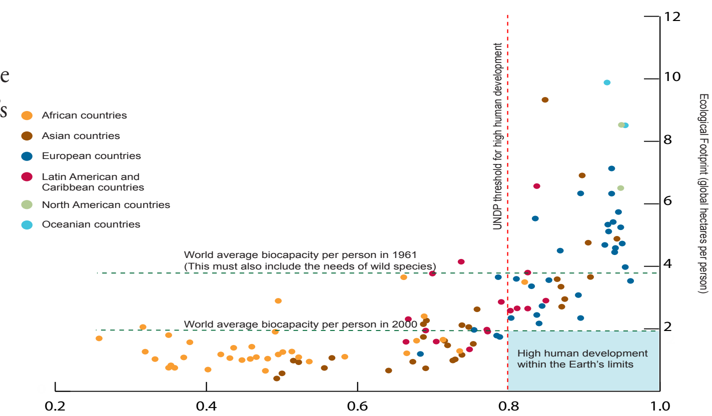


Figure 9c: Human Development Index and Ecological Footprint , 1980

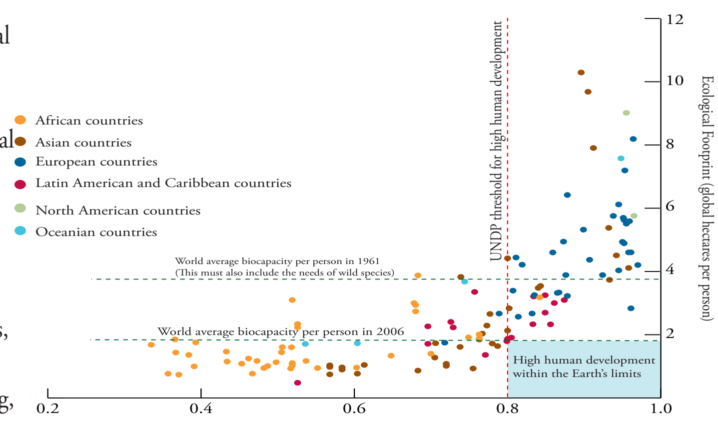


Figure 9d: Human Development Index and Ecological Footprint , 2006

Factors in Determining Biocapacity and Ecological Footprint

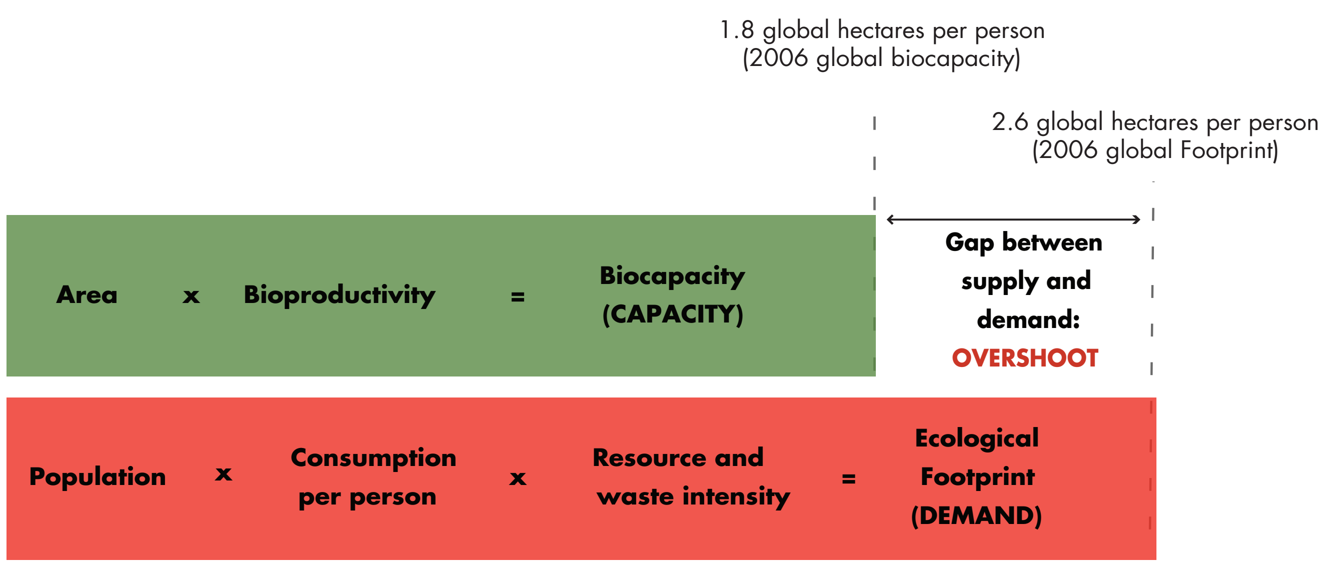
Biocapacity is determined by two factors: area of biologically productive land or water and the productivity of that area, measured by how much it yields per hectare. Since 1961, the area of land harvested under the most prevalent crops -- cereals -- has remained relatively constant, while the yield per hectare has more than doubled. In recent years, however, the area of land under cultivation has been increasing rapidly, and humanity is utilizing increasingly large areas of land for single plant species and intensive agriculture -- leaving less land undisturbed.

Careful land management can ensure that bioproductive areas do not decrease due to anthropogenic influence on factors including urbanization, deforestation, erosion, pollution, and desertification. Yields can often be increased through technology, but innovation needs to be managed cautiously to avoid harming human or ecological health. Mechanized agriculture equipment, genetically engineered seeds, irrigation, fertilizers, and pesticides can increase the yield of biologically productive land. However, many of these technological inputs come at the expense of a larger Ecological Footprint due to additional energy and resource inputs. These technologies may also decrease biocapacity in future years by increasing topsoil runoff, reducing water availability, decreasing biological diversity, or increasing the degradation of surrounding areas.

In 1971, Paul R. Ehrlich and John P. Holdren released a seminal work that decomposed the anthropogenic driving forces of natural capital appropriation into three variables: Population, Affluence, and Technology (Ehrlich & Holdren, 1971). This model came to be known as the IPAT model (Environmental Impact = Population * Affluence * Technology), and remains a useful framework for examining environmental impact. Although all three factors are likely to be limiting in the long run, modern societies usually try to increase affluence and many attempt to maintain continuous population growth. Therefore, in attempting to avoid catastrophic resource depletion, continually improving technology is assumed.

The driving forces behind changes in the Ecological Footprint can be derived from the IPAT model, with a total of five factors influencing the degree of global overshoot or a country's ecological deficit. Ecological Footprint is determined by three factors: Population, consumption per person, and resource and waste intensity.

Figure 10. Footprint and biocapacity factors that determine global overshoot



Population

Population, one of the Ecological Footprints primary driving factors, can play a decisive role in the level of human development within a country or region. Although it is only one of the determining factors of the Ecological Footprint, the exponential growth of global population plays a disproportionally large role in humanity's total Ecological Footprint.

When disregarding population growth, humans have made significant progress by increasing the world average level of human development to from 0.60 to 0.72 between 1980 and 2006, without increasing the world average Ecological Footprint per person. However, over this period the total Ecological Footprint has increased by 47 percent.

Population growth rates vary widely across income, geography, and culture, and understanding these underlying trends is key to determining the future of environmental demands. In low-income countries, there has been a 112 percent increase in population since 1980. In contrast, middle-income countries have had a 52 percent increase in population during this same time period; high-income countries have increased only 23 percent in population. The pyramids below show population structure for low, middle, and high-income countries.

Historically, societies have tended to progress from young populations with a low life expectancy (characterized by a population pyramid with a wide base and a narrow peak) to older populations with higher life expectancy (characterized by a top-heavy population pyramid), due to medical and cultural changes. It can be expected that those regions with young populations today will undergo rapid population growth and a consequent multiplicative effect on their Ecological Footprint.

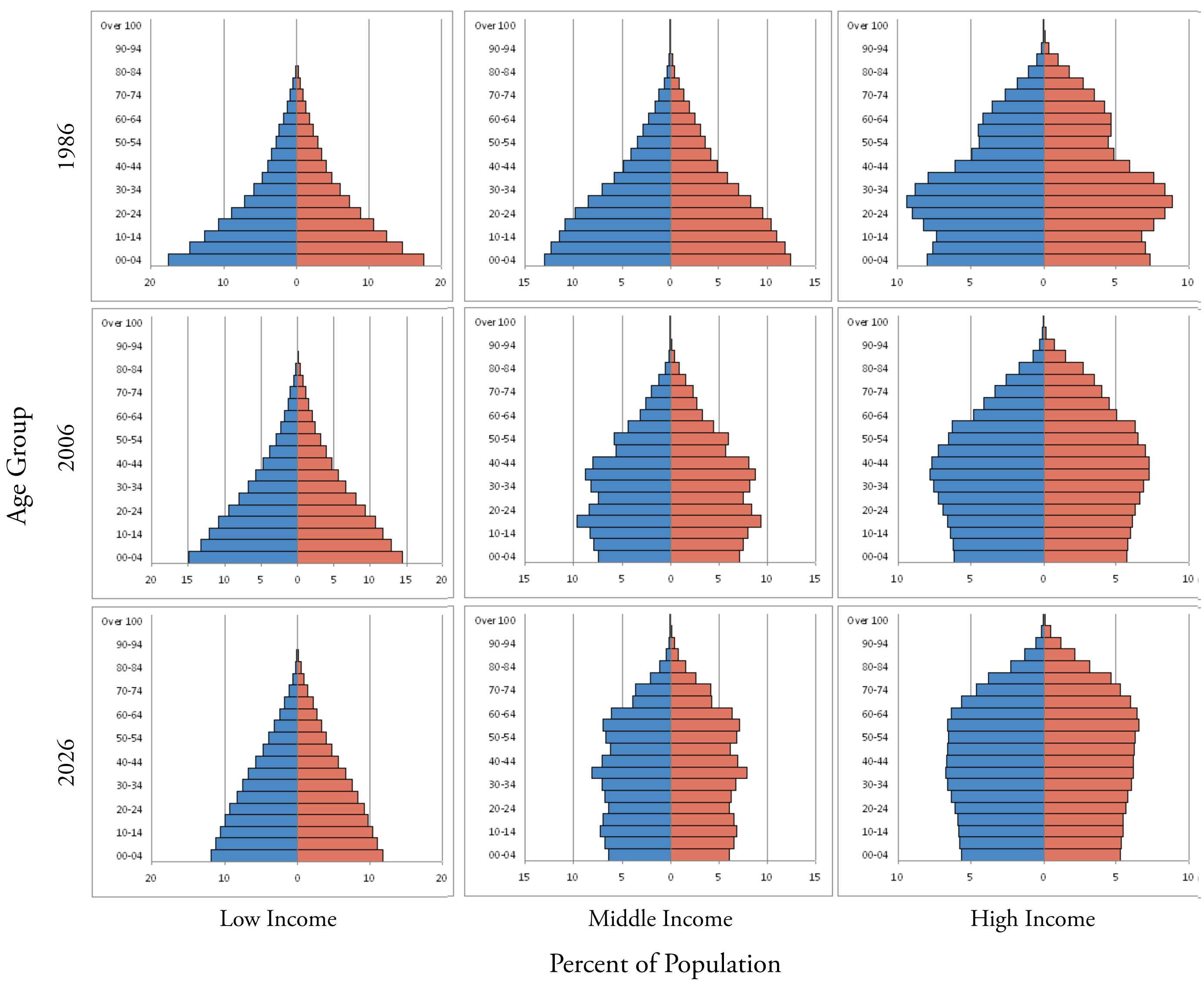


Figure 11: Population pyramids showing population structure by income group, 1986, 2006, 2026

Affluence: Consumption Per Person

Global affluence, as measured by the average value of goods and services that each person consumes, has risen dramatically over the last century: One example of this can be seen in Gross Domestic Product. GDP per capita has increased by 400 percent since the eve of the First World War in 1914. Even in the poorest region of the world, Africa, individual consumption has more than doubled over this era; in the affluent West, consumption has risen more than six-fold.

Affluence by this measure has been eagerly sought by nearly all national governments in the last 60 years, with a wide body of literature aiming to determine the link between GDP per person and true human welfare. However, in conjunction with the failure to find evidence of this link, criticism of GDP per person as a measure of affluence has been increasing, with the French president commissioning leading economists to explore the issue (Stiglitz et al. 2009). An increasingly problematic feature of GDP is that events which negatively impact the ability of people to lead happy, fulfilling lives by degrading their natural environment are counted as a positive effect.

In 1990, the United Nations produced the first Human Development Report, with the aim of putting people's welfare back into national and global decision making (UN HDR, 1990). Mahbub ul Haq, the report's founder, described the basic purpose of development as enlarging individual choices: a concept echoed by Amartya Sen in his book, "Development as Freedom. The Human Development Report" thus introduced a new measure, the Human Development Index (HDI), which aimed to measure human development of countries through three components: income, health, and education.

The Human Development Index is one of a growing body of indicators presented at a time when dissatisfaction with the use of GDP is increasing. The challenge for global institutions now is to define suitable indicators that represent progress towards a new goal based on human aspirations. In this report we use the HDI as an alternative measure to begin to understand the optimal trade-off between the necessary use of natural wealth to raise human well-being and the need for an intact biosphere to maintain it.

Technology: Resource and Waste Intensity

Over 200 years ago--at the beginning of the Industrial Revolution--Thomas Malthus wrote "Principle of Population" (Malthus, 1798): exposing his concerns that an increase in population and wealth will outstrip the suitability of the local environment to support it. As of 2009, many of his predictions have not occurred, in large part due to improvements in technology: the ability to extract greater wealth from the same amount of natural resources. Tracking the eco-efficiency and dematerialization of various societies will provide immensely valuable information for decisionmakers throughout the world. It is therefore imperative to link the National Footprint Accounts with a industrial sectors of the economy to bridge the gap from land use accounting and material flow accounting to environmental economics.

Ecological Footprint of Income Groups

A global analysis of the Ecological Footprint provides a first look at the distribution of the human demand on nature. However, to better understand how the Footprint is distributed world-wide, it is important to provide analysis of the demand generated across income groups.

Using the following World Bank classifications -- where high-income countries are defined as having a per person gross national income (GNI) of $10,066 or more; middle-income countries are defined as having a per person GNI ranging from $826 to $10,065; and low-income countries are defined as having a per person GNI of $825 or less -- we gain insight into the relationship between income level, changes in population, changes in consumption, and available biocapacity over time (World Bank).

At the same time as we see these trends in Ecological Footprint and population at a global level, the patterns we observe within the three income groups have quite different trends within the time series data. High-income countries have been characterized by a consistent increase in the average per-person Ecological Footprint, from 3.5 global hectares to 6.4 global hectares, with a relatively small increase in population. The large economic growth and improvements in quality of life that charactorize these countries are how population and affluence play a critical role in a countries total Ecological Footprint. Many countries within North America and Western Europe have only a small percentage of the global population, yet they also have some of the greatest affluence, and consequently, some of the largest Ecological Footprints.

The graphs to the right show how population and affluence affect the total Ecological Footprint and biocapacity values in each of the low-, middle-, and high-income groups.

While high-income countries are characterized by high per person consumption and high Ecological Footprint per-person values with relatively small populations, low-income countries are characterized by small consumption and a small Ecological Footprint per-person, but with larger population growth. Examing the Ecological Footprint and biocapacity by income group is useful to avoid inaccurately comparing a country's natural resource demand to world average figures within the context of global sustainability. For instance, at the global level, Ecological Footprint per person values can be considered relatively unchanged over time, while population doubles from nearly 3 billion in 1961 to 6.6 billion in 2006.

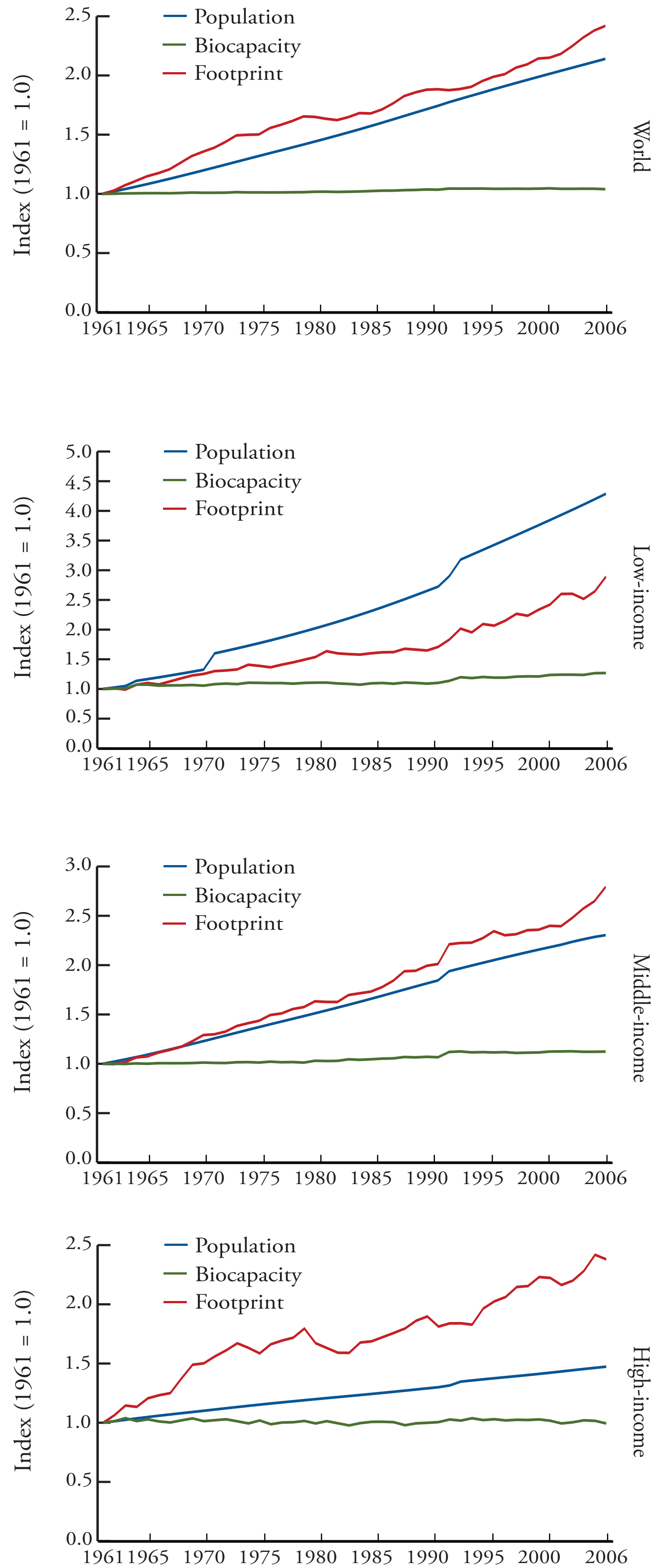


Figure 12: World, Low-income, Middle-income, and High-income Indexed to 1961

Ecological Footprint by Land Use Type and Income Group

As countries reach higher income levels, there is often a transition from a crop-dominant Ecological Footprint to a carbon Footprint-dominant Ecological Footprint. This trend can be seen in the percent of the total Ecological Footprint that each land use type occupies, and it provides insight on the substitution of resource consumption with fossil-fuel-based energy use.

South Asia, in particular, is forecasted to see large declines in crop yields under a climate change scenario (IFPRI 2009), requiring an expansion of cropland into other areas and increasing the share of the cropland Footprint. It remains to be seen whether the continued transition to a waste-based Ecological Footprint can continue, or whether there will be a trend back to a composition dominated by biomass.

The global charts to the right provide additional context once separating the results by different levels of income. Low-income countries maintain a relatively low carbon Footprint with a biomass-based Footprint accounting for approximately 80 percent of their Ecological Footprint. Middle-income countries appear to be in a period of transition, with a continued rapid decrease in the share of cropland and a rapid increase in the share of carbon Footprint. High-income countries saw a rapid growth in the share of the Footprint from carbon dioxide during the 1960s, with a corresponding decrease in the share from cropland (Galli et al. *forthcoming*).

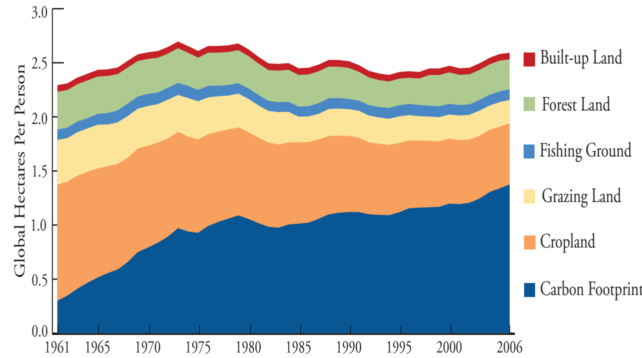


Figure 13. World Ecological Footprint per person, 1961-2006

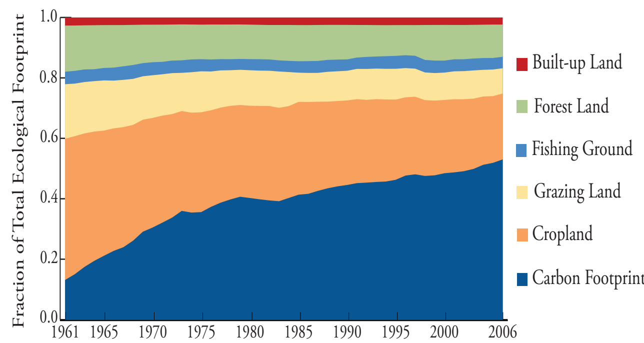


Figure 14. Composition of the World Ecological Footprint per person, 1961-2006

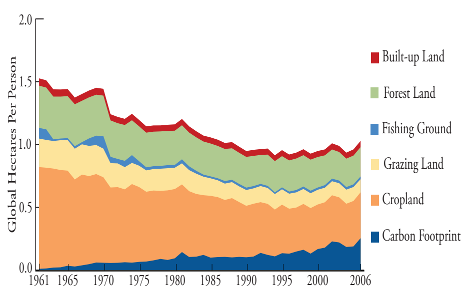


Figure 15a. Low Income Countries' Ecological Footprint per person, 1961-2006

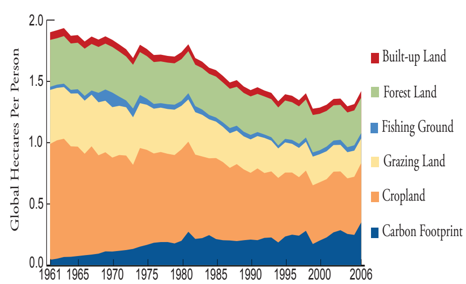


Figure 15b. Middle Income Countries' Ecological Footprint per person, 1961-2006

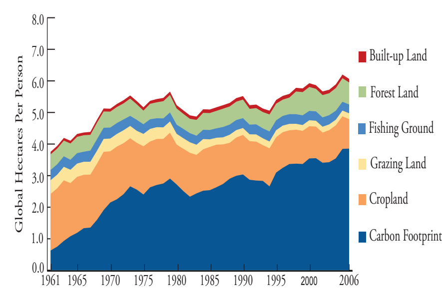


Figure 15c. High Income Countries' Ecological Footprint per person, 1961-2006

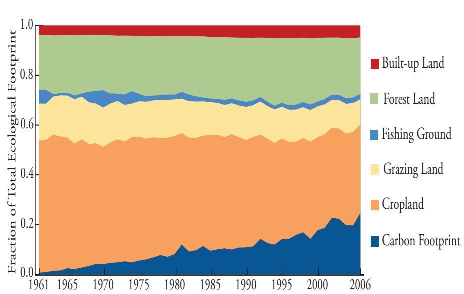


Figure 15d. Composition of Low Income Countries' Ecological Footprint per person, 1961-2006

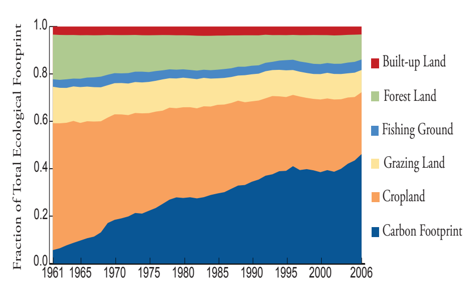


Figure 15e. Composition of Middle Income Coutnries' Ecological Footprint per person, 1961-2006

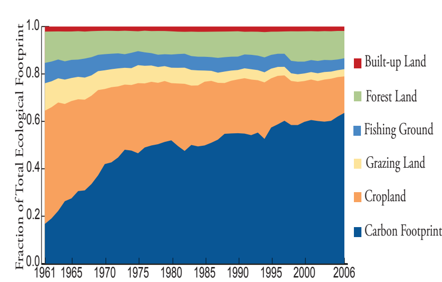


Figure 15f. Composition of High Income Countries' Ecological Footprint per person, 1961-2006

Table 3: Low-income Ecological Footprint of Production, Imports, Exports, and Consumption, 2006

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Low Income	1,276.9	0.89	0.24	0.11	1.03	0.99	-0.13
Benin	8.8	0.98	0.17	0.14	1.01	0.78	-0.03
Burkina Faso	14.4	1.38	0.05	0.07	1.36	1.34	0.02
Cambodia	14.2	0.89	0.02	0.01	0.90	0.95	-0.01
Central African Rep.	4.3	1.45	0.03	0.04	1.44	8.41	0.01
Chad	10.5	1.76	0.03	0.03	1.76	3.38	0.00
Congo, DRC	60.6	0.71	0.03	0.00	0.74	2.66	-0.03
Eritrea	4.7	0.71	0.06	0.00	0.77	1.74	-0.05
Gambia	1.7	0.88	0.25	0.05	1.08	1.19	-0.20
Ghana	23.0	1.40	0.45	0.25	1.60	1.12	-0.20
Guinea	9.2	1.44	0.06	0.04	1.47	2.94	-0.03
Guinea-Bissau	1.6	1.12	0.06	0.20	1.00	3.35	0.14
Haiti	9.4	0.36	0.12	0.00	0.48	0.24	-0.12
Korea, North	23.7	1.36	0.06	0.02	1.40	0.56	-0.05
Kyrgyzstan	5.3	1.00	0.57	0.29	1.28	1.51	-0.28
Laos	5.8	1.06	0.03	0.04	1.04	1.39	0.02
Liberia	3.6	1.02	0.14	0.01	1.15	2.59	-0.13
Madagascar	19.2	1.11	0.14	0.09	1.17	3.17	-0.06
Mali	12.0	1.77	0.21	0.12	1.85	2.53	-0.09
Mauritania	3.0	2.68	0.52	0.14	3.10	6.29	-0.38
Myanmar	48.4	1.02	0.02	0.07	0.97	1.55	0.05
Niger	13.7	1.62	0.09	0.03	1.68	1.92	-0.07
Nigeria	144.7	1.03	0.60	0.02	1.61	0.90	-0.58
Pakistan	160.9	0.64	0.21	0.10	0.75	0.37	-0.11
Papua New Guinea	6.2	2.24	0.14	0.68	1.71	3.74	0.54
Senegal	12.1	1.07	0.37	0.19	1.25	1.37	-0.18
Sierra Leone	5.7	0.72	0.06	0.01	0.77	0.99	-0.05
Solomon Islands	0.5	4.40	0.09	2.76	1.73	3.20	2.67
Somalia	8.4	1.44	0.10	0.02	1.52	1.60	-0.08
Tajikistan	6.6	0.69	0.25	0.07	0.87	0.49	-0.18
Tanzania	39.5	0.96	0.15	0.09	1.03	0.87	-0.06
Uzbekistan	27.0	1.84	0.07	0.18	1.73	0.92	0.11
Viet Nam	86.2	0.82	0.51	0.40	1.01	0.55	-0.11
Yemen	21.7	0.67	0.52	0.20	0.98	0.67	-0.31
Zambia	11.7	1.13	0.28	0.23	1.17	2.86	-0.04
Zimbabwe	13.2	1.06	0.23	0.26	1.04	0.74	0.03

Table 4: Middle-income Ecological Footprint of Production, Imports, Exports, and Consumption, 2006

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Middle Income	4,281.1	1.85	0.64	0.72	1.78	1.68	0.08
Albania	3.2	1.15	1.63	0.21	2.57	1.02	-1.42
Algeria	33.4	1.35	1.00	0.43	1.92	0.82	-0.57
Angola	16.6	0.79	0.16	0.00	0.95	3.36	-0.16
Argentina	39.1	5.48	0.72	3.19	3.00	7.05	2.47
Armenia	3.0	0.95	0.86	0.16	1.64	0.74	-0.69
Azerbaijan	8.4	1.88	0.98	0.57	2.29	0.98	-0.41
Belarus	9.7	4.09	2.29	2.17	4.21	3.39	-0.12
Bolivia	9.4	2.50	0.44	0.54	2.41	19.33	0.09
Bosnia/Herzegovina	3.9	2.61	2.20	1.41	3.39	1.66	-0.79
Botswana	1.9	2.87	1.41	0.40	3.88	4.27	-1.01
Bulgaria	7.7	3.59	2.33	2.67	3.25	2.66	0.34
Cameroon	18.2	1.09	0.25	0.24	1.11	2.05	-0.01
Chile	16.5	4.59	1.73	3.22	3.10	4.09	1.49
China	1,328.5	1.90	0.40	0.46	1.85	0.85	0.05
Colombia	45.6	1.58	0.67	0.39	1.87	3.86	-0.28
Congo	3.7	1.01	0.18	0.23	0.96	13.20	0.05
Costa Rica	4.4	1.64	2.21	1.15	2.70	1.81	-1.06
Croatia	4.6	2.28	3.74	2.68	3.34	1.80	-1.06
Cuba	11.3	1.52	0.90	0.09	2.33	1.07	-0.81
Djibouti	0.8	0.47	0.64	0.18	0.93	0.84	-0.46
Dominican Rep.	9.6	1.01	0.40	0.05	1.36	0.56	-0.35
Ecuador	13.2	2.15	0.90	1.14	1.91	2.31	0.24
Egypt	74.2	0.97	0.57	0.13	1.40	0.32	-0.43
Fiji	0.8	2.19	3.13	1.64	3.68	2.47	-1.48
Guatemala	13.0	1.38	0.77	0.44	1.71	1.08	-0.33
Honduras	7.0	1.72	0.95	0.44	2.23	1.98	-0.51
India	1,151.8	0.75	0.11	0.09	0.77	0.37	-0.02
Iran	70.3	2.64	0.31	0.29	2.66	0.99	-0.02
Iraq	28.5	1.03	0.31	0.01	1.33	0.25	-0.30
Jordan	5.7	1.13	2.10	1.19	2.04	0.26	-0.91
Kazakhstan	15.3	5.14	1.74	2.47	4.42	4.27	0.73
Latvia	2.3	6.16	4.27	5.83	4.60	7.24	1.56
Lebanon	4.1	1.20	1.00	0.07	2.13	0.37	-0.93
Libya	6.0	2.59	0.59	0.00	3.18	1.57	-0.59
Lithuania	3.4	3.15	6.08	5.91	3.32	3.66	-0.17
Mexico	105.3	2.24	2.13	1.12	3.25	1.70	-1.01
Moldova	3.8	1.61	0.70	0.56	1.75	1.13	-0.13
Morocco	30.9	1.11	0.87	0.64	1.34	0.90	-0.23
Namibia	2.0	5.21	1.73	3.94	3.00	8.71	2.21
Nicaragua	5.5	2.21	0.47	0.41	2.26	3.29	-0.06
Panama	3.3	2.74	1.32	0.85	3.21	3.44	-0.47
Paraguay	6.0	4.23	0.73	1.60	3.35	10.79	0.87
Peru	27.6	1.78	0.66	0.64	1.80	4.08	-0.02
Poland	38.1	3.69	2.85	2.65	3.89	1.84	-0.20
Romania	21.5	2.67	1.64	1.64	2.67	2.27	0.00
Russia	143.2	5.72	1.01	2.28	4.44	6.33	1.27
South Africa	48.3	3.36	0.91	1.53	2.74	1.72	0.62
Sri Lanka	19.2	0.76	0.26	0.09	0.93	0.36	-0.17

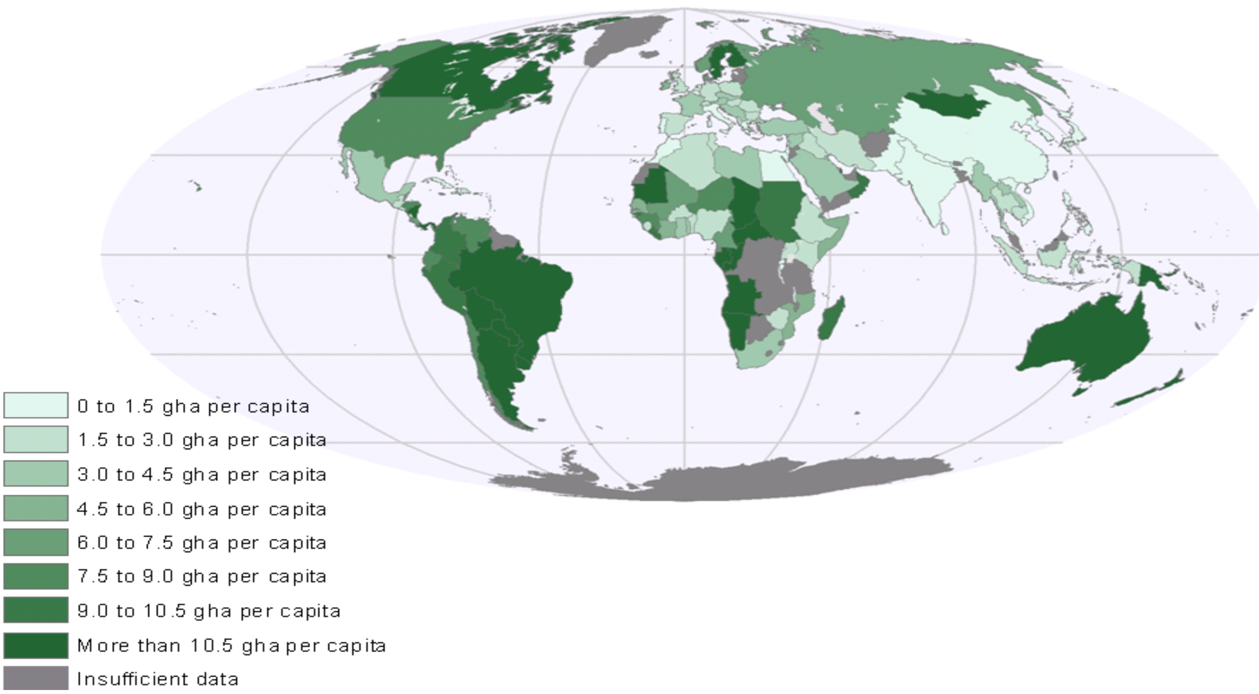
Table 4: Middle-income Ecological Footprint of Production, Imports, Exports, and Consumption, 2006 (continued)

