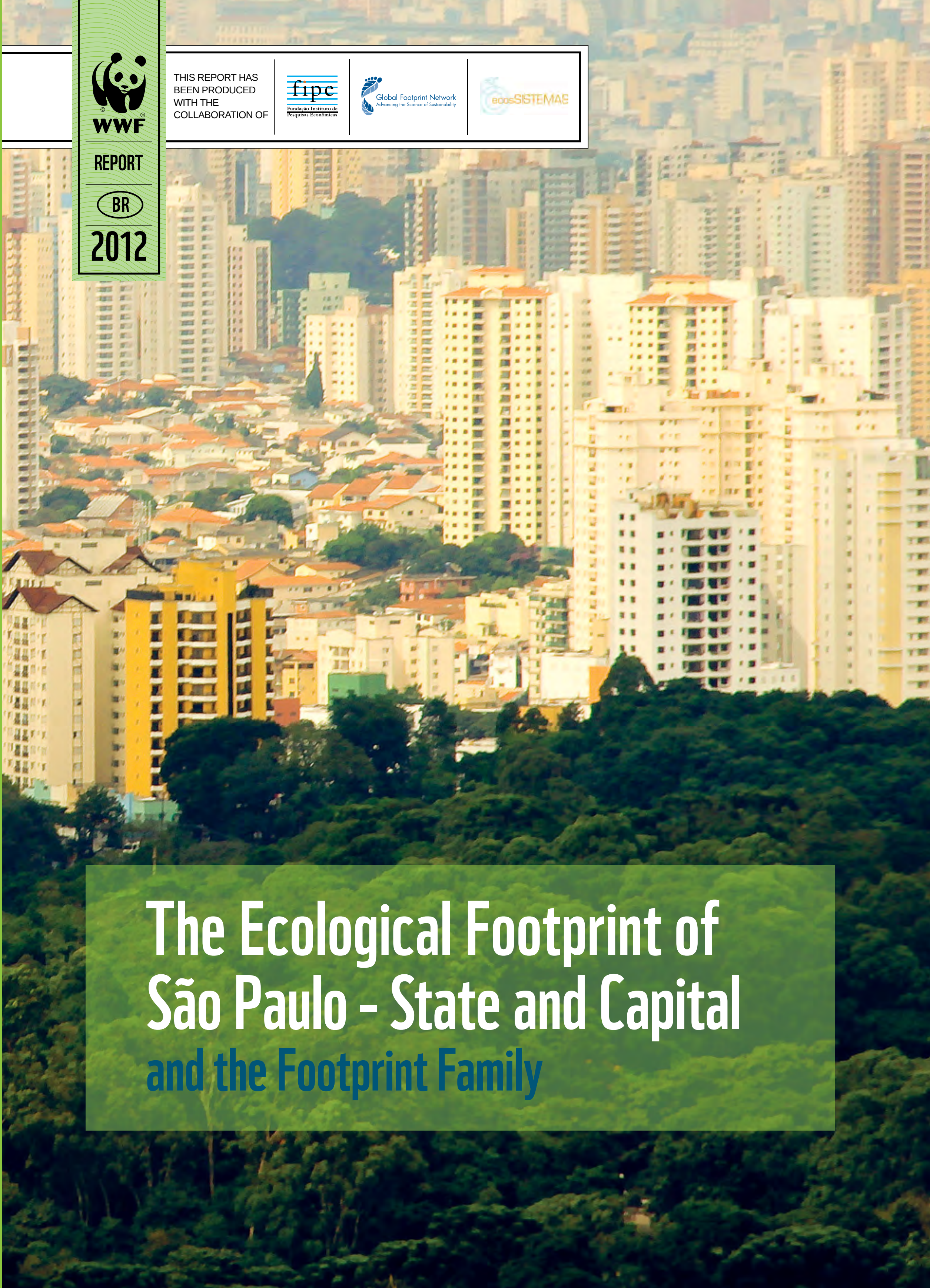

WWF

REPORT

BR

2012

THIS REPORT HAS BEEN PRODUCED WITH THE COLLABORATION OF

fipe Fundação Instituto de Pesquisas Econômicas

Global Footprint Network Advancing the Science of Sustainability

ecossistemas

The Ecological Footprint of São Paulo - State and Capital

and the Footprint Family

Mission

WWF-Brazil is a Brazilian non-governmental organisation dedicated to Nature Conservation. Its objectives are to harmonise human activity with biodiversity conservation and foster the rational use of natural resources to the benefit of the citizens of today and future generations. WWF-Brazil, based in Brasilia, was created in 1996 and unfolds projects throughout Brazil. It is part of the WWF Network, the world's largest independent Nature Conservation organisation, active in more than 100 countries and supported by 5 million members and volunteers.

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The Ecological Footprint of São Paulo State and Capital and the Footprint Family

Brasília, June - 2012

CONTENTS

PARTNERS MESSAGES

WWF Brazil

São Paulo, the biggest city in Latin America with a population almost as big as Chile's and the State of São Paulo of which it is the capital city, responsible for 33% of Brazil' Gross National Product (GNP) have a tremendous challenge to face: how to carry on being a land of opportunity but at the same time a place where the citizens enjoy a good quality of life, and to do so without exhausting natural resources. As a result of their decision to face that challenge and undertake the work of measuring their Ecological Footprints alongside WWF-Brazil, the two governments now have an important tool available that will help them to overcome it. Calculating the Ecological Footprint is the first step of the work, the starting point. The calculation clearly indicates where the greatest pressures are being placed on renewable natural resources thereby enabling more precise targeting of actions to reduce them, undertaken in the sphere of public policies, or by companies and individual citizens.

ecosSISTEMAS

Today's generations are witnessing extraordinary times, strongly marked by duality. At the same time that humanity is endowed with a legacy of comfort and development and is raising them to new levels, it is also witnessing the fact that not all are able to enjoy them. It is incumbent on us to reduce that inequality. The challenge of doing so is heightened by our awareness that the standard of development achieved by just a part of our civilization is already demanding more than our planet has to offer. We Brazilians are currently seeing our country take on a greater economic importance in the global sphere, something long wished for; but that brings with it great responsibilities. Should we follow the same path as those that went before us or should we propose an alternative direction for development? We hope that the present Ecological Footprint study of one of Brazil's most highly developed states and its capital, Brazil's largest city, will be of great assistance in determining the answer to that fundamental question.

Global Footprint Network
Advancing the Science of Sustainability

Global Footprint Network

As biological beings, we humans depend on the biosphere, its natural resources and its ecosystems, which support life on Earth. However, we are continuing to consume natural resources without due care for their management or accurate knowledge of demands on them (Ecological Footprint) or of the available supply (Biocapacity) of that natural capital. Our natural systems are only capable of regenerating a finite amount of natural resources and of absorbing limited quantities of residues. Brazil is still in the enviable position of being one of the planet's few ecological creditors but, even here, the resources are not evenly shared out. Eventually the world's biocapacity crisis is going to affect us all, including São Paulo, and when that happens, the victorious economic strategies will be those that prepare careful biocapacity management and a reduction in the demands made on natural capital. That is at the heart of the question São Paulo has to address; combating current deficits as soon and as effectively as possible.

fipe
Fundação Instituto de Pesquisas Econômicas

Economic Research Institute Foundation (FIPE)

One of the lessons learned from our long experience in conducting research surveys and developing economic indicators is that good initiatives spring from accurate diagnoses. To that end appropriate indicators are needed capable of providing high quality information. Although the environmental issue is of the greatest urgency, policy formulators in both public and private sectors still need far more good-quality information to guide their decision making processes.

In that sense, calculating the Ecological Footprints of the city of São Paulo opens up space for new actions, but this time more soundly based and directed at obtaining the rational use of natural resources by society in this capital city. The *Fundação Instituto de Pesquisas Econômicas* -FIPE (Economic Research Institute Foundation) has embraced this initiative fully aware of its importance and making available detailed information from the databases associated to its Family Budget Survey which has been gathering information on family consumption patterns in the city of São Paulo since October, 2008.

FOREWORD

WWF-Brazil

The state of São Paulo and its capital city can now count on an important environmental management tool: the Ecological Footprint. This methodology is used to measure the impacts of the population's consumption habits on the environment and is now numbered among the set of indicators used by the state and the capital city of São Paulo.

The Ecological Footprint is an environmental accounting mechanism that assesses the pressures that human populations are putting on natural resources. It is an important methodology that supports city-planning processes by indicating what mitigation actions can be undertaken to reduce those impacts. The calculation, which was originally only made for individuals, is now beginning to be applied to entire cities.

In 2011, with the collaboration of local partners and the Municipal Authority of the city, WWF-Brazil carried out the Ecological Footprint study of the city of Campo Grande, capital of the state of Mato Grosso do Sul, and the first Brazilian city to make this calculation. That aroused São Paulo's interest and the construction of a partnership began. The Footprint calculation has also been made for the city of Curitiba.

In São Paulo, the work has been carried out by means of a partnership arrangement with the municipal authority, the government of the state and the support of the Ecossistemas organisation and the Global Footprint Network (GFN). Other important support was given by the Economic Research Institute Foundation (FIPE), which made data from its Family Budget Survey databases available.

Latin America's largest city, São Paulo, has 10.8 million inhabitants according to the census data of the Brazilian Geography and Statistics Institute. However, if the greater São Paulo metropolitan area, with its 38 municipalities surrounding the capital, is considered then the population gets up to around 19 million people, almost the population of Chile.

In turn the state of São Paulo is home to 42 million people and is Brazil's biggest consumer market. It is also responsible for producing 47% of all vehicles manufactured in Brazil and contributes a huge 33% of the GNP. That means that carrying out the Footprint Study was a considerable challenge but at the same time, a great opportunity.

The partnerships established with the state and city governments send out an important positive message to other cities and may indicate new directions for consumers, public authorities and companies to take. They represent a form of re-thinking consumption patterns and a reflection on custody chains associated to production.

The Ecological Footprint calculation is, indeed, an important step but there is still a long way to go. This is a task that needs to involve everyone; governments, companies and citizens alike have a fundamental role to play in the process.

The next steps will be to mobilise the populace, and São Paulo's universities, companies and civil society organisations to seek for solutions that will diminish the impacts consumption has on the natural resources and contribute towards a much-improved environmental performance on the part of the municipality and the state thereby reducing the size of their Ecological Footprints.

We hope that the examples set by Campo Grande, Curitiba and São Paulo will be followed by other cities and that we will be enabled to construct proposals designed to mitigate their footprints and make this indicator become an important influence in determining the direction of sustainable public policies aimed at constructing a better future for their citizens and for the planet.

So far twenty-one cities/municipalities have committed themselves by signing the RIO CHARTER FOR SUSTAINABILITY, to proposing measurable means of verifying their sustainability actions. The Ecological Footprint has revealed itself to be a highly appropriate indicator for consistent monitoring of Humanity's efforts to reduce its Ecological Footprint, so essential to curbing biodiversity loss associated to excessive use of natural resources.

In undertaking such work those cities will also be setting an example for other countries. In WWF-Brazil's view, when evaluating their growth, cities and countries should not restrict their considerations to GNP figures or other strictly economic indicators currently employed. Such evaluations fail to take into account the impact of growth on natural resources. What is more important is that any growth should be sustainable and we believe that a good way of ensuring that is for cities and countries to meet their commitment to measure their ecological footprints and take steps to reduce them.

We would like to see this indicator become part of national accounting processes in the same way the GNP does today. We hope the study that we and our São Paulo state and municipal partners are presenting here will help towards constructing a way towards a more sustainable planet for us and for future generations.

Michael Becker
WWF-Brazil Cerrado-Pantanal Programme Coordinator

Maria Cecília Wey de Brito
WWF-Brazil CEO

São Paulo City Municipal Authority

In 2005 São Paulo city took the pioneering action, among Brazilian cities, of making an inventory of its Greenhouse Gas Emissions according to the standards recommended by the United Nations Organisation's Inter-governmental Panel on Climate Change (IPCC).

That was decisive step in the process of making municipal authorities and the populace at large aware that it was obligatory for a national city that wishes to be considered a world city, like São Paulo, to do its part in addressing the serious problem of global warming and the climate crisis without waiting for others to take the lead. Awareness aroused, the next step was action.

