The Ecological Footprint

Answering Questions Raised at European Commission Workshop:

Coming to grips with key indicators: Applying the Ecological Footprint

1 March 2011, 9:30 – 13:00

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Global Footprint Network
Advancing the Science of Sustainability

www.footprintnetwork.org

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What the Ecological Footprint measures

How much of the biosphere's regenerative capacity does humanity (or any human activity) demand? The Ecological Footprint accounts are developed to answer this one particular research question, nothing else.

For a population, this question becomes: *How much of the planet's (or a region's) regenerative capacity is demanded to provide all the ecological services (that are competing for mutually exclusive space) a specified population demands, including all the resources that the population consumes and to absorb all its waste, using prevailing technology?*

Accounts have typically two sides. For example, financial balance sheets include both "expenditure" and "income". Similarly, Footprint accounts compare demand on biocapacity (Footprint) against availability of biocapacity.

The Ecological Footprint emerged as a response to the challenge of sustainable development, which aims at securing human well-being within planetary constraints. By staying within planetary constraints, one makes sure that biocapacity is available now and for future generations. The ambition lying behind Footprint accounts is to provide motivational, managerial and monitoring capacity for assessing and dealing with these biophysical constraints.

Why biocapacity?

The quantity of human and non-human life on this planet is limited by the biosphere's regenerative capacity and it is upon this premise that the Ecological Footprint tool is built. This limitation also includes access to non-renewable resources from the lithosphere. For instance, the primary lithosphere resource, fossil fuel, is most restricted by the planet's biocapacity due to the biosphere's limited capacity to absorb waste (in the case of CO_2 emissions from burning fossil fuel). For instance, if humanity burned all the fossil fuel already discovered, the carbon concentration would apparently grow to at least 1700 ppm. Ores are another resource from the lithosphere. Ores and their products are not "used up" but dispersed. Hence, the limiting factor is the energy required to concentrate these materials. This puts the limitation back on energy, which in return is limited by biocapacity.

In a time of increasing ecological constraints, the research question described above could be the most critical one for the twenty-first century and more importantly is one that humanity cannot afford to ignore. Failing to live within the nature's budget will eventually lead to ecological bankruptcy and ultimately collapse. Thus there may be no single research endeavour more important than building an accurate understanding of humanity's demand on the biosphere. This requires an open, transparent and scientific process that can be applied in consistent and reproducible ways.

How criticism is stimulating further development of the Footprint tool

As originators of the method and stewards of the most widely used Ecological Footprints accounts in use today, Global Footprint Network (www.footprintnetwork.org) is the first to acknowledge that the Footprint accounts can and must be improved. As a scientific organization aiming to implement policy relevant tools and analyses, Global Footprint Network depends on input and suggestions from others regarding calculation methods and potential improvements.

There are numerous valid critiques of the Ecological Footprint method, many of which form the basis for an active research agenda as described below. A good summary is provided by Kitzes et al, 2007 –2009, www.footprintnetwork.org/download.php?id=32, http://dx.doi.org/10.1016/j.ecolecon.2008.06.022)

There is incremental criticism on the imperfections of the method, as well as fundamental criticism about the usefulness of the Footprint approach. Valid fundamental criticism falls into two domains:

1) ***Usefulness of the research question:*** "*Is the Footprint's research question relevant to sustainability?*" Global Footprint Network claims that the Footprint question is central to sustainability. Sustainability cannot be meaningful unless the availability or regenerative capacities of the ecological constraints of nature, within whose boundaries sustainable development must act, are known. Thus, just as it is important for farmers to know the size of their farm, whether their farmland extends over 5,000, 500 or 5 hectares, having this knowledge about the capacity of the land makes a significant difference to the opportunities that are available to the farmer; one could contend that the same logic applies for a region or even the whole world. By understanding the restrictions of the planet's capacity and where the limitations lie, humanity can move towards sustainability in an informed manner.