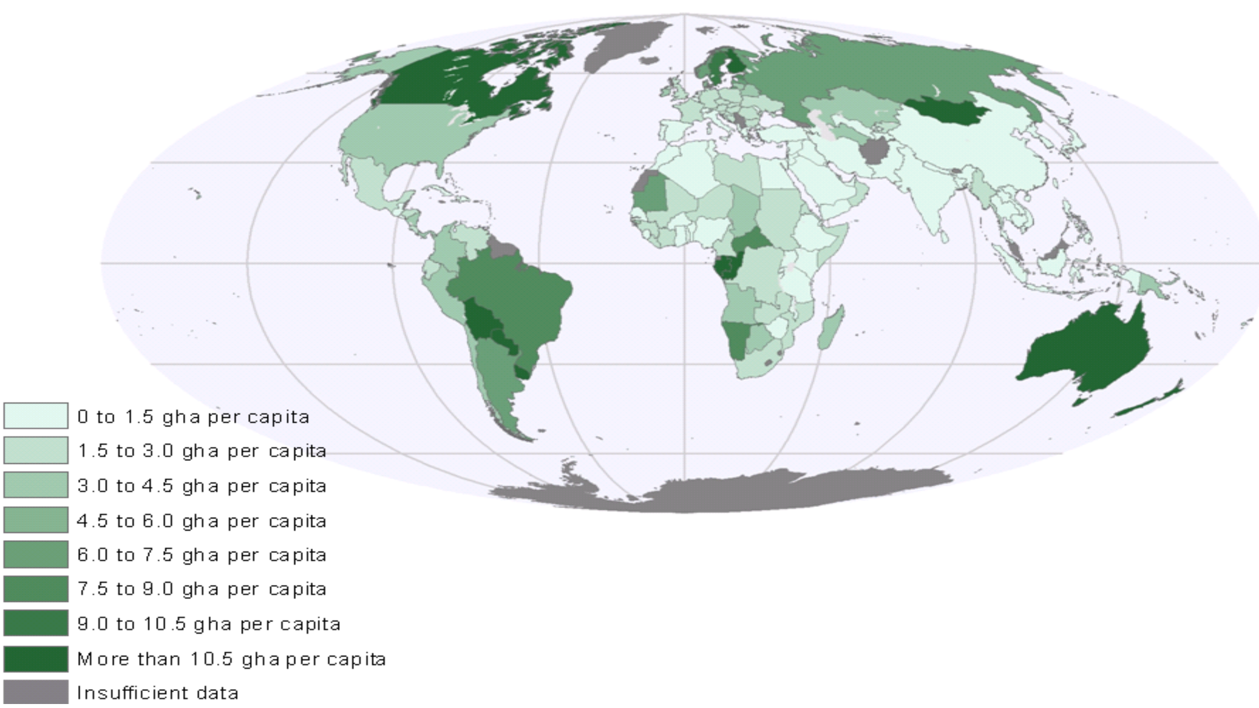
Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
Sudan	37.7	1.98	0.32	0.07	2.23	2.82	-0.25
Syria	19.4	1.51	0.94	0.83	1.61	0.87	-0.11
Thailand	63.4	2.14	1.81	2.23	1.72	1.06	0.42
Tunisia	10.2	1.51	1.57	1.19	1.88	1.15	-0.38
Turkey	73.9	2.12	1.73	1.02	2.84	1.47	-0.71
Turkmenistan	4.9	3.93	0.03	0.14	3.83	3.39	0.11
Ukraine	46.6	3.58	1.36	2.28	2.67	2.22	0.92
Venezuela	27.2	2.48	0.90	1.04	2.33	2.65	0.14

Table 5: High-income Ecological Footprint of Production, Imports, Exports, and Consumption, 2006

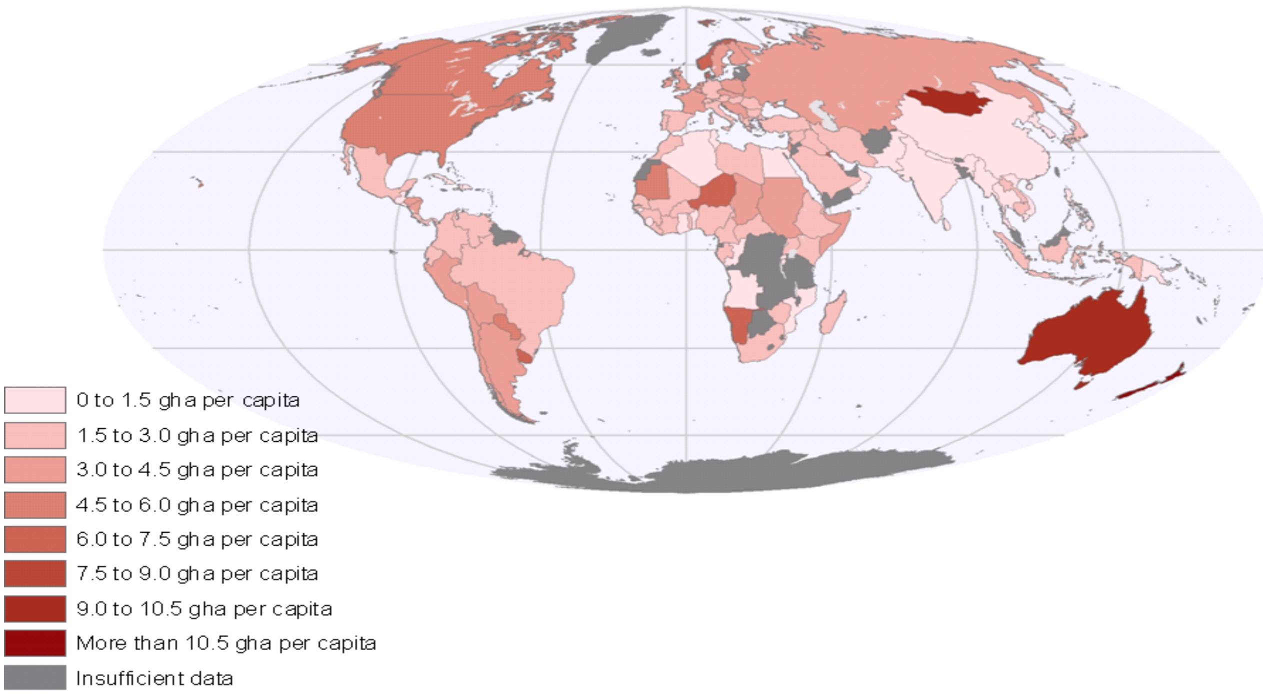
Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
High Income	1,022.1	5.75	4.94	4.68	6.06	3.35	-0.26
Austria	8.3	4.79	9.92	9.82	4.89	2.99	-0.09
Belgium	10.4	4.20	22.95	21.45	5.70	1.09	-1.50
Canada	32.6	13.43	6.36	14.04	5.76	17.08	7.67
Czech Republic	10.2	5.73	6.50	6.90	5.32	2.64	0.40
Denmark	5.4	6.49	12.07	11.37	7.19	5.19	-0.70
Estonia	1.3	6.81	7.70	8.09	6.42	8.99	0.40
Finland	5.3	11.59	10.15	16.23	5.51	12.99	6.08
France	61.3	3.99	5.32	4.71	4.60	2.83	-0.61
Germany	82.6	4.17	6.26	6.40	4.03	1.86	0.13
Greece	11.1	3.44	4.34	2.03	5.76	1.36	-2.32
Hungary	10.1	3.79	3.62	4.19	3.23	2.58	0.56
Ireland	4.2	5.97	8.54	6.32	8.19	4.26	-2.22
Israel	6.8	2.84	4.27	1.73	5.38	0.33	-2.54
Italy	58.8	2.88	5.40	3.34	4.94	1.03	-2.06
Japan	128.0	3.19	3.19	2.26	4.11	0.62	-0.93
Korea, South	48.0	3.48	4.43	4.17	3.73	0.29	-0.25
Kuwait	2.8	6.83	1.20	0.13	7.90	0.52	-1.07
Netherlands	16.4	3.69	16.09	15.18	4.60	1.05	-0.91
New Zealand	4.1	12.49	4.17	9.08	7.58	12.04	4.91
Norway	4.7	10.99	11.00	17.78	4.20	6.11	6.78
Oman	2.5	4.18	3.65	4.29	3.54	2.53	0.64
Portugal	10.6	2.78	5.10	3.51	4.37	1.18	-1.59
Saudi Arabia	24.2	4.71	3.13	4.36	3.48	1.30	1.23
Singapore	4.4	2.75	15.42	13.66	4.51	0.04	-1.76
Slovakia	5.4	3.92	7.96	6.93	4.94	2.68	-1.03
Slovenia	2.0	3.41	9.99	9.52	3.89	2.36	-0.47
Spain	43.9	3.73	5.53	3.64	5.63	1.32	-1.90
Switzerland	7.5	2.64	7.10	4.15	5.59	1.28	-2.95
United Arab Emirates	4.2	7.64	3.37	0.71	10.29	1.36	-2.65
United Kingdom	60.7	3.54	4.99	2.42	6.12	1.58	-2.57
United States	302.8	8.37	3.21	2.57	9.02	4.43	-0.64

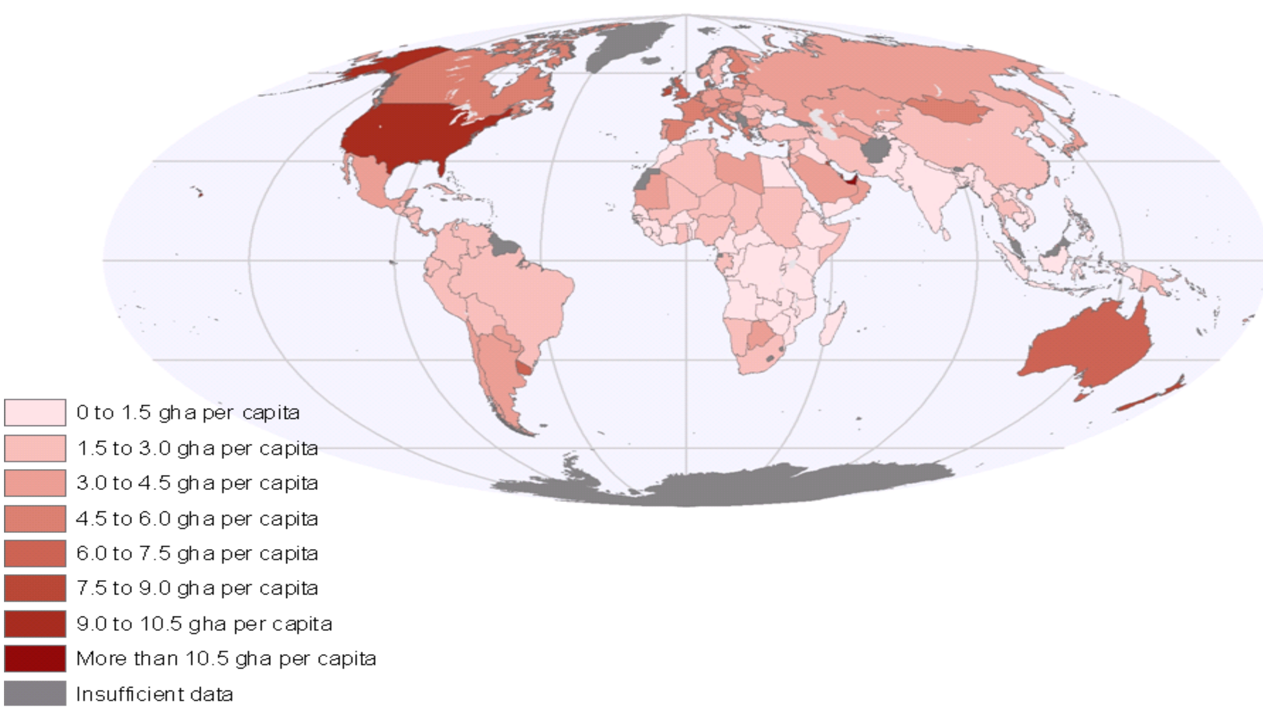
World Maps



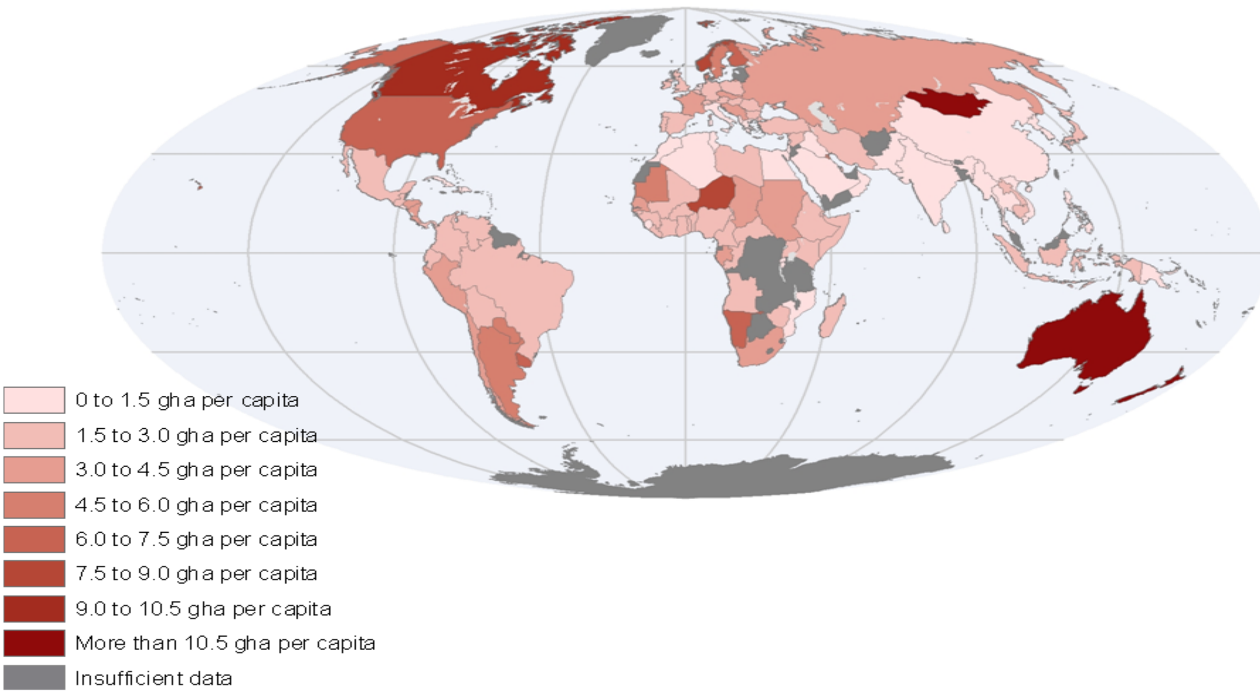


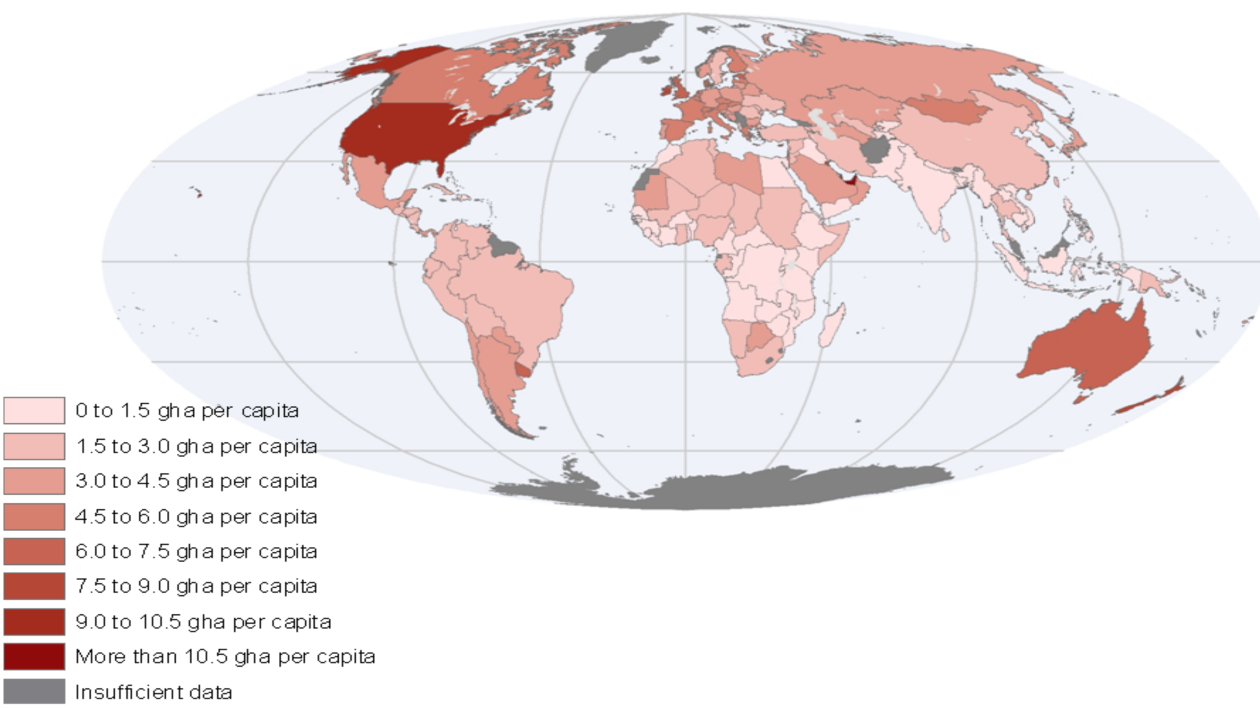
Map 1. Biological capacity per person, 1961 and 2006.



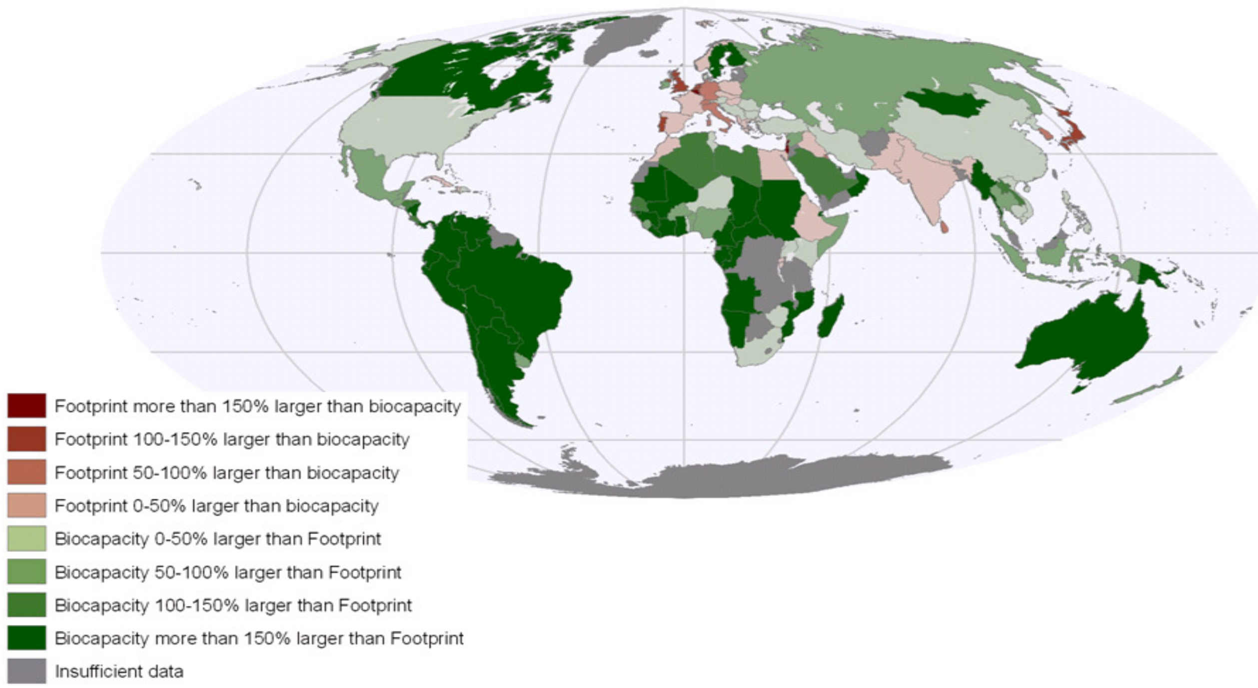


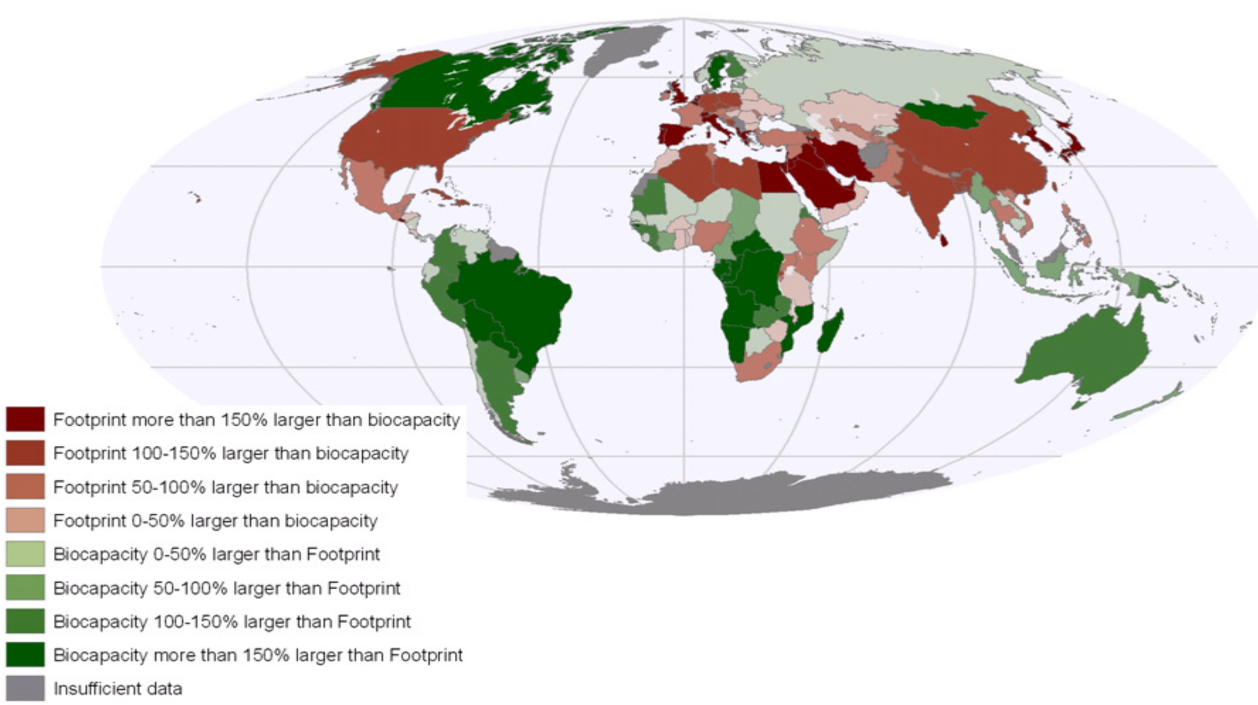
Map 2. Ecological Footprint of consumption per person, 1961 and 2006.



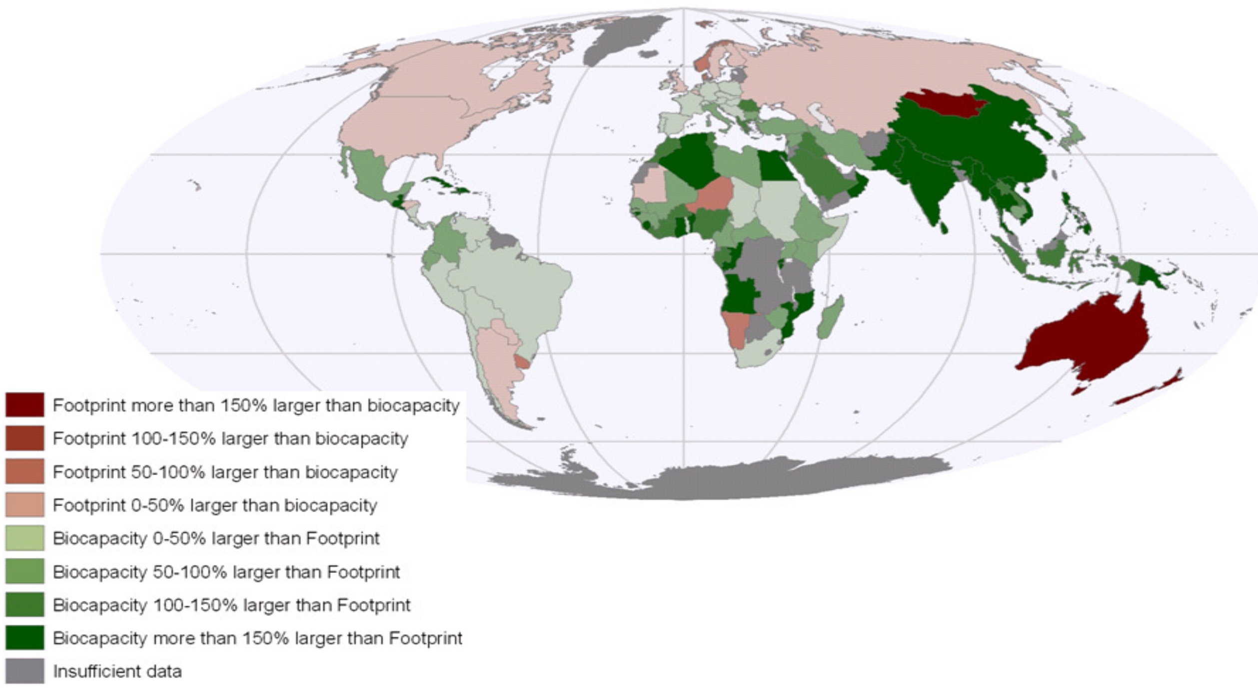


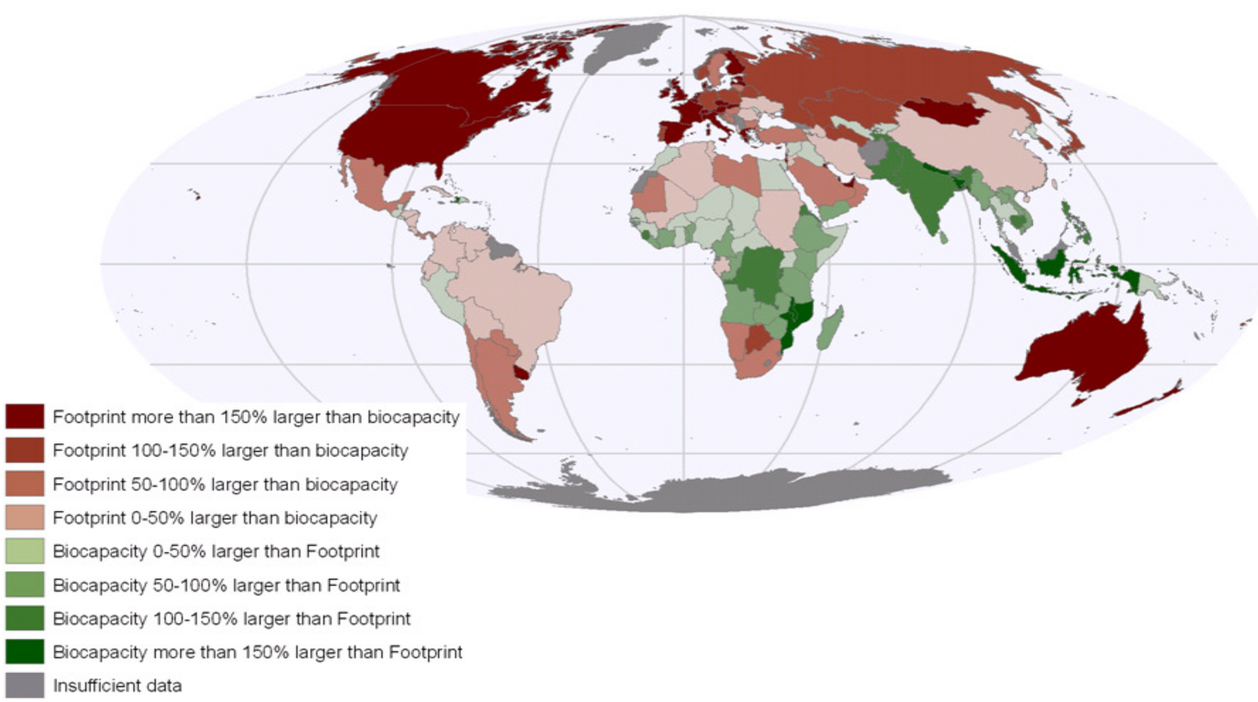
Map 3. Ecological Footprint of production per person, 1961 and 2006.



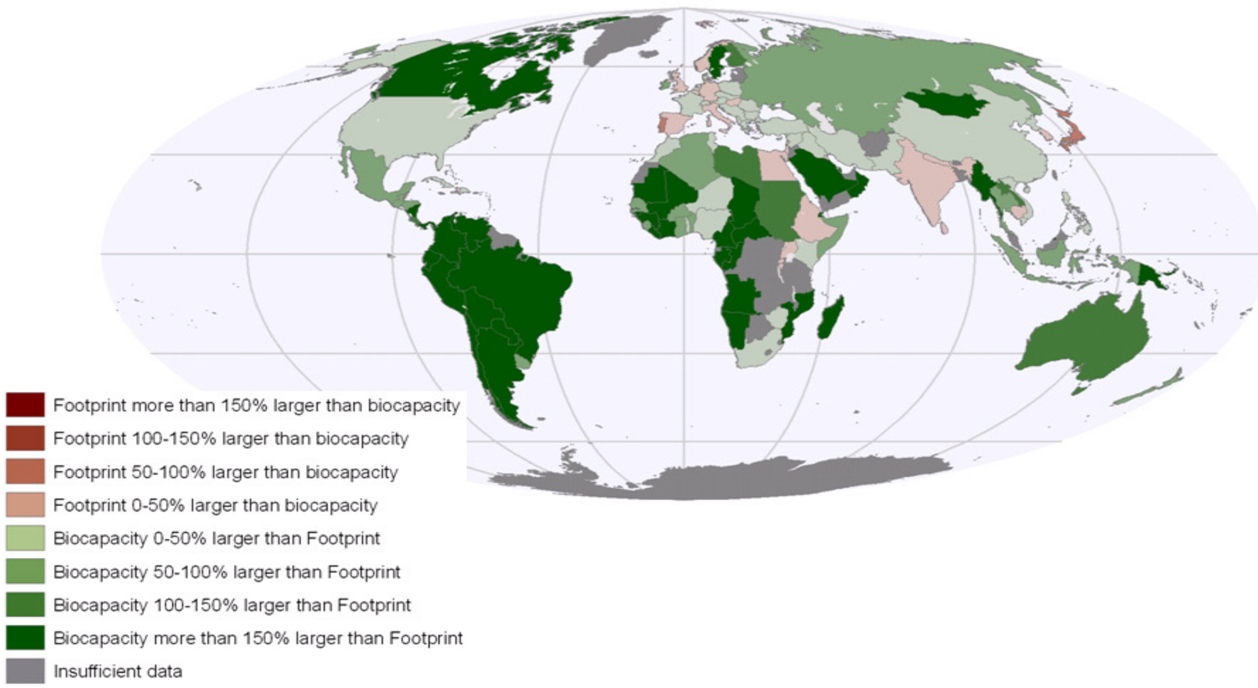


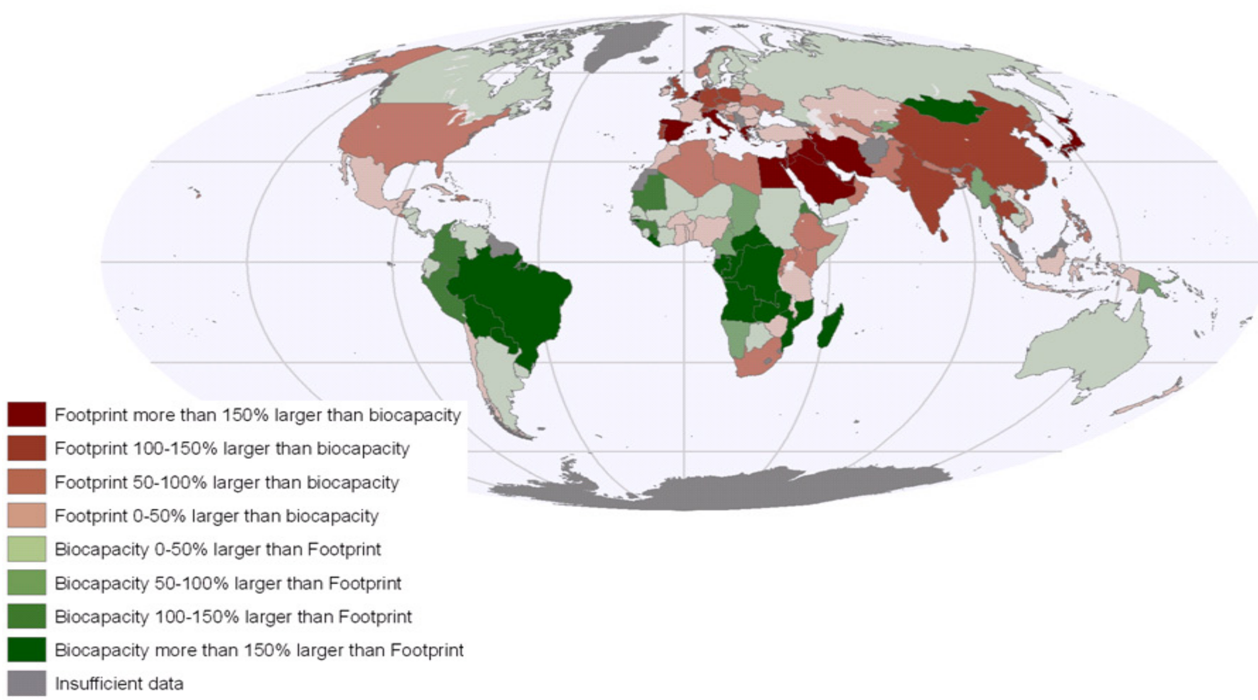
Map 4. Ecological creditor and debtor countries, 1961 and 2006. The ecological creditor and debtor map above compares the Ecological Footprint of consumption with domestic biocapacity.