In regard to mitigation actions we can point to the following initiatives: capturing methane from the sanitary landfills sufficient to generate electricity for 500 thousand inhabitants; enactment of the first climate change legislation with stipulated goals in Brazil in June 2009; energy efficiency programme involving vehicle inspection, expansion of collective transport and the Eco-fleet programme designed to reduce dependence on petroleum-based fuels and which has currently been implanted in 15% of the 15 thousand-strong bus fleet; and the adoption of the compact city concept in new urban operations.

In the field of adaptation, we would highlight the 100 parks for São Paulo programme involving the planting of 15 million saplings of native tree species, and linear parks established as a measure to combat flooding; and more importantly the provision of safe housing options for those living in high risk areas.

But we want more and that is why we willingly entered this partnership with WWF-Brazil and government of the state to conduct our Ecological Footprint calculations. It is a very different indicator from the one recommended by the IPCC because it demonstrates the city's impacts stemming from its consumption of biocapacity and above all of the biocapacity of areas far beyond our territorial boundaries. The results reveal a considerable challenge and point out the changes that must be made to our life style, our ways of living together and of consuming.

Eduardo Jorge
Head of the Greenery and Environment Department of the São Paulo Municipal Government

The State of São Paulo

A much-needed joint Ecological Footprint calculation

In month of April, we, the State Government, WWF-Brazil and the City of São Paulo Municipal Authority formed a partnership to conduct the processes of calculating the Ecological Footprints of the state and city of São Paulo; a consistent way of finding out the extent of land that a person or an entire society uses, on average, to sustain itself. On that occasion a formal agreement was drawn up and signed by the NGO and the two spheres of government to undertake Ecological Footprint studies and make the footprint calculations.

The April meeting also served as the moment to begin preparing the technical staff of the two governments to enable them to make the calculations that involve, among other things, addressing the categories of productive land (agricultural land, grazing land, oceans, forests, built up areas) and different forms of consumption (nutrition, housing, electricity, goods and services, transport and others). The technology used and the sizes of the respective populations are also involved in the calculation.

São Paulo is the biggest city in Latin America and the figures associated to it are impressive. The Brazilian Geography and Statistics Institute registers the population of the capital itself as 10.8 million inhabitants. In turn the state of São Paulo has 42 million inhabitants.

Calculating the footprint is just the first stage of the work. Based on the results it will be necessary to mobilise the populace, the universities, companies and civil society organisations.

The footprints we leave reveal a lot about who we are. Exaggerated consumption, waste, excessive use of natural resources, environmental degradation and the huge volumes of residues are the trail we leave behind and they glaringly point out how much we must, and can change our lifestyles in favour of nature. As WWF-Brazil makes clear, the Ecological Footprint is an estimate rather than a highly accurate measurement, but it is an extremely valuable estimate insofar as it gives us a clear vision of the extent to which our way of life is in accordance with natural resources, with the Earth's capacity to offer us and renew its natural resources.

That is why participating in the Ecological Footprint calculation is a wise step that will enable us to gain access to valuable information and a measurement of how much each one of us needs to contribute by making small but constant changes and adjustments towards the construction of a greener, more sustainable and more human world.

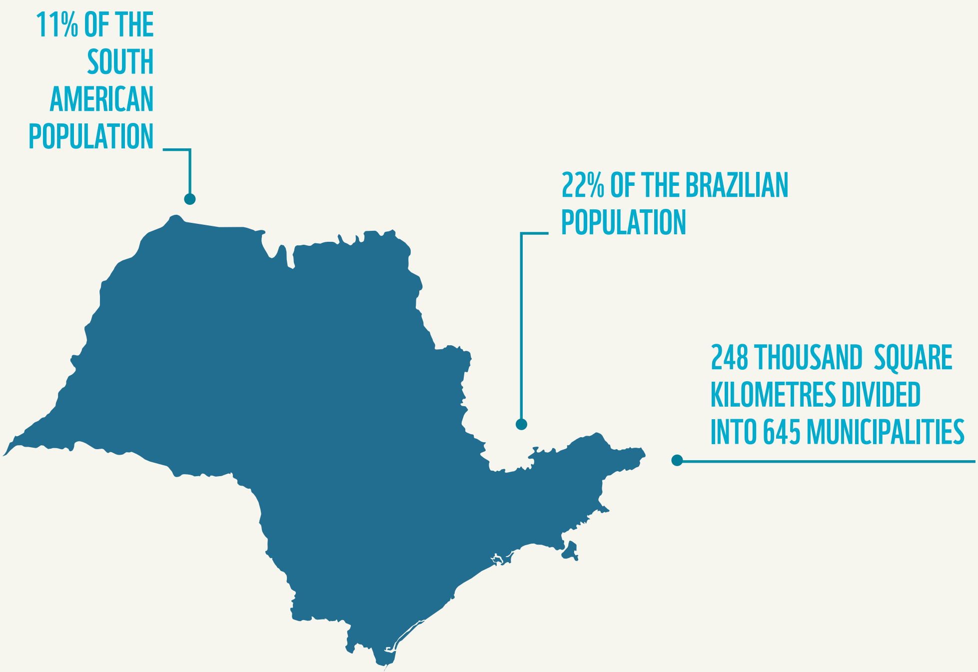
Bruno Covas
Head of the Environment Department of the Government of the State of São Paulo

São Paulo in numbers

The state of São Paulo is one of the 26 states that, together with the Federal District, make up the Federal Union. It is located in Brazil's southeast macro-region and has a population of 41 million inhabitants. 96% of them live in cities. The state is home to 22% of the Brazilian population and 11% of the population of the entire South American continent. Its area of 248 thousand square kilometres is administratively divided up into 645 municipalities.

The state's gross internal product is larger than Argentina's GNP and represents almost 34% of the Brazilian GNP. The state is also responsible for 38% of all industrial transformation value and 26% of total Brazilian exports.

The state also has a notable livestock and agricultural production corresponding to 9% of the national production and in the case of ethanol; the state's vast sugarcane plantations produce 58% of the total of Brazilian production.



Superlatives are also appropriate when we speak of the state capital, São Paulo city.

While the greater metropolitan area of the capital city occupies a mere one thousandth of all Brazilian land space, it is home to 10% of the Brazilian population, almost 20 million people (3 million more than the population of the Netherlands) and the mark of its presence is clearly visible to astronauts orbiting the planet.

At the heart of this great metropolitan area is the city itself, home to over 11 million people, the sixth most populous city in the world and the biggest city in the southern hemisphere in terms of population size. São Paulo is a cosmopolitan city with over 70 different nationalities making up its population mix. It is also considered to be the third largest Italian city outside of Italy itself and the largest Japanese city outside of Japan, the third largest Lebanese city outside of the Lebanon, the biggest Portuguese city outside of Portugal and Spanish city outside of Spain.

In addition to being the financial heart of South America with one of the world's most important Stock Exchanges, the BM&F BOVESPA, it is also a world capital of gastronomy. There is no lack of options for tourists or city residents. There are 12 thousand restaurants, 15 thousand bars, 3.2 thousand bakeries (baking 7 thousand loaves a minute), 500 *churrascarias* (traditional coal-roasted meat restaurants), 250 Japanese restaurants, 1.5 thousand Pizzerias serving one million pizzas a day, and two thousand food delivery services to choose from.

The statistics for both state and capital are dizzying[1]. This report will set out some additional impressive figures to add to the list.

1 The sources for the information reproduced in this chapter are: the IBGE, the World bank, the portal of the São Paulo State Government, the Portal of the Municipal Authority of the City of São Paulo, the Investe São Paulo portal, Netherlands Statistics, SP Tourism Portal, and the CIA World Factbook.

INTRODUCTION

The Ecological Footprint is a method used to measure the 'tracks' we leave on the Planet because of our consumption habits. The calculation has already been made for many countries and it is now being expanded to embrace the more local level of cities and states.

The aim is not just to calculate the Ecological Footprint but rather to establish it as a useful tool for regional and urban environmental management and the calculation itself is a fundamental part of that process. For this indicator to have any meaning however, the population needs to be mobilised and enabled to understand what it means and on the basis of a discussion of the results obtained, design mitigation strategies jointly with the public and private sectors. Thus the calculation goes beyond being an exercise in environmental accounting and becomes a tool capable of stimulating the population at large to review its consumption habits and start to choose more sustainable products, as well as encouraging companies to improve their production chains.

The Ecological Footprint of a country, state, city or individual corresponds to the size of the areas of productive land and ocean needed to sustain a given lifestyle. It is a way of translating into hectares the extent of land that a person or a society uses to house and feed itself; to move around, dress and consume goods in general. It must be underscored that the focus of the calculation is on the consumption of renewable natural resources. The Ecological Footprint is different from other members of the 'Footprint Family' like the Carbon Footprint and the Water Footprint in the aspect of the outreach of the analysis it involves. While the Ecological Footprint makes a wide embracing assessment of impacts on the biosphere, the Water Footprint addresses impacts on water resources associated to a specific production chain. That approach is also typical of the Carbon Footprint which analyses greenhouse gas emissions associated to a given activity or production process.

The Ecological Footprint is an environmental accounting method that evaluates the pressure human populations' consumption places on natural resources. It is expressed in global hectares thereby making it possible to compare different consumption patterns and verify whether they lie within the planet's ecological capacity. A global hectare is a hectare with the global average productivity of the world's productive lands and waters in a given year. Biocapacity on the other hand represents the ecosystems' ability to produce renewable natural resources for human consumption and to absorb the residues generated by the populations' activities. The main aim of the Ecological Footprint is to find out whether consumption and biocapacity are in equilibrium.

That being so, the Ecological Footrpint examines biocapacity for various categories of resources (agriculture, grazing land, forests. fisheries, built up areas, energy and the areas needed for carbon dioxide absorption) and compares them with different consumption categories (food, housing, mobility and transport, goods and services, government and infrastructure). The day to day decisions made in regard to each category of consumption are what generate the impacts on biocapacity.

Currently the average world Ecological Footprint corresponds to 2.7 global hectares per person whereas the biocapacity available for each individual is only 1.8 global hectares. That puts humanity in a situation of serious ecological deficit to the amount of 0.9 gha per capita, or stated differently, humanity is currently consuming one and a half planets thereby overshooting the planets's regenerative capacity by 50%. In the mid-1980s humanity began consuming more than the planet naturally has to offer and has done so ever since. It has been estimated that if we carry on consuming in this way, by 2050 we will need more than two planets to maintain our consumption patterns.

The Brazilian Ecological Footrprint is 2.9 global hectares per inhabitant showing that the Brazilian's average consumption of natural resources is close to the world average figure.

EXECUTIVE SUMMARY

The state of São Paulo's average Ecological Footprint is 3.52 global hectares per capita and that of its capital city, 4.38 *gha/cap*. It means that if everyone on the planet were to consume the way the inhabitants of São Paulo state do, then two planets would be needed to sustain their lifestyle and if they consumed like people in the capital city do, then almost two and a half planets would be needed.

The Ecological Footprint of the city of São Paulo is 49% bigger than the Brazilian average and 25% bigger than that of São Paulo state. In turn, the state's Ecological Footprint is 20% larger than the Brazilian national average, which is 2.93 global hectares per person.

It should be noted that the pattern of footprint composition among the various categories maintains the same proportions as the Brazilian national pattern that is to say there is a strong demand for grazing land, agriculture land and forests. Brazilians have a smaller demand for CO2 absorption areas as compared to the global average, due to the lower levels of emissions associated to the energy matrix and the intense use of biofuels in mobile sources of emissions (Figure 1).