2) ***Quality of current results:*** "*Assuming that the research question is relevant, is the Footprint method, as executed in its latest edition, producing results whose reliability and accuracy are too poor to be useful? In other words, would a government be better off without the results?*" Certainly, the accuracy and detail of the Footprint results need further enhancement. Therefore, Global Footprint Network, which coordinates and implements the most widely used Ecological Footprint Accounts at the national level, together with more than 100 partner organizations from across the world, builds on 20 years of methodological development and continues to refine and develop the tool. Also, it has encouraged a number of national government organizations to test the accounts independently or if requested with technical assistance from Global Footprint Network. In order to prevent exaggeration of the overuse of the planet's regenerative capacity the method is constructed to be conservative. Therefore, the results are most likely an underestimate of overshoot. This only strengthens the argument for a significant and rapid reduction of resource throughput within the human economy in order to secure human wellbeing. Such reductions are in stark contradiction with most policies implemented today. Recognizing this contradiction, as well as the biophysical necessity to avoid staying in overshoot in order to maintain resource availability, it is highly unlikely that humanity, or any nation, would be better off with no Footprint results, despite the current limitations of the Footprint approach.

If the foundations of the Footprint method are accepted, then a third domain of criticism becomes relevant: *How can the method be improved?* Most criticism is relevant to this question and this is the area on which Global Footprint Network's current development of the methodology is focused.

What exactly are Ecological Footprint accounts and how are they being improved?

Sustainable development implies a commitment giving all people the opportunity to lead fulfilling lives within the means of planet Earth. This kind of development continues to be identified as the primary overarching policy goal, as for instance in the merging "Green Economy" debate in the context of Rio2012 or OECD's Green Growth strategy. Yet when it comes to actual environmental strategies and policies are decision makers asking the right questions to lead us towards this goal?

When people catch more fish than fishing grounds can regenerate, fisheries eventually collapse; when people harvest more timber than forests can re-grow, they advance deforestation; when people emit more CO_2 than the biosphere can absorb, CO_2 accumulates in the atmosphere and contributes to global warming. This overuse of renewable resources is called "biocapacity overshoot." To achieve sustainable development, it is crucial to have information regarding humanity's demand, both global and local, on the material flows of the biosphere as well as what the biosphere is actually able to provide, for any given year.

Hence Ecological Footprint accounting compares the actual amount of biological resources produced and the wastes absorbed by the planet in a given year with the number of resources humans extract and how much waste is subsequently generated in that year. This accounting can be done at any scale, from the resource demand of a single activity or a single individual, to that of a city, country, or the entire world. Global Footprint Network's most recent national and global accounts (2010) show that, in 2007, the most recent year for which data are available, humanity continued to be in overshoot[1], demanding approximately 50% more than what the biosphere renewably provided in that year.

These accounts use about 6,000 data points per country and year. The overwhelming majority of these data points are taken from official UN statistics, mainly FAO, COMTRADE, and IEA.

Often accounts are confused with composite indicators, but they are systematically distinct approaches. Accounts start from a clear research question. They use as their measurement element a unit that is relatively substitutable among themselves. Examples include financial accounting, which includes GDP, where dollars are the unit, or greenhouse gas accounts, where the unit is CO_2 equivalents. In the case of Footprint accounting, the unit is global hectares[2]. In none of the accounts are the units universally interchangeable. They are just reasonably good approximation of more or less interchangeable unit. For example one dollar to a low-income person may be worth much more than to a billionaire; yet, the dollar is a good approximation of a comparable unit of purchasing power. In contrast composite indicators, such as a Mercer quality of life indicator which compares the liveability of cities, or the World Economic Forum competitiveness indicator comparing national economies, or Transparency International's corruption perceptions index measuring the perceived

[1] Ecological Overshoot occurs when a population's demand on an ecosystem exceeds the capacity of that ecosystem to regenerate the resources it consumes and to absorb its wastes.