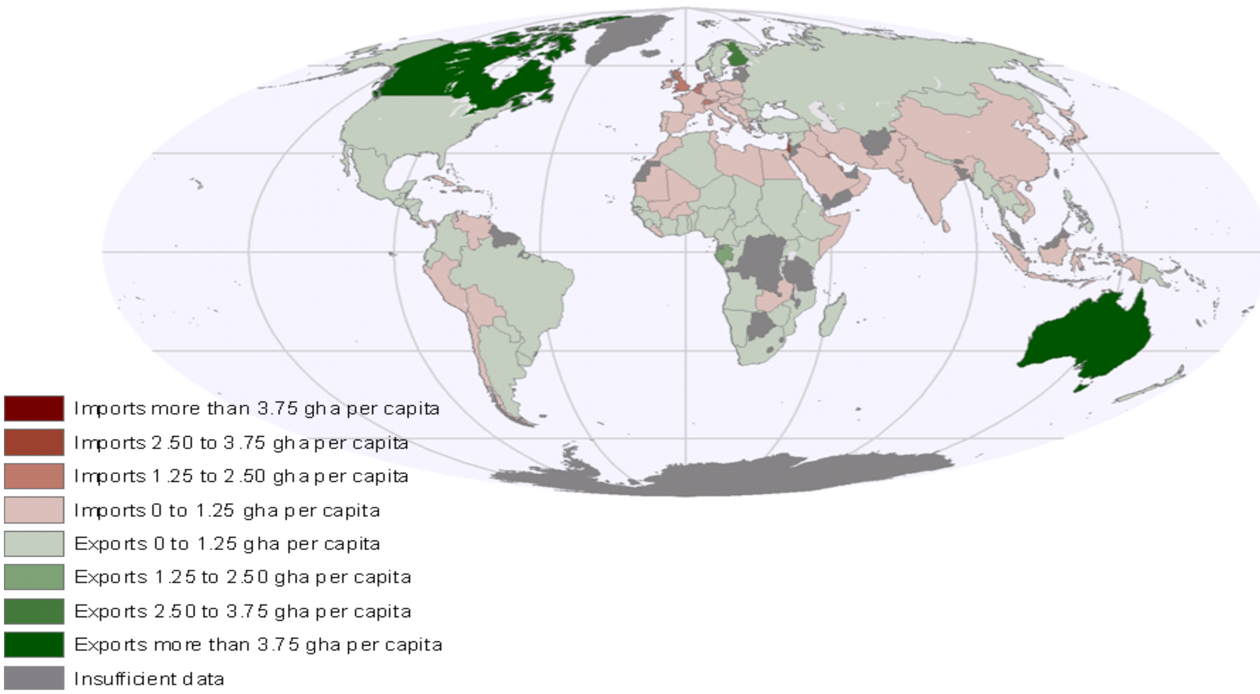


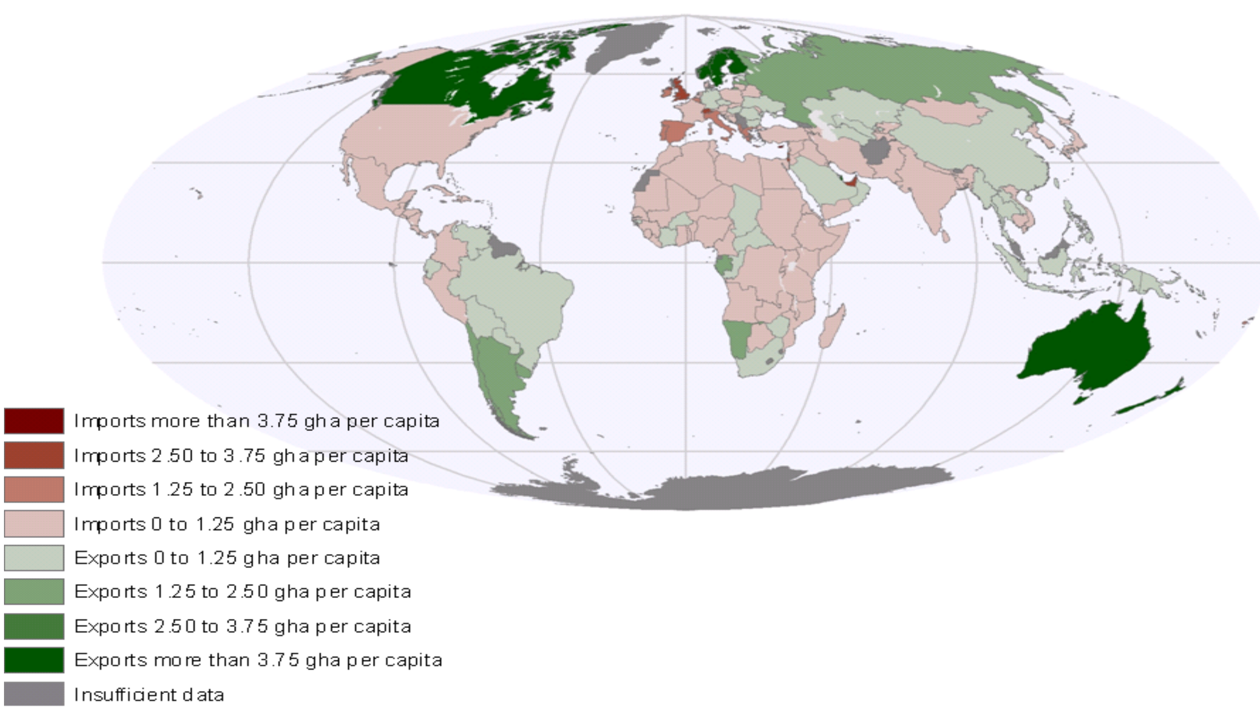
Map 5. Global ecological creditor and debtor countries, 1961 and 2006. The global ecological creditor and debtor map above compares the Ecological Footprint of consumption within each country's boundaries with globally available biocapaciity.





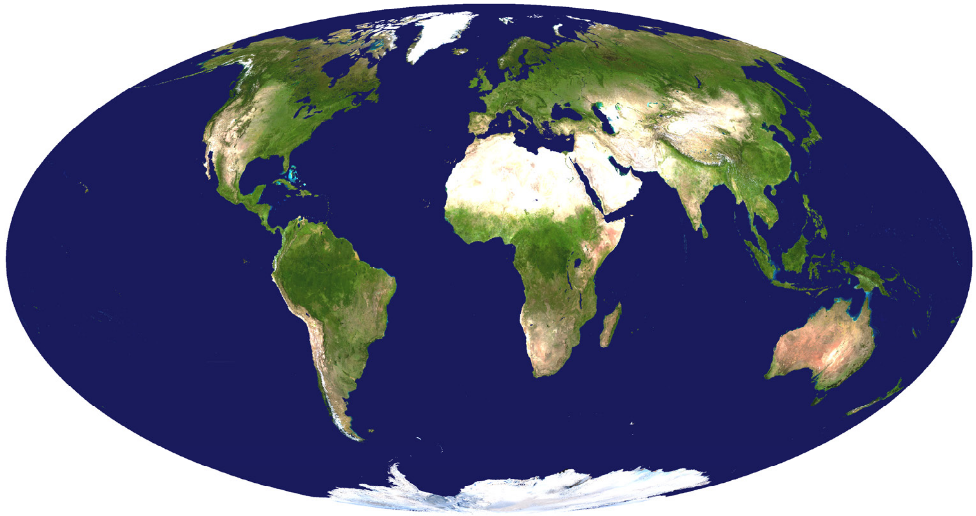
Map 6. Ecological remainder and overshoot countries, 1961 and 2006. The ecological remainder and overshoot map above compares the Ecological Footprint of production and biocapacity within each country's boundaries. Unlike the ecological creditor and debtor maps, production [by definition] omits international trade.





Map 7. Net importing and exporting countries, 1961 and 2006. The net trade flow map above identifies the net importing countries (red) and net exporting countries (green). Net importing countries import more biocapacity than they export and have an Ecological Footprint of consumption greater than their Ecological Footprint of production. The opposite is true for net exporting countries.

Regional Results from the National Footprint Accounts



Regions and countries differ greatly in both their demand on biocapacity, and on the biocapacity they have available within their borders. Many countries use more biocapacity than are available within their boundaries. This comes in part from import of resources, but typically to a greater extent through use of the global commons as a dumping ground for carbon dioxide emissions. For fossil fuels, the actual area used for extraction, refining and production of power is relatively small compared to the bioproductive area needed to absorb the waste products from burning these fuels. The latter area constitutes the carbon component of the Ecological Footprint.

If everyone in the world lived like an average resident of the United States or the United Arab Emirates, the biocapacity of more than 4.5 Earths would be required to support humanity's consumption rates. If instead the world were to live like the average South Korean, only 1.8 planets would be needed. And if the world lived like the average person in India did in 2006, humanity would be using less than half the planet's biocapacity. Figure 16 shows both per person Footprint and population size for six regions of the world in 1961 and 2005 and Figure 17 shows the same for regional biocapacity--regions are expressed in United Nations defined regions. While Asia had a low average per person Footprint in 2006, it housed more than half of the world's population and thus had the largest total Footprint of all regions. The region's total Footprint was almost twice its biocapacity in that year. The opposite was true for the Latin America and the Carribean region, whose biocapacity was approximately twice the size of its Footprint. In addition to the Asia region, the North America, and European regions were also ecological debtors, with total Footprints exceeding their biocapacity. This means these regions were relying on the biocapacity of the other areas of the world, in addition to their own, for provision of resources and for waste assimilation.

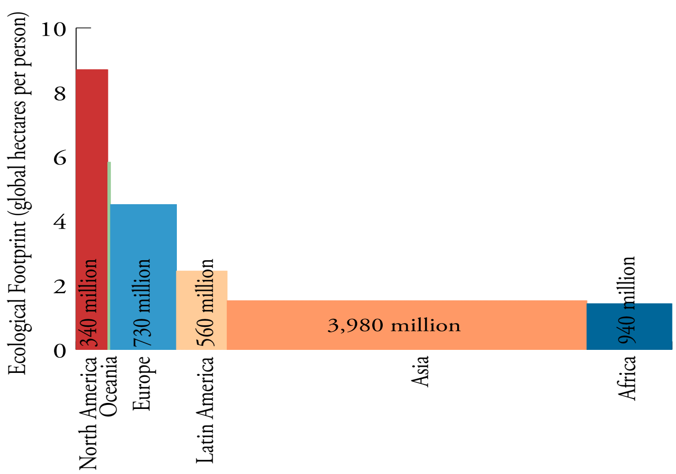


Figure 16: Ecological Footprint by region, 2006

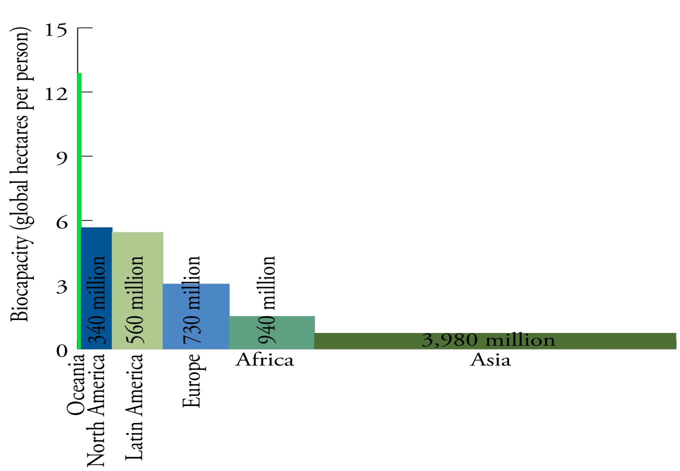
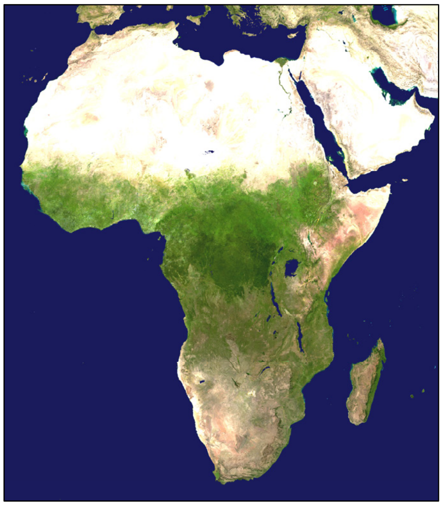


Figure 17: Biocapacity by region, 2006

AFRICA



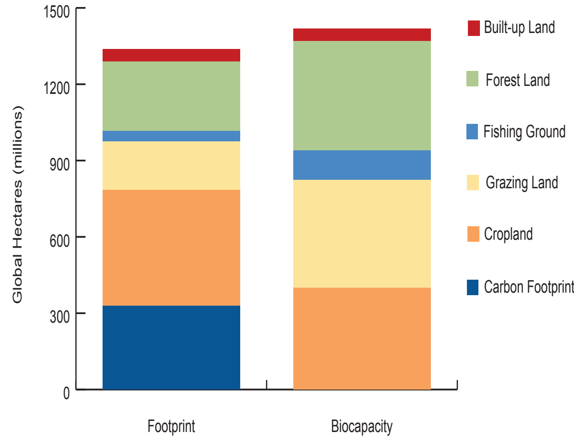


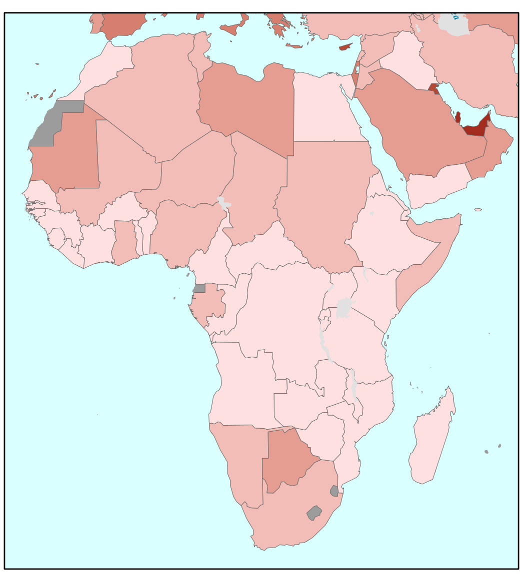
Figure 18: Africa total Ecological Footprint and biocapacity by land use type, 2006

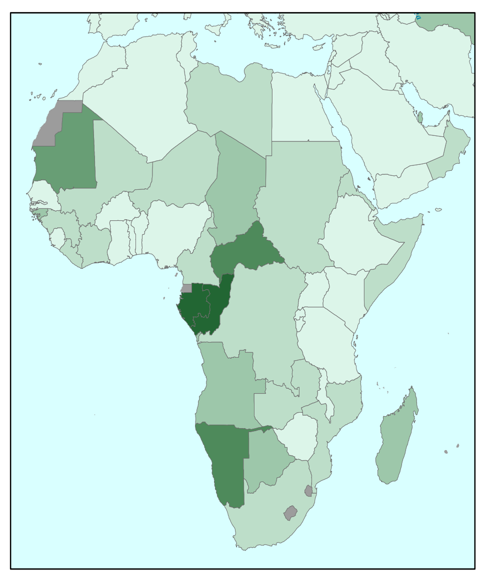
Africa comprises 2,960 million hectares of land, 1,820 million of which are counted as bioproductive area in the National Footprint Accounts. Of this bioproductive land area, 631 million hectares are forested, 245 million are cropland, 911 million are grasslands, while infrastructure occupies 30 million hectares of the continent. Bordering the Mediterranean Sea, Atlantic Ocean, and Indian Ocean, Africa also has 115 million hectares of continental shelf area and 67 million hectares of inland water.

Taking into account differences between average African yields and corresponding global yields for cropland, grazing land, forest, and fisheries, Africa's total biocapacity is 1,420 million gha. This gives Africa an average biocapacity of 0.46 gha per hectare of bioproductive land and water, where the world average is by definition 1 gha per ha. The biocapacity available per person varies widely among African countries. Egypt has the lowest biocapacity relative to population at 0.32 gha per person. At the other end of the range, Republic of Congo has 13.2 gha of biocapacity available per person. Republic of Congo also has the highest total biocapacity of any African country, containing 11 percent of the continent's overall biocapacity.

Africa's average per person Ecological Footprint of consumption is 1.4 gha, substantially lower than the global average Footprint of 2.6 gha per person. However, there are substantial differences between countries. Malawi has a per person Ecological Footprint of consumption of just 0.6 gha per person, the lowest in the world. Botswana has the highest Ecological Footprint of consumption among African countries, at 3.9 gha per person.

Most countries in Africa have total Footprints of production lower than their biocapacity, indicating that the domestic harvest and emissions quantities are within the bounds of what their ecological resources can provide. However, this is not true of all African countries. Egypt shows the greatest percentage ecological overshoot, with a total Footprint of production just over three times greater than biocapacity. South Africa exhibits the greatest total overshoot, with a Footprint of production 79 million gha greater than its biocapacity. Africa's overall Footprint of production is 31 percent less than its available biocapacity.





Carbon dioxide emissions account for 53 percent of the global total Ecological Footprint. In the case of Africa, carbon dioxide emissions account for 20 percent and 25 percent of the total Ecological Footprint of production, and of consumption, respectively. This indicates that internal economic activity, as well as final demand, are relatively more dependent on direct biotic inputs than on fossil fuel energy, as compared to the rest of the world. For both production and consumption, Somalia has the world's lowest carbon Footprint as a fraction of total Ecological Footprint, constituting just 0.004 percent of the total both for production and consumption Footprints.

Africa as a whole is a net importer of biocapacity, although several African countries do export more ecological goods than they import. Africa's net imports from the rest of the world have an embodied biocapacity equal to 12 percent of Africa's total Footprint of consumption, or 11 percent of its internal biocapacity.

The Ecological Footprint of the average African resident dropped by 22 percent between 1961 and 2006. However, in the same time span Africa's total population grew by 278 percent, driving a large increase in total ecological demand over that period.

The average African Footprint is small compared to the rest of the world. For many residents of countries in Africa, the material consumption represented by the Ecological Footprint is too small to meet basic food, shelter, health, and sanitation needs. In order to make vital quality of life improvements, large segments of Africa's population must have greater access to natural resources. Yet Africa's growing population and the world's escalating resource consumption are making this increasingly difficult.

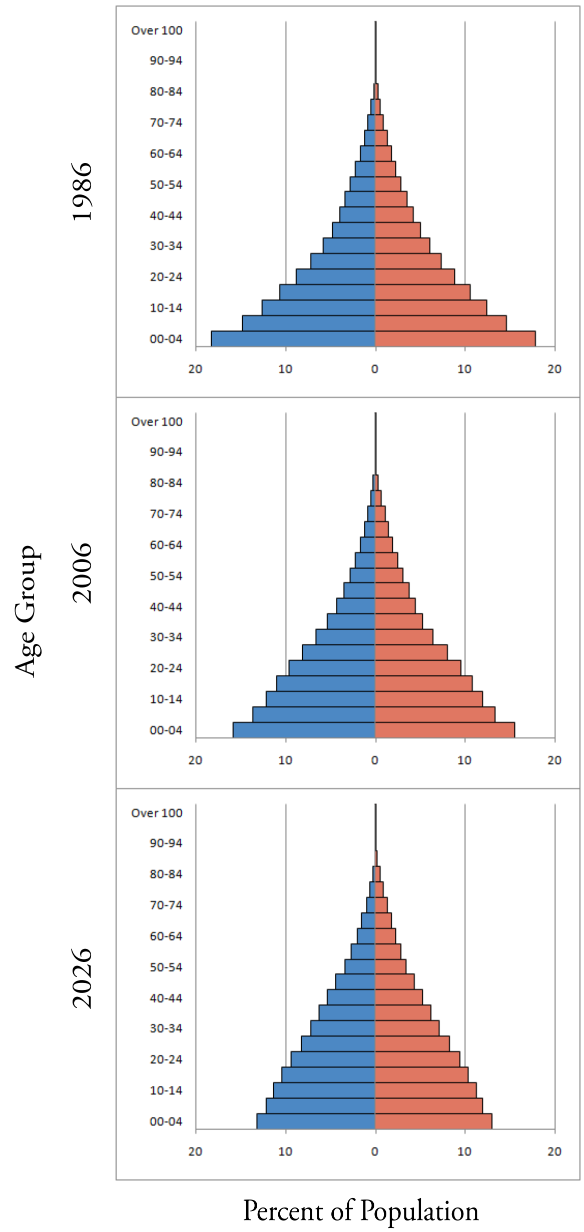


Figure 20: Africa population pyramids showing population structure, 1986, 2006, 2026

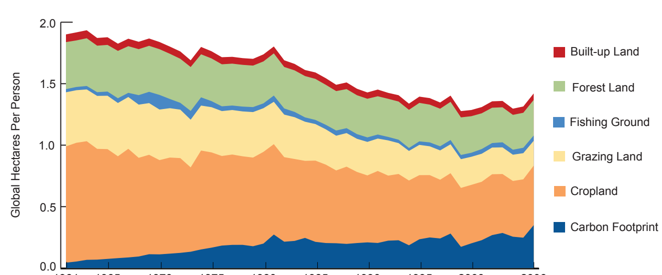


Figure 19: Africa Ecological Footprint per person

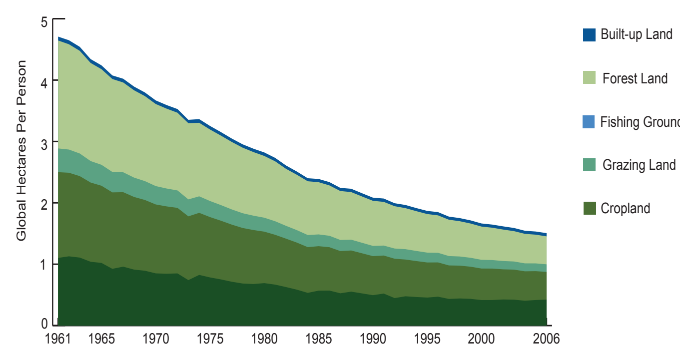


Figure 21: Africa biocapacity per person

Table 6: Africa per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Africa	942.5	1.25	0.4	0.24	1.42	1.51	-0.16
Algeria	33.4	1.35	1.00	0.43	1.92	0.82	-0.57
Angola	16.6	0.79	0.16	0.00	0.95	3.36	-0.16
Benin	8.8	0.98	0.17	0.14	1.01	0.78	-0.03
Botswana	1.9	2.87	1.41	0.40	3.88	4.27	-1.01
Burkina Faso	14.4	1.38	0.05	0.07	1.36	1.34	0.02
Cameroon	18.2	1.09	0.25	0.24	1.11	2.05	-0.01
Central African Rep.	4.3	1.45	0.03	0.04	1.44	8.41	0.01
Congo	3.7	1.01	0.18	0.23	0.96	13.20	0.05
Chad	10.5	1.76	0.03	0.03	1.76	3.38	0.00
Djibouti	0.8	0.47	0.64	0.18	0.93	0.84	-0.46
Egypt	74.2	0.97	0.57	0.13	1.40	0.32	-0.43
Congo, DRC	60.6	0.71	0.03	0.00	0.74	2.66	-0.03
Eritrea	4.7	0.71	0.06	0.00	0.77	1.74	-0.05
Gambia	1.7	0.88	0.25	0.05	1.08	1.19	-0.20
Ghana	23.0	1.40	0.45	0.25	1.60	1.12	-0.20
Guinea	9.2	1.44	0.06	0.04	1.47	2.94	-0.03
Guinea-Bissau	1.6	1.12	0.06	0.20	1.00	3.35	0.14
Libya	6.0	2.59	0.59	0.00	3.18	1.57	-0.59
Liberia	3.6	1.02	0.14	0.01	1.15	2.59	-0.13
Morocco	30.9	1.11	0.87	0.64	1.34	0.90	-0.23
Madagascar	19.2	1.11	0.14	0.09	1.17	3.17	-0.06
Namibia	2.0	5.21	1.73	3.94	3.00	8.71	2.21
Mali	12.0	1.77	0.21	0.12	1.85	2.53	-0.09
Mauritania	3.0	2.68	0.52	0.14	3.10	6.29	-0.38
Niger	13.7	1.62	0.09	0.03	1.68	1.92	-0.07
Nigeria	144.7	1.03	0.60	0.02	1.61	0.90	-0.58
South Africa	48.3	3.36	0.91	1.53	2.74	1.72	0.62
Sudan	37.7	1.98	0.32	0.07	2.23	2.82	-0.25
Senegal	12.1	1.07	0.37	0.19	1.25	1.37	-0.18
Tunisia	10.2	1.51	1.57	1.19	1.88	1.15	-0.38
Sierra Leone	5.7	0.72	0.06	0.01	0.77	0.99	-0.05
Somalia	8.4	1.44	0.10	0.02	1.52	1.60	-0.08
Tanzania	39.5	0.96	0.15	0.09	1.03	0.87	-0.06
Zambia	11.7	1.13	0.28	0.23	1.17	2.86	-0.04
Zimbabwe	13.2	1.06	0.23	0.26	1.04	0.74	0.03

Table 7: Africa per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
Africa	1.42	0.48	0.20	0.29	0.04	0.35	0.05
Algeria	1.92	0.76	0.14	0.13	0.03	0.81	0.04
Angola	0.95	0.34	0.19	0.13	0.09	0.14	0.04
Benin	1.01	0.50	0.05	0.30	0.03	0.10	0.03
Botswana	3.88	0.23	1.78	0.19	0.01	1.60	0.06
Burkina Faso	1.36	0.67	0.22	0.37	0.01	0.02	0.08
Cameroon	1.11	0.54	0.13	0.24	0.04	0.09	0.05
Central African Rep.	1.44	0.68	0.38	0.29	0.00	0.02	0.07
Congo	0.96	0.30	0.03	0.41	0.08	0.09	0.05
Chad	1.76	0.61	0.77	0.29	0.00	0.01	0.07
Djibouti	0.93	0.37	0.28	0.05	0.04	0.17	0.03
Egypt	1.40	0.41	0.02	0.13	0.06	0.69	0.08
Congo, DRC	0.74	0.16	0.01	0.49	0.01	0.01	0.05
Eritrea	0.77	0.19	0.27	0.20	0.04	0.03	0.04
Gambia	1.08	0.50	0.14	0.19	0.08	0.12	0.04
Ghana	1.60	0.42	0.05	0.57	0.16	0.35	0.05
Guinea	1.47	0.46	0.35	0.52	0.03	0.04	0.06
Guinea-Bissau	1.00	0.39	0.34	0.16	0.00	0.05	0.06
Libya	3.18	0.81	0.18	0.10	0.10	1.95	0.04
Liberia	1.15	0.30	0.02	0.70	0.03	0.06	0.04
Morocco	1.34	0.70	0.15	0.06	0.06	0.32	0.05
Madagascar	1.17	0.30	0.43	0.26	0.04	0.08	0.06
Namibia	3.00	0.71	1.39	0.00	0.04	0.80	0.05
Mali	1.85	0.62	0.83	0.18	0.01	0.12	0.08
Mauritania	3.10	0.38	2.02	0.21	0.00	0.44	0.05
Niger	1.68	1.13	0.19	0.27	0.00	0.05	0.04
Nigeria	1.61	0.63	0.06	0.21	0.04	0.61	0.05
South Africa	2.74	0.78	0.21	0.30	0.10	1.29	0.06
Sudan	2.23	0.70	0.99	0.22	0.00	0.27	0.05
Senegal	1.25	0.47	0.24	0.22	0.09	0.18	0.04
Tunisia	1.88	0.82	0.10	0.21	0.12	0.58	0.04
Sierra Leone	0.77	0.20	0.04	0.37	0.08	0.05	0.03
Somalia	1.52	0.20	0.76	0.49	0.00	0.01	0.05
Tanzania	1.03	0.31	0.31	0.25	0.00	0.11	0.05
Zambia	1.17	0.44	0.15	0.36	0.01	0.16	0.05
Zimbabwe	1.04	0.25	0.36	0.28	0.00	0.12	0.03

Table 8: Africa total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17,090.7	3,727.2	1,427.3	1,823.0	649.6	9,063.6	400.1
Africa	1,338.2	455.9	190.4	273.1	40.3	329.2	49.4
Algeria	63.9	25.4	4.6	4.5	1.0	27.0	1.5
Angola	15.7	5.7	3.2	2.1	1.5	2.4	0.7
Benin	8.9	4.4	0.4	2.6	0.3	0.8	0.3
Botswana	7.2	0.4	3.3	0.4	0.0	3.0	0.1
Burkina Faso	19.6	9.7	3.1	5.3	0.1	0.2	1.1
Cameroon	20.1	9.8	2.4	4.4	0.8	1.7	0.9
Central African Rep.	6.1	2.9	1.6	1.3	0.0	0.1	0.3
Congo	3.5	1.1	0.1	1.5	0.3	0.3	0.2
Chad	18.4	6.4	8.1	3.0	0.0	0.1	0.8
Djibouti	0.8	0.3	0.2	0.0	0.0	0.1	0.0
Egypt	103.8	30.7	1.7	9.9	4.3	51.0	6.1
Congo, DRC	44.7	9.7	0.8	29.8	0.7	0.6	3.0
Eritrea	3.6	0.9	1.3	0.9	0.2	0.1	0.2
Gambia	1.8	0.8	0.2	0.3	0.1	0.2	0.1
Ghana	36.9	9.7	1.3	13.1	3.6	8.0	1.2
Guinea	13.5	4.2	3.3	4.8	0.3	0.4	0.5
Guinea-Bissau	1.6	0.6	0.6	0.3	0.0	0.1	0.1
Libya	19.2	4.9	1.1	0.6	0.6	11.8	0.3
Liberia	4.1	1.1	0.1	2.5	0.1	0.2	0.1
Morocco	41.3	21.5	4.7	1.9	1.8	9.9	1.4
Madagascar	22.4	5.8	8.3	5.0	0.7	1.5	1.1
Namibia	6.1	1.4	2.9	0.0	0.1	1.6	0.1
Mali	22.2	7.4	9.9	2.2	0.1	1.5	1.0
Mauritania	9.4	1.2	6.1	0.6	0.0	1.4	0.2
Niger	23.1	15.5	2.7	3.7	0.0	0.7	0.6
Nigeria	232.6	91.2	8.8	30.2	6.5	88.4	7.5
South Africa	132.2	37.9	10.1	14.3	4.6	62.5	2.9
Sudan	84.1	26.2	37.4	8.4	0.1	10.0	2.0
Senegal	15.1	5.7	2.9	2.7	1.1	2.2	0.5
Tunisia	19.2	8.4	1.0	2.2	1.2	6.0	0.5
Sierra Leone	4.4	1.1	0.2	2.1	0.5	0.3	0.2
Somalia	12.8	1.7	6.4	4.2	0.0	0.0	0.5
Tanzania	40.5	12.1	12.2	10.0	0.0	4.4	1.8
Zambia	13.7	5.2	1.8	4.3	0.1	1.9	0.6
Zimbabwe	13.7	3.3	4.8	3.7	0.0	1.5	0.4