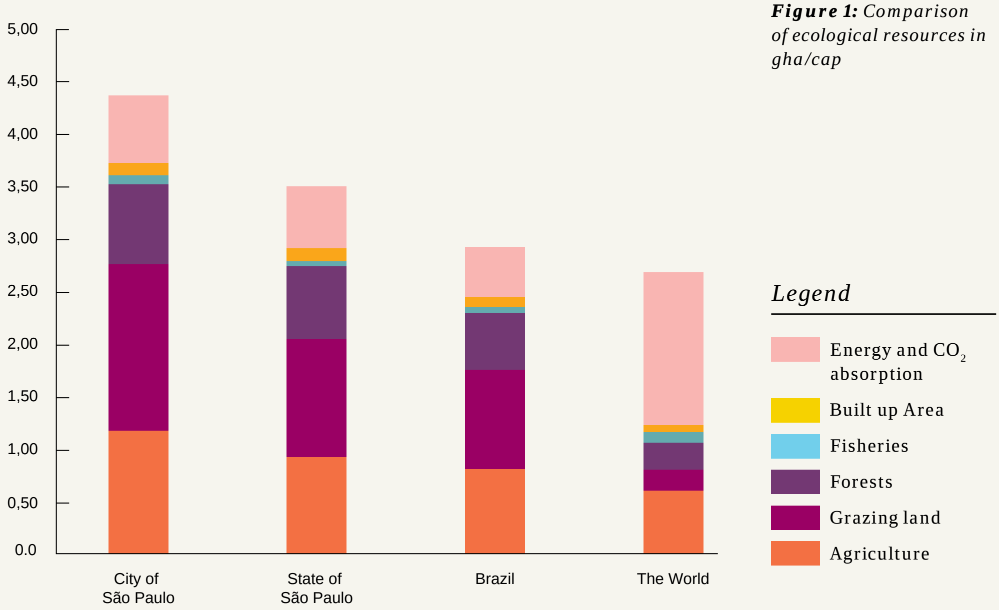
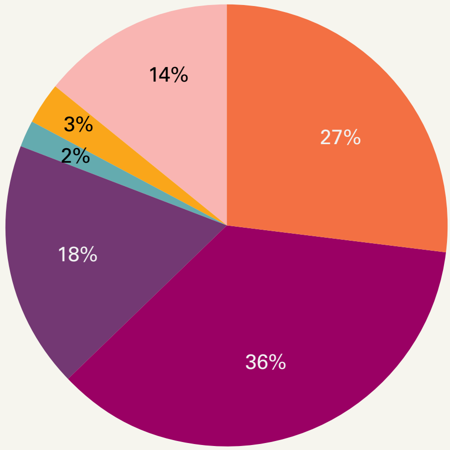


Figure 1: *Comparison of ecological resources in gha/cap*

Figure 2:
Proportional footprint composition by ecological resources



Legend

Energy and CO_2 absorption
Built up Area
Fisheries
Forests
Grazing land
Agriculture

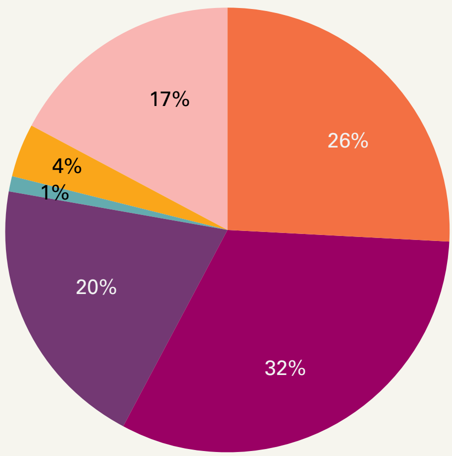


Figure 3:
São Paulo state's proportional footprint composition by ecological resources

The ecological resources represented by agriculture land (grain, vegetables, and foodstuff production and other plant-based products) and grazing land (meat, hides, wool, animal fats production and other animal-based products) represent over half the Ecological Footprints of state and capital city residents alike and are mainly consumed in the form of food. The Forest component (wood, paper, fibres, forest essences), which also contributes considerably to footprint size in both cases, is largely associated to the acquisition of goods: clothing, furniture, other household items, recreation material, books etc. (Figures 2 and 3).

The consumption of ecological resources by the population can be more readily understood by observing the Ecological Footprint segregated by consumption categories.

The greater part of the Ecological Footprints of both state and capital city populations is associated to the consumption of food, goods and transport. (Figures 4, 5 and 6). For a more detailed discrimination see the chapter 'The Ecological Footprints of the State and the City of São Paulo'.

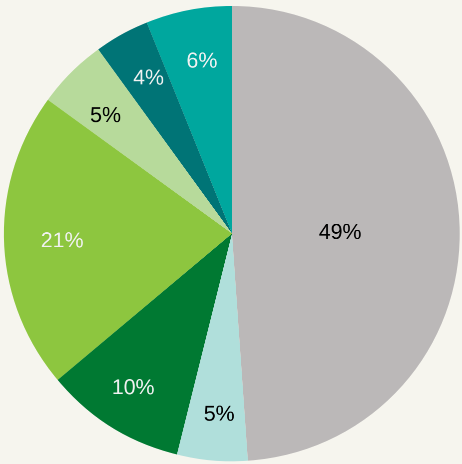


Figure 4: *São Paulo city footprint by consumption categories in percentages*

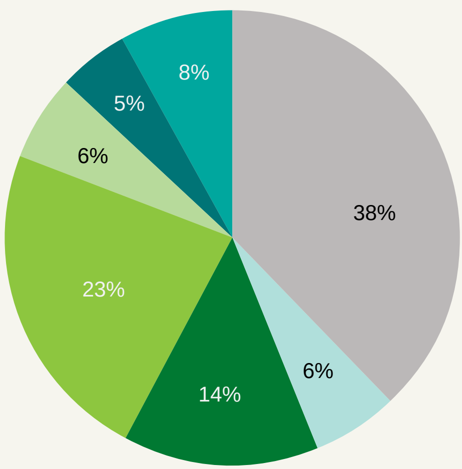


Figure 5: *São Paulo State footprint by consumption categories in percentages*

Legend

- Food
- Housing
- Mobility
- Goods
- Services
- Government
- GFCF

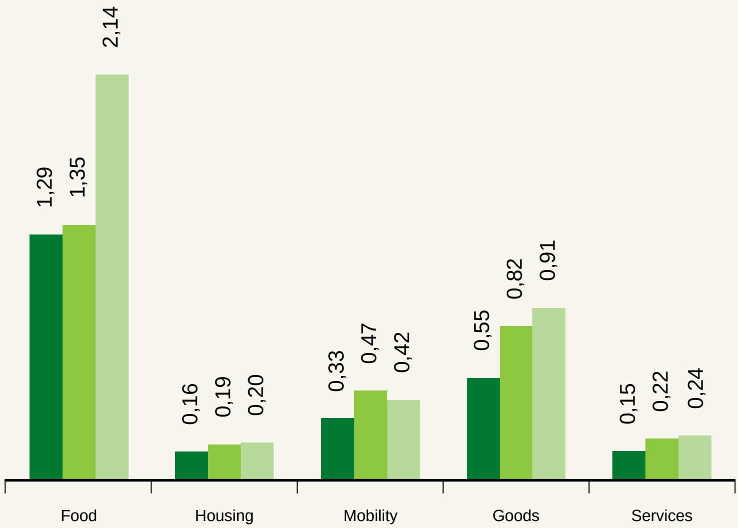
Figure 6: *Brazilian, São Paulo state and São Paulo capital city Ecological Footprints by direct consumption classes (gha/cap)*

Legend

Brazil

São Paulo State

São Paulo City



In addition to the Ecological Footprint calculations the biocapacity of these regions has also been calculated (figure 7).

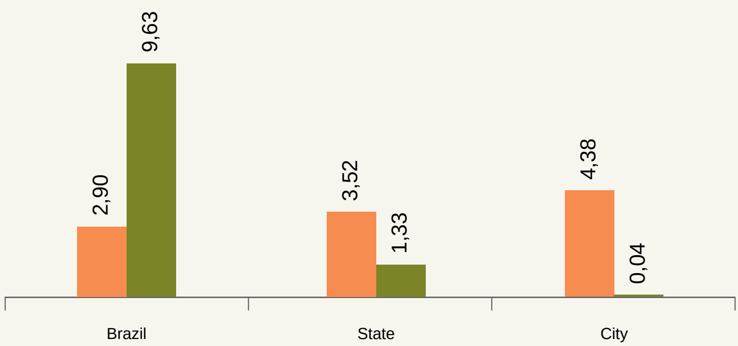
Biocapacity is the potential ability of a given area of agricultural land, grazing land, forests, coastal waters, continental waters, built up areas or hydroelectric installations to generate ecological resources.

Figure 7: *Brazilian, São Paulo state and São Paulo capital city Ecological Footprints and Bio-capacities in gha/cap*

Legend

Ecological Footprint

Biocapacity



Brazil is one of the world's great ecological creditors because its population's demand for resources (Ecological Footprint) is far less than the production of those resources within its territorial limits (biocapacity). The state and the city of São Paulo are borrowers of regional ecological resources because their demands are considerably greater than their ecological production. It must be remembered that biocapacity is expressed in global hectares per inhabitant so that regions that are very densely inhabited like the state and city of São Paulo, when they divide their ecological production of their areas by the number of inhabitants, come up with very small figures indeed.

That means therefore that consumption in São Paulo must be largely sustained by renewable natural resources in other regions of the country. At this point it is important to stress the question of interdependence because São Paulo state and city dwellers, as consumers, are responsible for the production of food and goods in the state of Pará, for example.

To find out more about biocapacity see the chapters headed 'What is Biocapacity?' and 'The Biocapacity of the State and City of São Paulo'.

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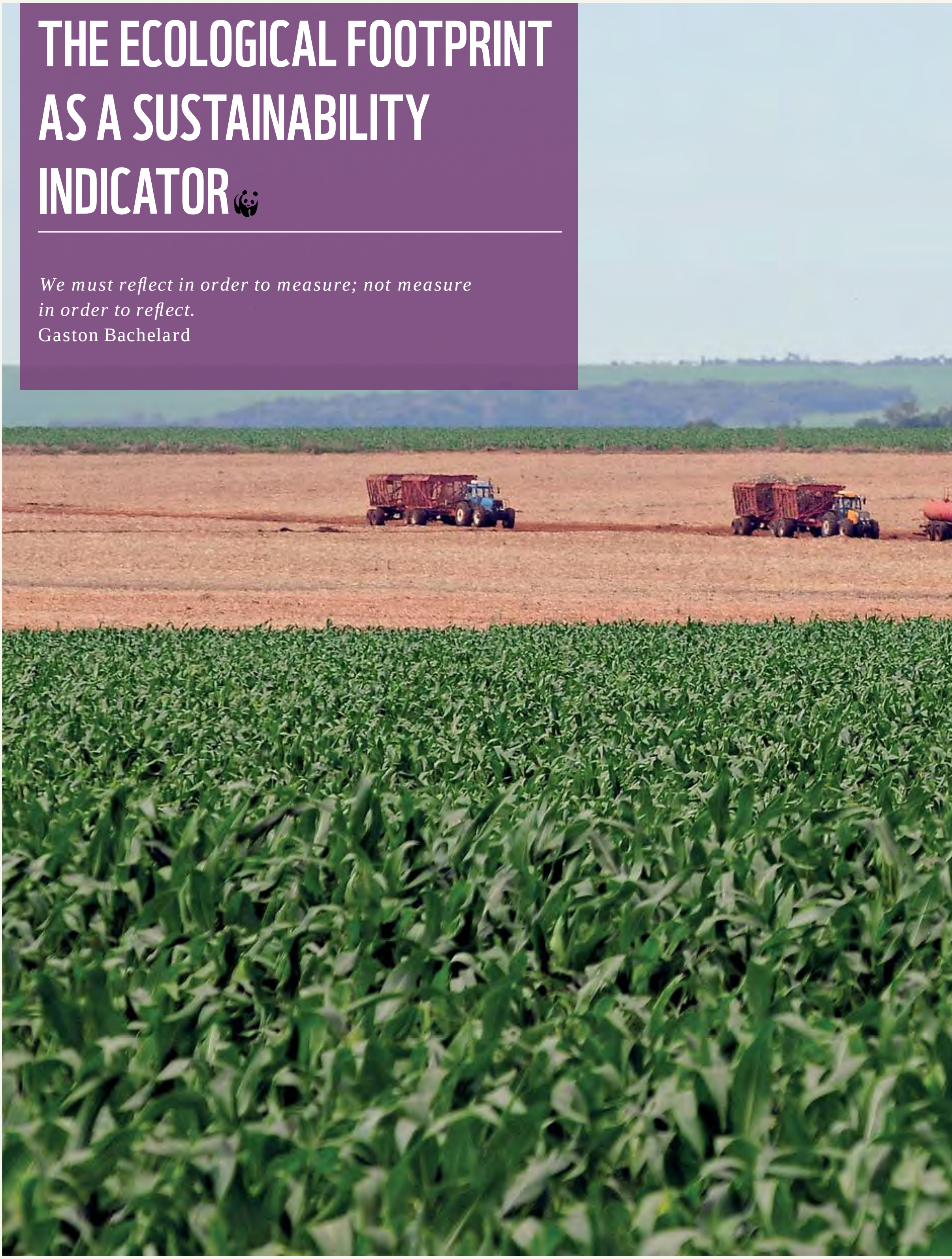
THE ECOLOGICAL FOOTPRINT AS A SUSTAINABILITY INDICATOR

We must reflect in order to measure; not measure in order to reflect.
Gaston Bachelard



WWF's 2010 biennial report basically revealed that globally there has been a 30% loss of biodiversity: "humanity is no longer living off the interest of its natural capital, it is using up the capital itself" and "at this level of ecological defcit, the final exhaustion of ecological assets and the massive collapse of the ecosystems seem to be increasingly probable", the report declares.