[2] A global hectare is a common unit that encompasses the average productivity of all the biologically productive land and sea area in the world in a given year. Biologically productive areas include cropland, forest and fishing grounds, and do not include deserts, glaciers and the open ocean.

levels of public sector corruption, are a somehow arbitrary aggregation of diverse indicators that are then averaged out according to a particular weighing framework. The upside of indices is that they can be as broad as they wish and cover entire topic areas. The downside is that the results depends on the arbitrary architecture of the index, with assumed or implied trade-offs. In other words, they lack a clear, method independent research question and are therefore at the periphery of truly scientific inquiries. In spite of their limited scientific robustness, indices may still serve useful functions, for instance they can be used as alarm bells, but cannot be used as management tools or for determining trade-offs.

The underlying premise of the Footprint accounts is based on the recognition that the ecological services demanded for human activities are competing for space, which allows biological processes to harvest rain and sunlight. All the mutually exclusive areas needed for all the demanded services then can be added up to the Footprint.

The area that is demanded is calculated by turning the formula for yield on its head. Since yield is defined as:

$$Yield = \frac{Amount\ per\ year}{Area\ occupied}$$

It follows that

$$Area\ occupied = \frac{Amount\ per\ year}{Yield}$$

Rather than expressing the area results in hectares, each hectare is adjusted for their respective biocapacity. These adjusted hectares are called *global hectares* and essentially, these global hectares are biologically productive hectares with world average bioproductivity. They are the standard measurement units for both Footprint and biocapacity. One global hectare worth of any area is (in the idealized theory) able to produce a similar amount of ecological services. It is a "similar" amount, because different hectares across the world do not provide identical services –even so, hectares across biomes and vastly different plant communities, from tropical to boreal, from wet to dry, can be compared for their productivity of meat, cereals, timber, or carbon sequestration capacity.

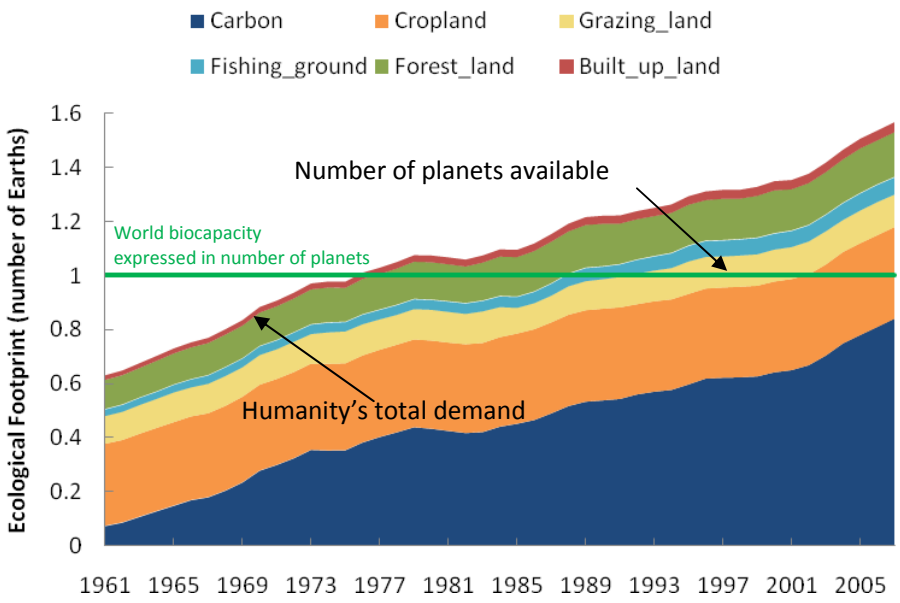

Figure 1: This graph shows the ratio between human demand and the Earth's biocapacity, and the components of the human demand, from 1961 to 2007. [Source Global Footprint Network, National Footprint Accounts edition 2010]

More on this calculation methodology is available through Global Footprint Network, including the *Ecological Footprint Atlas* with the complete 2007 data and results (based on the 2010 edition), a method paper, and a guidebook to the National Footprint Accounts (all available at www.footprintnetwork.org/atlas). In addition to these scientific publications, a summary of the results for the general public is presented in *Living Planet Reports*, published by WWF (the Worldwide Fund for Nature), with support from Global Footprint Network, and the Zoological Society of London (see LPR 2008 and LPR 2010, www.panda.org/livingplanet). The 2010 Edition of the National Footprint Accounts was launched in September 2010. And as with any edition, the 2011 edition launched in fall 2011 will feature a number of improvements.