Table 9: Africa per person biocapacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
Africa	1.51	0.42	0.45	0.46	0.12	0.05
Algeria	0.82	0.37	0.35	0.04	0.01	0.04
Angola	3.36	0.22	2.01	0.78	0.31	0.04
Benin	0.78	0.48	0.05	0.19	0.03	0.03
Botswana	4.27	0.15	3.02	0.70	0.33	0.06
Burkina Faso	1.34	0.69	0.22	0.34	0.00	0.08
Cameroon	2.05	0.59	0.13	1.14	0.13	0.05
Central African Rep.	8.41	0.65	0.38	7.31	0.00	0.07
Congo	13.20	0.23	4.05	8.35	0.51	0.05
Chad	3.38	0.60	1.54	1.07	0.10	0.07
Djibouti	0.84	0.00	0.28	0.00	0.54	0.03
Egypt	0.32	0.21	0.00	0.00	0.02	0.08
Congo, DRC	2.66	0.14	0.13	2.29	0.05	0.05
Eritrea	1.74	0.13	0.27	0.11	1.18	0.04
Gambia	1.19	0.38	0.14	0.21	0.42	0.04
Ghana	1.12	0.51	0.32	0.18	0.06	0.05
Guinea	2.94	0.42	1.06	0.80	0.60	0.06
Guinea-Bissau	3.35	0.49	0.41	0.34	2.05	0.06
Libya	1.57	0.37	1.14	0.02	0.00	0.04
Liberia	2.59	0.19	0.81	1.19	0.37	0.04
Morocco	0.90	0.46	0.20	0.08	0.11	0.05
Madagascar	3.17	0.28	1.70	0.92	0.21	0.06
Namibia	8.71	0.40	1.99	0.41	5.87	0.05
Mali	2.53	0.64	0.98	0.76	0.07	0.08
Mauritania	6.29	0.16	4.09	0.06	1.93	0.05
Niger	1.92	1.09	0.72	0.07	0.00	0.04
Nigeria	0.90	0.60	0.20	0.02	0.02	0.05
South Africa	1.72	0.68	0.70	0.02	0.25	0.06
Sudan	2.82	0.63	0.99	0.97	0.17	0.05
Senegal	1.37	0.37	0.22	0.52	0.21	0.04
Tunisia	1.15	0.67	0.10	0.06	0.28	0.04
Sierra Leone	0.99	0.15	0.41	0.18	0.21	0.03
Somalia	1.60	0.11	0.77	0.28	0.39	0.05
Tanzania	0.87	0.31	0.31	0.15	0.06	0.05
Zambia	2.86	0.51	1.29	0.99	0.03	0.05
Zimbabwe	0.74	0.18	0.37	0.14	0.01	0.03

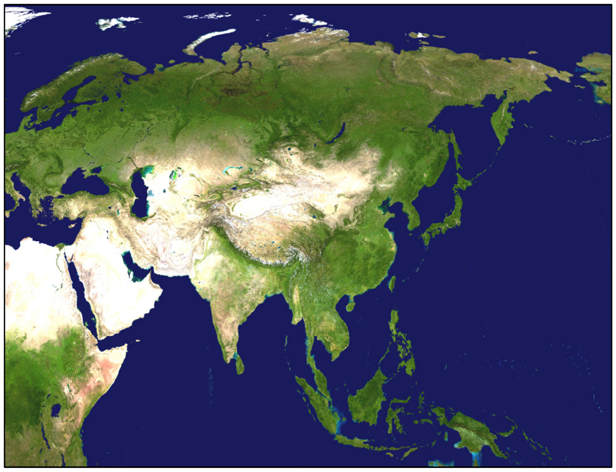
Table 10: Africa total biocacpacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
Africa	1,418.8	399.2	427.2	430.3	116.5	49.4
Algeria	27.2	12.3	11.8	1.3	0.4	1.5
Angola	55.6	3.6	33.2	12.9	5.1	0.7
Benin	6.9	4.2	0.4	1.7	0.3	0.3
Botswana	7.9	0.3	5.6	1.3	0.6	0.1
Burkina Faso	19.2	10.0	3.2	4.9	0.0	1.1
Cameroon	37.2	10.8	2.3	20.8	2.4	0.9
Central African Rep.	35.9	2.8	1.6	31.2	0.0	0.3
Congo	48.7	0.9	15.0	30.8	1.9	0.2
Chad	35.3	6.3	16.1	11.2	1.0	0.8
Djibouti	0.7	0.0	0.2	0.0	0.4	0.0
Egypt	23.8	15.9	0.0	0.0	1.8	6.1
Congo, DRC	161.5	8.8	7.7	138.9	3.2	3.0
Eritrea	8.1	0.6	1.3	0.5	5.6	0.2
Gambia	2.0	0.6	0.2	0.3	0.7	0.1
Ghana	25.8	11.6	7.3	4.1	1.5	1.2
Guinea	27.0	3.9	9.7	7.3	5.6	0.5
Guinea-Bissau	5.5	0.8	0.7	0.6	3.4	0.1
Libya	9.5	2.2	6.9	0.1	0.0	0.3
Liberia	9.3	0.7	2.9	4.2	1.3	0.1
Morocco	27.7	14.2	6.2	2.4	3.4	1.4
Madagascar	60.8	5.4	32.6	17.6	4.1	1.1
Namibia	17.8	0.8	4.1	0.8	12.0	0.1
Mali	30.3	7.7	11.8	9.1	0.8	1.0
Mauritania	19.1	0.5	12.5	0.2	5.9	0.2
Niger	26.4	15.0	9.9	0.9	0.0	0.6
Nigeria	129.9	86.5	29.0	3.5	3.4	7.5
South Africa	82.9	32.8	34.0	1.0	12.2	2.9
Sudan	106.3	23.9	37.4	36.7	6.3	2.0
Senegal	16.5	4.5	2.7	6.3	2.5	0.5
Tunisia	11.7	6.8	1.0	0.6	2.9	0.5
Sierra Leone	5.7	0.9	2.4	1.1	1.2	0.2
Somalia	13.5	0.9	6.5	2.4	3.3	0.5
Tanzania	34.4	12.1	12.2	5.7	2.5	1.8
Zambia	33.5	5.9	15.1	11.5	0.4	0.6
Zimbabwe	9.8	2.4	4.9	1.9	0.2	0.4

Table 11: Africa percent change, 1961-2006

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
Africa	224.7	-61.3	34.9	-68.0	11.7	-	-
Algeria	203.0	92.2	482.2	-59.2	23.7	-	0.75
Angola	224.1	-26.5	138.3	-70.1	-3.1	-	0.55
Benin	271.8	-22.5	188.2	-67.8	19.6	0.35	0.49
Burkina Faso	210.1	-17.7	155.1	-47.0	64.4	0.25	0.38
Cameroon	229.0	-52.9	54.9	-72.3	-8.9	0.46	0.52
Central African Rep.	173.7	-25.6	103.7	-64.0	-1.3	0.34	0.37
Chad	245.4	-50.8	69.8	-70.5	1.7	-	0.39
Congo	258.5	-32.9	140.5	-72.7	-2.3	-	0.60
Djibouti	810.0	-56.4	296.8	-87.5	13.9	-	0.52
Egypt	159.8	77.1	359.9	-41.0	53.3	0.50	0.70
Gambia	348.2	-15.1	280.6	-72.9	21.7	-	0.45
Guinea	189.0	-33.0	93.5	-63.7	4.8	-	0.43
Guinea-Bissau	196.0	-19.5	138.4	-64.3	5.8	0.26	0.39
Liberia	231.4	-25.8	145.8	-73.9	-13.6	0.37	0.43
Madagascar	248.0	-50.7	71.6	-69.3	6.9	-	0.54
Mali	192.5	-22.1	127.8	-58.7	20.8	0.25	0.37
Mauritania	232.7	-39.2	102.4	-69.2	2.6	-	0.52
Morocco	158.2	-11.3	129.1	-37.0	62.6	0.47	0.65
Niger	335.8	-76.8	1.1	-77.9	-3.5	-	0.34
Senegal	258.3	-46.4	92.0	-75.8	-13.4	-	0.46
Sierra Leone	150.3	-41.7	46.0	-59.2	2.0	-	0.36
Somalia	192.8	-49.5	48.0	-65.9	-0.1	-	-
South Africa	170.5	-7.9	149.1	-58.4	12.5	0.66	0.68
Sudan	222.2	-35.3	108.4	-71.0	-6.5	-	0.53
Tunisia	137.7	25.6	198.6	-37.0	49.7	-	0.76
Zimbabwe	241.4	-50.7	68.2	-71.5	-2.6	-	-

ASIA



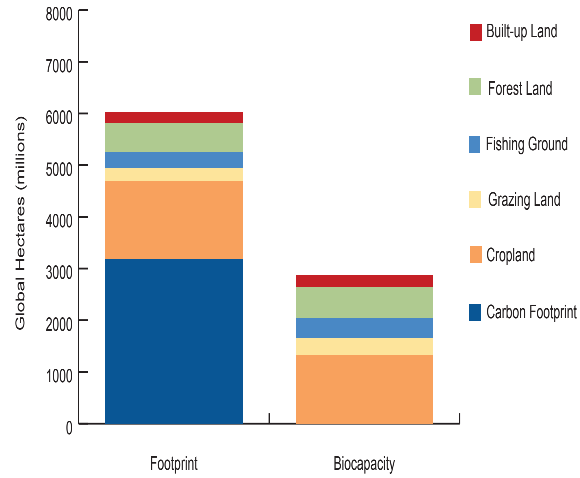


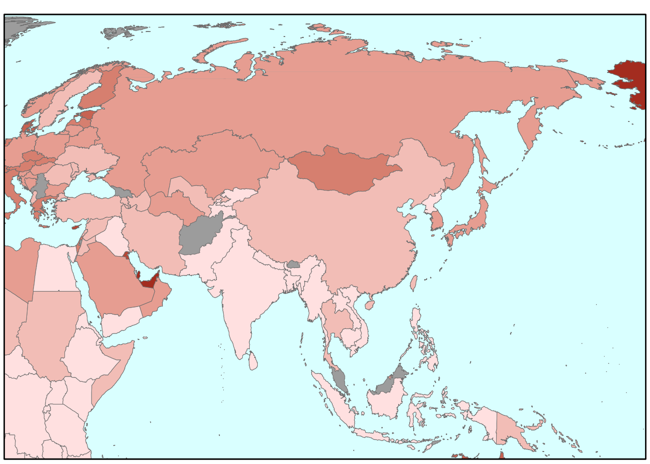
Figure 22: Asia Total Ecological Footprint and biocapacity by land use type, 2006

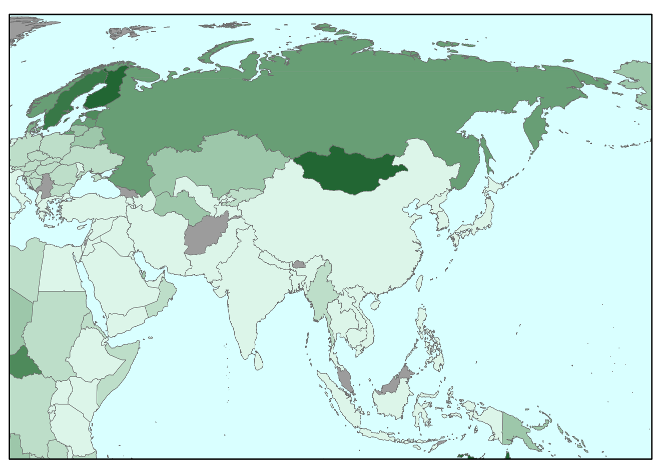
The total land area of Asia is 3,100 million hectares. Of this area, 2,320 million hectares are counted as bioproductive in the National Footprint Accounts. Within this total bioproductive area, forest and cropland areas are roughly equal, at 570 million hectares each. Grasslands cover 1,090 million hectares, while 89.4 million hectares support anthropogenic infrastructure. Asia's marine resources are distributed across 520 million hectares of continental shelf and 102 million hectares of inland waters.

Comparing the yields of these areas to the corresponding global average yields, Asia's total biocapacity is 2,867 million gha. Thus the average concentration of biocapacity is 0.82 gha per hectare of bioproductive land and water. This is slightly lower than the global average, which by definition is 1. Asia has 0.72 gha of biocapacity per person, less than half the global average, and the lowest biocapacity relative to population of any of the world's regions.

Asia's average per-person Ecological Footprint of consumption is 1.6 gha, well below the global average of 2.6 gha per person. However, the difference between the countries with the highest and the lowest per-person Footprint of consumption in Asia is greater than in any other region of the world. Residents of the United Arab Emirates have the world's highest average Ecological Footprint, at 10.3 gha per person, while the average Footprint of consumption in Pakistan is just 0.75 gha per person.

Most countries in Asia have total Footprints of production higher than their biocapacity, indicating either that domestic natural capital is being degraded, or that they are imposing a demand for external biocapacity through carbon dioxide emissions in excess of what their own ecosystems could potentially sequester. Singapore shows by far the greatest percentage overshoot in Asia, with a Footprint of production more than 70 times greater than available biocapacity. The second highest is Kuwait, with a total Footprint of production 12.3 times greater than its biocapacity.





In absolute terms, China exhibits the greatest degree of overshoot among Asian countries, having a Footprint of production 1,390 million global hectares greater than its biocapacity.

Carbon dioxide emissions account for 56 percent of Asia's total Ecological Footprint of production, and 53 percent of its Footprint of consumption. The world's carbon Footprint is 53 percent of its total Ecological Footprint, so the scale of Asia's carbon Footprint relative to its other resource demands is comparable to the global average. However, Asia's average Ecological Footprint per person is lower than the world average, so the per person carbon Footprint is also less.

Asia as a whole is a net importer of biocapacity, as are most Asian countries. Notable exceptions are China, Saudi Arabia, and Thailand, which each export more than 25 million gha of embodied biocapacity. Asia's net imports from the rest of the world have an embodied Footprint equal to 12 percent of Asia's total Footprint of consumption, or 11 percent of its internal biocapacity.

Of the world's regions, Asia has shown the greatest total growth in Ecological Footprint of consumption, increasing by 4,020 million gha since 1961. The Ecological Footprint of the average Asian resident increased by 46 percent between 1961 and 2006, while Asia's total population grew by 185 percent. Thus, while population growth is a major factor in the increase in Asia's total Ecological Footprint of consumption, growth in per capita Footprint has also contributed substantially.

The average Ecological Footprint of consumption per person varies more between Asian countries than between those of any other region. This reflects the large differences in affluence and in consumption patterns between various Asian countries.

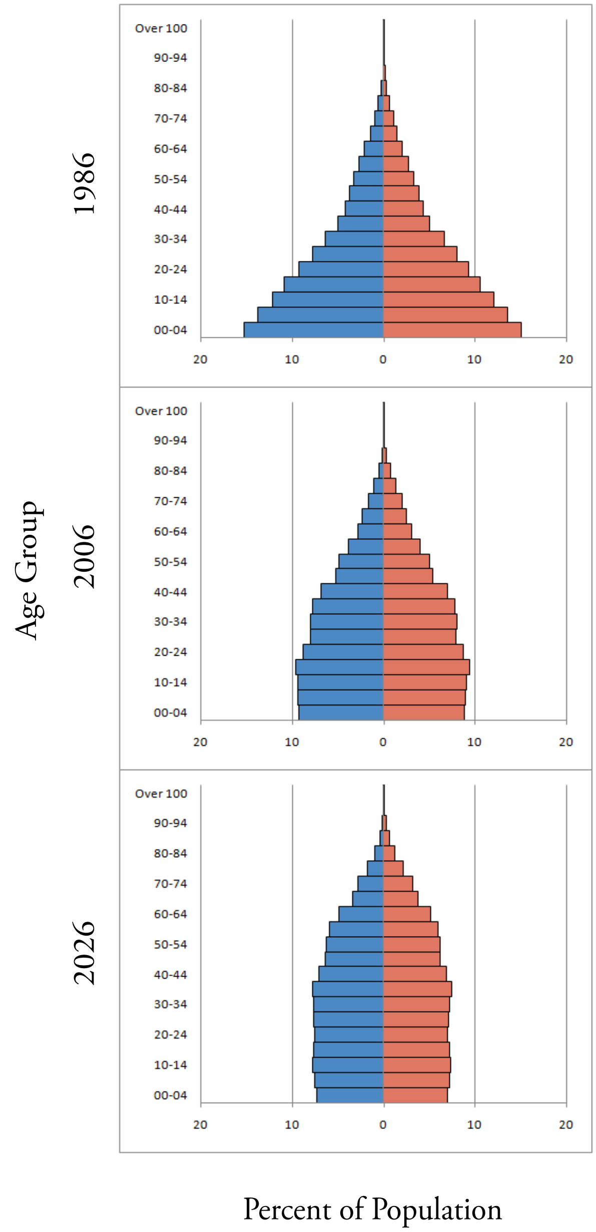


Figure 24: Asia popoulation pyramids showing poopulation structure, 1986, 2006, 2026

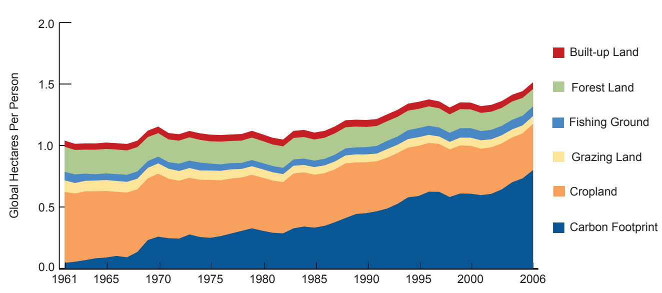


Figure x. Asia Ecological Footprint per person, 1961-2006

Figure 23: Asia Ecological Footprint per person

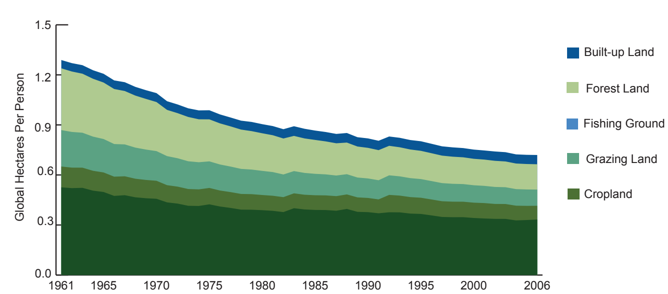


Figure x. Asia Biocapacity per person, 1961-2006

Figure 23: Asia biocapacity per person

Table 12: Asia per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Asia	3,983.9	1.45	0.63	0.58	1.51	0.72	-0.05
Armenia	3.0	0.95	0.86	0.16	1.64	0.74	-0.69
Azerbaijan	8.4	1.88	0.98	0.57	2.29	0.98	-0.41
Cambodia	14.2	0.89	0.02	0.01	0.90	0.95	-0.01
China	1,328.5	1.90	0.40	0.46	1.85	0.85	0.05
India	1,151.8	0.75	0.11	0.09	0.77	0.37	-0.02
Iran	70.3	2.64	0.31	0.29	2.66	0.99	-0.02
Iraq	28.5	1.03	0.31	0.01	1.33	0.25	-0.30
Israel	6.8	2.84	4.27	1.73	5.38	0.33	-2.54
Japan	128.0	3.19	3.19	2.26	4.11	0.62	-0.93
Jordan	5.7	1.13	2.10	1.19	2.04	0.26	-0.91
Kazakhstan	15.3	5.14	1.74	2.47	4.42	4.27	0.73
Korea, North	23.7	1.36	0.06	0.02	1.40	0.56	-0.05
Korea, South	48.0	3.48	4.43	4.17	3.73	0.29	-0.25
Kuwait	2.8	6.83	1.20	0.13	7.90	0.52	-1.07
Kyrgyzstan	5.3	1.00	0.57	0.29	1.28	1.51	-0.28
Laos	5.8	1.06	0.03	0.04	1.04	1.39	0.02
Lebanon	4.1	1.20	1.00	0.07	2.13	0.37	-0.93
Myanmar	48.4	1.02	0.02	0.07	0.97	1.55	0.05
Oman	2.5	4.18	3.65	4.29	3.54	2.53	0.64
Pakistan	160.9	0.64	0.21	0.10	0.75	0.37	-0.11
Saudi Arabia	24.2	4.71	3.13	4.36	3.48	1.30	1.23
Singapore	4.4	2.75	15.42	13.66	4.51	0.04	-1.76
Sri Lanka	19.2	0.76	0.26	0.09	0.93	0.36	-0.17
Syria	19.4	1.51	0.94	0.83	1.61	0.87	-0.11
Tajikistan	6.6	0.69	0.25	0.07	0.87	0.49	-0.18
Thailand	63.4	2.14	1.81	2.23	1.72	1.06	0.42
Turkey	73.9	2.12	1.73	1.02	2.84	1.47	-0.71
Turkmenistan	4.9	3.93	0.03	0.14	3.83	3.39	0.11
United Arab Emirates	4.2	7.64	3.37	0.71	10.29	1.36	-2.65
Uzbekistan	27.0	1.84	0.07	0.18	1.73	0.92	0.11
Viet Nam	86.2	0.82	0.51	0.40	1.01	0.55	-0.11
Yemen	21.7	0.67	0.52	0.20	0.98	0.67	-0.31

Table 13: Asia per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
Asia	1.51	0.38	0.06	0.14	0.08	0.80	0.06
Armenia	1.64	0.58	0.22	0.06	0.00	0.72	0.06
Azerbaijan	2.29	0.62	0.26	0.07	0.01	1.26	0.07
Cambodia	0.90	0.46	0.07	0.25	0.00	0.08	0.04
China	1.85	0.36	0.13	0.15	0.06	1.08	0.07
India	0.77	0.28	0.01	0.12	0.01	0.31	0.04
Iran	2.66	0.66	0.17	0.05	0.13	1.57	0.09
Iraq	1.33	0.42	0.03	0.01	0.01	0.84	0.02
Israel	5.38	1.03	0.09	0.36	0.15	3.69	0.07
Japan	4.11	0.58	0.03	0.28	0.47	2.68	0.07
Jordan	2.04	0.69	0.08	0.17	0.07	0.94	0.08
Kazakhstan	4.42	1.18	0.15	0.13	0.01	2.91	0.06
Korea, North	1.40	0.31	0.00	0.14	0.01	0.88	0.05
Korea, South	3.73	0.69	0.04	0.24	0.61	2.09	0.06
Kuwait	7.90	0.71	0.10	0.19	0.12	6.65	0.14
Kyrgyzstan	1.28	0.55	0.11	0.03	0.00	0.50	0.09
Laos	1.04	0.41	0.08	0.39	0.01	0.07	0.10
Lebanon	2.13	0.66	0.15	0.27	0.09	0.91	0.05
Myanmar	0.97	0.50	0.01	0.33	0.00	0.06	0.07
Oman	3.54	0.59	0.18	0.15	0.40	2.09	0.12
Pakistan	0.75	0.29	0.01	0.08	0.01	0.30	0.04
Saudi Arabia	3.48	1.29	0.11	0.14	0.14	1.62	0.18
Singapore	4.51	0.66	0.06	0.30	0.32	3.14	0.02
Sri Lanka	0.93	0.30	0.01	0.15	0.26	0.16	0.04
Syria	1.61	0.54	0.16	0.08	0.03	0.76	0.06
Tajikistan	0.87	0.39	0.15	0.02	0.00	0.26	0.06
Thailand	1.72	0.54	0.01	0.17	0.21	0.73	0.06
Turkey	2.84	1.01	0.08	0.26	0.04	1.37	0.08
Turkmenistan	3.83	0.74	0.49	0.00	0.01	2.46	0.12
United Arab Emirates	10.29	1.98	0.19	0.49	0.38	7.19	0.06
Uzbekistan	1.73	0.39	0.08	0.03	0.00	1.16	0.07
Viet Nam	1.01	0.32	0.00	0.19	0.00	0.44	0.06
Yemen	0.98	0.32	0.16	0.03	0.02	0.40	0.05

Table 14: Asia total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17,090.7	3,727.2	1,427.3	1,823.0	649.6	9,063.6	400.1
Asia	6,031.7	1,495.0	251.8	561.4	314.3	3,187.9	221.3
Armenia	4.9	1.7	0.7	0.2	0.0	2.2	0.2
Azerbaijan	19.2	5.2	2.2	0.6	0.1	10.6	0.6
Cambodia	12.7	6.5	1.0	3.6	0.0	1.1	0.6
China	2,456.2	480.5	166.5	195.4	84.2	1,436.3	93.3
India	886.0	322.4	8.3	137.8	15.6	361.5	40.4
Iran	186.6	46.0	11.7	3.3	8.8	110.6	6.1
Iraq	38.0	12.1	0.8	0.2	0.3	23.8	0.7
Israel	36.6	7.0	0.6	2.4	1.0	25.1	0.5
Japan	526.1	73.8	4.0	36.3	60.7	342.4	8.9
Jordan	11.7	4.0	0.5	1.0	0.4	5.4	0.5
Kazakhstan	67.6	18.0	2.2	1.9	0.1	44.5	0.9
Korea, North	33.2	7.4	0.0	3.4	0.3	20.9	1.2
Korea, South	179.5	33.3	1.9	11.7	29.3	100.5	2.7
Kuwait	22.0	2.0	0.3	0.5	0.3	18.5	0.4
Kyrgyzstan	6.7	2.9	0.6	0.2	0.0	2.6	0.5
Laos	6.0	2.3	0.5	2.2	0.0	0.4	0.6
Lebanon	8.6	2.7	0.6	1.1	0.4	3.7	0.2
Myanmar	46.8	24.4	0.3	16.1	0.0	2.7	3.3
Oman	9.0	1.5	0.5	0.4	1.0	5.3	0.3
Pakistan	120.1	47.5	1.3	13.3	1.9	49.1	7.1
Saudi Arabia	84.1	31.1	2.7	3.5	3.4	39.1	4.4
Singapore	19.8	2.9	0.3	1.3	1.4	13.8	0.1
Sri Lanka	17.9	5.7	0.2	3.0	5.1	3.2	0.8
Syria	31.3	10.4	3.1	1.5	0.5	14.7	1.1
Tajikistan	5.7	2.6	1.0	0.1	0.0	1.7	0.4
Thailand	109.3	34.0	0.7	11.0	13.3	46.3	3.9
Turkey	209.6	74.7	5.9	19.0	3.1	101.0	6.0
Turkmenistan	18.8	3.6	2.4	0.0	0.0	12.1	0.6
United Arab Emirates	43.7	8.4	0.8	2.1	1.6	30.5	0.3
Uzbekistan	46.7	10.5	2.3	0.7	0.0	31.3	1.9
Viet Nam	87.5	27.7	0.4	16.1	0.0	38.1	5.3
Yemen	21.3	7.0	3.6	0.6	0.4	8.7	1.1

Table 15: Asia per person biocpacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
Asia	0.72	0.33	0.08	0.15	0.10	0.06
Armenia	0.74	0.30	0.29	0.07	0.02	0.06
Azerbaijan	0.98	0.54	0.26	0.11	0.02	0.07
Cambodia	0.95	0.45	0.12	0.20	0.14	0.04
China	0.85	0.35	0.12	0.22	0.08	0.07
India	0.37	0.27	0.00	0.02	0.04	0.04
Iran	0.99	0.55	0.21	0.07	0.07	0.09
Iraq	0.25	0.14	0.02	0.05	0.01	0.02
Israel	0.33	0.20	0.01	0.03	0.02	0.07
Japan	0.62	0.13	0.00	0.33	0.08	0.07
Jordan	0.26	0.12	0.02	0.03	0.00	0.08
Kazakhstan	4.27	1.62	2.28	0.25	0.07	0.06
Korea, North	0.56	0.27	0.00	0.24	0.00	0.05
Korea, South	0.29	0.14	0.00	0.09	0.00	0.06
Kuwait	0.52	0.03	0.01	0.00	0.33	0.14
Kyrgyzstan	1.51	0.53	0.75	0.08	0.06	0.09
Laos	1.39	0.41	0.08	0.77	0.04	0.10
Lebanon	0.37	0.20	0.06	0.06	0.01	0.05
Myanmar	1.55	0.52	0.01	0.61	0.35	0.07
Oman	2.53	0.11	0.08	0.00	2.22	0.12
Pakistan	0.37	0.27	0.00	0.01	0.04	0.04
Saudi Arabia	1.30	0.50	0.16	0.21	0.25	0.18
Singapore	0.04	0.00	0.00	0.00	0.02	0.02
Sri Lanka	0.36	0.20	0.02	0.04	0.05	0.04
Syria	0.87	0.55	0.22	0.04	0.00	0.06
Tajikistan	0.49	0.23	0.18	0.01	0.02	0.06
Thailand	1.06	0.64	0.01	0.18	0.17	0.06
Turkey	1.47	0.90	0.13	0.31	0.05	0.08
Turkmenistan	3.39	0.86	2.25	0.02	0.15	0.12
United Arab Emirates	1.36	0.14	0.00	0.13	1.03	0.06
Uzbekistan	0.92	0.52	0.23	0.06	0.03	0.07
Viet Nam	0.55	0.32	0.00	0.16	0.01	0.06
Yemen	0.67	0.14	0.15	0.05	0.28	0.05

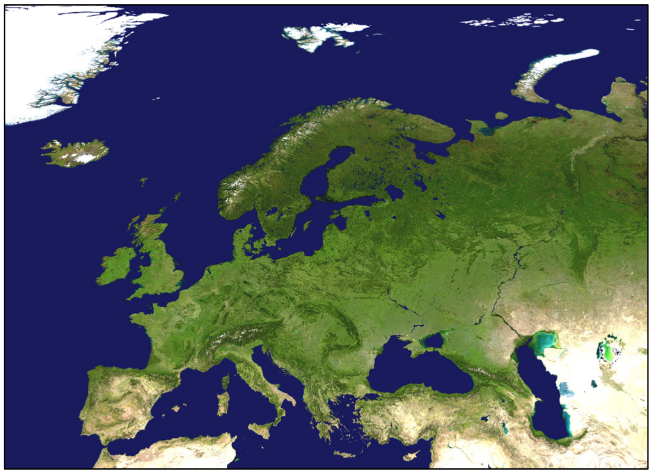
Table 16: Asia total biocapacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
Asia	2,867.1	1,325.9	328.5	604.7	386.8	221.3
Armenia	2.2	0.9	0.9	0.2	0.1	0.2
Azerbaijan	8.3	4.5	2.2	0.9	0.2	0.6
Cambodia	13.4	6.3	1.7	2.8	2.0	0.6
China	1,131.3	470.0	165.8	298.2	104.0	93.3
India	428.8	315.1	4.8	26.0	42.5	40.4
Iran	69.3	38.5	15.1	4.8	4.8	6.1
Iraq	7.0	3.9	0.7	1.5	0.2	0.7
Israel	2.2	1.4	0.1	0.2	0.1	0.5
Japan	78.8	16.7	0.0	42.8	10.5	8.9
Jordan	1.5	0.7	0.1	0.2	0.0	0.5
Kazakhstan	65.4	24.7	34.9	3.8	1.0	0.9
Korea, North	13.2	6.3	0.0	5.7	0.0	1.2
Korea, South	14.2	6.8	0.0	4.5	0.1	2.7
Kuwait	1.4	0.1	0.0	0.0	0.9	0.4
Kyrgyzstan	7.9	2.8	3.9	0.4	0.3	0.5
Laos	8.0	2.3	0.4	4.4	0.2	0.6
Lebanon	1.5	0.8	0.2	0.3	0.0	0.2
Myanmar	75.2	25.3	0.3	29.6	16.8	3.3
Oman	6.5	0.3	0.2	0.0	5.7	0.3
Pakistan	60.2	43.6	0.8	1.9	6.8	7.1
Saudi Arabia	31.4	12.2	3.8	5.0	6.1	4.4
Singapore	0.2	0.0	0.0	0.0	0.1	0.1
Sri Lanka	6.9	3.8	0.5	0.8	1.0	0.8
Syria	17.0	10.7	4.2	0.9	0.1	1.1
Tajikistan	3.3	1.5	1.2	0.1	0.1	0.4
Thailand	67.4	40.8	0.8	11.3	10.7	3.9
Turkey	108.4	66.2	9.9	22.6	3.7	6.0
Turkmenistan	16.6	4.2	11.0	0.1	0.7	0.6
United Arab Emirates	5.8	0.6	0.0	0.6	4.4	0.3
Uzbekistan	24.8	14.1	6.3	1.7	0.9	1.9
Viet Nam	47.4	27.2	0.3	13.7	0.9	5.3
Yemen	14.6	3.1	3.2	1.0	6.2	1.1

Table 17: Asia percent change

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
Asia	129.3	45.6	252.1	-44.2	35.1	-	-
Cambodia	155.2	-53.7	18.2	-54.3	16.7	-	0.58
China	97.5	164.8	422.9	-17.4	63.1	0.53	0.76
India	153.2	-12.5	121.6	-53.8	16.9	0.43	0.60
Iran	215.3	20.8	280.7	-65.1	9.9	0.56	0.78
Iraq	276.8	-21.0	197.8	-84.6	-41.9	-	-
Israel	209.5	52.9	373.3	-54.7	40.2	0.83	0.93
Japan	34.7	90.4	156.5	-40.9	-20.4	0.89	0.96
Korea, North	111.3	25.5	165.1	-60.6	-16.8	-	-
Korea, South	86.8	266.9	585.3	-49.3	-5.3	0.72	0.93
Laos	182.7	-41.8	64.6	-63.4	3.6	-	0.61
Myanmar	124.8	13.2	154.5	-55.1	0.9	-	0.58
Pakistan	239.6	-16.4	183.9	-55.7	50.5	0.40	0.57
Singapore	159.1	298.9	933.6	-58.7	7.0	0.79	0.94
Sri Lanka	93.1	-9.9	73.9	-43.3	9.5	0.65	0.76
Turkey	155.1	18.6	202.7	-51.7	23.1	0.63	0.80
Viet Nam	150.0	37.6	244.0	-40.1	49.8	-	0.72

EUROPE



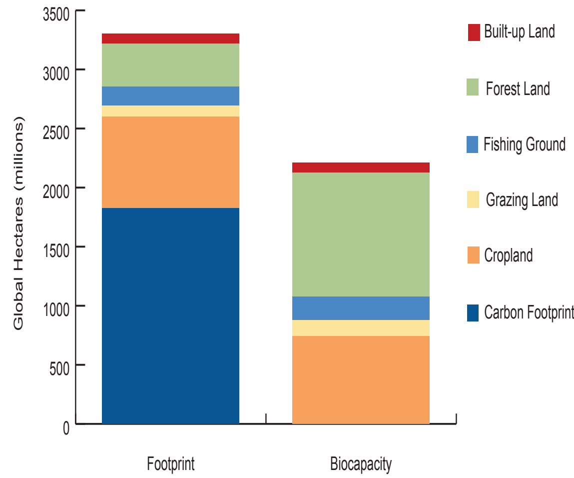


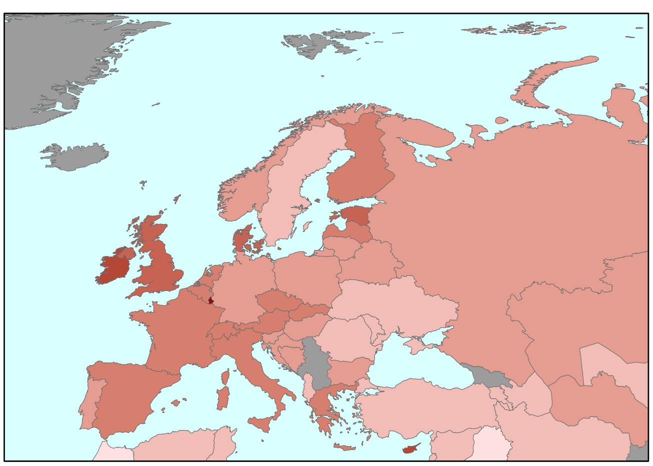
Figure 26: Europe Total Ecological Footprint and biocapacity by land use type, 2006

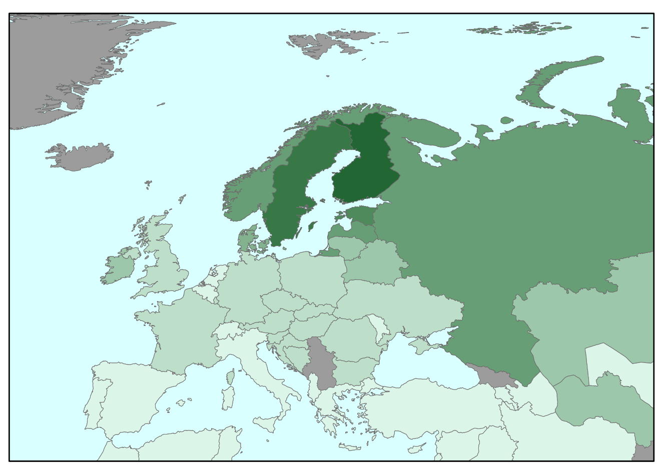
Europe has a total land area of 2,220 million hectares, of which 1,490 million hectares are counted as bioproductive in the National Footprint Accounts. Within this total bioproductive area, 298 million hectares are cropland, 1000 million hectares are forests, 183 million hectares are grasslands, while infrastructure occupies 25 million hectares. In addition to this terrestrial bioproductive area, Europe has 218 million hectares of continental shelf and 92 million hectares of inland waters.