Currently humanity is consuming renewable resources at a faster rate than the rate ecosystems are capable of regenerating them, and it continues to liberate more carbon dioxide (CO2) then the ecosystems are capable of absorbing.

The Meadows et al. report (1972), entitled The Limits to Growth[1] already announced back then a time limit for the expansion of the current model for world development: "If present day tendencies in population growth, industrialization, pollution, food production and the exhaustion of natural resources are not changed, the limits to growth on this planet will be arrived at some time in the coming 100 years. The most likely result will be a sudden uncontrollable decline in the population and in industrial capacity".

Beside portraying that scenario however, the Meadows report also set out the key formula for achieving sustainable development: "It is possible to change those growth tendencies and establish a situation of economic stability that will be sustainable over the long term". Later, in 1983, the Brundtland Commission Report[2] 'Our Common Future' produced by the United Nations World Commission on Environment and Development (WCED) was to reinforce the human side of the sustainable development concept. In addition to warning about the set of problems involving the environment, the Brundtland Report underscores the connection between "the deterioration of the human condition" and extreme poverty and inequality in the world.

In 1992, the evolution of sustainable development thinking was boosted by the contributions of 1,600 scientists from 72 countries – among them 102 Nobel Prize winners –, who began to call more attention to the intrinsic connection of the 'enviroment- social – economic' triad to the concept of sustainable development.

The United Nations Conference on Environment and Development – Rio 92, was held in Rio de Janeiro and elaborated the document 'World Scientists Warning to Humanity' which shocked public opinion with the following statement: "Human

1 Meadows, Donella, J. Randers and D. Meadows (1972). Limits to Growth. New York: Universe Books.

2 WCED (1987): Our Common Future. World Commission on Environment and Development, Oxford.

beings and the Natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. Fundamental changes are urgent if we are to avoid the collision our present course will bring about". According to the scientists it is necessary to create sustainable development indicators capable of orientating decision making processes and contributing to the sustainability of systems integrated to the environment.

New Indicators for Sustainability

Creating sustainability indicators means elaborating a statistical base in order to measure the effects of social, environmental policies and economic development policies. Education and family values, the people's culture, respect for nature and sustainable exploitation of its resources are some of the many key aspects of development that the classical development indicators like the GNP totally fail to capture.

In the view of many economists[3], in addition to financial resources, an indicator needs to include natural wealth and assets, and the social and intellectual capital of the peoples. The GNP for example does not monitor the planet's environmental degradation or even the living conditions of its populations. In that light, indicators that take into account peoples' well being are more efficient and helpful to making decisions on the progress of a sustainable society.

Chapter 40 of the Agenda 21 also stresses that the indicators usually used to measure economic development do not give any accurate indications about sustainability because the evaluation methods employed are imperfect or inadequately applied. In essence, the indicators of sustainable development should be able to provide decision makers with a solid basis that attempts to integrate the aspects, of economic development, environmental sustainability and social equilibrium. The indicators to be developed must go beyond merely reflecting growth and be capable of indicating efficiency, sufficiency, equality, and the quality of life[4].

In analysing sustainable development, the definition or measurement of a country's wealth needs to take into account

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3 Redef ning Wealth and Progress (1990): New Ways to Measure Economic, Social, and Environmental Change: The Caracas Report on Alternative Development Indicators. Knowledge Systems Inc.

4 Meadows, D. (1998): Indicators and Information Systems for Sustainable development. A report of the Balton Group.The sustainability Institute, Hartland Four Corners.

the environmental, social and economic aspects. In the process of transformation, governments, companies, organisations and individuals must search for indicators they can use to guide their decisions, and elaborate policies and strategies in view of the scarcity of natural resources and the unsustainable nature of the current development model.

The Human Development Index (HDI) elaborated by the UN Environment and Development Programme is a well-known indicator for measuring social development. The HDI is obtained by combining three basic indicators: life expectancy, income and schooling level. Even so it fails to take into account the collateral effects of progress such as uncontrolled urban growth, unemployment, increase in the crime rate, new health demands, pollution, the erosion of the family unit, and inequality. Nevertheless it is still an important indicator that comes close to, and tries to capture the social aspect of sustainability. The social aspect of sustainable development calls for engagement and confrontation actions directed at natural resource users in an effort to form a new kind of citizen with an understanding of current environmental problems that is so essential to the full exercise of citizenship.

The Ecological Footprint is the other sustainability indicator that has a strong environmental dimension underlying its concept. It calls for changes in societies' consumer and production habits and such changes can only be achieved if there is strong engagement of civil society, local governments and the private sector. To redress negative indexes obtained in Ecological Footprint measurements, stimulating responsible consumption and total re-cycling, and the implementation of social technologies with low impacts are among some of the actions that need to be taken.

If there is to be change then it is essential that all sectors of society should feel themselves responsible for making it happen.

THE DEFINITION OF A COUNTRY AND ITS PEOPLES' WEALTH MUST CONSIDER THE TRIAD ENVIRONMENT - SOCIETY - ECONOMY

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WHAT IS THE ECOLOGICAL FOOTPRINT?

Developed in 1993 by a team headed by Mathis Wackernagel and William Rees at the University of British Columbia, the accounting method known as the Ecological Footprint is coordinated nowadays by the Global Footprint Network, founded in 2003, and its 50 partner organisations.

The Ecological Footprint is an accounting methodology that accompanies humanity's concurrent demands on the biosphere by making a comparison between human demands and the planet's regenerative capacity. It is achieved by adding up the areas needed to supply the renewable resources people use, the areas occupied by infrastructure and the areas needed to absorb all the residues. The balance sheets currently being used for National Ecological Footprint accompany the use of resource materials that include grains and fish for food and other uses, and wood and pastureland for cattle. The only residue currently being considered, however, is CO2 emissions.

Because people consume resources from many parts of the world, the Ecological Footprint being presented here calculates their areas irrespective of where they are located on the Earth's surface.

To discover whether the human demand for renewable resources and the need for CO2 absorption can be maintained, the Ecological Footprint is compared with the planet's regenerative capacity; that is, with its biocapacity. Both the Ecological Footprint (which represents the demand for renewable resources) and the biocapacity (which represents the availability of renewable resources) are expressed in units known as global hectares. A global hectare represents the productive capacity of one hectare of land considering the world's average productivity figures.

In the calculation we take into account many of the uses and resources that can be measured in term of the area needed to maintain biological productivity. There are some resources and residues, however, which are not susceptible to being measured in this fashion and they are excluded from the footprint calculation. Solid residues and water do not enter, as such, in the Ecological Footprint calculation. That fact however in no way invalidates the Ecological Footprint calculation; we just need to remember that the calculation itself systematically underestimates all the impacts on the environment. It only detects the use of renewable natural resources, but that in itself is an excellent parameter to measure our progress on the road to a more sustainable way of life.

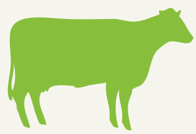
Ecological Footprint components

Carbon

Represents the areas of forest lands needed to absorb CO2 emissions from fossil fuel use except for the part absorbed by the oceans and which causes their acidification.

Agricultural Land

Represents the area of arable land used to produce foodstuffs and fibres for human consumption, feed for cattle, vegetable oils and rubber



Grazing Land

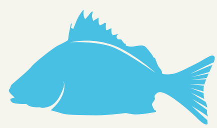
Represents the area of pastures used to raise beef and dairy cattle and for the production of hide and wool products.

Forests

Represents the amount of forest land needed to supply wood products, cellulose and firewood.

Built up Areas

Represents the area of land covered by human-built infrastructure including transport, housing, industrial installations and hydroelectric dam reservoirs.



Fisheries

Calculated on the basis of the estimated primary production needed to sustain shellfish and fish catches based on catch data for marine and freshwater species.

WHAT IS BIOCAPACITY?

Biocapacity or biological capacity, is the capacity of ecosystems to produce useful biological materials and to absorb the residues generated by human beings under current methods of management and extraction technology. Useful biological materials are defined as whatever materials human economies effectively demanded in a given year.

Biocapacity embraces:

- Arable land used for the production of food, fibres, bio-fuels;
- Pastures for the production of animal origin products like beef, milk, leather, wool;
- Continental and marine fisheries;
- Forests, that not only supply wood but also absorb CO_2;
- Built up areas that occupy former agricultural land;
- Hydroelectric installations that occupy land with their dam reservoirs.

Biocapacity takes into account the available land and its productivity measured by the crops or trees growing on each hectare.

Cropland in countries with a dry climate or a cold one, for example, may be less productive than cropland in countries with warm or humid climate. If the land and sea of a given nation are highly productive, the country's biocapacity might be represented by more global hectares than the actual number of hectares of its land area. Similarly, any increase in productivity of crops may be reflected as an increase in biocapacity. The areas of land used for the predominant crops like the cereals have remained relatively stable since 1961 but the amount produced per hectare has almost doubled.

Biocapacity is a measurement that enables direct comparisons to be made. Biocapacity is also drawn on by other species that consume available natural resources for their survival. Thus it is important to remember that the services provided by the natural ecosystems need to be shared with the planet's other living beings.

Both biocapacity and the Ecological Footprint are expressed in global hectares (gha) that represent their productivity.

THE ECOLOGICAL OVERLOAD IS INCREASING

During the 1980s, humanity as a whole passed the point of equilibrium where the annual Ecological Footprint corresponded to the Earth's annual biocapacity. In other words, the planet's human population began to consume renewable resources faster than the ecosystems were capable of replenishing and emit more CO_2 than the ecosystems were capable of absorbing. That situation is described as 'ecological overload' or 'overshoot', and it has persisted ever since.

The results of the last Ecological Footprint calculation show that the tendency remains unchanged. In 2007, humanity's footprint amounted to 18 billion gha or 2.7 gha *per capita*. The Earth's biocapacity, however, only amounted to 11.9 billion gha or 1.8 gha per person (figure 9 and GFN 2010a). That corresponds to an ecological overload of 50%, which means that the earth would take 1.5 years to regenerate the renewable resources that people used in 2007 and the same time to absorb all the CO_2 for that year. In other words, people used 1.5 planets in the course of their activities (see box 'What does the overload really mean?').