Common misconceptions, criticisms and questions

1. The Ecological Footprint is biased against international trade

The Ecological Footprint does not bias against trade, but instead simply reports the world as it currently stands with many countries running biocapacity deficits and therefore dependent upon resources from external sources in the form of imports. Like money can be used to describe trade flows, so can the Footprint describe these flows in terms of embodied biocapacity. The Footprint method makes not prescriptions about trade regimes. [3]

2. Are the equivalence factors adequate?

Equivalence factors attempt to compare hectares across various land-uses. They are needed for consistent aggregation of biocapacity. Equivalence factors translate the area of a specific land use type available or demanded into units of world average biologically productive area (expressed in global hectares). Thus, it varies by land use type and year.

Currently, the equivalence factors are calculated as the ratio of the maximum potential ecological productivity of world average land of a specific land use type (e.g. cropland) and the average productivity of all biologically productive lands on Earth. What does this mean?

To calculate equivalence factors Global Footprint Network uses the suitability indexes from FAO's Global Agro-Ecological Zones assessment combined with information about actual areas of cropland, forest, and grazing area from FAOSTAT. The GAEZ model divides all land globally into five categories, each of which is assigned a suitability score:

Very Suitable – 0.9
Suitable – 0.7
Moderately Suitable – 0.5
Marginally Suitable – 0.3
Not Suitable – 0.1

The current equivalence factor calculation assumes that the most productive land is put to its most productive use. The calculations assume that the most suitable land available will be planted to cropland, the next most suitable land will be under forest, and the least suitable land will be grazing area. The equivalence factor is calculated as the ratio of the average suitability index for a given land type divided by the average suitability index for all land types. This means that current (and future) equivalence factors are based on global-average agricultural suitability of various biomes.

For its next National Footprint Account edition (2011), Global Footprint Network will sharpen the calculation method and estimate equivalence factor according to actual land-use (based on GIS maps), rather than merely assuming a hierarchy of land uses. Also, it will isolate the portion of yield change that is human induced as a separate factor. This innovation will allow for more meaningful depictions of time series (the new unit of global hectares will be "constant global hectares". These

[3] Humanity has maintained use of resources outside the realms of settlements since the beginning of civilisation. Indeed most current communities are far from self-sustaining, and exist by drawing upon the resources beyond their borders. Even hunter-gatherer tribes depended on far larger areas than the settlements themselves. Thus the space required to sustain populations has historically been far larger than the main living space of communities. The Ecological Footprint does not present a position on trade. Rather it helps to show that resources within the world are limited. Therefore if all nations run at a biocapacity deficit then there will not be enough natural resources for humanity.

constant global hectares represent a set portfolio amount of products and services an average hectare was able to provide in a given year. In this way, a given level of consumption (and production) can be more meaningfully be compared across years.

3. Are climate changes impacts on Biodiversity included? E.g. droughts, floods etc

Climate change is not directly measured by the Ecological Footprint. Still, loss (or gain) of biocapacity is tracked by the Footprint from year to year (as long as the input data reflect these changes). But it is not possible to determine whether these changes are directly caused by climate change. However, predictions of climate models can be translated into estimates of biocapacity changes. Also annual fluctuation in the biocapacity of countries indicates the country's higher vulnerability to changing weather patterns.

4. Is the Footprint just historical or can it be used to make dynamic forward looking projections?

The Ecological Footprint is, like any accounting system, documenting the past. Limited by global data availability, mainly UN data sets, it still has the ability to provide data for over 200 nations for 46 years (1961-2007). The historical time series help inform discussion about possible future trends. Also, scenario outputs can be translated into Footprint and biocapacity outcomes.