Accounting for differences in the yields of these areas and the corresponding global average yields, Europe's total biocapacity is 2,212 million gha. Thus each physical hectare of bioproductive land and water represents on average 1.48 gha. By definition, the global average is 1 gha per hectare. Europe has 3 gha of biocapacity per person, higher than the global average.

The average European resident has an Ecological Footprint of consumption of 4.5 gha, much higher than the global average of 2.6 gha per person. Residents of Moldova have the lowest average Footprint of consumption in Europe, at 1.75 gha per capita. Moldova is also the only country in Europe with an average Footprint of consumption less than the global average availability of biocapacity per person. At the other end of the range, Ireland has an average Footprint of consumption of 8.2 gha per person, the highest in Europe.

The total Ecological Footprints of production of most European countries are higher than their domestic supplies of biocapacity. Notable exceptions are the Russian Federation and Sweden, each having a biocapacity more than 25 million gha greater than Ecological Footprint of production. In absolute terms, Germany overshoots its ecological resources by the most, with a Footprint of production 190 million gha higher than biocapacity. As a fraction of available biocapacity, Malta shows the greatest degree of overshoot. Its Footprint of production is 290 percent higher than its biocapacity. Overall, Europe's Ecological Footprint of production is 904 million gha higher than its biocapacity.





54 percent of Europe's total Ecological Footprint of production, and 55 percent of its Footprint of consumption, are attributable to carbon dioxide emissions. This is comparable to the world average magnitude of the carbon Footprint within the Ecological Footprint. Since the total Ecological Footprint of the average European is much higher than the world average, the carbon Footprint will be correspondingly higher as well.

Europe as a whole is a net importer of biocapacity, although numerous European counties are net biocapaty exporters. The Russian Federation, Sweden, Ukraine, Finland and Norway all have net exports greater than 25 million gha. The embodied Footprint of Europe's net imports is equivalent to 5.5 percent of Europe's total Footprint of consumption, or 8.2 percent of its internal biocapacity.

Europe's total Ecological Footprint of consumption has increased by 1,070 million gha since 1961. This increase was driven primarily by growth in per capita resource flows, though population growth also contributed: the Ecological Footprint of the average European resident grew by 33 percent between 1961 and 2006, while Europe's total population increased by 12 percent.

The majority of countries in Europe have per capita Ecological Footprints higher than the global average, correlated with higher per capita incomes and consumption.

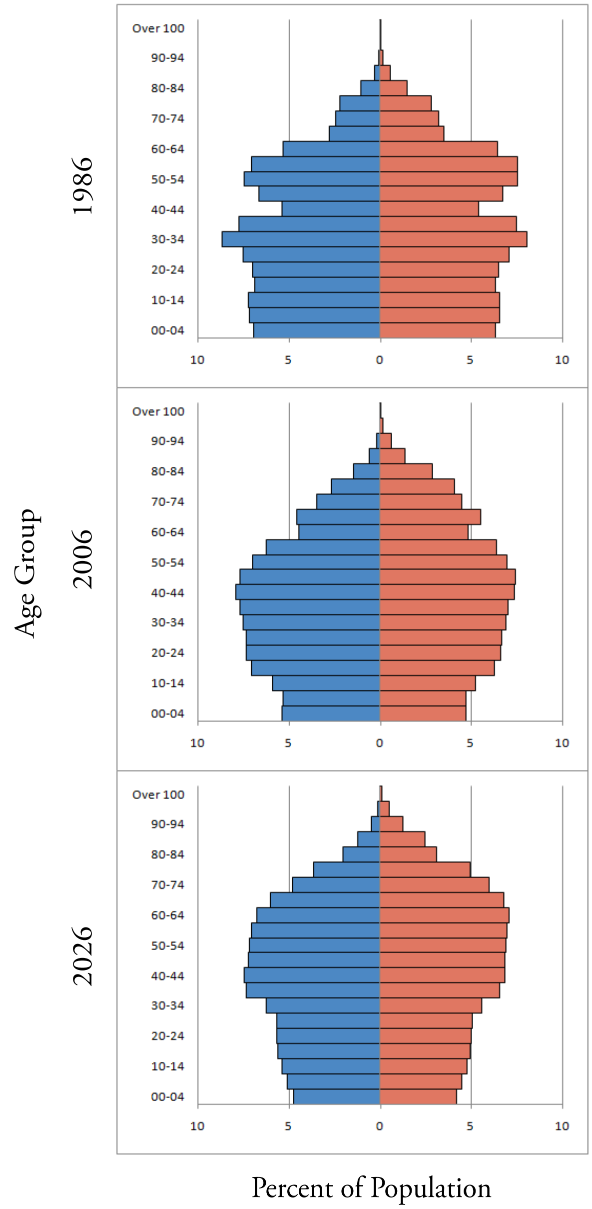


Figure 28: Europe Total population pyramid showing poopulation structure, 1986, 2006, 2026

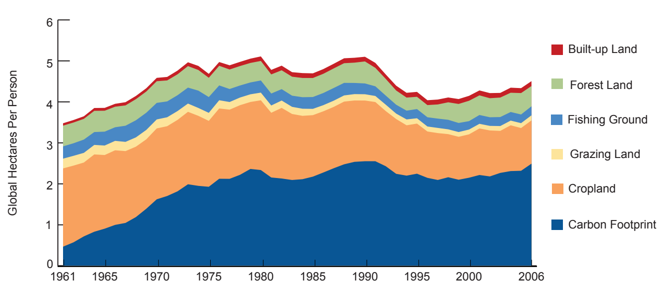


Figure 27: Europe Ecological Footprint per person

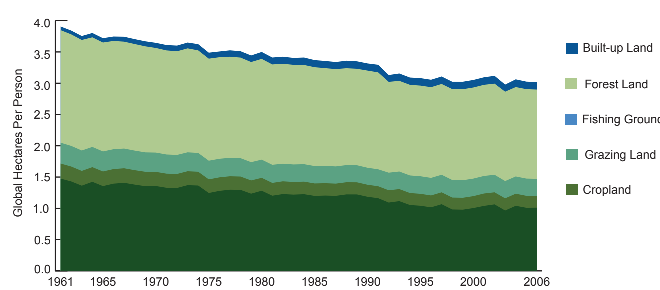


Figure 29: Europe biocpacity per person

Table 18: Europe per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Europe	731.3	4.26	4.66	4.41	4.51	3.03	-0.25
Albania	3.2	1.15	1.63	0.21	2.57	1.02	-1.42
Austria	8.3	4.79	9.92	9.82	4.89	2.99	-0.09
Belarus	9.7	4.09	2.29	2.17	4.21	3.39	-0.12
Belgium	10.4	4.20	22.95	21.45	5.70	1.09	-1.50
Bosnia/Herzegovina	3.9	2.61	2.20	1.41	3.39	1.66	-0.79
Bulgaria	7.7	3.59	2.33	2.67	3.25	2.66	0.34
Croatia	4.6	2.28	3.74	2.68	3.34	1.80	-1.06
Czech Republic	10.2	5.73	6.50	6.90	5.32	2.64	0.40
Denmark	5.4	6.49	12.07	11.37	7.19	5.19	-0.70
Estonia	1.3	6.81	7.70	8.09	6.42	8.99	0.40
Finland	5.3	11.59	10.15	16.23	5.51	12.99	6.08
France	61.3	3.99	5.32	4.71	4.60	2.83	-0.61
Germany	82.6	4.17	6.26	6.40	4.03	1.86	0.13
Greece	11.1	3.44	4.34	2.03	5.76	1.36	-2.32
Hungary	10.1	3.79	3.62	4.19	3.23	2.58	0.56
Ireland	4.2	5.97	8.54	6.32	8.19	4.26	-2.22
Italy	58.8	2.88	5.40	3.34	4.94	1.03	-2.06
Latvia	2.3	6.16	4.27	5.83	4.60	7.24	1.56
Lithuania	3.4	3.15	6.08	5.91	3.32	3.66	-0.17
Moldova	3.8	1.61	0.70	0.56	1.75	1.13	-0.13
Netherlands	16.4	3.69	16.09	15.18	4.60	1.05	-0.91
Norway	4.7	10.99	11.00	17.78	4.20	6.11	6.78
Poland	38.1	3.69	2.85	2.65	3.89	1.84	-0.20
Portugal	10.6	2.78	5.10	3.51	4.37	1.18	-1.59
Romania	21.5	2.67	1.64	1.64	2.67	2.27	0.00
Russia	143.2	5.72	1.01	2.28	4.44	6.33	1.27
Slovakia	5.4	3.92	7.96	6.93	4.94	2.68	-1.03
Slovenia	2.0	3.41	9.99	9.52	3.89	2.36	-0.47
Spain	43.9	3.73	5.53	3.64	5.63	1.32	-1.90
Switzerland	7.5	2.64	7.10	4.15	5.59	1.28	-2.95
Ukraine	46.6	3.58	1.36	2.28	2.67	2.22	0.92
United Kingdom	60.7	3.54	4.99	2.42	6.12	1.58	-2.57

Table 19: Europe per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
Europe	4.51	1.06	0.12	0.50	0.22	2.49	0.12
Albania	2.57	0.96	0.25	0.08	0.02	1.18	0.08
Austria	4.89	0.72	0.16	0.73	0.11	2.98	0.19
Belarus	4.21	1.43	0.23	0.41	0.12	1.93	0.08
Belgium	5.70	1.84	0.38	0.56	0.17	2.44	0.31
Bosnia/Herzegovina	3.39	1.07	0.18	0.47	0.06	1.54	0.08
Bulgaria	3.25	0.77	0.22	0.36	0.04	1.69	0.17
Croatia	3.34	0.49	0.09	0.56	0.06	2.03	0.11
Czech Republic	5.32	1.03	0.12	0.99	0.07	2.95	0.16
Denmark	7.19	1.10	0.21	1.24	0.60	3.77	0.28
Estonia	6.42	0.44	0.15	2.40	0.14	3.15	0.13
Finland	5.51	1.27	0.03	1.02	0.38	2.67	0.14
France	4.60	0.81	0.16	0.63	0.30	2.49	0.21
Germany	4.03	0.93	0.07	0.51	0.14	2.21	0.18
Greece	5.76	0.93	0.25	0.43	0.12	3.94	0.08
Hungary	3.23	1.16	0.06	0.41	0.03	1.39	0.17
Ireland	8.19	1.06	0.72	0.64	0.33	5.19	0.25
Italy	4.94	1.02	0.20	0.50	0.24	2.88	0.08
Latvia	4.60	0.97	0.15	2.39	0.16	0.86	0.07
Lithuania	3.32	0.35	0.09	0.93	0.33	1.54	0.10
Moldova	1.75	0.72	0.06	0.07	0.00	0.84	0.05
Netherlands	4.60	1.22	0.21	0.41	0.18	2.44	0.14
Norway	4.20	1.19	0.04	0.59	0.18	2.05	0.15
Poland	3.89	0.65	0.01	0.66	0.11	2.38	0.07
Portugal	4.37	0.85	0.19	0.14	0.74	2.41	0.04
Romania	2.67	0.84	0.09	0.33	0.05	1.21	0.14
Russia	4.44	1.51	0.05	0.43	0.15	2.23	0.06
Slovakia	4.94	0.59	0.06	0.59	0.07	3.48	0.15
Slovenia	3.89	0.79	0.06	0.78	0.10	2.07	0.09
Spain	5.63	1.16	0.17	0.46	0.53	3.25	0.05
Switzerland	5.59	0.72	0.20	0.43	0.14	3.98	0.11
Ukraine	2.67	0.87	0.01	0.17	0.11	1.45	0.07
United Kingdom	6.12	0.93	0.20	0.58	0.23	4.00	0.18

Table 20: Europe total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17,090.7	3,727.2	1,427.3	1,823.0	649.6	9,063.6	400.1
Europe	3,297.5	772.1	90.4	362.3	161.7	1,824.2	86.9
Albania	8.1	3.1	0.8	0.2	0.1	3.8	0.2
Austria	40.7	6.0	1.4	6.0	0.9	24.8	1.6
Belarus	41.1	13.9	2.3	4.0	1.2	18.8	0.8
Belgium	59.4	19.2	3.9	5.8	1.8	25.4	3.2
Bosnia/Herzegovina	13.3	4.2	0.7	1.8	0.2	6.1	0.3
Bulgaria	25.0	5.9	1.7	2.8	0.3	13.0	1.3
Croatia	15.2	2.2	0.4	2.5	0.3	9.3	0.5
Czech Republic	54.2	10.5	1.2	10.1	0.7	30.1	1.7
Denmark	39.1	5.9	1.2	6.7	3.3	20.5	1.5
Estonia	8.6	0.6	0.2	3.2	0.2	4.2	0.2
Finland	29.0	6.7	0.2	5.4	2.0	14.0	0.7
France	282.3	49.7	9.9	38.9	18.3	152.5	12.9
Germany	333.4	76.5	6.1	41.8	11.4	182.7	14.9
Greece	64.0	10.4	2.8	4.7	1.3	43.9	0.9
Hungary	32.4	11.7	0.6	4.1	0.3	14.0	1.7
Ireland	34.6	4.5	3.1	2.7	1.4	21.9	1.0
Italy	290.1	60.2	11.9	29.6	14.0	169.5	4.9
Latvia	10.5	2.2	0.4	5.5	0.4	2.0	0.2
Lithuania	11.3	1.2	0.3	3.2	1.1	5.2	0.3
Moldova	6.7	2.8	0.2	0.3	0.0	3.2	0.2
Netherlands	75.4	19.9	3.5	6.8	3.0	40.0	2.3
Norway	19.6	5.5	0.2	2.8	0.8	9.6	0.7
Poland	148.2	24.9	0.5	25.3	4.3	90.6	2.6
Portugal	46.2	9.0	2.0	1.5	7.8	25.5	0.4
Romania	57.5	18.2	2.0	7.0	1.1	26.1	3.1
Russia	636.0	216.7	7.8	61.2	21.9	319.8	8.6
Slovakia	26.6	3.2	0.3	3.2	0.4	18.7	0.8
Slovenia	7.8	1.6	0.1	1.6	0.2	4.1	0.2
Spain	247.0	51.0	7.7	20.4	23.2	142.5	2.2
Switzerland	41.7	5.4	1.5	3.2	1.1	29.7	0.8
Ukraine	124.2	40.5	0.6	7.7	5.0	67.3	3.1
United Kingdom	371.6	56.3	12.1	35.2	14.1	242.9	11.1

Table 21: Europe per person biocpacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
Europe	3.03	1.01	0.19	1.43	0.28	0.12
Albania	1.02	0.53	0.12	0.20	0.09	0.08
Austria	2.99	0.60	0.17	2.02	0.00	0.19
Belarus	3.39	1.36	0.34	1.58	0.02	0.08
Belgium	1.09	0.32	0.12	0.28	0.05	0.31
Bosnia/Herzegovina	1.66	0.58	0.13	0.86	0.00	0.08
Bulgaria	2.66	1.20	0.19	0.99	0.10	0.17
Croatia	1.80	0.22	0.15	0.98	0.34	0.11
Czech Republic	2.64	1.11	0.14	1.22	0.00	0.16
Denmark	5.19	2.50	0.04	0.29	2.09	0.28
Estonia	8.99	0.67	0.39	3.21	4.59	0.13
Finland	12.99	1.38	0.00	8.66	2.81	0.14
France	2.83	1.28	0.28	0.89	0.18	0.21
Germany	1.86	0.87	0.10	0.64	0.08	0.18
Greece	1.36	0.79	0.10	0.14	0.25	0.08
Hungary	2.58	1.72	0.11	0.57	0.01	0.17
Ireland	4.26	0.98	0.91	0.25	1.88	0.25
Italy	1.03	0.53	0.08	0.27	0.07	0.08
Latvia	7.24	1.03	0.72	3.34	2.08	0.07
Lithuania	3.66	0.70	0.92	1.64	0.29	0.10
Moldova	1.13	0.95	0.05	0.07	0.01	0.05
Netherlands	1.05	0.27	0.06	0.08	0.50	0.14
Norway	6.11	0.69	0.03	3.23	2.01	0.15
Poland	1.84	0.82	0.13	0.71	0.12	0.07
Portugal	1.18	0.24	0.26	0.57	0.08	0.04
Romania	2.27	0.84	0.18	1.00	0.10	0.14
Russia	6.33	1.55	0.33	4.18	0.21	0.06
Slovakia	2.68	0.83	0.09	1.60	0.00	0.15
Slovenia	2.36	0.22	0.25	1.80	0.00	0.09
Spain	1.32	0.84	0.13	0.24	0.06	0.05
Switzerland	1.28	0.26	0.17	0.73	0.01	0.11
Ukraine	2.22	1.47	0.14	0.40	0.15	0.07
United Kingdom	1.58	0.62	0.11	0.11	0.56	0.18

Table 22: Europe total biocapacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
Europe	2,212.6	741.1	136.2	1,046.9	201.6	86.9
Albania	3.2	1.7	0.4	0.6	0.3	0.2
Austria	24.9	5.0	1.4	16.8	0.0	1.6
Belarus	33.0	13.2	3.3	15.4	0.2	0.8
Belgium	11.3	3.3	1.3	2.9	0.6	3.2
Bosnia/Herzegovina	6.5	2.3	0.5	3.4	0.0	0.3
Bulgaria	20.4	9.2	1.4	7.7	0.8	1.3
Croatia	8.2	1.0	0.7	4.4	1.6	0.5
Czech Republic	26.9	11.4	1.4	12.4	0.0	1.7
Denmark	28.2	13.6	0.2	1.6	11.3	1.5
Estonia	12.0	0.9	0.5	4.3	6.2	0.2
Finland	68.3	7.2	0.0	45.5	14.8	0.7
France	173.7	78.7	16.9	54.4	10.9	12.9
Germany	154.1	71.5	8.2	52.6	6.9	14.9
Greece	15.2	8.8	1.1	1.6	2.8	0.9
Hungary	25.9	17.3	1.1	5.7	0.1	1.7
Ireland	18.0	4.1	3.8	1.0	8.0	1.0
Italy	60.8	31.2	4.9	15.8	3.9	4.9
Latvia	16.6	2.3	1.6	7.6	4.8	0.2
Lithuania	12.5	2.4	3.1	5.6	1.0	0.3
Moldova	4.3	3.6	0.2	0.3	0.0	0.2
Netherlands	17.2	4.4	1.1	1.3	8.1	2.3
Norway	28.5	3.2	0.1	15.1	9.4	0.7
Poland	70.1	31.1	5.1	26.9	4.5	2.6
Portugal	12.5	2.5	2.7	6.0	0.9	0.4
Romania	48.9	18.2	3.9	21.6	2.1	3.1
Russia	906.2	222.2	47.0	599.0	29.5	8.6
Slovakia	14.4	4.5	0.5	8.6	0.0	0.8
Slovenia	4.7	0.4	0.5	3.6	0.0	0.2
Spain	58.0	36.7	5.7	10.5	2.8	2.2
Switzerland	9.5	1.9	1.3	5.5	0.1	0.8
Ukraine	103.5	68.2	6.4	18.8	6.9	3.1
United Kingdom	95.7	37.4	6.7	6.5	34.1	11.1

Table 23: Europe percent change

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
Europe	21.6	33.4	52.7	-20.8	-9.3	-	-
Albania	91.0	42.5	172.2	-34.2	25.6	-	0.81
Austria	17.5	95.7	129.9	-14.6	0.3	0.87	0.95
Belgium	14.1	32.0	50.5	-25.4	-14.9	0.87	0.95
Bulgaria	-3.1	35.5	31.3	-1.9	-4.9	-	0.84
Denmark	17.7	12.1	31.9	-23.5	-10.0	0.88	0.95
France	32.5	38.2	83.1	-9.2	20.3	0.88	0.96
Germany	12.6	37.1	54.3	0.1	12.7	0.87	0.95
Greece	32.6	283.6	408.8	0.6	33.5	0.84	0.94
Hungary	0.4	10.2	10.7	7.5	8.0	0.80	0.88
Ireland	49.0	126.2	237.0	-22.3	15.7	0.84	0.96
Italy	16.2	116.0	151.1	-20.7	-7.8	0.86	0.95
Netherlands	40.6	40.0	96.9	-26.6	3.3	0.89	0.96
Poland	26.9	24.8	58.3	-38.3	-21.7	-	0.88
Portugal	18.8	73.6	106.2	6.3	26.2	0.77	0.91
Romania	16.2	45.5	69.1	-5.5	9.8	-	0.83
Spain	42.7	120.0	214.0	-27.0	4.2	0.86	0.95
Switzerland	36.6	90.1	159.7	-27.7	-1.3	0.90	0.96
United Kingdom	14.8	59.0	82.5	1.4	16.5	0.86	0.95

LATIN AMERICA AND THE CARRIBEAN

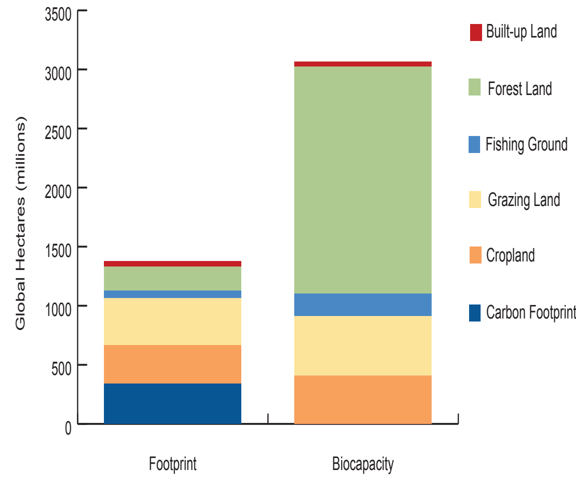


Figure 30: Latin America and Carribean **Total Ecological Footprint and biocapacity by land use type, 2006**

Latin America and the Carribean have a total land area of 2,030 million hectares, of which the National Footprint Accounts list 1,650 million hectares as bioproductive. This total bioproductive area is composed of 167 million hectares of cropland, 919 million hectares of forests, 550 million hectares of grasslands, and 17 million hectares of potentially productive land occupied by infrastructure. The aquatic resources of the region include 288 million hectares of continental shelf and 28 million hectares of inland waters.

The total biocapacity of Latin America and the Carribean is 3,070 million gha, so on average there are 1.9 gha per hectare of bioproductive area. The region's biocapacity is high relative to its population, with 5.4 gha available per person.

The average resident of Latin America and the Carribean has an Ecological Footprint of consumption of 2.4 gha, slightly below the global average. Paraguay has the highest average Footprint of consumption in the region, at 3.4 gha per person, while Haiti has by far the lowest, at 0.47 gha per person.

The region's total Ecological Footprint of production is 1,510 million gha less than its available biocapacity, by far the largest regional ecological remainder in the world. However, approximately half of countries in the region place a higher direct demand on their domestic biocapacity than it can support. Mexico has the highest total overshoot in the region, with a Footprint of production 57 million gha greater than its biocapacity. Brazil, on the other hand, has an ecological remainder of over 1000 million gha, the highest any country in the world. Bolivia has the world's second highest remainder, at 158 million gha.

The contribution of the carbon Footprint to the overall Ecological Footprint of Latin America and the Carribean is substantially lower than the world average. Carbon dioxide emissions account

for 25 percent of both the region's Footprint of consumption and its Footprint of production. This shows a higher economic reliance on direct ecological inputs relative to fossil fuel use.

The region is a net exporter of biocapacity, supplying 176 million gha more to the rest of the world than it imports. Brazil's net exports of biocapacity total 189 million gha, the second highest of any country in the world, after Canada. This total is higher than regional net exports, since exports of biocapacity are concentrated among a few countries, while the majority are net importers. Mexico is the largest net importer of biocapacity in the region, at 106 million gha.

Latin America and the Carribean's total Ecological Footprint of consumption has increased by 133 percent, or 786 million gha, since 1961. This increase has occurred despite a 6.4 percent decline in the average Footprint of consumption per person.

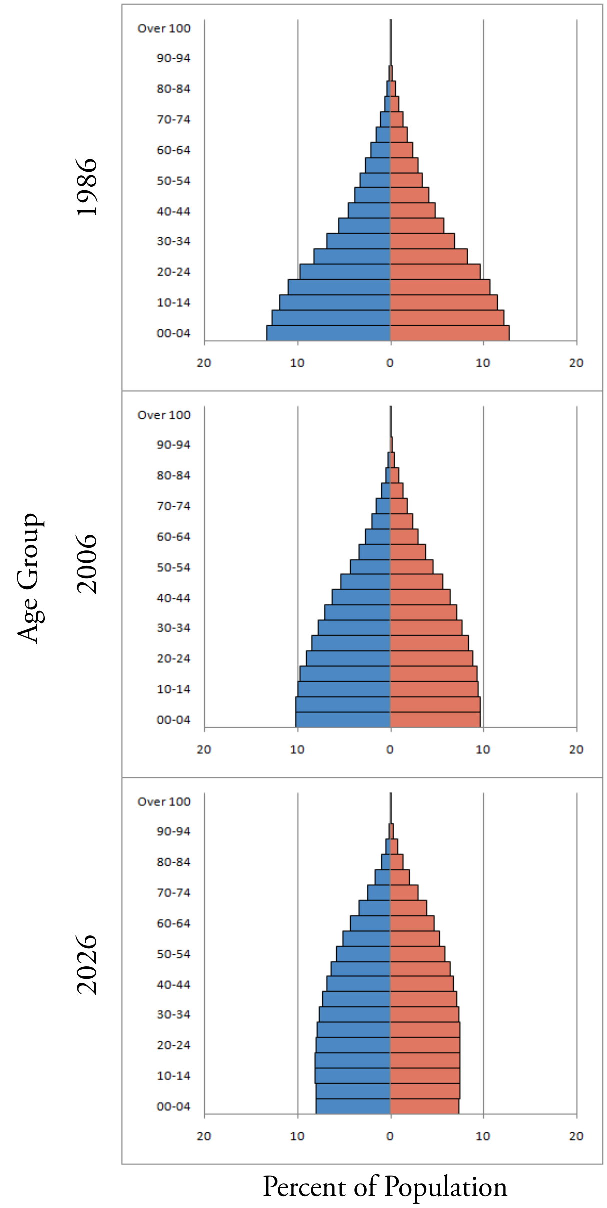


Figure 32: Latin America and Carribean Total population pyramid showing poopulation structure, 1986, 2006, 2026

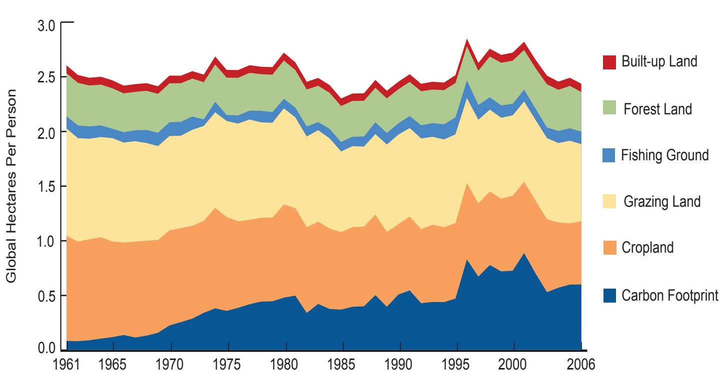


Figure 31: Latin America and Carribean Ecological Footprint per person

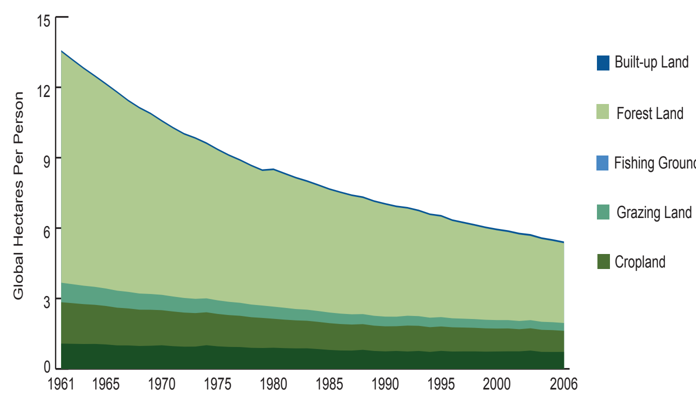


Figure 33: Latin America and Carribean biocpacity per person

Table 24: Latin America and Carribean per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Latin America	564.7	2.75	0.95	1.27	2.44	5.43	0.32
Argentina	39.1	5.48	0.72	3.19	3.00	7.05	2.47
Bolivia	9.4	2.50	0.44	0.54	2.41	19.33	0.09
Chile	16.5	4.59	1.73	3.22	3.10	4.09	1.49
Colombia	45.6	1.58	0.67	0.39	1.87	3.86	-0.28
Costa Rica	4.4	1.64	2.21	1.15	2.70	1.81	-1.06
Cuba	11.3	1.52	0.90	0.09	2.33	1.07	-0.81
Dominican Rep.	9.6	1.01	0.40	0.05	1.36	0.56	-0.35
Ecuador	13.2	2.15	0.90	1.14	1.91	2.31	0.24
Guatemala	13.0	1.38	0.77	0.44	1.71	1.08	-0.33
Haiti	9.4	0.36	0.12	0.00	0.48	0.24	-0.12
Honduras	7.0	1.72	0.95	0.44	2.23	1.98	-0.51
Mexico	105.3	2.24	2.13	1.12	3.25	1.70	-1.01
Nicaragua	5.5	2.21	0.47	0.41	2.26	3.29	-0.06
Panama	3.3	2.74	1.32	0.85	3.21	3.44	-0.47
Paraguay	6.0	4.23	0.73	1.60	3.35	10.79	0.87
Peru	27.6	1.78	0.66	0.64	1.80	4.08	-0.02
Venezuela	27.2	2.48	0.90	1.04	2.33	2.65	0.14