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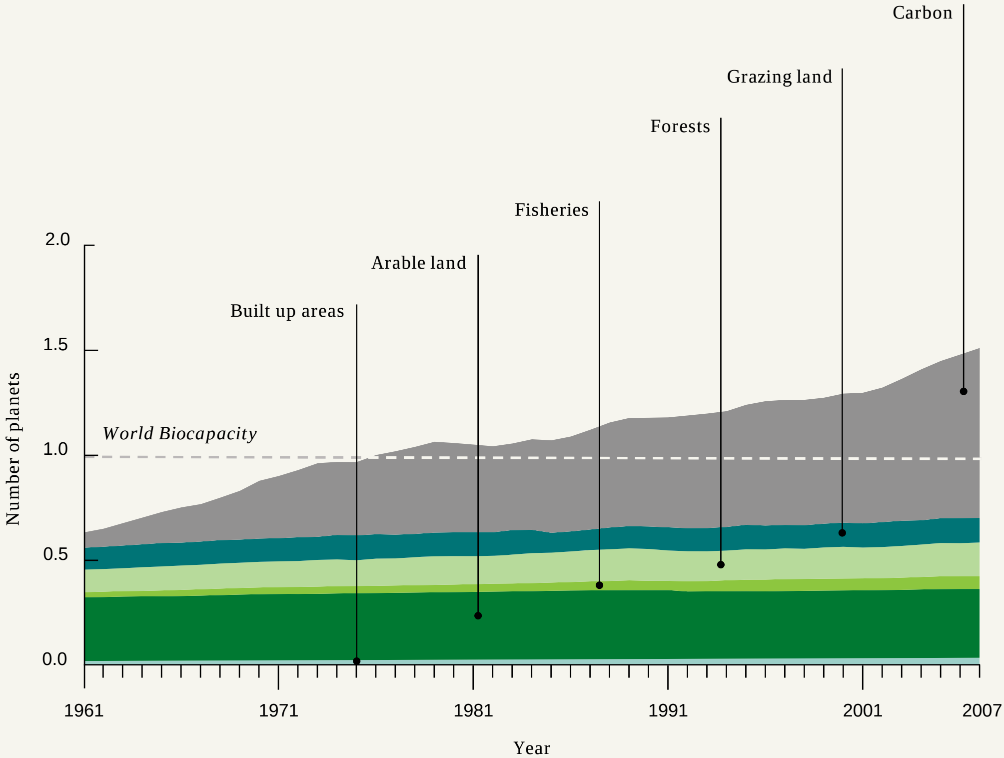


Figure 09: Ecological Footprint by components, 1961–2006

The Footprint is shown as a number of planets. The dotted white line represents total biocapacity always corresponding to one planet Earth, although in fact Earth's biocapacity may vary from year to year. Hydroelectricity generation has been included under 'built up areas' and firewood under the heading 'forests' (Global Footprint Network, 2010)

What does the overload really mean?

How can people be using up 1.5 Earth's when in fact only one planet exists? In the same way that we can withdraw more money from a bank deposit than just the interest it yields, it is also possible to use up renewable resources at a faster rate than they are generated. For example, wood can be taken out of a forest at faster rate than it manages to grow back, fish can be removed from their habitat in greater quantities than their populations can replace each year and so on. That, however, cannot be done indefinitely because, eventually, the resources will be exhausted.

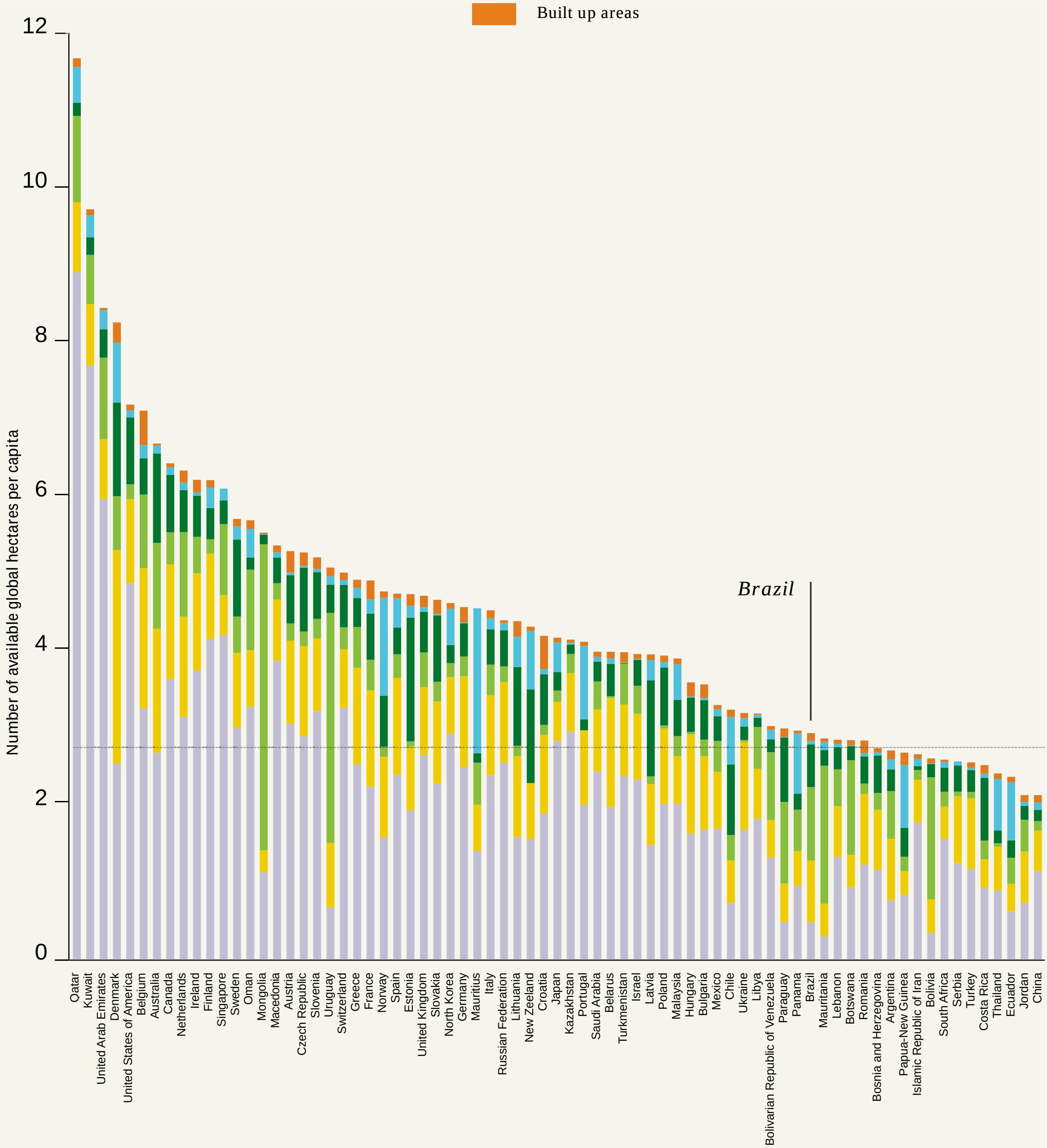
In the same way the CO2 emissions may exceed the rhythm at which the forests and other ecosystems can absorb them, which means that additional lands will be necessary to fully sequester the emissions.

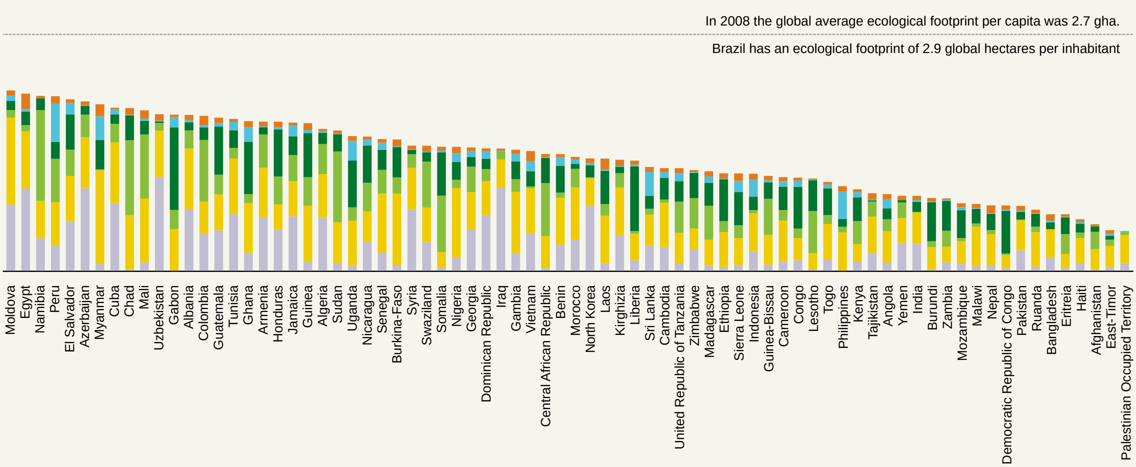
The exhaustion of natural resources has already occurred in some places. One example is the collapse of the cod stocks in Icelandic fisheries that took place in the 1980s. What usually happens in such cases is that humanity seeks out other areas or other species that are still common, to exploit. The same phenomenon can be observed in regard to forest resources.

At current levels of consumption, however, sooner or later those other resources are going to run out as well and also, some ecosystems will collapse even before their resources have been completely exhausted.

There is also the question of the evident excess of greenhouse gases that the vegetation has been incapable of absorbing. Increased CO2 concentrations in the atmosphere leads to a rise in global temperatures and climate change as well as acidification of the oceans. All of that represents greater pressures on biodiversity and on the ecosystems.

Figure 10: *Ecological Footprint by countries and per capita. This comparison embraces all countries with over 1 million inhabitants for which data are available. (Global Footprint Network, 2011)*




In 2008 the global average ecological footprint per capita was 2.7 gha.
Brazil has an ecological footprint of 2.9 global hectares per inhabitant
Moldova
Egypt
Namibia
Peru
El Salvador
Azerbaijan
Myanmar
Cuba
Chad
Mali
Uzbekistan
Gabon
Albania
Colombia
Guatemala
Tunisia
Ghana
Armenia
Honduras
Jamaica
Guinea
Algeria
Sudan
Uganda
Nicaragua
Senegal
Burkina-Faso
Syria
Swaziland
Somalia
Nigeria
Georgia
Dominican Republic
Iraq
Gambia
Vietnam
Central African Republic
Benin
Morocco
North Korea
Laos
Kirghizia
Liberia
Sri Lanka
Cambodia
United Republic of Tanzania
Zimbabwe
Madagascar
Ethiopia
Sierra Leone
Indonesia
Guinea-Bissau
Cameroon
Congo
Lesotho
Togo
Philippines
Kenya
Tajikistan
Angola
Yemen
India
Burundi
Zambia
Mozambique
Malawi
Nepal
Democratic Republic of Congo
Pakistan
Ruanda
Bangladesh
Eritreia
Haiti
Afghanistan
East-Timor
Palestinian Occupied Territory

THE FOOTPRINT FAMILY AND THE ENVIRONMENTAL PRESSURES THEY REPRESENT

The three indicators – Ecological Footprint, Carbon Footprint and Water Footprint – make it possible to represent various facets of the consequences and impacts on natural capital stemming from human activities.

Insofar as it reveals the bio-productive area that people demand because of their resource consumption and CO2 emissions, the Ecological Footprint can be used to obtain an idea of their impact on the *biosphere*. By quantifying the effect of resource use on the climate, the Carbon Footprint describes the impacts that humanity has on the *atmosphere*. By monitoring the real and hidden flows of water, the Water Footprint can be used to obtain information about humanity's impacts on the *Hydrosphere*.

The Footprint Family can best be described as a set of indicators associated to consumption capable of monitoring human pressures on the planet in terms of appropriating ecological assets, greenhouse gas emissions and fresh water consumption and pollution. They monitor three key ecosystem compartments: the biosphere, the atmosphere and the hydrosphere.

The three indicators can be considered as complementary to the discussion on sustainability and as tools capable of monitoring different aspects of human pressures on various compartments that provide support for life on Earth.

THREE KEY ECOSYSTEM COMPARTMENTS ARE MONITORED: THE BIOSPHERE, THE ATMOSPHERE AND THE HYDROSPHERE

Ecological Footprint (EF)

Scientific Question

Considering the amount of available resources (biocapacity) on the local and global scales, and the biosphere's capacity to regenerate them, what amount of resources can human beings consume directly or indirectly?

Principal message

Foster recognition of ecological limitations, safeguard the ecosystems' pre-conditions (healthy forests, clean water, clean air, fertile soils, biological diversity, and others) and guarantee the functionality of ecosystem services thereby permitting the biosphere to provide long-term support for human life.