5. The carbon portion of the Footprint seems exaggerated – this is not useful with respect to biodiversity

The Ecological Footprint is a capital maintenance account. It answers how much biocapacity is needed to provide all the services demanded by people. If people demand more services than are being regenerated ("overshoot") then the accounts calculate how much more biocapacity is needed to cover this demand. In the case of the carbon Footprint, the accounts calculate how much biocapacity is needed in order not to increase the carbon concentration in the atmosphere in that year (i.e. not leaving a debt for future generations). If carbon is absorbed through human means or technological intervention, then it is not counted. The accounts only include the carbon which humanity assumes the biosphere will take care of. Given humanity's significant dependence on fossil fuel, it should therefore not surprise, that the carbon Footprint currently makes up such a large proportion of the Ecological Footprint. Note that this was not the case in the past, and is not true either for most lower-income countries.

Hence, the dominance of carbon within the Ecological Footprint is by no means exaggerated, but simply represents the real amount of carbon dioxide that is emitted most prolifically through the burning of fossil fuels. Over the last few years there has been a tendency to focus upon the carbon issue, but this is not the only problem. The Ecological Footprint captures far more issues than the emission of carbon dioxide. Indeed, the Footprint tracks natural resources from different land types and as such the availability of space for biodiversity can be insinuated. The Footprint accounts for the forestry land that is cut down and converted to cropland and therefore implies a loss of biodiversity and eco-system services. Also, if indeed humanity should decide to move aggressively out of fossil fuel, Footprint accounting helps to identify to what extent this move leads to a burden shift to other land types, or truly reduces humanity's demand on biocapacity. Also, less availability of cheap fossil fuel may have a significant impact on agricultural productivity, potentially increasing the land demand for agriculture. This is also captured by Footprint accounting.

6. Need to weigh between environmental issues, e.g. acidification, eutrophication

The Ecological Footprint attempts to measure demand on biocapacity. It does not include aspects outside of that scope. For instance, pollution affecting human health, but not biocapacity (such as noise, or urban air pollution, radioactivity), is not captured by the Footprint.

However, pollution that affects bioproductivity should be included. There the limitation is that the demand on biocapacity of those kinds of pollution is not systematically tracked and therefore there are no globally comparable data sets to include those impacts in Ecological Footprint accounts. Examples of such pollution is acidification or eutrophication (some local Footprint studies have included such pollution impacts).

However, as these pollution effects change biocapacity, this change will be recorded by future biocapacity. But ideally, in more perfect accounts, this change in biocapacity should be debited against the present Footprint.

This omission indicates the general bias of Footprint accounts – the high likelihood that they exaggerate biocapacity and underestimate Footprints.

7. Is Biocapacity fixed? It's not constant, why?

Biocapacity is not fixed. It represents the availability of natural, renewable resources that can be harvested by humanity. The abundance and productivity of natural capital changes each year. For instance natural disasters such as forest fires, or human induced degradation like deforestation, soil loss, climatic impacts or acidification can reduce biocapacity. On the other hand, careful agricultural and forestry management can also magnify biocapacity.

Sometimes, results are presented in terms of "number of planets". This is equivalent to showing the ratio between humanity's Footprint and the planet's biocapacity. Since it is a ratio, only one of the line changes (the one line, representing one planet, does for mathematical reasons not shift; however, note that this does not imply that biocapacity is not changing).

8. Value given for forest land is less than for crop – is that not bad for biocapacity? As you deforest to convert to cropland does then biocapacity not increase? Intensive use of farming – impact on biocapacity, sustainability...

In ideal theory, a global hectare is independent of the chosen land-use. However, in practical application this is not fully true. Still, if a piece of forest is converted into crop land, it is incorrect to assume that biocapacity automatically goes up. While the equivalence factor goes up (cropland hectares represent typically higher biocapacity than forest hectares), the yield factor drops. The latter factor drops because relatively high yielding forest may be converted into relatively low yielding cropland.