Table 25: Latin America and Carribean per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
Latin America	2.44	0.58	0.71	0.36	0.11	0.60	0.08
Argentina	3.00	0.43	1.36	0.20	0.20	0.71	0.09
Bolivia	2.41	0.47	1.22	0.16	0.01	0.47	0.07
Chile	3.10	0.67	0.32	0.95	0.55	0.49	0.12
Colombia	1.87	0.31	0.78	0.13	0.04	0.52	0.08
Costa Rica	2.70	0.44	0.26	0.73	0.05	1.13	0.09
Cuba	2.33	0.96	0.11	0.12	0.04	1.05	0.05
Dominican Rep.	1.36	0.46	0.13	0.12	0.07	0.54	0.04
Ecuador	1.91	0.36	0.40	0.25	0.11	0.74	0.06
Guatemala	1.71	0.36	0.22	0.55	0.03	0.51	0.05
Haiti	0.48	0.25	0.04	0.10	0.02	0.05	0.02
Honduras	2.23	0.46	0.34	0.59	0.03	0.73	0.07
Mexico	3.25	1.00	0.18	0.32	0.10	1.58	0.07
Nicaragua	2.26	0.61	0.62	0.42	0.12	0.43	0.06
Panama	3.21	0.47	0.55	0.23	0.68	1.22	0.05
Paraguay	3.35	0.32	1.68	0.87	0.01	0.41	0.07
Peru	1.80	0.53	0.24	0.18	0.45	0.30	0.10
Venezuela	2.33	0.51	0.36	0.13	0.19	1.07	0.07

Table 26: Latin America and Carribean total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17090.7	3727.2	1427.3	1823.0	649.6	9063.6	400.1
Latin America	1375.3	326.1	398.4	204.4	64.8	339.8	42.7
Argentina	117.5	16.7	53.1	8.0	8.0	28.0	3.7
Bolivia	22.5	4.4	11.4	1.5	0.1	4.4	0.7
Chile	51.0	11.0	5.2	15.6	9.1	8.1	2.0
Colombia	85.1	14.3	35.6	5.9	1.9	23.7	3.7
Costa Rica	11.9	1.9	1.1	3.2	0.2	4.9	0.4
Cuba	26.2	10.9	1.2	1.3	0.4	11.8	0.6
Dominican Rep.	13.1	4.5	1.3	1.1	0.6	5.2	0.4
Ecuador	25.2	4.8	5.3	3.2	1.4	9.7	0.8
Guatemala	22.3	4.7	2.8	7.2	0.3	6.6	0.6
Haiti	4.5	2.3	0.4	1.0	0.1	0.5	0.2
Honduras	15.5	3.2	2.4	4.1	0.2	5.1	0.5
Mexico	342.2	105.6	19.0	33.6	10.1	166.3	7.6
Nicaragua	12.5	3.4	3.4	2.3	0.7	2.4	0.4
Panama	10.6	1.6	1.8	0.8	2.2	4.0	0.2
Paraguay	20.2	1.9	10.1	5.2	0.0	2.5	0.4
Peru	49.6	14.7	6.6	5.1	12.4	8.2	2.6
Venezuela	63.4	13.8	9.7	3.6	5.2	29.2	1.8

Table 27: Latin America and Carribean per person biocpacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
Latin America	5.43	0.72	0.90	3.40	0.33	0.08
Argentina	7.05	2.32	1.94	0.78	1.91	0.09
Bolivia	19.33	0.67	2.75	15.77	0.07	0.07
Chile	4.09	0.45	0.53	2.16	0.83	0.12
Colombia	3.86	0.22	1.32	2.19	0.04	0.08
Costa Rica	1.81	0.35	0.65	0.60	0.11	0.09
Cuba	1.07	0.59	0.09	0.20	0.14	0.05
Dominican Rep.	0.56	0.25	0.13	0.12	0.02	0.04
Ecuador	2.31	0.33	0.40	1.33	0.20	0.06
Guatemala	1.08	0.35	0.22	0.41	0.05	0.05
Haiti	0.24	0.15	0.04	0.01	0.02	0.02
Honduras	1.98	0.43	0.33	0.88	0.26	0.07
Mexico	1.70	0.65	0.31	0.50	0.17	0.07
Nicaragua	3.29	0.74	0.66	1.25	0.57	0.06
Panama	3.44	0.33	0.56	1.79	0.70	0.05
Paraguay	10.79	1.30	2.68	6.67	0.06	0.07
Peru	4.08	0.41	0.57	2.73	0.27	0.10
Venezuela	2.65	0.29	0.34	1.91	0.05	0.07

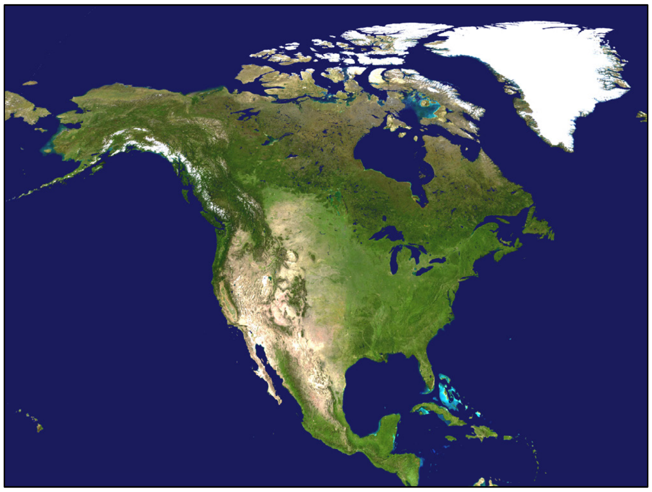
Table 28: Latin America total biocapacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
Latin America	3,065.2	407.8	507.6	1,919.4	188.3	42.7
Argentina	276.0	90.7	76.0	30.7	74.9	3.7
Bolivia	180.9	6.3	25.7	147.5	0.6	0.7
Chile	67.4	7.4	8.7	35.5	13.7	2.0
Colombia	175.8	10.0	60.2	99.9	1.9	3.7
Costa Rica	8.0	1.6	2.9	2.6	0.5	0.4
Cuba	12.1	6.6	1.0	2.3	1.6	0.6
Dominican Rep.	5.4	2.4	1.3	1.1	0.2	0.4
Ecuador	30.5	4.3	5.3	17.5	2.7	0.8
Guatemala	14.1	4.6	2.9	5.3	0.7	0.6
Haiti	2.2	1.4	0.4	0.1	0.2	0.2
Honduras	13.8	3.0	2.3	6.2	1.8	0.5
Mexico	178.7	68.5	32.3	52.6	17.6	7.6
Nicaragua	18.2	4.1	3.6	6.9	3.2	0.4
Panama	11.3	1.1	1.8	5.9	2.3	0.2
Paraguay	64.9	7.8	16.1	40.1	0.4	0.4
Peru	112.5	11.3	15.7	75.3	7.5	2.6
Venezuela	72.1	7.8	9.2	52.0	1.2	1.8

Table 29: Latin America percent change

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
Latin America	149.6	-6.4	133.5	-60.0	-0.2	-	-
Argentina	86.8	-20.0	49.5	-40.9	10.4	0.79	0.86
Bolivia	173.0	-20.4	117.3	-66.1	-7.4	0.56	0.73
Colombia	162.5	-20.6	108.3	-63.2	-3.4	0.69	0.80
Costa Rica	218.5	-0.7	216.4	-72.4	-12.1	0.76	0.85
Cuba	54.6	107.6	220.9	3.2	59.5	-	0.86
Dominican Rep.	177.6	15.3	220.1	-64.4	-1.2	0.64	0.77
Ecuador	188.9	-4.2	176.9	-72.6	-20.7	0.71	0.81
Guatemala	206.3	18.4	262.6	-61.5	18.0	0.53	0.70
Haiti	139.3	-47.7	25.1	-69.4	-26.9	0.43	0.53
Honduras	236.7	-41.2	97.8	-76.2	-19.9	0.57	0.73
Nicaragua	204.1	-25.5	126.7	-77.7	-32.1	0.57	0.70
Panama	183.7	15.7	228.2	-70.6	-16.6	0.76	0.83
Paraguay	207.3	-32.2	108.4	-75.8	-25.6	0.68	0.76

NORTH AMERICA



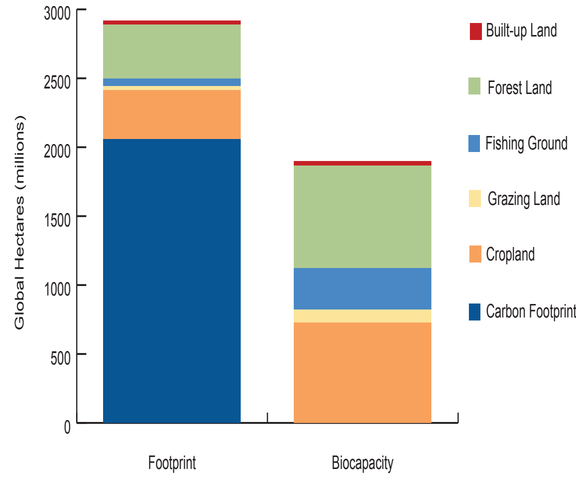


Figure 34: North America **total Ecological Footprint and biocapacity by land use type, 2006**

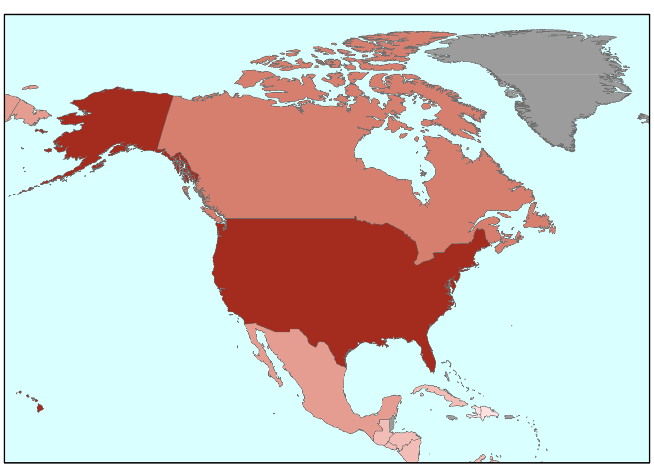
The total land area of North America is 1,870 million hectares, 1,100 million hectares of which are counted as bioproductive in the National Footprint Accounts. This area consists of 225 million hectares of cropland, 613 million hectares of forests, 253 million hectares of grasslands, and 9.1 million hectares of potentially productive land occupied by infrastructure. In addition, the region includes 511 million hectares of continental shelf and 136 million hectares of inland waters.

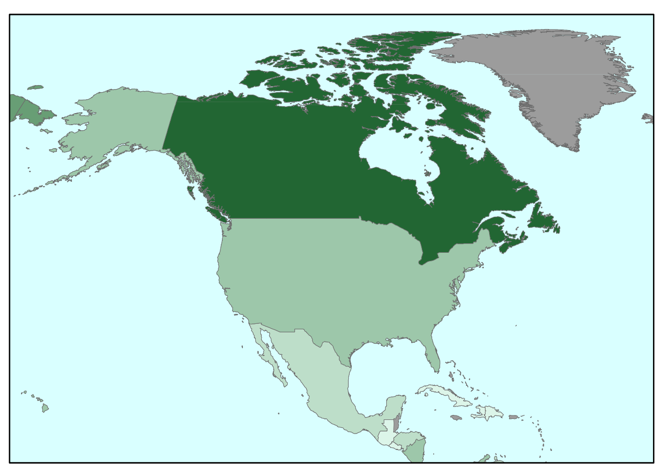
North America has a total biocapacity of 1,900 million gha, averaging 1.7 gha per hectare of bioproductive area. The region's total biocapacity is high relative to its population, with 5.6 gha per person.

The average resident of North America has an Ecological Footprint of consumption of 8.7 gha, far higher than the average for any other region. The United States of America, with an average Footprint of consumption of 9.0 gha per person, account for 94 percent of North America's total Footprint of consumption.

North America overshoots its biocapacity by more than any other region in the world. Its Ecological Footprint of production is 1,080 gha greater than available biocapacity. The contrast between Canada and the United States of America is sharp. The former has an ecological remainder of 119 million gha, the third highest in the world. The latter exhibits the second highest total overshoot of any country in the world, with Footprint of production exceeding biocapacity by nearly 1,120 million gha.

The contribution of the carbon Footprint to the overall Ecological Footprint of North America is higher than the world average. Carbon dioxide emissions account for 70 percent of the region's Footprint of consumption and 58 percent of its Footprint of production. Thus, most of its overshoot takes the form of use of global biocapacity through carbon dioxide emissions, rather than overuse of domestic ecological resources. The carbon dioxide emissions component of consumption is higher than that of





consumption, meaning that a large share of final demand in North America is likely linked to emissions elsewhere in the world.

North America is a net exporter of biocapacity, with exports 55 million gha greater than imports. Total flows of embodied biocapacity between North America and the rest of the world are much greater, but they are relatively balanced. The net outflow is equivalent to just 1.8 percent of the region's Footprint of consumption, or 2.9 percent of its biocapacity. Again, large differences appear. Canada is the world's largest net exporter of biocapacity, exporting 250 million gha more than it imports. The United States of America occupies the other extreme as the largest net importer of biocapacity in the world. The embodied Footprint of its net imports is 195 million gha, though this is equal to just 7.1 percent of its total Ecological Footprint of consumption.

Home to 5 percent of the global population, North America accounts for 17 percent of the world's total Ecological Footprint of consumption. Since 1961, North America's total Ecological Footprint of consumption has grown by almost 1,800 million gha. The region's total population increased by just 11 percent over that period, but the resource flows mobilized per person grew substantially. The 160 percent increase in North America's total Ecological Footprint of consumption during that time is almost entirely attributable to growth in demand per person. The increasing flows of inputs and waste associated with relatively affluent lifestyles of many North American residents have been a major contributor to the increase in global overshoot.

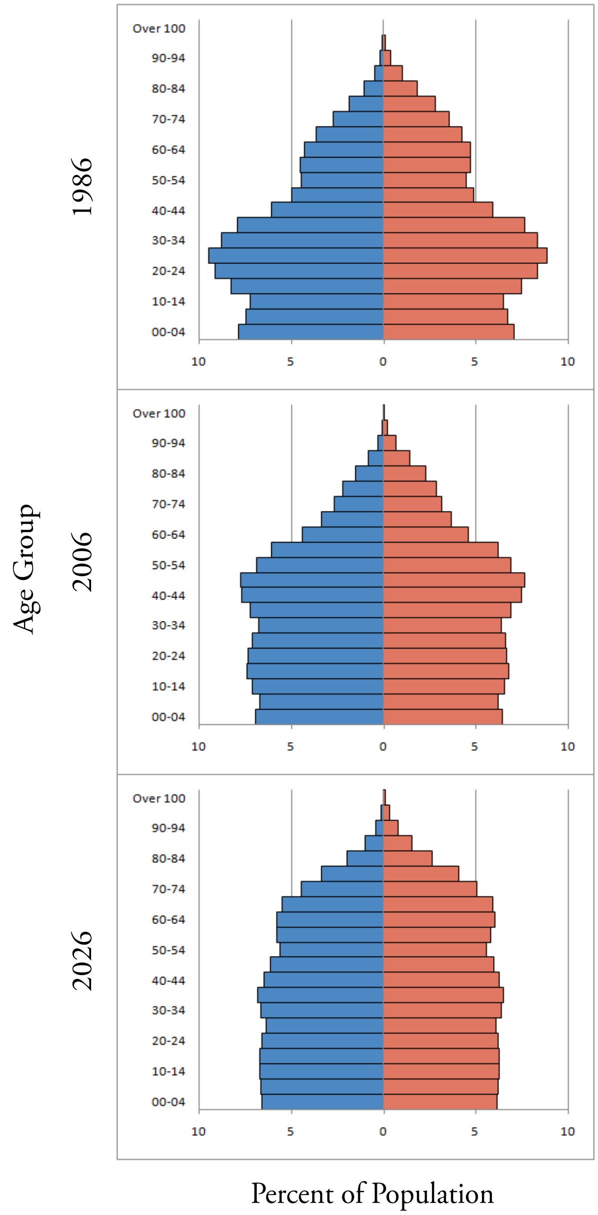


Figure 36: North America total population pyramid showing poopulation structure, 1986, 2006, 2026

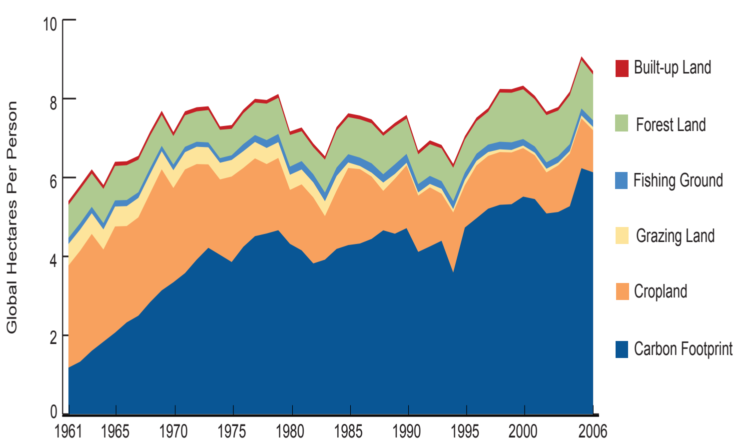


Figure 35: North America Ecological Footprint per person

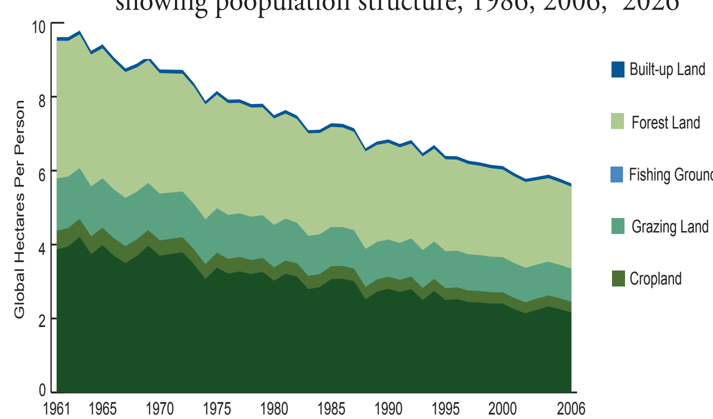


Figure 37: North America biocpacity per person

Table 30: North America per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
North America	335.5	8.86	3.52	3.68	8.7	5.65	0.16
Canada	32.6	13.43	6.36	14.04	5.76	17.08	7.67
United States	302.8	8.37	3.21	2.57	9.02	4.43	-0.64

Table 31: North America per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
North America	8.70	1.07	0.08	1.16	0.17	6.13	0.09
Canada	5.76	0.54	0.26	1.05	0.23	3.60	0.08
United States	9.02	1.12	0.06	1.17	0.16	6.41	0.09

Table 32: Nortth America total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17,090.7	3,727.2	1,427.3	1,823.0	649.6	9,063.6	400.1
North America	2,918.2	357.7	27.5	389.7	57.2	2,057.1	30.2
Canada	187.6	17.7	8.5	34.2	7.5	117.2	2.6
United States	2,730.3	339.9	19.0	355.5	48.5	1,939.7	27.6

Table 33: North America per person biocpacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
North America	5.65	2.17	0.29	2.22	0.89	0.09
Canada	17.08	4.30	0.26	8.39	4.05	0.08
United States	4.43	1.94	0.29	1.55	0.56	0.09

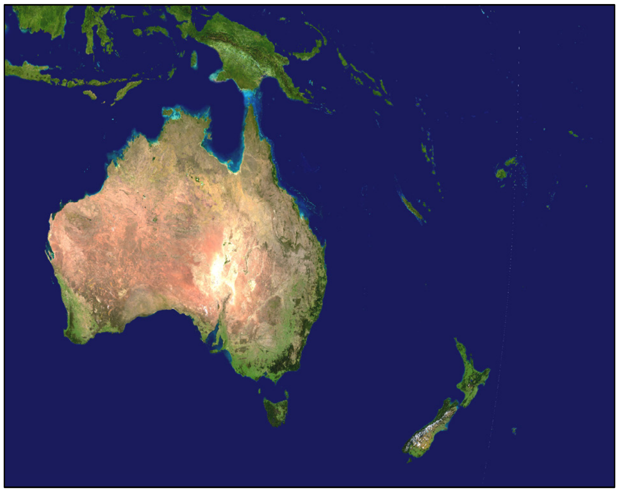
Table 34: North America total biocapacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
North America	1,897.3	726.8	96.5	743.6	300.3	30.2
Canada	556.4	139.9	8.6	273.2	132.0	2.6
United States	1,340.9	586.9	87.8	470.4	168.2	27.6

Table 35: North America percent change

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
North America	61.8	60.9	160.4	-41.2	-4.8	-	-
United States	60.2	64.2	163.0	-43.1	-8.8	0.89	0.96

OCEANIA



Oceania has a total land area 905 million hectares, of which the National Footprint Accounts list 656 million hectares as bioproductive area. Of this bioproductive total, 56 million hectares are cropland, 209 million hectares are covered by forests, 420 million hectares are grasslands, and 1 million hectares are used for infrastructure. The region also has 253 million hectares of continental shelf area and 8.2 million hectares of inland waters.

While Oceania encompasses almost 30 different countries and territories, data availability is limited for many of these. Therefore, most of these are not reported individually, but are included in aggregate figures. The three largest countries in the region, Australia, Papua New Guinea, and New Zealand are home to 91 percent of its population. These three countries also account for 98 percent of the region's total Ecological Footprint of consumption, and a similar share of its biocapacity.

Oceania has a total biocapacity of 434 million gha. With its relatively

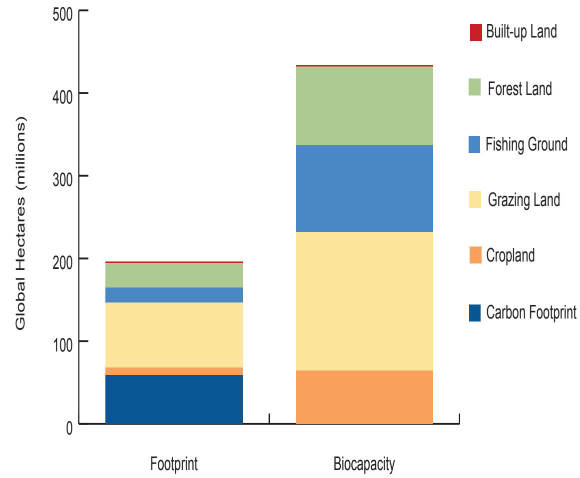


Figure 38: Oceania **total Ecological Footprint and biocapacity by land use type, 2006**

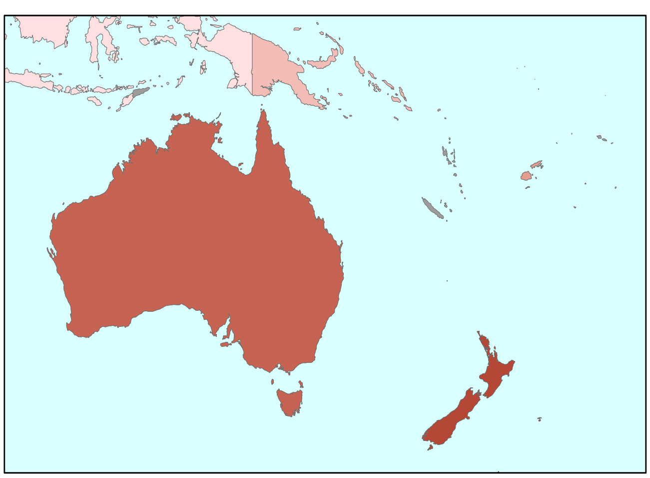
low population, the region has an average of 12.8 gha per resident. Its bioproductive area nonetheless exhibits lower than world average yields, with an average biocapacity of 0.66 gha per hectare.

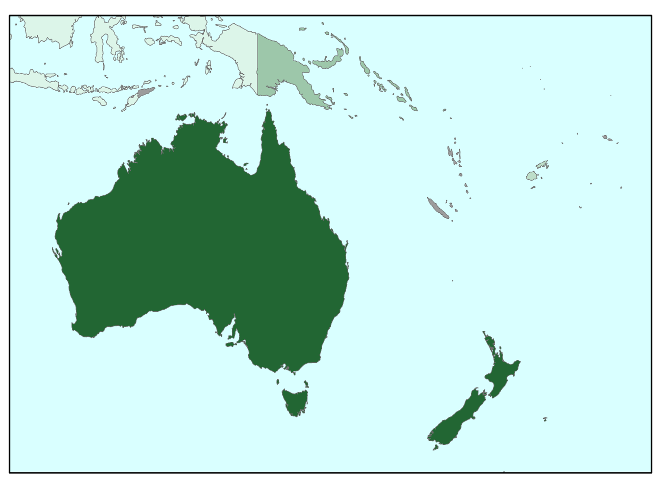
The average resident of Oceania has an Ecological Footprint of consumption of 5.8 gha, more than double the global average. New Zealand has the highest average Footprint of consumption, at 7.6 gha per capita.

Oceania as a whole has an ecological remainder of 90 million gha. Australia and Papua New Guinea have remainders of 86 million gha and 9.8 million gha, respectively. New Zealand, on the other hand, overshoots its biocapacity by 1.8 million gha.

Oceania exports 148 million gha more than it imports. This is equivalent to 34 percent of its domestic biocapacity, proportionally far higher than any other region of the world.

Oceania's total Ecological Footprint of consumption increased by





35 percent from 1961 to 2006. In the same period its total Ecological Footprint of production increased by 76 percent, due mainly to a large increase in exported biocapacity. The region's average Ecological Footprint of consumption per person is substantially higher than global average biocapacity per person. The equivalent of 3.2 planets would be needed to sustain the world's population at the current average consumption levels for the region However,. since the total population of Oceania is relatively low, its Footprint of consumption accounts for only 1.1 percent of the global total Ecological Footprint.

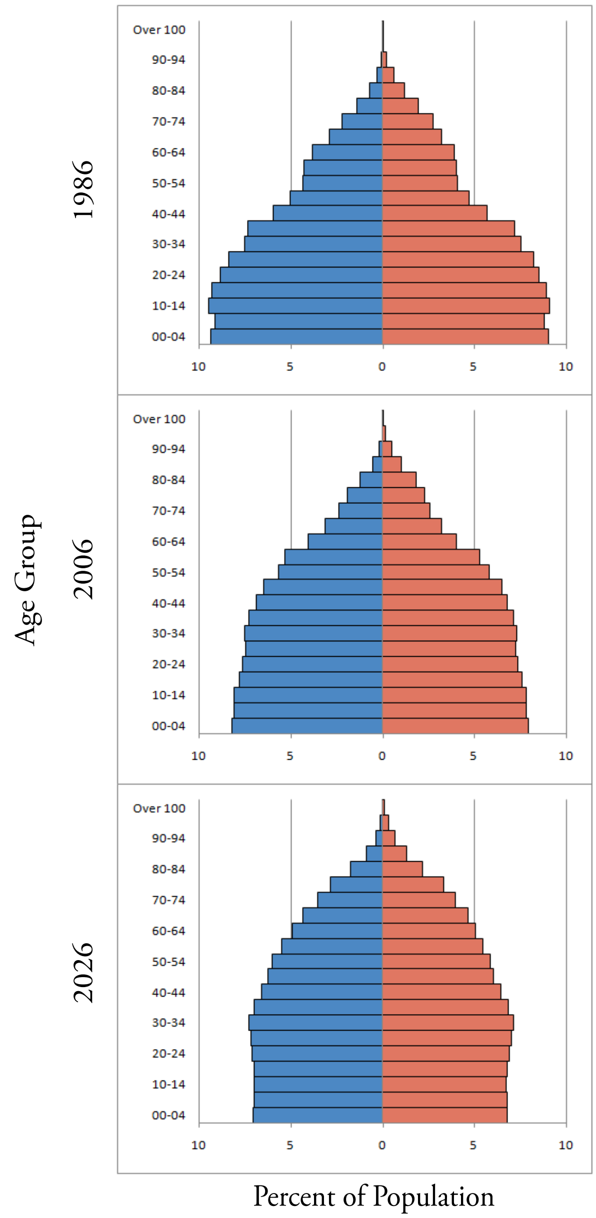


Figure 40: Oceania atotal population pyramid showing poopulation structure, 1986, 2006, 2026

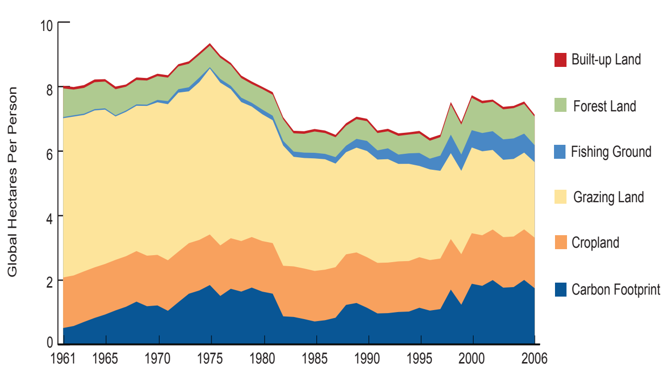


Figure 39: Oceania Ecological Footprint per person

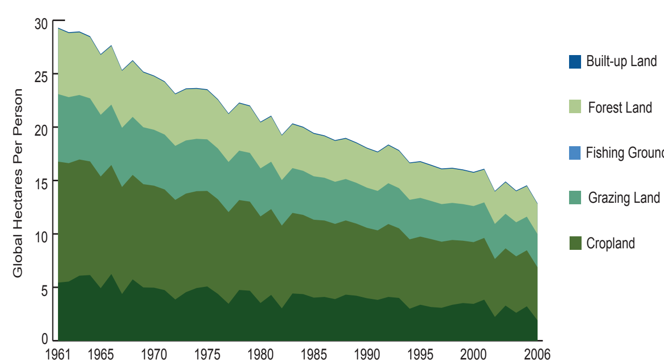


Figure 41: Oceania biocpacity per person

Table 36: Oceania per person Footprint of production, imports, exports, and consumption

Country/Region	Population [millions]	Ecological Footprint of Production [gha per person]	Ecological Footprint of Imports [gha per person[	Ecological Footprint of Exports [gha per person]	Ecological Footprint of Consumption [gha per person]	Biocapacity [gha per person]	Net Exports of Ecological Footprint [gha per person]
World	6,592.9	2.59	-	-	2.59	1.81	-
Oceania	33.8	10.17	2.67	8.36	5.80	12.82	5.69
Fiji	0.8	2.19	3.13	1.64	3.68	2.47	-1.48
New Zealand	4.1	12.49	4.17	9.08	7.58	12.04	4.91
Papua New Guinea	6.2	2.24	0.14	0.68	1.71	3.74	0.54
Solomon Islands	0.5	4.40	0.09	2.76	1.73	3.20	2.67

Table 37: Oceania per person Footprint by land use type

Country/Region	Total Ecological Footprint [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Carbon Footprint [gha per person]	Built-up Land [gha per person]
World	2.59	0.57	0.22	0.28	0.10	1.37	0.06
Oceania	5.80	0.26	2.33	0.88	0.52	1.75	0.06
Fiji	3.68	0.55	0.18	0.48	0.41	1.99	0.07
New Zealand	7.58	0.44	2.45	1.12	1.21	2.21	0.14
Papua New Guinea	1.71	0.21	0.02	0.30	0.87	0.21	0.11
Solomon Islands	1.73	0.42	0.01	0.25	0.75	0.10	0.20

Table 38: Oceania total Footprint by land use type

Country/Region	Total Ecological Footprint [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Carbon Footprint [millions gha]	Built-up Land [millions gha]
World	17,090.7	3,727.2	1,427.3	1,823.0	649.6	9,063.6	400.1
Oceania	196.4	8.7	78.9	29.8	17.8	59.1	2.1
Fiji	3.1	0.5	0.1	0.4	0.3	1.7	0.1
New Zealand	31.4	1.8	10.2	4.6	5.0	9.1	0.6
Papua New Guinea	10.6	1.3	0.1	1.8	5.4	1.3	0.7
Solomon Islands	0.8	0.2	0.0	0.1	0.4	0.1	0.1

Table 39: Oceania per person biocpacity by land use type

Country/Region	Total Biocapacity [gha per person]	Cropland [gha per person]	Grazing Land [gha per person[	Forest Land [gha per person]	Fishing Grounds [gha per person]	Built-up Land [gha per person]
World	1.81	0.56	0.26	0.74	0.18	0.06
Oceania	12.82	1.90	4.95	2.82	3.09	0.06
Fiji	2.47	0.48	0.11	1.32	0.50	0.07
New Zealand	12.04	1.04	3.47	5.03	2.36	0.14
Papua New Guinea	3.74	0.30	0.05	2.59	0.70	0.11
Solomon Islands	3.20	0.50	0.01	2.42	0.08	0.20

Table 40: Oceania total biocapacity by land use type

Country/Region	Total Biocapacity [millions gha]	Cropland [millions gha]	Grazing Land [millions gha]	Forest Land [millions gha]	Fishing Grounds [millions gha]	Built-up Land [millions gha]
World	11,901.5	3,713.3	1,725.9	4,891.4	1,170.9	400.1
Oceania	434.0	64.3	167.6	95.3	104.7	2.1
Fiji	2.1	0.4	0.1	1.1	0.4	0.1
New Zealand	49.9	4.3	14.4	20.8	9.8	0.6
Papua New Guinea	23.2	1.8	0.3	16.1	4.3	0.7
Solomon Islands	1.6	0.2	0.0	1.2	0.0	0.1

Table 41: Oceania percent change

Country/Region	Population	Ecological Footprint per person	Total Ecological Footprint	Biocapacity per person	Total Biocapacity	HDI 1980	HDI 2006
World	114.0	13.0	141.9	-51.4	4.0	-	-
Oceania	107.6	-35.3	34.8	-56.0	-8.4	-	-
New Zealand	70.8	-44.8	-5.8	-51.5	-17.2	0.86	0.95

Account Templates and Guidebook

The *Guidebook to the National Footprint Accounts: 2009 Edition* provides a detailed description of the 2009 Edition of the National Footprint Accounts. The National Footprint Account calculations for a single country and year are organized in 79 interconnected worksheets in a Microsoft Excel workbook. All raw datasets are stored in a database maintained by Global Footprint Network, which is queried for the appropriate country and year values in order to populate the NFA Excel workbook. The NFA time series are generated by successively populating the NFA workbook with values for each country and year, and then recording the values of certain specified output cells back to the database.