Data and sources

The Ecological Footprint makes use of:

- Data on local production, imports, exports of agricultural, forestry and f shery products (FAOSTAT, UN, Comtrade, and others);
- Land use and settlement data (FAOSTAT, and others);
- Incorporated CO2 data (local and traded – IEA, and others);
- Data on land productivity (FAOSTAT) and potential productivity of crops (FAO-GAEZ model) – all those data are needed to be able to express the results in terms of global hectares.

Unit of measurement

The unit of measurement for the Ecological Footprint is the global hectare (gha) of bio-productive land. Gha is not just a measure of area, but a unit of ecological production associated to an area. Results can also be expressed in simple hectares.

Indicator Coverage

Aspects of the Ecological Footprint:

- It is a multi-dimensional indicator that is explicit for a given time that can be applied to products, cities, regions, nations and the entire biosphere. In the period 1961–2006, more than 200 countries had their Ecological Footprints calculated (cf. Ewing *et al.*, 2009a);

- It documents human society's direct and indirect demands on the capacity of sources (resource production) and 'wells' (that sequester carbon);

- It informs the dimensions of the demands on natural resources as well as the supply of those resources by the biosphere;

- It is the only aggregating ecological benchmark;

- It fosters recognition of ecological limitations, the protection of ecosystems and the maintenance of their services.

Usefulness in policy formulation

With the use of the Ecological Footprint it is possible to:

- Evaluate the planet's limitations and identify ecosystems that are under society-induced pressure;

- Monitor society's progress towards developing minimum sustainability criteria (demand ≤ supply);

- Monitor the efficiency of resource use policies in general and current levels of resource use;

- Analyse the consequences of using renewable forms of energy as alternatives;

- Provide the general public with information on the environmental impacts of differing life styles;

- Accompany the pressures on biodiversity;

- Demonstrate the unequal distribution of natural resource use and the need to implement international policies that work towards establishing an equilibrium in the use made of natural resources by the countries of the world;

- Implement international policies directed at reducing natural resource consumption.

Positive Aspects

The Ecological Footprint makes it possible to compare human demands on nature with the offer of natural resources and in that light establish clearly defined goals. It establishes an assessment of the multiple anthropogenic pressures on renewable natural resources. It is a tool that is easy to understand and communicate and brings with it a strong conservationist message.

Negative Aspects

The Ecological Footprint is unable to cover all aspects of sustainability or address all areas of environmental concern especially those areas where there is no regenerative capacity. It reveals the pressures that are leading to degradation of natural assets (like the impoverishment of soils, the reduction of biodiversity) but it is incapable of predicting future impacts.

Another feature the footprint lacks is the ability to make a better definition of the impact in a specific geographic region.

Water Footprint

Scientific Question

Considering the natural capital/assets in terms of the fresh water (blue, green and grey)[1] needed for human consumption, the main question that the water footprint attempts to answer is: what volume of water does an individual, community or business need to produce or consume goods and services?

Principal Message

The primary aim of the Water Footprint is to demonstrate the hidden connections between human consumption and the use of water and the hidden connections between global trade and water resource management. In the f rst situation the footprint is not limited to the water that an individual community or business consumes directly but also considers how much water is used in the production of goods and services, the water that is embedded in economic activities. To that end it defines the concept of virtual water, which is the water that is actually part of world trade, embedded in the products that are negotiated in world trade.

1 Blue Water, is fresh water coming from surface or underground springs. Green water refers to rain falling directly on the soil without running off or penetrating to replenish water tables. Grey water refers to the volume of fresh water needed to assimilate the pollutant load stemming from anthropic processes based on quality standards in effect

Data and sources

The Water Footprint is calculated on the basis of:

- Demographic data (World Bank);
- Data on the areas of arable land in the world (FAO) and on total renewable water resources and total water extraction (FAO);
- Data on international agricultural trading (PC-TAS) and industrial products (WTO);
- Local data on various aspects such as climate, farming patterns, irrigations, soils, the quality of percolated water, pesticide and fertilizer use indexes and others.

Unit of Measurement

The unit of measurement is usually a volume of water per time unit (m^3/year for example). When production processes are being evaluated the Water Footprint may be expressed as the total volume of water used in production divided by the weight of the products produced and therefore expressed as m^3/ton or litres/kg). It must be stressed that water footprint can also be expressed for a given area as a function of a time unit. That is usually the case with the water footprint calculations for river basins or countries.

Indicator Coverage

The Water Footprint:

- Is a geographically explicit multi-dimensional indicator. It can be calculated for products, public organizations, economic sectors, individuals, cities and nations. In the period 1997-2001, 140 nations were analysed using this indicator (cf. Chapagain and Hoekstra, 2004);
- Documents direct and indirect use of water resources as a source (demand for blue water and green water) and as a ‘well’ (grey water for pollution dilution);
- Only measures the demand side in terms of fresh water consumed (according to sources) and polluted (according to pollution type) by human activities;
- Seeks to analyse the consumption of water resources by economic processes, production, trade and services.

Usefulness in policy formulation

The Water Footprint:

- Endows water resource management and governance with a new global dimension;
- Enables nations to gain a better understanding of their dependence on water resources beyond their own frontiers;
- Offers river basin management authorities more precise information on scarce water resources that are being allocated for products being exported with low financial value;
- Suggests to companies ways they can monitor their dependence on scarce water resources along the length of their supply chains and in their production processes;
- Demonstrates the unequal distribution of water resource use and the need to implant international policies stimulating equilibrium in water resource use among the different countries.
- Promotes a discussion of the need for international policies directed at reducing water resource consumption.

Positive Aspects

The Water Footprint presents a spatial distribution chart of a country's water resource demands. It expands traditional analyses restricted to 'water extraction' by including the categories of green and grey water. It visualises the connections between local consumption and the global appropriation of fresh water. It also integrates water use and water pollution as elements of the production chain.

Negative Aspects

The Water Footprint only analyses human demands for water and not the demands of the ecosystems as a whole. It depends on local data that is often unavailable or difficult to collect. It is liable to truncation errors in the calculations. No studies have been done regarding data uncertainties although they are known to be significant. Calculations of 'grey' water rely heavily on estimates and suppositions.

Carbon Footprint

Scientific Question

What is the total amount of Greenhouse Gases–(CO_2, CH_4, N_2O, HFC, PFC and SF_6) emitted directly or indirectly as a result of human activities or accumulated along the life cycle of products?

Principal Message

The Carbon Footprint[2] is mainly based on the consumption of goods and services and the greenhouse gases generated by that consumption. Thus it serves as complement to the inventories made by the Kyoto Protocol that calculate the greenhouse gas balance sheets associated to production only.

Data and sources

The Carbon Footprint makes use of:

- Economic data from national accounts (Materials–Products matrixes, Supply, utilization and others);
- International trade statistics (UN, OECD, GTAP, and others);
- Environmental Accounts data on GG emissions (IEA, GTAP, and others).

Unit of Measurement

The Carbon Footprint may measure total carbon or carbon equivalent (CO_2e[3]) that is emitted directly or indirectly by a given human activity or accumulated during the useful life of a product. The unit used to express it is the Kg of CO_2 when only carbon dioxide is being considered, or Kg of carbon equivalent when other greenhouse gases are being taken into account as well. To avoid suppositions and introducing uncertainties, there is no conversion to express it in terms of area. Often however it is expressed in units *per capita*.

2 Carbon Footprint is used here to determine emissions associated to human production activities, which means that its significance is different from that of the GG emissions Inventory.

3 Carbon equivalent – defines the equivalence of other gases in relation to CO2.

Indicator Coverage

The Carbon Footprint:

- Is a multi-dimensional indicator that can be applied to products, processes, companies, industries, governments, populations and so on. Up until 2001, 73 nations and 14 regions had been analysed using this calculation (cf. Hertwich e Peters, 2009);

- Documents all direct and indirect GG emissions stemming from the use of resources and products (sources);

- Only measures the aspect of demand in terms of Greenhouse Gases emitted;

- Does not offer any benchmarking possibilities.

- Has no defined limits established.

- Seeks to analyse the carbon emissions associated to economic processes, to production, trade and services.

- Can only measure the demand side of the emissions related to the production of a product or a service.

THE CARBON FOOTPRINT ALLOWS FOR A CLEAR ASSESSMENT OF THE HUMAN CONTRIBUTION TO CLIMATE CHANGE

Usefulness in policy formulation

The Carbon Footprint offers:

- An alternative point of view for an international policy on climate change insofar as it complements the regional and territorial approach of the UNFCCC;

- A better understanding of each country's responsibility thereby facilitating international cooperation and partnerships between developed and developing countries;

- A contribution towards the conception of a harmonised international price for GG emissions;

- A more precise charting of the unequal distribution of natural resource use and the need to implement international policies promoting equilibrium in resource use among the different countries;

- Supporting information for the discussions on the need for international policies directed at reducing natural resource consumption.

Positive Aspects

The Carbon Footprint makes it possible to obtain a clear assessment of human contributions to climate change and it is consistent with economic and environmental accounting standards. In fact the data on which the Carbon Footprint calculation is based are relatively more consistent than those of the other Footprints.

Negative Aspects

The Carbon Footprint is not capable of accompanying the whole range of human demands on the environment. Additional studies are essential for any analysis of the impacts of climate change in the national and sub-national scales. Efforts need to be made to construct tables similar to the MRIO (Multi-regional Input Output) tables and related environmental extensions. There is also no limit set for the Carbon Footprint. We do have a limit in regard to global emissions but that does not mean that it has been incorporated into the Carbon Footprint calculations.

Complementary quality

The three indicators that form the footprint family are mutually complementary in regard to any evaluation being made of human pressures on the planet.

Adopting a form of measurement based on consumption makes it feasible to evaluate direct and indirect demands that human beings are making of the natural capital and to obtain a clear understanding of the 'invisible' or hidden' sources of human pressure. We need to be aware that not all dimensions of the worth and value of natural resources are captured by the indicators described above[4].

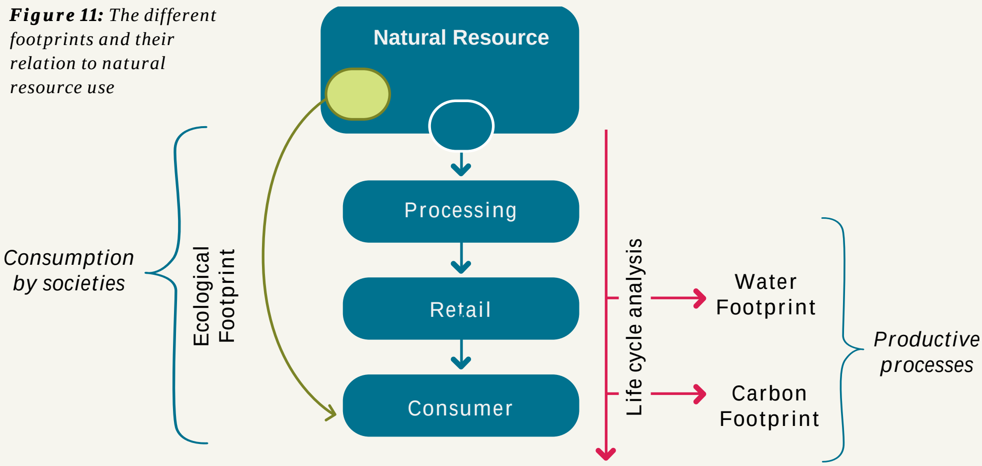
There are values attached both to use and to non use of natural resources. Among the use values that the indicators capture it is only possible to map situations of direct use of natural resources. We cannot capture the indirect forms of use that nature offers like ecosystem services or the values associated to the future uses of natural resources.

So it must be explained that it has only been possible to capture a part of the all the values constituted by natural resources – as can be seen from Figure 8 below.

4 Pearce, D.W.T.K (1990): The Economics of Natural Resource and the Environment. HarvesterWheatsheaf, New York.

All three footprints are aimed at capturing the different forms of pressure being put on natural resources by human consumption. The consumption itself is associated to a process that transforms raw materials along complex chains of custody involving a variety of agents and represented in a simplified manner in the illustration.