9. What is biocapacity?

Biocapacity is shorthand for biological capacity, which is the ability of an ecosystem to produce useful ecological services for humans. This includes regeneration of biological materials and absorption of wastes generated by humans. Biologically productive regions represent the area, both land and water, that support significant photosynthetic activity and biomass accumulation that can be utilised by humanity. There is an interesting debate around biocapacity and whether it is sustainable or can ever have a maximum. As currently measured, biocapacity just measures what is being regenerated, not whether this level of bioproductivity can be maintained.

Global Footprint Network is interested in researching more the "fragility of biocapacity" to get deeper insight into how much of the currently assumed biocapacity may not last due to water, energy or soil constraints.

10. Is the term 'Ecological Footprint' misleading?

The term Ecological Footprint is just a name.

Yet it is now a widely used phrase that intuitive many people can readily understand. The name "Footprint" reflects "area demand" as in "footprint of a satellite" or "footprint of a building."

Ecology is a study of nature's household. One significant lens of the science of ecology is tracking the metabolism and energy flows of nature. That's what "ecological" refers to in "Ecological Footprint." Also note that most of nature is heavily disturbed (or shaped) by human activity – yet continues to be in the realm of ecology.

But yes, since the field of ecology is so vast, there is the potential that the name "Ecological Footprint" could be misunderstood. Which, of course, is true for any name. This is why Global Footprint Network emphasizes that "Ecological Footprint" is a name for a research question: how much biocapacity is demanded by a given human activity?

Global Footprint Network has deliberately not trademarked the term to make it available for public use. To protect its integrity, Global Footprint Network has developed standards and a partner network where partners commit to use the Ecological Footprint term in consistent ways, faithful to the research question and the standards.

The more large institution use the term in consistent ways – such as WWF, WBCSD, UNDP, UNEP, or EEA, the less confusion is being generated. The promotion, and slight distortion of the carbon Footprint by BP was a somehow lucky occurrence. Global Footprint Network had been concerned about the possibility that a large force like BP could totally distort and confuse the concept. But in this case, it has, in spite of the slight distortion from the original concept, helped to promote rather than thwart, the understanding that there are global limits, and that consumption is an ultimate driver of resource demand.

Ultimately, the issue is about biocapacity. Footprint is merely demand on biocapacity. If the European Commission prefers to have biocapacity accounts, and call the Footprint "demand on biocapacity" it may have a more scientific ring to it, but may reduce the concept's ability to communicate the results.

11. Problems of scale

The Ecological Footprint can be applied at any level of scale, be it for a single activity, person, city, nation or even the whole world. The boundaries must be set clearly when making the assessment.

12. Level of precision and accuracy?

The level of precision and accuracy of the Ecological Footprint is determined by the methodology and the input data to the National Footprint Accounts. Of course, the accuracy and detail of the Footprint results need further development. Therefore, Global Footprint Network builds on 20 years of methodological development and continues to refine and develop the tool with inputs from its

partner organisations and the advisory board. A number of national government organisations have independently tested the accounts to a high level.

Underlying statistics unfortunately do not identify their confidence ranges either. Sensitivity analyses can indicate likely confidence ranges – but not with statistical accuracy.

13. What is the Footprint tracking?

The Ecological Footprint fundamentally tracks the resource flows of all natural and renewable sources that are consumed by humanity and subsequent wastes that are naturally sequestered. These flows are aggregated into six different land type demands – cropland, grazing land, forest land, carbon uptake land, built-up land and fishing grounds. These six land categories can be summed to give the final total Ecological Footprint or biocapacity value.

14. What is the input data? Quality?

The input data to the Ecological Footprint comes from a variety of international datasets, including the UN, FAO and IEA. Therefore the quality of the results of the National Footprint Accounts is dependent upon the level of accuracy and availability of these data.