The Guidebook is written for the intermediate to advanced NFA user interested in extracting data from the 2009 Edition or in understanding the methodology in detail. The 2009 Edition of the National Footprint Accounts for each country and year from 1961 thru 2006 are available under license from Global Footprint Network. The National Footprint Account calculations for Hungary and for the world are available under a free academic license. Also available are special research licenses which permit modification of the accounts. For details, visit http://www.footprintnetwork.org/en/index.php/GFN/page/licenses/ or contact licensing@footprintnetwork.org.

What information is in the Guidebook?

The *Guidebook for the National Footprint Accounts: 2009 Edition* contains explanations of each worksheet in the National Footprint Accounts workbook, detailing the format of the sheet, how calculations are performed within the sheet, and how it is connected with the other calculations in the accounts. The 79 worksheets are grouped by component (cropland, grazing land/livestock, fishing grounds, forest, carbon, and built-up land). Within each land use type the worksheets are generally related in a hierarchical structure, going from several raw data inputs to one summary sheet of final Footprint estimates. The Guidebook includes a diagram showing the hierarchy of worksheets for each land use type.

Figure 42, below, shows the layout of a Guidebook entry and how it describes a worksheet. For each land use type in the calculation, the Guidebook also lists all data sources used, and what worksheets they appear in. Table 42 is an example of the references contained in the Guidebook, in this case for the carbon Footprint calculation.

Table 42: Guidebook example, table with sources, 2006

Table 3.Guidebook Example; Table with Sources, 2006

Data	Worksheet Referenced	Data Sources
Emissions from fossil fuels, by nation and economic sector	iea_fossil_n	IEA CO2 Emissions from Fuel Combustion. Database. 2007. http://wds.iea.org/wds/.
Emissions from fossil fuels, by nation	cdiac_fossil_n	Marland, G., T.A. Boden, and R. J. Andres. 2007. Global, Regional, and National Fossil Fuel CO2 Emissions. In Trends: A Compendium of Data on Global Change. Oak Ridge, TN: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory and U.S. Department of Energy
International trade quantities by commodity	comtrade_n	UN Commodity Trade Statistics Database. http://comtrade.un.org/.
Embodied energy of commodities	fossil_efi, fossil_efe	PRé Consultants Ecoinvent Database, version 7.1. http://www.pre.nl/ecoinvent/default.htm.
Carbon sequestration factor	cnst_carbon	IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture Forestry and Other Land Use. http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html.
Ocean sequestration	cnst_carbon	IPCC. 2001. Climate Change 2001: The Scientific Basis. Cambridge, UK: Cambridge University Press, 2001.
World heat and electricity carbon intensity	cnst_carbon	IEA CO2 Emissions from Fuel Combustion Database. 2007. http://wds.iea.org/wds/.

5.2.1 Ef_crop

Level 2 (Only cropland worksheet at this level)

Ef_crop summarizes the cropland Footprints of Production, Import, Export, and Consumption.

Layout: This worksheet begins with one identifying column. The 'Name' column reports the names of the considered groups of products summarized in this worksheet: 'crop products,' 'cropland in livestock,' and 'unharvested cropland.' This identifying column is followed by four columns that report the Footprints of Production ('EF_P'), Imports ('EF_I'), Exports ('EF_E'), and Consumption ('EF_C') for each products' group.

Data and Calculation: For the 'crop products' group, the 'EF_P', 'EF_I', and 'EF_E' columns report values directly from the Level 3 worksheets, crop_efp, crop_efi, and crop_efe, respectively. For the 'cropland in livestock' group, two grazing land-related Level 3 worksheets, livestock_efi and livestock_efe, are used as value sources for the 'EF_I', and 'EF_E' columns. These worksheets are used to estimate the amount of cropland embodied in traded livestock. For the 'unharvested cropland' group, the 'EF_P' column reports values to adjust for the land locally left fallow. Finally, for each group, the 'EF_C' column is calculated using the Equation 2_1.

The final row in the ef_crop table totals the Footprints of Production, Imports, Exports, and Consumption to obtain total Footprints for the crop land use type. The total Footprint of Production for the 'crop products' group is calculated by summing only the Footprint of Production of primary products to avoid double counting. The total Footprint of Consumption is calculated by applying Equation 2_1 to the total EFP, EFI, and EFE.

Refers to: crop_efp (L3), crop_efi (L3), crop_efe (L3), livestock_efi (L3), livestock_efe (L3), crop_unharv_efp (L3)

Referenced by: *summary* (L1)

Level: This describes how the worksheet fits into the 5-level hierarchy used to describe interactions between worksheets. Level 1 is the highest-order worksheet, containing a summary of all Footprint and biocapacity components, while Level 5 worksheets generally contain source data.

Worksheet Name: This is the name of the worksheet, which is found in the tabs at the bottom of the National Footprint Accounts template.

Summary: This summarizes what information the worksheet contains.

Layout: This section describes how the worksheet is laid out and what the different column headings mean.

Data and Calculation: This section describes what information the worksheet draws from other worksheets. It also describes calculations performed within the worksheet. For worksheets with raw data, this section also describes how this information is used in other worksheets.

Equations: In the calculation sections, equations are often referenced. These equations are fully explained elsewhere in the Guidebook.

References: These show how the worksheet is connected to other worksheets in the National Footprint Accounts. Levels shown in parenthesis.

Figure 42: Example template from the Guidebook for the National Footprint Accounts, 2009

Limitations of the Ecological Footprint Method

The Ecological Footprint is designed to quantify the demand for the biosphere's regenerative capacity imposed by human activities. The limitations of the Ecological Footprint fall into four broad categories: scope, comprehensiveness, implementation, and extent of implications.

The *Ecological Footprint Standards 2009* require that Footprint studies specify the limitations of the assessment. In particular, the Standards emphasize that the Footprint is not a complete indicator of sustainability, and needs to be accompanied by complimentary indicators.

Limitations of Scope: What the Footprint Does Not Measure

The Ecological Footprint is an indicator of human demand for ecological goods and services linked directly to ecological primary production. As such it addresses very specific aspects of the economy – environment relationship, and should not be taken as a stand-alone sustainability indicator. Rather, it should be used in the context of a broader set of indicators that provide a more complete picture of sustainability. The following are some specific aspects of sustainability that the Ecological Footprint does not address:

- Availability or depletion of non-renewable resources. The Ecological Footprint focuses solely on resources for which the biosphere provides regenerative capacity on a human timescale. It does not track the use or depletion of nonrenewable resource stocks such as oil, natural gas, coal,or metal deposits. These are only addressed by the Ecological Footprint where their extraction, refinement, distribution, use, or disposal imposes a demand on the biosphere's regenerative capacity.

- Inherently unsustainable activities. Similar to the omission of nonrenewable inputs, the Ecological Footprint does not account for wastes which the biosphere has little or no assimilative capacity for. Therefore the release of heavy metals, radioactive compounds, and persistent synthetic compounds is not addressed by the Ecological Footprint.

- Environmental management and harvest practices. The Ecological Footprint per tonne of each primary ecosystem product is globally constant, since this value is determined using world average yields. This means, for instance, that a tonne of timber is assigned the same Ecological Footprint regardless of its origins or the forestry practices by which it was obtained. Thus, the Ecological Footprint can indicate a sustainable scale of harvest but does not provide a good means of evaluating ecosystem use and management.

- Land and ecosystem degradation. The Ecological Footprint counts harvest quantities and yields. It does not address any of the underlying variables which contribute to determining yields, such as soil structure, nutrient availability, or climate variables. If ecological degradation leads to a decline in yields over successive years, then a biocapacity calculation would capture this. However, Ecological Footprint and biocapacity have no predictive ability on this topic. In fact, increasing biocapacity may sometimes be directly at odds with the broader interests of sustainability, as all this actually reflects is an increase in yield.

- Ecosystem disturbance or resilience of ecosystems. With the possible exception of its built-up land component, the Ecological Footprint does not give a direct indication of ecosystem disturbance. Rather disturbance would be a secondary effect of the resource flows described in the Ecological Footprint, and would be determined by numerous mediating variables. Nor does biocapacity provide information on an ecosystem's ability to sustain disturbance, or what degrees or types of disturbance would precipitate substantial overall changes to the system. Ecosystem changes such as those related to succession or species invasion will only affect biocapacity figures in as much as they alter yields.

- Use or contamination of freshwater. Use or contamination of freshwater, whether from surface or underground sources, is not directly included in the Ecological Footprint since it is very difficult to determine the biocapacity, if any, required by hydrological cycles. Indirect demands associated with water use, such as fossil fuel emissions associated with pumping water supplies, would appear in the Ecological Footprint. Likewise, biocapacity might indirectly reflect changes in freshwater availability by showing their impact on yields. However, a complimentary indicator such as the water footprint would be needed for a more direct assessment of water demand.

Limitations of Current Methodology and Data: What the Footprint Does Not Measure Well

- Biocapacity required for uptake of carbon dioxide emissions. The Ecological Footprint of carbon dioxide emissions is calculated by assuming that all emissions must be taken up by forests. This neglects biotic carbon uptake in other biomes, which if included might affect the estimated Ecological Footprint per unit of carbon dioxide emissions.

- Bioproductivity occupied by hydroelectric reservoirs and other infrastructure. These areas are assumed to have world average productivity. Greater specificity would be desirable.

- Ecological tradeoffs of land conversion. By the current National Footprint Accounts methodology, loss of forest cover to urbanization may provide counter-intuitive results in biocapacity. This is due to a lack of geographic specificity. All cropland is assigned the global average equivalence factor, weighted by yield. This means that if national average yields are not substantially affected, newly added cropland hectares may be assigned a higher biocapacity than the land cover they replace. In addition, all land occupied by infrastructure is assumed to have the biocapacity per hectare of cropland, rather than of the land cover it has displaced.

- Aquaculture Production. Aquaculture production systems are not currently included in the National Footprint Accounts. Aquaculture fish and wild catch are aggregated in trade data, so the Footprint of consumption may be underestimated for large exporters of aquaculture fish and overestimated for large importers of aquaculture fish.

Potential Errors in Implementation

As with any scientific assessment, Ecological Footprint results need to be evaluated in terms of reliability and validity. This is a complex task given that the National Footprint Accounts draw on a wide range of datasets, many of which have incomplete coverage, and most of which do not specify confidence limits. Considerable care is taken to minimize any data inaccuracies or calculation errors that might distort the National Footprint Accounts, including inviting national governments to collaboratively review the assessment of their country for accuracy, and develop improvements in the method either specific to their country or that generalize to all countries. In addition, efforts are continually made to improve the transparency of the National Footprint Accounts, allowing for more effective internal and external review. Overall, the Accounts are designed to err on the side of over-reporting biocapacity and under-reporting Ecological Footprint of production, making it less likely that any errors will significantly overstate the scale of human demand for biocapacity. Five potential sources of error have been identified:

Conceptual and methodological errors. These include:

Systematic errors in assessing the overall demand on nature.

Some demands, such as freshwater consumption, soil erosion and toxic release are excluded from the calculations. Failure to capture all types of ecological demands typically leads to underestimates of ecological deficit.

Allocation errors.

Incomplete or inaccurate trade and tourism data distort the distribution of the global Footprint among producing and consuming nations. This means, for example, that the consumption of a Swedish tourist to Mexico is currently allocated to Mexico rather than Sweden. Similarly, the National Footprint Accounts do not include international trade in services, meaning that the Footprint of providing these services will be inaccurately allocated to the country of origin. The widespread use of global average Footprint intensities in calculating the embodied Ecological Footprint of traded goods is another source of potentially large inaccuracies in national Ecological Footprint estimates. The bias introduced by such problems is not systematic across countries, but rather depends on a country's net trade flow, and its intensity relative to the world average.

These problems complicate the calculation of national and regional Ecological Footprints. However they do not affect the calculation of the global total Ecological Footprint, only the accuracy with which this quantity is allocated to the consumption activities it serves.

Data errors in statistical sources for one particular year.

Source data sets are currently taken at face value, and errors in these will affect final Ecological Footprint estimates. Much of the production and trade data used in the National Footprint Accounts are from UN datasets, which contain values reported by individual countries. Coverage is often incomplete, and some reported values are questionable.

Systematic misrepresentation of reported data in UN statistics.

Distortions may arise from over-reported production in planned economies, under-reported timber harvests on public land, poorly funded statistical offices, and subsistence, black market, and non-market (or informal) activities. Since most consumption occurs in the affluent regions of the world, these data weaknesses may not distort the global picture significantly.

Systematic omission of data in UN statistics.

There are demands on nature that are significant but are not, or are not adequately, documented in UN statistics. Examples include data on the biological impact of water scarcity or pollution, and the impact of waste on bioproductivity. Some of the aforementioned distortions generate margins of error on both sides of the data point, but errors leading to an under-reporting of global ecological overshoot almost certainly outweigh the other errors. With every round of improvement in the Accounts and the ongoing integration of more comprehensive data sets and independent data sources, the consistency and reliability of data can be checked more effectively, and the robustness of the calculations will improve. Overall, Ecological Footprint calculations and the data sources employed have improved significantly since 1990, as additional digitized data have been added to the National Footprint *Accounts and internal cross-checking and data*

set correspondence checks have been introduced. There is significant opportunity for methodological improvement. A research paper written by more than a dozen Footprint researchers, including members of the National Accounts Committee, identified open research topics for improving the existing National Footprint Account methods (Kitzes et al. 2007a). A similar research agenda was echoed by a 2008 report commissioned by DG Environment (Best et al. 2008). Many of these suggested improvements address standing criticisms of current methods from both within and outside this group of authors.

Interpreting the Footprint: What the Results Mean

The following are some of the limitations on conclusions which can be drawn from Ecological Footprint results:

- The Ecological Footprint functions as an indicator of the drivers of human pressure on ecosystems, rather than measuring these pressures themselves. For instance, the Ecological Footprint is not an appropriate proxy for human pressures on biodiversity. This is in part because the various types of demand considered have potentially widely disparate population and ecosystem level effects, but also because the ecological outcomes of human demand for ecological goods and services invariably depend on mediating variables beyond the scope of the Ecological Footprint, such as management practices.

- Overshoot reflects an imbalance of rates and thus has physical ramifications; either a drawdown of stocks of natural capital or an accumulation of wastes. However, it does not follow that there is some outcome attributable to a specific level of overshoot, regardless of cause. For example, the effects of a buildup of atmospheric carbon dioxide are likely to differ vastly from the effects of depleting marine fish stocks. Thus total overshoot can generally not be linked to specific environmental effects, nor is it reasonable to envision a specific maximum attainable level of overshoot. This is even more so of the concept of ecological debt: while summing 'accumulated overshoot' is a useful pedagogical device, it is not predictive of any specific outcome, nor is it reflective of an expected recovery time for ecosystems.

- In addition, overshoot in some ecological demand categories may be masked by lower Footprint in others. A clear example is the case of carbon dioxide emissions: according to the National Footprint Accounts, humanity entered overshoot sometime between the mid-1970s and the mid-1980s. However, the buildup of anthropogenic atmospheric carbon dioxide may well have started centuries earlier. For this reason entering overshoot does not necessarily mark a distinct shift in the economy-environment system.

- It can be difficult to broadly relate a country's situation with regard to sustainability to its Footprint relative to biocapacity. If a country's Footprint of production exceeds its biocapacity, this may indicate that its domestic natural capital is being drawn down. However, this is not universally true, as many countries' overshoot of their domestic biocapacity takes the form of carbon dioxide emissions into the global atmosphere, which is an inherently global demand for biocapacity. Thus a Footprint of production greater than biocapacity may well be, but is not necessarily, an indication of unsustainability within that country. On the other hand, the scale of a country's Footprint of consumption relative to its domestic biocapacity should not be taken as an indication of the sustainability or unsustainability of that country. Alternative to domestic resource depletion or the use of global commons, this 'deficit' situation may quite simply be the effect of international trade in goods derived from biocapacity. These exchanges of goods may bring mutual benefit to participants, more than they represent vulnerabilities.

Quality Assurance Procedures for Raw Data and Results

The Ecological Footprint and biocapacity assessment for any given country and year relies on over 5,400 raw data points. This leaves much potential for missing or erroneous source data to contribute to implausible Footprint estimates or abrupt year-to-year changes in a country's Footprint that do not reflect actual changes in consumption. In some cases the solution to this problem has been to systematically estimate missing data points based on data for surrounding years, as described below.

The methodology for the National Footprint Accounts has been applied consistently to all countries in the 2009 Edition, with some specific exceptions as documented here. The next section describes the few modifications that were applied to source data, as well as country-specific adjustments of the Footprint calculation.

The primary procedure used to test the 2009 Edition templates and identify potential template errors was to compare results from the 2009 and the 2008 Editions of the Accounts for the same data years. In the initial screening, country rankings for biocapacity and Footprint were compared across the two editions. The second step was to compare time series for the six land-use types as well as for total biocapacity, Footprint of consumption and Footprint of production. This comparison was done for all 241 countries, regions, and territories over the 1961-2006 time period. In addition, abrupt inter-annual shifts in any of the Footprint or biocapacity components were identified.

When large discrepancies were identified, tests were conducted to determine whether they originated from template errors, the underlying data set, or the methodological improvements in the later edition of the Accounts. These tests also helped identify methodological issues that will need to be explored through further research. For example, one issue that was identified as needing additional consideration is the question of which crops need to be put in a separate category of lower productivity crops in order not to skew national yield factors. Because millet and sorghum may generally be planted on dryer, less productive land rather than on average crop land, not treating them separately may lead to biocapacity overestimates for countries with significant millet and sorghum harvests.

Country-Specific Adaptations of the National Footprint Accounts

Calculating the Ecological Footprint of a country over time utilizes a large number of data points from a wide variety of sources. In the course of compiling the National Accounts, inconsistencies and gaps in the raw data were identified and in some cases corrected. This section will detail all measures taken to address missing raw data, as well as country-specific adaptations that were applied in calculating the National Footprint Accounts, 2009 Edition.

The goal of this section is not to identify every potentially erroneous result in the National Accounts. Rather, it is to outline all alterations to raw data used in the 2009 Edition of the National Footprint Accounts, in sufficient detail to render the results described in this document reproducible.

Missing Data

Most of the data sources used in the National Footprint Accounts encompass countries for which one or more years' data are missing. For the UN COMTRADE database, the basis for calculating the embodied carbon Footprint of traded goods, missing years were identified, but left blank due to lack of consensus methodology for interpolating or extrapolating missing years.

Individual Country Patches

For a few countries, specific variations on the standard assumptions or calculation methodology were applied. These are detailed here.

Finland

Country-specific extraction rates (ratios of secondary/primary product) for forest products were made available by the Finnish government. These were used instead of global averages in calculating the Footprint intensities of domestic production and of exports.

Norway

Apparent underestimates of Norway's carbon Footprint were addressed by lowering the assumed embodied energy in crude petroleum exports.

Standards and National Footprint Accounts Committees

In 2004, Global Footprint Network initiated a consensus, committee-based process to achieve two key objectives:

- Establish a scientific review process for the Ecological Footprint; methodology
- Develop application and communication standards.

These committees, which began operating in the spring of 2005, are comprised of members drawn from the Network's partner organizations, and represent government, business, academia, and NGOs.

Two committees are now overseeing scientific review procedures for the National Footprint Accounts and developing standards for Footprint applications. The Committee Charter provides more detail on the objectives and procedures for each of the committees.

- The Ecological Footprint Standards Committee develops standards and recommends strategies to ensure that the Footprint is applied and reported in a consistent and appropriate manner in all key domains, at a variety of scales, and over time.
- The National Footprint Accounts Review Committee supports continual improvement of the scientific basis of the National Footprint Accounts, which provide conversion factors that translate quantities of resources used or wastes emitted into the bioproductive land or sea area required to generate these resources or absorb these wastes. These conversion factors serve as the reference data for Footprint applications at all scales.

The committees draft protocols and develop standards which are then circulated for feedback. This is an iterative process, managed by the committees with the support of Global Footprint Network staff. Pilot testing of protocols and standards helps refine them and confirm their applicability to real-world Footprint projects.

In order to guarantee both transparency and the best possible standards, standards development follows the ISEAL guidelines, with opportunities for both partner and public comment during the development process.

The first standards were published in 2006. *Ecological Footprint Standards 2009* addresses the use of source data, derivation of conversion factors, establishment of study boundaries and communication of findings. It focuses on applications that analyze the Footprint of sub-national populations.

Development of the next edition of Ecological Footprint Standards is currently underway. This work will expand the Standards to more specifically address Footprint analysis of organizations, products, processes and services. Global Footprint Network partners are required to comply with the *Ecological Footprint Standards 2009*.

Regular Review

Protocols and standards are reviewed on a regular basis, and revised as necessary. The goal is to establish continuous improvement in both the scientific basis and transparency of the methodology, and the quality and consistency with which Ecological Footprint applications are conducted and findings communicated.

Future Standardization Plans

Future plans include the development of a third-party certification system whereby practitioners can have their applications audited for adherence to the standards. Certification will ensure that assessments are accurate, consistent, and up-to-date, and are using methodology and conversion factors from the most recent edition of the National Footprint Accounts.

The current members of the committees are as follows:

Ecological Footprint Standards Committee

Andreas Schweitzer, Borawind Ag
Brad Ewing, Global Footprint Network
Craig Simmons, Best Foot Forward
Jane Hersey, BioRegional
John Walsh, Carbon Decisions
Laura de Santis Prada, Ecossistemas Design Ecológico
Miroslav Havranek, Charles University Environment Centre
Natacha Gondran, Ecole Nationale Supérieur des Mines de Saint-Étienne
Philip Stewart, WSP Environmental
Sally Jungwirth, EPA Victoria
Sharon Ede, Zero Waste
Simone Bastianoni, University of Siena--Ecodynamics Group
Stefan Giljum, SERI
Stuart Bond, WWF

National Footprint Accounts Review Committee

Alessandro Galli, Global Footprint Network
Anke Schaffartzik, Institute of Social Ecology in Vienna (IFF)
David Vackár, Charles University Environment Centre
Jarmo Muurman, Finnish Ministry of Environment
Laurent Jolia-Ferrier, Empreinte Ecologique SARL
Marco Bagliani, IRES Piemonte Research Institute
William Rees, University of British Columbia
Yoshihiko Wada, Ecological Footprint Japan

Research and Developments

The National Footprint Accounts, from the first national assessments in 1992 (for Canada) and the first consistent multi-national assessments in 1997 (for the Rio+5 Forum) have been continually improved. Since 2005 updates to the National Footprint Accounts have been guided by Global Footprint Network's National Footprint Accounts Review Committee. In May of 2007, Ecological Footprint researchers and practitioners from around the world gathered at the International Ecological Footprint Conference at Cardiff University to present and discuss the current state of Ecological Footprint methodology, policy, and practice. One outcome of the conference was the publication of *A Research Agenda for Improving National Ecological Footprint Accounts*, with 28 leading Footprint researchers and practitioners as authors (Kitzes et al. 2007a). This paper set forth a comprehensive list of 26 research topics that reflected the major concerns and suggestions of the authors. Many of these same topics were confirmed as research priorities in a review of the Ecological Footprint commissioned by DG Enviornment and released in June 2008, Potential of the Ecological Footprint for monitoring environmental impact from natural resource use, available at http://ec.europa.eu/environment/natres/studies.htm (Best et al. 2008).

This chapter provides a brief discussion of nine research topics included in the Research Agenda paper that have been addressed over the past year, or may be addressed in future research. The methodological changes and research priorities in the coming years at Global Footprint Network will continue to follow the suggestions of the National Accounts Committee and leading Footprint researchers and practitioners. By publishing this appendix in The Ecological Footprint Atlas 2008, Global Footprint Network continues to improve the scientific rigor and transparency that are required to develop a robust resource accounting tool such as the Ecological Footprint.

Detailed Written Documentation

The Research Agenda paper called for improved documentation of the manner in which the Footprint methodology is implemented in the National Footprint Accounts, and of how the methdology and implementation may have changed from previous editions. In response, Global Footprint Network has published the *Guidebook to the National Footprint Accounts: 2009 Edition* and *Calculation Methodology for the National Footprint Accounts, 2009 Edition*, in addition to the *Ecological Footprint Atlas: 2009*. These publications significantly advance documentation of the detailed National Account calculations templates, and "describe, and justify where necessary, differences between current calculation methods and previous methods" (Ewing et al. 2009). In future years, Global Footprint Network anticipates publishing even more detailed and comprehensive documentation to further improve the transparency and scientific rigor of the National Footprint Accounts. These documents, along with greater transparency and clarity in the actual programming of the accounts, are important components of the quality assurance process for the Accounts.

Trade

As recommended in the Research Agenda paper, Global Footprint Network, in collaboration with partner organizations, is reviewing the use of input-output analysis (I-O) to improve the estimation of the Ecological Footprint embodied in traded goods. The Ecological Footprint embodied in traded goods can be estimated using life cycle assessments (LCA), I-O, or a hybrid approach. In the 2009 Edition of the National Footprint Accounts, and all previous National Footprint Accounts, the embodied Footprint in traded goods was calculated by multiplying the reported weights of product flows between countries by Footprint intensities in global hectares per tonne to calculate total global hectares imported or exported (e.g., Monfreda et al. 2004). According to the Research Agenda paper,

> "These intensities are derived from ecosystem yields combined with embodied material and energy values usually drawn from LCA product analyses.
>
> An alternative "Input-Output" framework for assessing Footprint trade has also been proposed (Bicknell 1998, Lenzen and Murray 2001, Bagliani et al 2003, Hubacek and Giljum 2003, Turner et al 2007, Wiedmann et al 2007). The I-O based approach "allocate(s) the Ecological Footprint, or any of its underlying component parts, amongst economic sectors, and then to final consumption categories, using direct and indirect monetary or physical flows as described in nation-level supply and use or symmetric I-O tables. By isolating the total value or weight imports and exports by sector, and combining these with Footprint multipliers, total Footprint imports and exports can be calculated. I-O tables are provided by national statistical offices (e.g., ABS 2007) or international organizations (e.g., OECD 2006b).
>
> Within an LCA framework, the most important priority will be to locate more robust country-specific embodied energy and resource figures to more accurately capture the carbon embodied in traded goods. These "Footprint intensities" could be calculated using an I-O approach.
>
> In addition, although these data have historically been lacking, the increasing global focus on carbon and carbon markets could potentially lead to increasing research in this area. Many newer LCA databases derive their estimates using I-O frameworks, which may lead to convergence between these two methods (Hendrickson et al. 1998, Joshi 1999, Treloar et al. 2000, Lenzen 2002, Suh and Huppes 2002, Nijdam et al. 2005, Heijungs et al. 2006, Tukker et al. 2006, Weidema et al. 2005, Wiedmann et al 2006a).
>
> Some authors (e.g. Weisz and Duchin 2006) have argued that the best approach for environmentally-related I-O analysis would be the use of hybrid I-O tables comprising both physical and monetary data. Such a hybrid approach may overcome some of the shortcomings of an I-O based framework, such

as long time delays between the publication of tables, large categories (particularly for agricultural sector) and other documented error types associated with general I-O analysis (Bicknell 1998). Although the use of monetary input output frameworks can help to establish a direct link between economic activities and environmental consequences, questions remain about how accurate monetary tables are as proxies for assessing land appropriation (Hubaceck and Giljum 2003).

Although in the past I-O tables have been available only for a subset of countries, newer multi-sector, multi-region I-O analyses could be applied to Ecological Footprint analysis. The theoretical basis for these models has been discussed, (Turner et al. in press, Wiedmann et al. 2007), but such an analysis has not yet been completed. The application of such models will need to explicitly consider the production recipe, land and energy use as well as emissions (OECD 2006a). A recently awarded EU grant to partner organizations of Global Footprint Network should generate some pioneering work in this area within the next couple of years.

Monetary I-O based frameworks also may provide the additional benefit of accounting more accurately for the embodied Footprint of international trade in services. As many services traded across borders require biocapacity to operate but have no physical products directly associated with them (e.g., insurance, banking, customer service, etc.), trade in these services could only be captured by non-physical accounts. The current omission of trade in services has the potential to bias upward the Footprint of service exporting nations, such as those with large telecommunications sectors, research and development, or knowledge-based industries" (Kitzes et al. 2007a).

Equivalence Factors

Methodological discussions in the coming year may focus on the basis for the equivalence factors, and specifically whether new global net primary production (NPP) estimates will allow these calculations to be based on usable NPP (as they have been previously) instead of the current suitability indices method.

One possible update would be to overlay the Global Land Cover map (GLC 2000) with the Global Agro-Ecological Zones (GAEZ 2000) map of potential productivity. This method could replace the current calculation, which is not spatial, but rather assumed that the best land is allocated to cropland, the next best to forest, and the poorest to grazing land using GAEZ. The spatial method will be more accurate at reflecting the actual "quality" of the land currently used to support each land cover type. It would also be possible through this method to calculate a separate equivalence factor for built-up land based on the potential productivity of the land that it covers (rather than assuming all built-up land covers average cropland).

Nuclear Footprint

As noted in Appendix A: Methodology Differences Between the 2006 and 2008 Editions of the National Footprint Accounts in the *Ecological Footprint Atlas 2008*, the emissions proxy component of the nuclear Footprint was removed from the 2008 Accounts. This component used a carbon-intensity proxy that the Committee concluded was not a scientifically defensible approach to calculating the Footprint of nuclear electricity. Research on how nuclear energy production could be included in Footprint assessments is still under way.

Carbon Footprint

Currently, carbon dioxide emissions represent the most significant human demand on the biosphere. As the largest component of the Ecological Footprint, any methodological changes made in calculating the carbon Footprint have the potential of signifcantly changing the total Footprint. There are may ways the Footprint associated with carbon dioxide emissions could be calculated; several of these are discussed in A Research Agenda for Improving National Ecological Footprint Accounts (Kitzes et al. 2007a).

Within the sequestration approach currently used, a number of issues still need to be addressed. Further research is needed, for example, to decide if and how non-CO_2 greenhouse gases should be included in the calculation, how to more accurately calculate the ocean and forest absorption of carbon dioxide, how to take into account differences between coniferous and deciduous carbon dioxide absorption, and whether below ground biomass accumulation should also be included, as recommended in the 2006 IPCC accounting manuals.

Emissions from Non-Fossil Fuels and Gas Flaring

As noted in Appendix A: Methodology Differences Between the 2006 and 2008 Editions of the National Footprint Accounts in the *Ecological Footprint Atlas 2008*, carbon dioxide emissions from land use change were added to the 2008 Edition of the National Footprint Accounts. The Accounts continue to only allocate this to the global total, but not individual countries. Fugitive emissions from flaring of associated gas in oil and gas production, industrial emissions from cement production, and emissions from tropical forest fires and from some forms of biofuel production are also now included in the Accounts (IEA 2007).

Fisheries Yields

Research in the coming year will focus on improving the accuracy of the fishing ground Footprint; initial work has been sponsored by the Oak Foundation. The measurement of fisheries is fraught with methodological and data challenges. This initial research will review the conceptual foundation for calculating the fishing ground Footprint and biocapacity, and identify more effective ways to calculate upper harvesting limits.

Constant Yield Calculations

In order to more meaningfully interpret time series, a method will be developed to convert global hectares, which represent an amount of actual productivity that varies each year, into constant global hectares. The latter would reflect productivity increases over time by pegging productivity against a global hectare of a fixed year. This would also have implications for the calculation of equivalence factors, which might then more accurately reflect changes over time in the relative productivity of the various area types.

Policy Linkages and Institutional Context

The link between the National Footprint Accounts and other existing standards for economic and environmental accounts needs to be made more explicit. These latter standards include the System of National Accounts, the System of Environmental and Economic Accounting (United Nations et al. 2003), the European Strategy for Environmental Accounting, spatial and remote sensing databases, existing ecosystem and natural capital accounting frameworks, and greenhouse gas and carbon dioxide reporting conventions. This is particularly relevant when the National Footprint Accounts are disaggregated by consumption components. It also is pertinent the assessment of trade flows. One step in this process was the adoption of standard product codes, such as HS2002 or SITC rev.3 (UN Comtrade 2007), for product classification since the 2008 Edition of the National Footprint Accounts.