Figure 11: *The different footprints and their relation to natural resource use*



Once the biocapacity has been delineated the Ecological Footprint establishes a direct link between the renewable natural resources effectively available and their consumption in the form of goods and services, without considering certain aspects more strictly associated to the production chains such as processing and distribution. These aspects are much more related to analyses of product life cycles, which evaluates their useful lives, passing through all the stage and processes involved until the product is placed on the market, or depending on the scope of the analysis, until the disposal of its residues has been completed. In the latter case, each stage of production can be analysed separately.

The Carbon Footprint and the Water Footprint are much more closely related to analyses of product life-cycles or processes than the Ecological Footprint. That is one of the main differences between these sustainability indicators.

However, only the Ecological Footprint and the Water Footprint are capable of accounts that include an evaluation of the planet's capacity as a source (resource production) and also its capacity as a 'sink' (residue assimilation). In the case of the Carbon Footprint, all it does is to analyse the GG emissions that generate impacts on the biosphere. Of the three, the Ecological Footprint is the only indicator capable of establishing an ecological benchmark (biocapacity) demonstrating human pressure on the planet. Anthropic GG emissions are tracked as much by the Ecological Footprint as by the Carbon Footprint, but the underling intention of the Ecological Footprint in regard to carbon, is to measure the volume of ecosystem services needed to absorb those residues.

ECOLOGICAL FOOTPRINT AND WATER FOOTPRINT PROVIDE ACCOUNTS OF THE PLANET'S CAPACITY AS A SOURCE (RESOURCE PRODUCTION)

Furthermore, the Ecological Footprint is based on the premise that we are making use of natural assets that are finite and that means that it is not sufficient merely to improve efficiency in resource use especially when the ricochet effect of economies is considered.[5] There is an urgent need to think in terms of the qualitative growth of the economies and their interactions with the environment given that the extraction of renewable natural resources is also influential in determining land settlement patterns.

The three indicators reveal the unequal distribution of resource use among the inhabitants of the world's different regions. Based on such data it is possible to provide support for development policies and endorse concepts such as contraction and convergence, environmental justice and fair sharing.

5 The ricochet effect postulates that natural resource savings achieved with the introduction of new technology is rapidly lost because of the ongoing expansion in the total use being made of them

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THE ECOLOGICAL FOOTPRINT AND THE FUTURE OF THE PLANET

Forecasts for the year 2050 suggest that if we carry on with present day patterns we will be needing more than two planets to keep up or consumption level. A global effort to revert that tendency is urgently needed so that people can go back to living within limits of the planet's biocapacity.

The average global Ecological Footprint today is 2.7 global hectares per person but the available biocapacity is only 1.8 global hectares per person. That means the global population is running up a serious ecological deficit. Right now humanity needs 1.5 planets to maintain its current consumption patterns and that is putting planetary biocapacity at great risk.

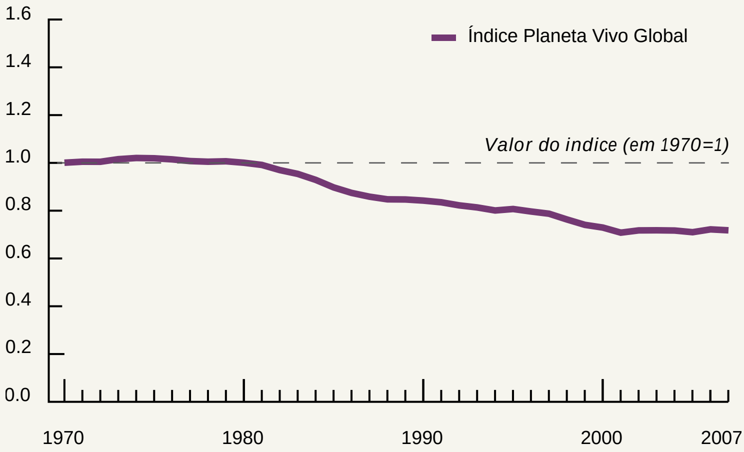
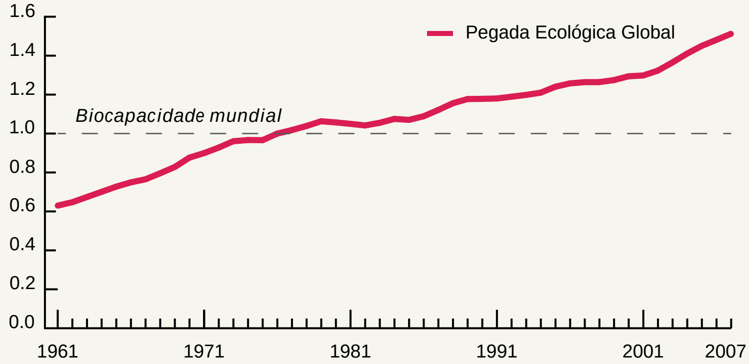


Figure 12: Living Planet Index

The global index shows that vertebrate species populations were reduced by almost 30% between 1970 and 2007 (WWF/ZSL, 2010)

Figure 13: Global Ecological Footprint Index

Human demands on the biosphere more than doubled from 1961 to 2007 (Global Footprint Network, 2010)

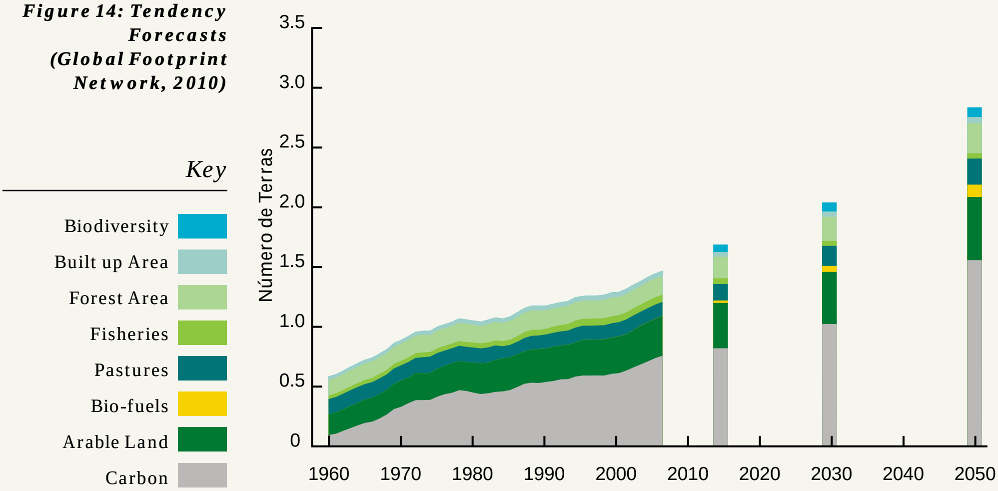


By consuming more resources than are actually available we start to exhaust the supply of them and undermine their capacity to regenerate and continue sustaining our populations.

Since the end of the 1960s humanity has been consuming over and above the possibilities of resource regeneration and that has gone on right down to the present day. Forecasts for the year 2050 suggest that if we carry on with present day patterns we will be needing more than two planets to keep up our consumption level. A global effort to revert that tendency is urgently needed so that people can go back to living within limits of the planet's biocapacity.

Figure 14: Tendency Forecasts (Global Footprint Network, 2010)

Key



Brazil's Ecological Footprint

The Brazilian Ecological Footprint is 2.9 global hectares per inhabitant, showing that the average consumption of ecological resources by a Brazilian person is close to the global Ecological Footprint average per inhabitant of 2.7 global hectares.

An examination of the Brazilian footprint in a temporal series shows only a small tendency to increase up until 2005 indicating a relative stability in consumer patterns over that period.

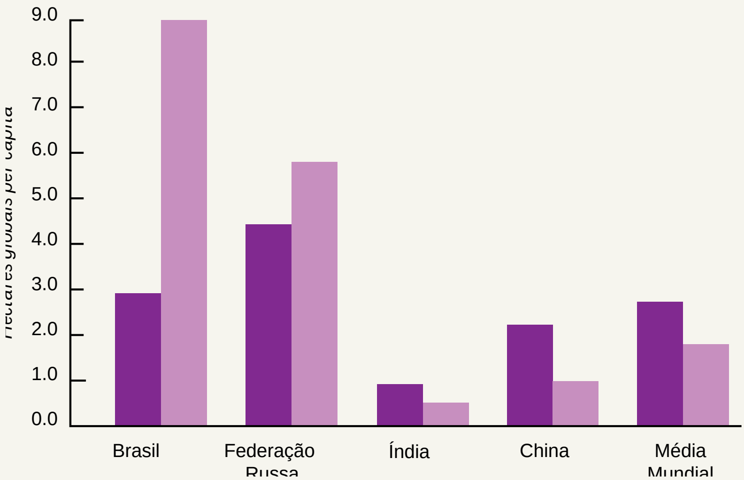


Figure 15: Comparison of Brazilian ecological Footprint and Biocapacity with BRIC countries (Taken from: Results from National Footprint Accounts 2010 edition, GFN)

Key

- Ecological Footprint
- Biocapacity

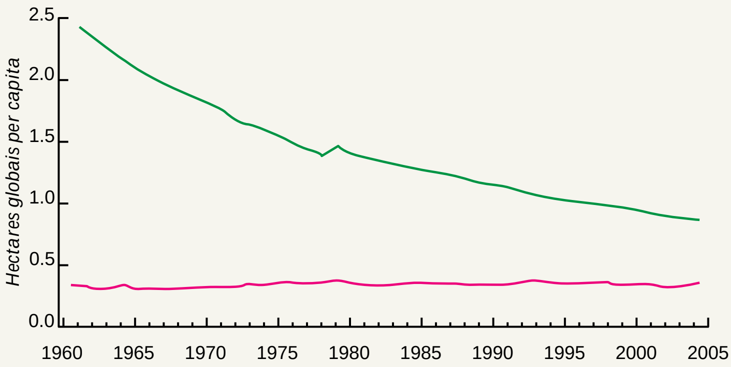
On the other hand, however, Brazilian biocapacity has been showing a strong decline over the years due to the impoverishment of ecological services and the degradation of the ecosystems (figure 16).