The primary inputs are detailed below in Table 1.

Dataset	**Source**	**Description**
Production of primary agricultural products	FAO ProdSTAT	Data on physical quantities (tonnes) of primary products produced in each of the considered countries.
Production of crop-based feeds used to feed animals	Feed from general marketed crops data is directly drawn from the SUA/FBS from FAOSTAT Data on crops grown specifically for fodder is drawn directly from the FAO ProdSTAT	Data on physical quantities (tonnes) of feeds, by type of crops, available to feed livestock
Production of seeds	Data on crops used as seeds is calculated by Global Footprint Network based on data from the FAO ProdSTAT	Data on physical quantities (tonnes) of seed
Import and Export of primary agricultural and livestock products	FAO TradeSTAT	Data on physical quantities (tonnes) of products imported and exported by each of the considered countries.
Livestock crop consumption	Calculated by Global Footprint Network based upon the following datasets: • FAO Production for primary Livestock • Haberl, H., K.H. Erb, F. Krausmann, V. Gaube, A. Bondeau, C. Plutzar, S.	Data on crop-based feed for livestock (tonnes of dry matter per year), split into different crop categories.

	Gingrich, W. Lucht and M. Fischer-Kowalski. 2007. Quantifying and mapping the human appropriation of net primary production in earth's terrestrial ecosystems. *PNAS* 104: 12942-12947.	
Production, import and export of primary forestry products	FAO ForeSTAT	Data on physical quantities (tonnes and m^3) of products (timber and wood fuel[4]) produced, imported and exported by each country.
Production, import and export of primary fishery products	FAO FishSTAT	Data on physical quantities (tonnes) of marine and inland fish species landed as well as import and export of fish commodities.
Carbon dioxide emissions by sector	International Energy Agency	Data on total amounts of CO_2 emitted by each sector of a country's economy
Built-up/ infrasturcture areas	A combination of data sources is used, in the following order of preference: 1. CORINE Land Cover 2. FAO ResourceSTAT 3. Global Agro-Ecological Zones (GAEZ) Model 4. Global Land Cover (GLC) 2000 5. Global Land Use Database from the Center for Sustainability and the Global Environment (SAGE) at University of Wisconsin	Built-up areas by infrastructure type and country. Except for data drawn from CORINE for European countries, all other data sources only provide total area values.
Cropland yields	FAO ProdSTAT	World average yield for 164 primary crop products
National yield factors for cropland	Calculated by Global Footprint Network based on cropland yields and Country specific un-harvested percentages.	Country specific yield factors for cropland
Grazing land	Chad Monfreda (personal communication).	World average yield for grass production. It represents the

[4] In Global Footprint Network's national accounts, "wood fuel" is not considered to be a derived product because fuel wood productivity is higher than timber productivity since more of a tree can be used for fuel than for timber. It is treated in a same manner as the primary products in the Footprint calculation. Therefore, it is covered under primary products in the MRIO model.

yields	2008. SAGE, University of Wisconsin, Madison.	average above-ground edible net primary production for grassland available for consumption by ruminants.
Fish yields	Calculated by Global Footprint Network based on several data including: • Sustainable catch value (Gulland 1971) • Trophic levels of fish species (Froese and Pauly 2008) • Data on discard factors, efficiency transfer, and carbon content of fish per tonne wet weight (Pauly and Christensen 1995).	World-average yields for fish species. They are based on the annual marine primary production equivalent.
Forest yields	World average forest yield calculated by Global Footprint Network based on national Net Annual Increment (NAI) of biomass. NAI data is drawn from two sources: Temperate and Boreal Forest Resource Assessment – TBFRA (UNECE and FAO 2000). Global Fiber Supply Model – GFSM (FAO, 1998).	World average forest yield. It is based on the forests' Net Annual Increment of biomass. NAI is defined as the average annual volume over a given reference period of gross increment less that of neutral losses on all trees to a minimum diameter of 0 cm (d.b.h.).
Carbon Uptake land yield	Calculated by Global Footprint Network based on data on terrestrial carbon sequestration (IPCC 2006) and the ocean sequestration percentage (IPCC 2001). Further details can be found in (Kitzes et al. 2009), page 69.	World average carbon uptake capacity. Though different ecosystems have the capacity to sequester CO_2, carbon uptake land is currently assumed to be forest land only by the Ecological Footprint methodology.
Equivalence Factors (EQF)	Calculated by Global Footprint Network based on data on land cover and agricultural suitability. Data on agricultural suitability is obtained from Global Agro-Ecological Zones (GAEZ). FAO and International Institute for Applied Systems Analysis 2000. Land cover data drawn from ResourceSTAT	EQF for crop, grazing, forest and marine land. Based upon the suitability of land as measured by the Global Agro-Ecological Zones model (FAO 2000a).