Research Collaborations

Global Footprint Network serves as the steward of the National Footprint Accounts, which record both a country's resource availability and its resource use. In an effort to make the Accounts as accurate and complete as possible, Global Footprint Network invites national governments to participate in research collaborations to improve their National Footprint Accounts. Global Footprint Network encourages any country to seek a research collaboration with the Network to test and improve the Accounts.

The National Footprint Accounts are calculated using millions of data points. The Accounts include more than 241 countries, territories, and regions, where data is available from 1961 to 2006. To ensure the most robust resource accounting database, Global Footprint Network actively engages with governments to review source data, create solutions-based tools utilizing the National Footprint Accounts, and providing feedback and support for statistical agencies.

With improved data and methodology the Ecological Footprint can provide relevant and robust resource-use information that national, regional, and local decision-makers can use to establish policy and budget priorities that take into account the supply of and demand on ecological assets.

Completed government reviews of the Ecological Footprint methodology

The first of these was completed by the government of Switzerland. Four Swiss government agencies led the effort and the Swiss Statistical Offices published the review in 2006. The report exists in English, French, German and Italian. They also published a more technical background report (available only in English). Switzerland features the Ecological Footprint among its sustainability indicators (MONET) since 2009.

The European Commission's DG Environment recently concluded its review of the Ecological Footprint with a 350-page report which is highly supportive of the measure and confirms Global Footprint Network's research agenda. The report can be downloaded at: "Potential of the Ecological Footprint for monitoring environmental impact from natural resource use".

Recently, the Service de l'Observation et des Statistiques (SOeS) of the French Ministry of Sustainable Development produced the study Une expertise de l'empreinte écologique (May 2009, No 4), which examined the transparency and reproducibility of the National Footprint Accounts. The report documents that their research team was able to reproduce Ecological Footprint trends within 1-3 percent of the values published by Global Footprint Network. SOeS' initial report is available at http://www.ifen.fr/uploads/media/etudes_documentsN4.pdf or see http://www.ifen.fr/publications/nos-publications/etudes-documents/2009/une-expertise-de-l-empreinte-ecologique-version-provisoire.html.

Other reviews of the Ecological Footprint have been conducted by Eurostat, the statistical agency of the European Union (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-AU-06-001/EN/KS-AU-06-001-EN.PDF), Germany (http://www.umweltdaten.de/publikationen/fpdf-l/3489.pdf), Ireland (http://erc.epa.ie/safer/iso19115/displayISO19115.jsp?isoID=56#files), and

Belgium (www.wwf.be/_media/04-lies-janssen-ecologische-voetafdrukrekeningen_236536.pdf).

The United Arab Emirates is currently completing a review of the Ecological Footprint, and Ecuador is preparing to begin a research collaboration reviewing the Ecological Footprint in late 2009.

For example, Global Footprint Network is currently engaged in a research initiative with the United Arab Emirates, in collaboration with the UAE Ministry of Environment and Water (MoEW), the Abu Dhabi Global Environmental Data Initiative (AGEDI), the Emirates Wildlife Society, and the World Wide Fund for Nature (EWS-WWF). Called Al Basama Al Beeiya (Ecological Footprint), this initiative involves multiple stakeholders across the nation working together to improve the UAE's National Footprint Accounts data and to extend Ecological Footprint analysis into national policy by developing guidelines for more a resource-conscious and resource-efficient nation.

How are countries using their National Footprint Accounts?

Countries, especially but not only those that have engaged in research collaborations with Global Footprint Network, use their National Footprint Accounts to better understand the demands they are placing on productive ecosystems, and the capacity they have internally or are accessing elsewhere to meet these demands. This can help them identify resource constraints and dependencies, as well as recognize resource opportunities. In addition, countries use their Ecological Footprint and biocapacity data for:

- Exploring policy creation, to:
  - Protect national interests and leverage existing opportunities;
  - Bring their economies in line with global limits, including planning for a low-carbon future;
  - Foster innovation that maintains or improves quality of life while reducing dependence on ecological capacity.
- Leveraging trade opportunities, to:
  - Create a strong trade position for exports by better understanding who has ecological reserves and who does not;
  - Minimize and prioritize external resource needs.
- Creating a baseline for setting goals and monitoring progress toward lasting and sustainable economic development; in particular, to guide investment in infrastructure that is both efficient in its use of resources, and resilient if supply disruptions occur.

- Providing a complementary metric to GDP that can help lead to a better way of gauging human progress and development.

For more information on resource collaborations, please contact data@footprintnetwork.org.

Frequently Asked Questions

How is the Ecological Footprint calculated?

The Ecological Footprint measures the amount of biologically productive land and water area required to produce the resources an individual, population or activity consumes and to absorb the waste they generate, given prevailing technology and resource management. This area is expressed in global hectares, hectares with world-average biological productivity. Footprint calculations use yield factors to take into account national differences in biological productivity (e.g., tonnes of wheat per UK hectare versus per Argentina hectare) and equivalence factors to take into account differences in world average productivity among land types (e.g., world average forest versus world average cropland).

Footprint and biocapacity results for nations are calculated annually by Global Footprint Network. The continuing methodological development of these National Footprint Accounts is overseen by a formal review committee (www.footprintstandards.org/committees). A detailed methods paper and copies of sample calculation sheets can be obtained at no charge; see www.footprintnetwork.org./atlas.

Why is the global total Ecological Footprint not equal to the sum of all national Footprints?

The Ecological Footprint of humanity as a whole is calculated by applying the standard Ecological Footprint methodology to global aggregate data. There are several sources of discrepancies between the calculated world Footprint and the sum of all the national Footprints. The main reasons for differences are listed here, in descending order of significance to the 2009 edition of the National Footprint Accounts:

- Carbon dioxide emissions from non-fossil-fuel sources. The carbon component of the Ecological Footprint includes a broad category of non-fossil-fuel carbon dioxide emissions. This group combines emissions from industrial processes, land-use change and flaring associated with oil and natural gas production. It also includes emissions from chemical reactions during cement production, and from the production of some biofuels. For lack of a suitable means of allocating these emissions to final consumption activities, the Footprint of emissions in this category is included only in the global total. This category accounts for 15 percent of the world's carbon emissions, or approximately 0.2 gha per person.
- The grazing Footprints of production of individual nations are capped at biocapacity. Since the annual productivity of grazing land accounts for nearly all available above-ground biomass, overshoot in this component is only physically possible for very short periods of time. For this reason, a nation's grazing gand Footprint of production is not allowed to exceed its calculated biocapacity. Sixty-seven nations are affected by this cap, though on the global scale the grazing land Footprint is less than the biocapacity. In total the national caps on grazing land Footprint remove approximately 20 percent of the global grazing land Footprint.
- The raw data contains discrepancies. Because much of the raw data used to calculate the National Footprint Accounts is based on self-reporting by individual countries, there are some discrepancies in reported values. This is particularly apparent in trade flows, where the sum of all countries' reported imports of a given commodity does not exactly equal the sum of their reported exports. More than 40 percent of the world's Ecological Footprint is allocated through international trade. Discrepancies among countries' reported import and export quantities contribute to differences between the total global Footprint and the sum of the individual Footprints of all countries.

What does a per person national Footprint actually mean?

A per person national Footprint measures the amount of bioproductive space under constant production required to support the average individual of that country. For example, a five-hectare per person Footprint means that an average individual in that country uses all of the services produced in a year by five hectares of world-average productive land. This land does not need to be within the borders of the individual's country as biocapacity is often embodied in goods imported from other countries to meet consumption demands.

What is included in the Ecological Footprint? What is excluded?

To avoid exaggerating human demand on nature, the Ecological Footprint includes only those aspects of resource consumption and waste production for which the Earth has regenerative capacity, and where data exist that allow this demand to be expressed in terms of productive area. For example, freshwater withdrawal is not included in the Footprint, although the energy used to pump or treat it is.

Ecological Footprint accounts provide snapshots of past resource demand and availability. They do not predict the future. Thus, while the Footprint does not estimate future losses caused by present degradation of ecosystems, if persistent this degradation will likely be reflected in future accounts as a loss of biocapacity.

Footprint accounts also do not indicate the intensity with which a biologically productive area is being used, nor do they pinpoint specific biodiversity pressures. Finally, the Ecological Footprint is a biophysical measure; it does not evaluate the essential social and economic dimensions of sustainability.

How do you measure biocapacity and how do you determine how much is available?

Biocapacity per person is calculated by taking the total amount of bioproductive land worldwide and dividing it by world population. It is a globally aggregated measure of the amount of land and sea area available per person to produce crops (cropland), livestock (grazing land), timber products (forest) and fish (fishing grounds), and to support infrastructure (built-up-land). A nation's biocapacity may include more global hectares than the nation has actual hectares if its land and sea area are highly productive. Biocapacity assessments reflect technological advancements that increase yields, as the conversion of hectares into global hectares takes into account productivity.

How does the Ecological Footprint account for the use of fossil fuels?

Fossil fuels such as coal, oil, and natural gas are extracted from the Earth's crust rather than produced by current ecosystems. When burning this fuel, carbon dioxide is produced. In order to avoid carbon dioxide accumulation in the atmosphere, in accordance with the goal of the UN Framework Convention on Climate Change, two options exist: a) human technological sequestration, such as deep well injection; or b) natural sequestration. Natural sequestration corresponds to the biocapacity required to absorb and store the CO_2 not sequestered by humans, less than the amount absorbed by the oceans. This is the Footprint for fossil fuels. Currently, negligible amounts of CO_2 are sequestered through human technological processes.

The sequestration rate used in Ecological Footprint calculations is based on an estimate of how much carbon the world's forests can remove from the atmosphere and retain. One 2006 global hectare can absorb the CO_2 released by burning approximately 1,525 litres of gasoline per year.

The fossil fuel Footprint does not suggest that carbon sequestration is the key to resolving global warming. Rather the opposite: It shows that the biosphere does not have sufficient capacity to cope with current levels of CO_2 emissions. As forests mature, their CO_2 sequestration rate approaches zero, and the Footprint per tonne of CO_2 sequestration increases. Eventually, forests may even become net emitters of CO_2.

How is international trade taken into account?

The national Ecological Footprint accounts calculate each country's net consumption by adding its imports to its production and subtracting its exports. This means that the resources used for producing a car that is manufactured in Japan, but sold and used in India, will contribute to the Indian, not the Japanese consumption Footprint.

The resulting national consumption Footprints can be distorted, since the resources used and waste generated in making products for export are not fully documented. This can bias the Footprints of countries whose trade-flows are large relative to their overall economies. These misallocations, however, do not affect the total global Ecological Footprint.

Does the Ecological Footprint take into account other species?

The Ecological Footprint describes human demand on nature. Currently, there are 1.8 global hectares of biocapacity available per person on planet Earth, less if some of the biologically productive area is set aside for use by wild species. The value society places on biodiversity will determine how much biocapacity should be reserved for the use of non-domesticated species. Efforts to increase biocapacity, such as through monocropping and the application of pesticides, may at the same time increase pressure on biodiversity; this means a larger reserve may be required to achieve the same conservation results.

If the world has been in overshoot for the past 20 years, why haven't we already run out of resources?

Humanity's demand first began to overshoot global biocapacity in the 1980s. Every year since, the rate at which the planet can regenerate resources has not been sufficient to keep up with the rate at which humanity has been using these resources. In 2006, this overshoot, or excess demand, was approximately 40 percent greater than the Earth's ability to meet this demand.

Regenerative capacity refers to the rate at which nature can take dispersed matter and turn it into resources, defined as concentrated and structured matter that humans find useful in one way or another. While the Earth is largely a closed system in terms of matter — there is little leaving the planet or arriving from space — it is an open system in terms of energy. This is fortunate, because without this input of energy, resources would be depleted, wastes would accumulate, and the planet would become an increasingly inhospitable place. Energy from the sun powers nature's regenerative processes, which act like a giant recycling machine, converting waste back into resources, and in doing so, maintaining the narrow range of conditions that have allowed humans to live and prosper on the planet.

Ecological Footprint methodology measures both the capacity of nature's recycling system — its biocapacity; and the demands humans are placing on it — their Footprint. There are two ways humanity's Footprint can overshoot the Earth's regenerative capacity: by using resources faster than the planet's living systems can regenerate them; or by degrading and dispersing matter — by creating waste — faster than nature can turn this waste into resources. This matter may be harvested from ecosystems, such forest or cropland, that exist on the surface of the planet; or it may be extracted from the Earth's crust in the form, for example, of fossil fuels. When regenerative capacity is exceeded by overharvesting, ecosystems become depleted, and if this depletion continues for too long, they collapse, sometimes with a permanent loss of productivity. When regenerative capacity is exceeded by extracting matter from the crust and dispersing it faster than it can be captured and concentrated by living systems, wastes begin to accumulate. The burning of fossil fuels, for example, is causing carbon dioxide to accumulate in the atmosphere and the oceans.

If overshoot was all due to overharvesting, standing stocks of renewable resources would be rapidly depleted. This is happening in fisheries, for example, where fish populations have dramatically collapsed, although data limitations make it difficult to show this in current Footprint accounts. However, to a considerably greater extent overshoot has resulted from bringing material up from the Earth's crust and dispersing it at a rate much faster than living systems can sequester it. As a result, we are depleting ecosystem stocks — trees, for example — at a slower rate than would be the case if all of overshoot was accounted for by overharvesting. This is why we have not yet run out of resources.

Does the Ecological Footprint say what is a "fair" or "equitable" use of resources?

The Footprint documents what happened in the past. It can quantitatively describe the ecological resources used by an individual or a population, but it does not prescribe what they should be using. Resource allocation is a policy issue, based on societal beliefs about what is or is not equitable. Thus, while Footprint accounting can determine the average biocapacity that is available per person, it does not stipulate how that biocapacity should be allocated among individuals or nations. However, it provides a context for such discussions.

Does the Ecological Footprint matter if the supply of renewable resources can be increased and advances in technology can slow the depletion of non-renewable resources?

The Ecological Footprint measures the current state of resource use and waste generation. It asks: In a given year, did human demand on ecosystems exceed the ability of ecosystems to meet this demand? Footprint analysis reflects both increases in the productivity of renewable resources (for example, if the productivity of cropland is increased, then the Footprint of 1 tonne of wheat will decrease) and technological innovation (for example, if the paper industry doubles the overall efficiency of paper production, the Footprint per tonne of paper will be cut by half). Ecological Footprint accounts capture these changes as they occur and can determine the extent to which these innovations have succeeded in bringing human demand within the capacity of the planet's ecosystems. If there is a sufficient increase in ecological supply and a reduction in human demand due to technological advances or other factors, Footprint accounts will show this as the elimination of global overshoot.

Does the Ecological Footprint ignore the role of population growth as a driver in humanity's increasing consumption?

The total Ecological Footprint of a nation or of humanity as a whole is a function of the number of people consuming, the quantity of goods and services an average person consumes, and the resource intensity of these goods and services. Since Footprint accounting is historical, it does not predict how any of these factors will change in the future. However, if population grows or declines (or any of the other factors change), this will be reflected in future Footprint accounts.

Footprint accounts also show how resource consumption is distributed among regions. For example, the total Footprint of the Asia-Pacific region, with its large population but low per person Footprint, can be directly compared to that of North America, with its much smaller population but much larger per person Footprint.

How do I calculate the Ecological Footprint of a city or region?

While the calculations for global and national Ecological Footprints have been standardized within the National Footprint Accounts, there are a variety of ways used to calculate the Footprint of a city or region. The family of "process-based" approaches use production recipes and supplementary statistics to allocate the national per person Footprint to consumption categories (e.g. food, shelter, mobility, goods and services). Regional or municipal average per person Footprints are calculated by scaling these national results up or down based on differences between national and local consumption patterns. The family of input-output approaches use monetary, physical or hybrid input-output tables for allocating overall demand to consumption categories.

There is growing recognition of the need to standardize sub-national Footprint application methods in order to increase their comparability across studies and over time. In response to this need, methods and approaches for calculating the Footprint of cities and regions are currently being aligned through the global Ecological Footprint Standards initiative. For more information on current Footprint standards and ongoing standardization debates, see www.footprintstandards.org.

For additional information about Footprint methodology, data sources, assumptions, and definitions please read the *Guidebook to the National Footprint Accounts 2009 Edition* and *Calculation Methodology for the National Footprint Accounts, 2009 Edition*.

http://www.footprintnetwork.org/atlas.

Glossary

Acre: One U.S. acre is equal to 0.405 hectares. For U.S. audiences, Footprint results are often presented in global acres (ga), rather than global hectares (gha).

Biodiversity buffer: The amount of biocapacity set aside to maintain representative ecosystem types and viable populations of species. How much needs to be set aside depends on biodiversity management practices and the desired outcome.

Biological capacity, or biocapacity: The capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and extraction technologies. "Useful biological materials" are defined as those used by the human economy. Hence what is considered "useful" can change from year to year (e.g. use of corn (maize) stover for cellulosic ethanol production would result in corn stover becoming a useful material, and thus increase the biocapacity of maize cropland). The biocapacity of an area is calculated by multiplying the actual physical area by the yield factor and the appropriate equivalence factor. Biocapacity is usually expressed in global hectares.

Biological capacity available per person (or per person): There were 11.9 billion hectares of biologically productive land and water on this planet in 2006. Dividing by the number of people alive in that year, 6.6 billion, gives 1.8 global hectares per person. This assumes that no land is set aside for other species that consume the same biological material as humans.

Biologically productive land and water: The land and water (both marine and inland waters) area that supports significant photosynthetic activity and the accumulation of biomass used by humans. Non-productive areas as well as marginal areas with patchy vegetation are not included. Biomass that is not of use to humans is also not included. The total biologically productive area on land and water in 2006 was approximately 11.9 billion hectares.

Carbon Footprint: When used in Ecological Footprint studies, this term is synonymous with demand on CO2 area. The phrase "Carbon Footprint" has been picked up in the climate change debate. Several web-calculators use the phrase "carbon Footprint". Many just calculate tonnes of carbon, or tonnes of carbon per Euro, rather than demand on bioproductive area. The Ecological Footprint encompasses the carbon Footprint, and captures the extent to which measures for reducing the carbon Footprint lead to increases in other Footprint components.

CO2 area (also CO2 land): The demand on biocapacity required to sequester (through photosynthesis) the carbon dioxide (CO_2) emissions from fossil fuel combustion. Although fossil fuels are extracted from the Earth's crust and are not regenerated in human time scales, their use demands ecological services if the resultant CO_2 is not to accumulate in the atmosphere. The Ecological Footprint, therefore, includes the biocapacity, typically that of unharvested forests, needed to absorb that fraction of fossil CO_2 that is not absorbed by the ocean.

Consumption: Use of goods or of services. The term "consumption" has two different meanings, depending on context. As commonly used in regard to the Footprint, it refers to the use of goods or services. A consumed good or service embodies all the resources, including energy, necessary to provide it to the consumer. In full life-cycle accounting, everything used along the production chain is taken into account, including any losses along the way. For example, consumed food includes not only the plant or animal matter people eat or waste in the household, but also that lost during processing or harvest, as well as all the energy used to grow, harvest, process and transport the food.

As used in Input-Output analysis, consumption has a strict technical meaning. Two types of consumption are distinguished: intermediate and final. According to the (economic) System of National Accounts terminology, intermediate consumption refers to the use of goods and services by a business in providing goods and services to other businesses. Final consumption refers to non-productive use of goods and services by households, the government, the capital sector, and foreign entities.

Consumption components (also consumption categories): Ecological Footprint analyses can allocate total Footprint among consumption components, typically food, shelter, mobility, goods, and services, often with further resolution into sub-components. Consistent categorization across studies allows for comparison of the Footprint of individual consumption components across regions, and the relative contribution of each category to the region's overall Footprint. To avoid double counting, it is important to make sure that consumables are allocated to only one component or sub-component. For example, a refrigerator might be included in the food, goods, or shelter component, but only in one.

Consumption Footprint: The most commonly reported type of Ecological Footprint. It is the area used to support a defined population's consumption. The consumption Footprint (in gha) includes the area needed to produce the materials consumed and the area needed to absorb the waste. The consumption Footprint of a nation is calculated in the National Footprint Accounts as a nation's primary production Footprint plus the Footprint of imports minus the Footprint of exports, and is thus, strictly speaking, a Footprint of apparent consumption. The national average or per person Consumption Footprint is equal to a country's Consumption Footprint divided by its population.

Consumption Land Use Matrix: Starting with data from the National Footprint Accounts, a Consumption Land Use Matrix allocates the six major Footprint land uses (shown in column headings, representing the five land types and CO_2 area) to the five Footprint consumption components (row headings). Each consumption component can be disaggregated further to display additional information. These matrices are often used as a tool to develop sub-national (e.g. state, county, city) Footprint assessments. In this case, national data for each cell is scaled up or down depending on the unique consumption patterns in the state, county or city.

Conversion factor: A generic term for factors that are used to translate a material flow expressed within one measurement system into another one. For example, a combination of two conversion factors —"yield factors" and "equivalence factors"— translates hectares into global hectares. The extraction rate conversion factor translates a secondary product into primary product equivalents.

Conversion Factor Library: See Footprint Intensity Table.

Daughter product: The product resulting from the processing of a parent product. For example wood pulp, a secondary product, is a daughter product of roundwood. Similarly, paper is a daughter product of wood pulp.

Double counting: In order not to exaggerate human demand on nature, Footprint Accounting avoids double counting, or counting the same Footprint area more than once. Double counting errors may arise in several ways. For example, when adding the Ecological Footprints in a production chain (e.g., wheat farm, flour mill, and bakery), the study must count the cropland for growing wheat only once to avoid double counting. Similar, but smaller, errors can arise in analyzing a production chain when the end product is used to produce the raw materials used to make the end product (e.g. steel is used in trucks and earthmoving equipment used to mine the iron that is made into the steel). Finally, when land serves two purposes (e.g. a farmer harvests a crop of winter wheat and then plants corn to harvest in the fall), it is important not to count the land area twice. Instead, the yield factor is adjusted to reflect the higher bioproductivity of the double-cropped land.

Ecological debt: The sum of annual ecological deficits. Humanity's Footprint first exceeded global biocapacity in the 70s or 80s, and has done so every year since. By 2006 this annual overshoot had accrued into an ecological debt that exceeded 2.5 years of the Earth's total productivity.

Ecological deficit/reserve: The difference between the biocapacity and Ecological Footprint of a region or country. An ecological deficit occurs when the Footprint of a population exceeds the biocapacity of the area available to that population. Conversely, an ecological reserve exists when the biocapacity of a region or country exceeds the Footprint of its population. If there is a regional or national ecological deficit, it means that the region or country is either importing biocapacity through trade, liquidating its own ecological assets, or emitting wastes into a global commons such as the atmosphere. In contrast, the global ecological deficit cannot be compensated through trade, and is equal to overshoot.

Ecological Footprint: A measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. The Ecological Footprint is usually measured in global hectares. Because trade is global, an individual or country's Footprint includes land or sea from all over in the world. Ecological Footprint is often referred to in short form as Footprint. "Ecological Footprint" and "Footprint" are proper nouns and thus should always be capitalized.

Ecological Footprint Standards: Specified criteria governing methods, data sources and reporting to be used in Footprint studies. Standards are established by the Global Footprint Network Standards Committees, composed of scientists and Footprint practitioners from around the world. Standards serve to produce transparent, reliable and mutually comparable results in studies done throughout the Footprint Community. Where Standards are not appropriate, Footprint Guidelines should be consulted. For more information, consult www.footprintstandards.org.

Ecological reserve: See ecological deficit/reserve.

Embodied energy: Embodied energy is the energy used during a product's entire life cycle in order to manufacture, transport, use and dispose of the product. Footprint studies often use embodied energy when tracking the trade of goods.

Energy Footprint: The sum of all areas used to provide non-food and non-feed energy. It is the sum of CO_2 area, hydropower land, forest for fuelwood, and cropland for fuel crops.

Equivalence factor: A productivity-based scaling factor that converts a specific land type (such as cropland or forest) into a universal unit of biologically productive area, a global hectare. For land types (e.g. cropland) with productivity higher than the average productivity of all biologically productive land and water area on Earth, the equivalence factor is greater than one. Thus, to convert an average hectare of cropland to global hectares, it is multiplied by the cropland equivalence factor of 2.64. Pasture lands, which have lower productivity than cropland, have an equivalence factor of 0.50 (see also yield factor). In a given year, equivalence factors are the same for all countries.

Extraction rate: A processing factor comparing the quantity of a parent product to the quantity of the resulting daughter product. When a parent product is processed its mass changes. For example, when wheat is processed into white flour, the bran and germ are stripped, lessening its mass. Therefore, in order to calculate the number of hectares needed to produce a given mass of flour, an extraction rate is needed. This extraction rate in this example is the ratio of tonnes of flour divided by the tonnes of wheat processed to produce the flour.

Footprint intensity: The number of global hectares required to produce a given quantity of resource or absorb a given quantity of waste, usually expressed as global hectares per tonne. The National Footprint Accounts calculate a primary Footprint Intensity Table for each country, which includes the global hectares of primary land use type needed to produce or absorb a tonne of product (i.e., global hectares of cropland per tonne of wheat, global hectares of forest per tonne carbon dioxide)."

Footprint Intensity Table: A collection of the primary and secondary product Footprint intensities from the National Footprint Accounts. Footprint intensity is usually measured in gha per tonne of product or waste (CO_2). The Footprint Intensity Table is maintained by Global Footprint Network, supported by the Network's National Accounts Committee.

Footprint-neutral or negative: Human activities or services that result in no increase or a net reduction in humanity's Ecological Footprint. For example, the activity of insulating an existing house has a Footprint for production and installation of the insulation materials. This insulation in turn reduces the energy needed for cooling and heating this existing house. If the Footprint reduction from this energy cutback is equal to or greater than the original Footprint of insulating the house, the latter becomes a Footprint-neutral or negative activity. On the other hand, making a new house highly energy efficient does not by itself make the house Footprint-neutral, unless it at the same time causes a reduction in other existing Footprints. This Footprint reduction has to be larger than the Footprint of building and operating the new house.

Global hectare (gha): A productivity-weighted area used to report both the biocapacity of the Earth, and the demand on biocapacity (the Ecological Footprint). The global hectare is normalized to the area-weighted average productivity of biologically productive land and water in a given year. Because different land types have different productivity, a global hectare of, for example, cropland, would occupy a smaller physical area than the much less biologically productive pasture land, as more pasture would be needed to provide the same biocapacity as one hectare of cropland. Because world bioproductivity varies slightly from year to year, the value of a gha may change slightly from year to year.

Guidelines (for Footprint studies): Suggested criteria governing methods, data sources and reporting for use when Footprint Standards are not appropriate or not yet developed.

Hectare: 1/100th of a square kilometre, 10,000 square meters, or 2.471 acres. A hectare is approximately the size of a soccer field. See also global hectare and local hectare.

IO (Input-Output) analysis: Input-Output (IO, also I-O) analysis is a mathematical tool widely used in economics to analyze the flows of goods and services between sectors in an economy, using data from IO tables. IO analysis assumes that everything produced by one industry is consumed either by other industries or by final consumers, and that these consumption flows can be tracked. If the relevant data are available, IO analyses can be used to track both physical and financial flows. Combined economic-environment models use IO analysis to trace the direct and indirect environmental impacts of industrial activities along production chains, or to assign these impacts to final demand categories. In Footprint studies, IO analysis can be used to apportion Footprints among production activities, or among categories of final demand, as well as in developing Consumption Land Use Matrices.

IO (Input-Output) tables: IO tables contain the data that are used in IO analysis. They provide a comprehensive picture of the flows of goods and services in an economy for a given year. In its general form an economic IO table shows uses — the purchases made by each sector of the economy in order to produce their own output, including purchases of imported commodities; and supplies — goods and services produced for intermediate and final domestic consumption and exports. IO tables often serve as the basis for the economic National Accounts produced by national statistical offices. They are also used to generate annual accounts of the Gross Domestic Product (GDP).

Land type: The Earth's approximately 11.9 billion hectares of biologically productive land and water are categorized into five types of surface area: cropland, grazing land, forest, fishing ground, and built-up land. Also called "area type".

Life cycle analysis (LCA): A quantitative approach that assess a product's impact on the environment throughout its life. LCA attempts to quantify what comes in and what goes out of a product from "cradle to grave," including the energy and material associated with materials extraction, product manufacture and assembly, distribution, use and disposal, and the environmental emissions that result. LCA applications are governed by the ISO 14040 series of standards (http://www.iso.org).

Local hectare: A productivity-weighted area used to report both the biocapacity of a local region, and the demand on biocapacity (the Ecological Footprint). The local hectare is normalized to the area-weighted average productivity of the specified region's biologically productive land and water. Hence, similar to currency conversions, Ecological Footprint calculations expressed in global hectares can be converted into local hectares in any given year (e.g. Danish hectares, Indonesian hectares) and vice versa. The number of Danish hectares equals the number of bioproductive hectares in Denmark – each Danish hectare would represent an equal share of Denmark's total biocapacity.

National Footprint Accounts: The central data set that calculates the Footprints and biocapacities of the world and roughly 126 nations from 1961 to the present (generally with a three-year lag due to data availability). The ongoing development, maintenance and upgrades of the National Footprint Accounts are coordinated by Global Footprint Network and its 90-plus partners.

Natural capital: Natural capital can be defined as all of the raw materials and natural cycles on Earth. Footprint analysis considers one key component, life-supporting natural capital, or ecological capital for short. This capital is defined as the stock of living ecological assets that yield goods and services on a continuous basis. Main functions include resource production (such as fish, timber or cereals), waste assimilation (such as CO_2 absorption or sewage decomposition) and life-support services (such as UV protection, biodiversity, water cleansing or climate stability).

Overshoot: Global overshoot occurs when humanity's demand on nature exceeds the biosphere's supply, or regenerative capacity. Such overshoot leads to a depletion of Earth's life-supporting natural capital and a build-up of waste. At the global level, ecological deficit and overshoot are the same, since there is no net-import of resources to the planet. Local overshoot occurs when a local ecosystem is exploited more rapidly than it can renew itself.

Parent product: The product processed to create a daughter product. For example wheat, a primary product, is a parent product of flour, a secondary product. Flour, in turn, is a parent product of bread.

Planet equivalent(s): Every individual and country's Ecological Footprint has a corresponding Planet Equivalent, or the number of Earths it would take to support humanity's Footprint if everyone lived like that individual or average citizen of a given country. It is the ratio of an individual's (or country's per person) Footprint to the per person biological capacity available on Earth (1.8 gha in 2006). In 2006, the world average Ecological Footprint of 2.6 gha equals 1.44 Planet equivalents.

Primary product: In Footprint studies, a primary product is the least-processed form of a biological material that humans harvest for use. There is a difference between the raw product, which is all the biomass produced in a given area, and the primary product, which is the biological material humans will harvest and use. For example, a fallen tree is a raw product that, when stripped of its leaves and bark, results in the primary product of roundwood. Primary products are then processed to produce secondary products such as wood pulp and paper. Other examples of primary products are potatoes, cereals, cotton and forage. Examples of secondary products are kWh of electricity, bread, clothes, beef and appliances.

Primary production Footprint (also primary demand): In contrast to the consumption Footprint, a nation's primary production Footprint is the sum of the Footprints for all the resources harvested and all of the waste generated within the defined geographical region. This includes all the area within a country necessary for supporting the actual harvest of primary products (cropland, pasture land, forestland and fishing grounds), the country's built-up area (roads, factories, cities), and the area needed to absorb all fossil fuel carbon emissions generated within the country. In other words, the forest Footprint represents the area necessary to regenerate all the timber harvested (hence, depending on harvest rates, this area can be bigger or smaller than the forest area that exists within the country). Or, for example, if a country grows cotton for export, the ecological resources required are not included in that country's consumption Footprint; rather, they are included in the consumption Footprint of the country that imports the t-shirts. However, these ecological resources are included in the exporting country's primary production Footprint.

Productivity: The amount of biological material useful to humans that is generated in a given area. In agriculture, productivity is called yield.

Secondary product: All products derived from primary products or other secondary products through a processing sequence applied to a primary product.

Tonnes: All figures in the National Footprint Accounts are reported in metric tonnes. One metric tonne equals 1000 kg, or 2205 lbs.

Yield: The amount of primary product, usually reported in tonnes per year, that humans are able to extract per-area unit of biologically productive land or water.

Yield factor: A factor that accounts for differences between countries in productivity of a given land type. Each country and each year has yield factors for cropland, grazing land, forest, and fisheries. For example, in 2006, German cropland was 2.1 times more productive than world average cropland. The German cropland yield factor of 2.1, multiplied by the cropland equivalence factor of 2.4, converts German cropland hectares into global hectares: One hectare of cropland is equal to 5.0 gha.

Note that primary product and primary production Footprint are Footprint-specific terms. They are not related to, and should not be confused with, the ecological concepts of primary production, gross primary productivity (GPP) and net primary productivity (NPP).

www.footprintnetwork.org

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Global Footprint Network
Advancing the Science of Sustainability

Global Footprint Network is an international think tank working to advance sustainability through use of the Ecological Footprint, a resource accounting tool that measures how much nature we have, how much we use, and who uses what. By making ecological limits central to decisionmaking, we are working to end overshoot and create a society where all people can live well, within the means of one planet. Global Footprint Network has offices in Oakland (California, USA), Brussels (Belguim), Zurich (Switzerland), and Washington, DC (USA).

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