Table 1: Fundamental sources and description for data used within the National Footprint Accounts.

15. The Footprint is communicative and comprehensive but does it not overpromise? Not all impacts are measured – e.g. toxicity, threats to biodiversity

The power of the Ecological Footprint is often recognized for its ability to communicate. This also leads to the common criticism that it promises too much.

If the user understands the research question behind the concept, the meaning of the results should be fairly clear. But the wider public may not know the exact research question. Still, the interpretation of "how many planet Earths would it take if all of humanity lived your lifestyle" seems pretty self-explanatory.

It is certainly fair to assume that some people misunderstand the measure, or believe aspects are covered that are actually not in the account (e.g., some might believe that the Footprint is a pollution measure).

Also, it is quite common that more sophisticated user misunderstand the Footprint as a measure of sustainability. As pointed out by the Footprint standards, the Footprint is a measure of "unsustainability" NOT of sustainability. For instance, if humanity's Footprint is larger than the world's biocapacity, humanity is in an unsustainable state. So the Footprint describes a necessary condition for sustainability, not a sufficient one.

16. Multi-Regional Input-Output model (MRIO) – is this included in official Footprint calculations? What is the status?

Global Footprint Network is developing a version of the National Footprint Accounts that utilise an MRIO model for its trade assessments. An MRIO-based beta version of the 2011 National Footprint Accounts is being generated (based on GTAP7), which will be produced alongside the classical calculation. Such beta version will be tested and compared against classical Ecological Footprint values, expanded and used as starting point to arrive at a full implementation of a Footprint-MRIO model in future editions of the National Footprint Accounts. It must be noted that currently the MRIO model does not have the level of detail of temporal, categorical or spatial coverage as the National Footprint Accounts. (GTAP7 covers the year 2004 and 93 nations, the National Footprint Accounts include a data for 1961-2007 for approximately 240 countries, of which around 150 are published. GTAP is limited to 59 categories). As such the beta version of the National Footprint Accounts will be limited by the data availability within the GTAP-7 database and the MRIO model. But it also opens new analytical possibilities: tracking trade flows and breaking overall demand into final demand categories.

17. Should we make concrete recommendations to governments or down to people level?

The Ecological Footprint is a diagnostic tool that can be used to inform decision makers of the position that they are currently residing in and how this compares to other nations of the world. It cannot be used to tell policy makers what exactly to implement, but can identify key areas where the problems lie and what the options might be. At a personal level this also applies; a variety of Footprint Calculators have been designed by Global Footprint Network which are highly engaging at a personal level.

18. Lithosphere vs biosphere – how does the Footprint affect oil-exporting countries? Is there a bias towards these countries?

Ecological Footprint accounts focuses on biosphere assets. Lithosphere assets are included in as far as they put a demand on biosphere resources. As explained, the accounts do not include the lithosphere resources, but rather include the absorptive capacity of the planet to sequester carbon dioxide emissions. Therefore the affects of oil exploration, refinery and final use are directly accounted for.

Fossil fuel deposits are not considered to be biocapacity, but rather an economic asset with which the owners can buy biocapacity or services thereof.