Figure 16: Consumption Categories x Ecological Resources

Key

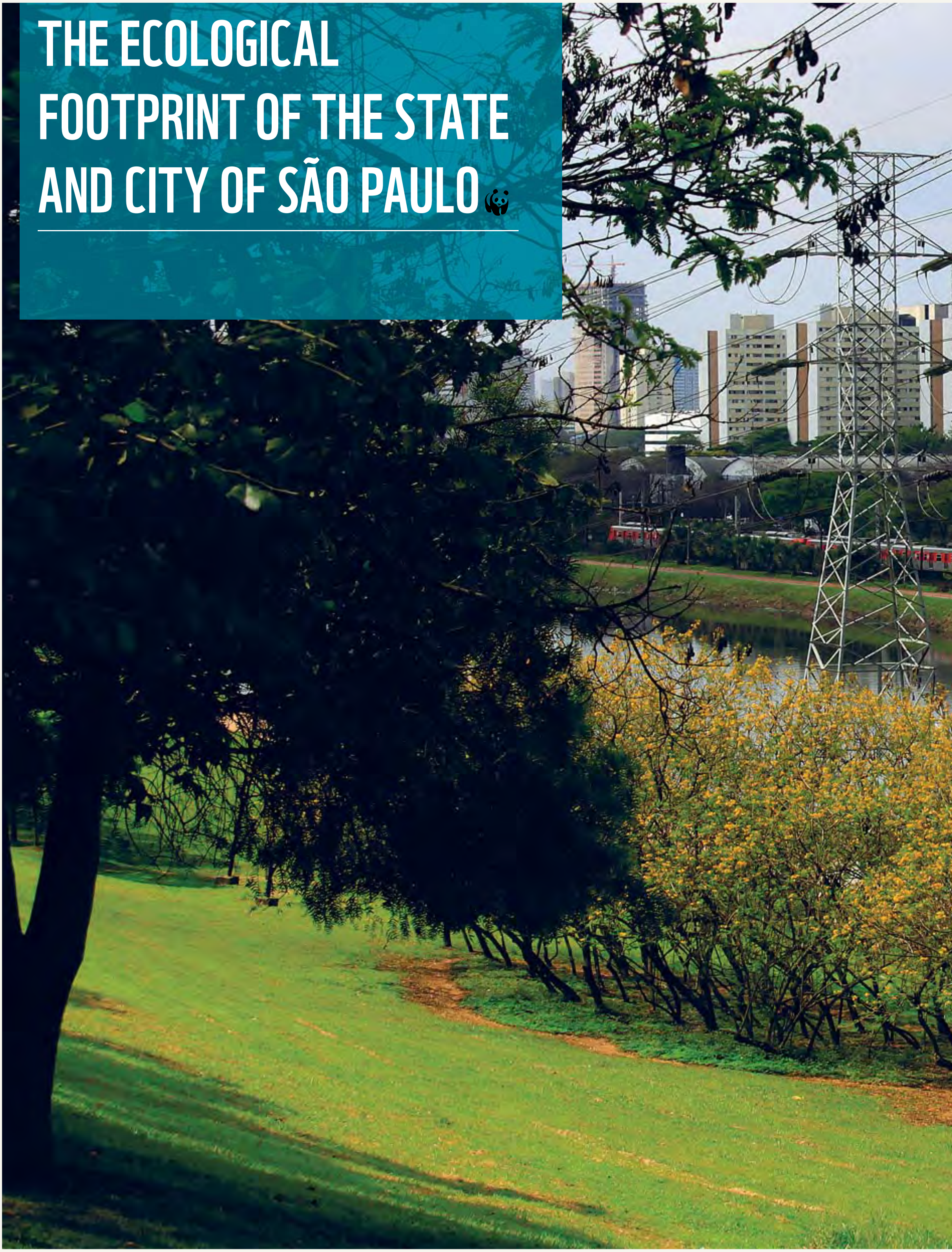
Ecological Footprint

Biocapacity



Even so Brazil occupies an important position on the world scene as one of the planet's greatest ecological creditors and is well situated in the context of the new green economy. To continue to occupy the position of ecological creditor, Brazil must revert this decline in its biocapacity by unfolding conservation actions and actions to make production more eco-efficient in a bid to diminish the Ecological Footprint of its population by adopting more conscientious consumer habits and maintaining demographic stability.

THE ECOLOGICAL FOOTPRINT OF THE STATE AND CITY OF SÃO PAULO



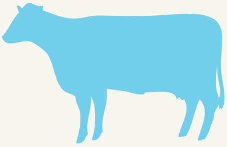
To calculate the Ecological Footprint of a given population the ecological resources that it is putting pressure on and the way they are being consumed need to be identified. To that end, ecological resources have been divided into six different categories and the consumer patterns have also been organised into five categories to embrace all that people consume. Of these last, three are related to direct 'domestic' consumption and the other two are consumption related to 'Government' and Gross Fixed Capital Formation.

Cross-referencing information obtained in the consumption survey with those of the natural resource demands of the state and city populations, we come up with a matrix of land-use and consumption patterns for the region's inhabitants. That makes it possible to verify where the São Paulo Footprint applies the most pressure identifying both the resource demanded and the category of consumption.

To gain a better understanding of how the resource versus consumption allocation is obtained we will now present the respective categories of consumption and of ecological resources.

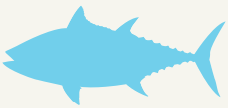
Ecological Resources

Agriculture – this refers to the areas of arable land the population needs to produce the vegetable foods, drinks produced on the basis of agricultural products (coffee, teas, beers, etc.) fibres of vegetable origin (cotton, flax, etc.) vegetable oils and other products stemming from agricultural activities. In the context of the Ecological Footprint, agriculture is considered to be a renewable biological resource insofar as production depends on arable land, which although it may be finite in size, generates resources on a regular basis. The loss of arable areas through erosion, exhaustion of the soils, desertification, salinization or being paved over leads to a decline in the biocapacity of this resource (agriculture).



Pastures – are areas covered by natural vegetation or cultivated but destined for feeding domestic animals to produce meat, dairy products, wool, animal fats and other products of animal origin. Just like agriculture, the pastures are finite areas for resource generation but they are also considered as a planetary biocapacity resource.

Forests – in the Ecological Footprint context, they are areas covered by natural or cultivated arboreal vegetation dedicated to the production of woods and fibres for human use. The forests too have finite sizes and resource generating capacities and they are considered to be one of the planet's ecological resources.



Fisheries – in terms of the Ecological Footprint, these are marine or river areas for the production of fish and other aquatic organisms for human consumption. Fish stocks in the rivers lakes and oceans are renewable but their regenerative capacity is directly affected by the intensity and volume of catches so that it is one of the planet's measurable ecological resources. Severe over fishing of fishery resources has led to a decline in the biocapacity of the fisheries as an ecological resource.

Built up areas – are considered in Ecological Footprint calculations as being an indirect resource. The built up areas were once biologically productive areas and so they are included in the population's Ecological Footprint account. Urbanisation and construction patterns show that built up areas are mostly situated on arable land and so they have an influence on the footprint similar to agriculture.

Energy and CO_2 Absorption – fossil fuels are not classified as ecological resources because there is no biological renovation of them and their eventual renewal would be on a time scale where it would be irrelevant for humans. However, the residues generated by their combustion, among them CO2 need to be absorbed by the ecosystems in order to keep the planet's temperature stable. Thus the use of these fossil resources is measured indirectly by the quantities of residues that need to be processed. When we analyse the question of greenhouse gases in Ecological Footprint accounting, we calculate the areas of preserved forests needed to sequester those gases. That means that they are not measured in CO_2 equivalents as is the case in climate change calculations, but instead, in the number of global hectares required to absorb them. Under the heading 'energy and CO_2 absorption' the areas that need to be inundated by hydroelectric dams to produce electricity are also considered.

Consumption Categories

Nutrition – food and alcoholic and non alcoholic drinks consumed in homes. Meals and drinks in restaurants and bars appear under the heading services.

Housing – considers expenses related to housing, payment of rent, occasional repairs, home maintenance, heating or cooling and electricity and fuel consumption associated to homes.

Mobility – refers to the populace's spending on transport, vehicle purchase, collective transport and fuel.

Goods – consists of all the goods items for the home and items for personal use purchased by the population such as shoes and clothing, furniture and electronic equipment, leisure equipment, magazines and books, personal care items and others.

Services – congregates all the population's consumption in terms of water supply and other domestic services, health and hospital services, postal and communication services, cultural and recreational services, education, personal care and others.

Government – refers to services provided by the public authorities in the federal, state and municipal spheres.

Gross Fixed Capital Formation (GFCF) – refers principally to long-term assets whether associated directly to the population (new houses, for example) or to companies (new factories or machines) or to government (like public infrastructure)[6].

6 To find out more about the Category Gross Fixed Capital Formation see the Chapter headed The New Brazilian CLUM on page 87.

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Consumption Categories X Ecological Resources

This report was elaborated in a different way from the classical Ecological Footprint studies where the information presented only refers to ecological resources. It was decided to present the data classified not only by ecological resources but also by consumption category which imbues this publication with additional theoretical and practical value insofar as it does not limit itself to an analysis of the aggregated Ecological Footprint alone.

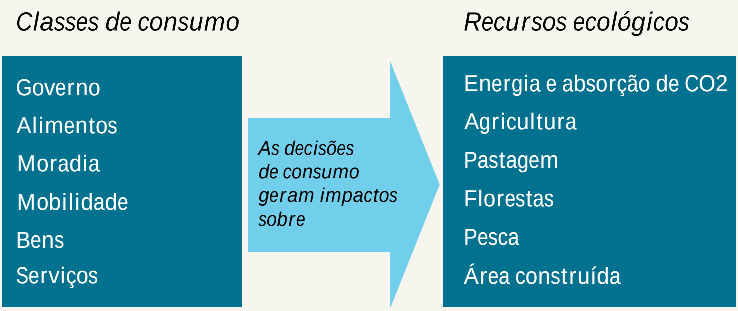


Figure 17: consumption categories x ecological resources

Consumer decisions generate impacts on natural resources

By distinguishing the pressures that the separate consumption categories (nutrition, housing, mobility, goods, services, and government) put on the planet's ecological resources (agriculture, pastures, forests, fisheries, built up areas, energy and CO2 absorption), we provide a tool to be used in the quest for more sustainable cities. We hope that by confronting the population of São Paulo with this evidence, it will, by means of its civil society organisations, class associations, government, companies and individuals, - manage to identify which activities and actions lead to degradation and consequently be more thoughtful in its consumer choices, either by reducing the volumes consumed or by preferring products and services that have lesser impacts (figure 17).

In the coming chapters we will set out the Ecological Footprint of the São Paulo population in detail, identifying the consumption categories and indicating the ecological resources that are under the greatest pressure.

São Paulo's Ecological Footprint

The state of São Paulo's average Ecological Footprint is 3.52 global hectares *per capita* and that of its capital city, 4.38 *gha/cap*. It means that if everyone on the planet were to consume the way the inhabitants of São Paulo state do, then two planets would be needed to sustain their lifestyle and if they consumed like people in the capital city do, then almost two and a half planets would be needed.

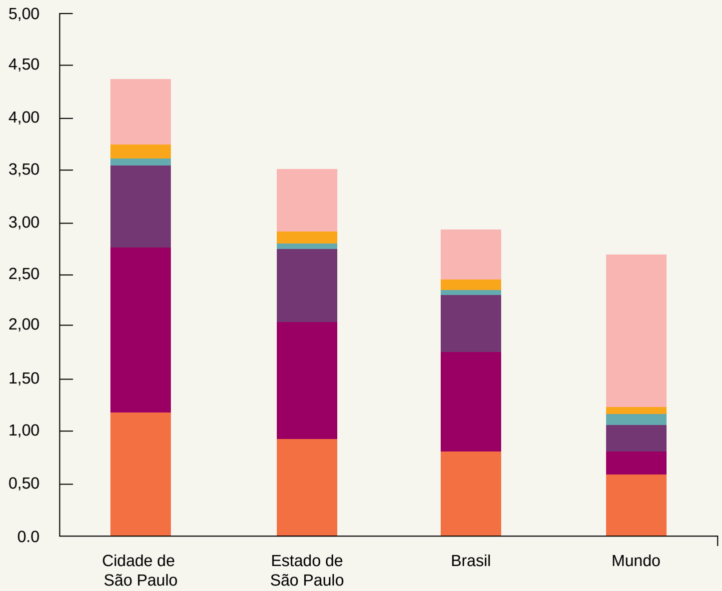
The Ecological Footprint of the city of São Paulo is 49% bigger than the Brazilian average and 25% bigger than that of São Paulo state. In turn, the state's Ecological Footprint is 20% larger than the Brazilian national average, which is 2.93 global hectares per person.

It should be noted that the pattern of footprint composition among the various categories maintains the same proportion as the Brazilian national pattern that is to say there is a strong demand for grazing land, agriculture land and forests. Brazilians have a smaller demand for CO2 absorption areas as compared to the global average due to the lower levels of emissions associated to the energy matrix and the intense use of biofuels in mobile sources of emissions (Figure 18).

Figure 18: Ecological Footprint by ecological resource categories (gha/cap)

Key

Energy and CO_2 Absorption
Built up Areas
Fisheries
Forests
Pastures
Agriculture



The ecological resources represented by Agriculture (grain, vegetables, and foodstuff production and other plant-based products) and grazing land (meat, hides, wool, animal fats production and other animal-based products) represent over half the Ecological Footprints of state and capital city residents alike and are mainly consumed in the form of food. The Forest component (wood, paper, fibres, forest essences), which also contributes considerably to footprint size in both cases, is largely associated to the acquisition of goods: clothing, furniture, other household items, recreation material, books etc.

The consumption of ecological resources by the population can be more readily understood by observing the Ecological Footprint segregated by consumption categories.

The greater part of the Ecological Footprints of both state and capital city populations is associated to the consumption of food, goods and transport. (Figure 19).

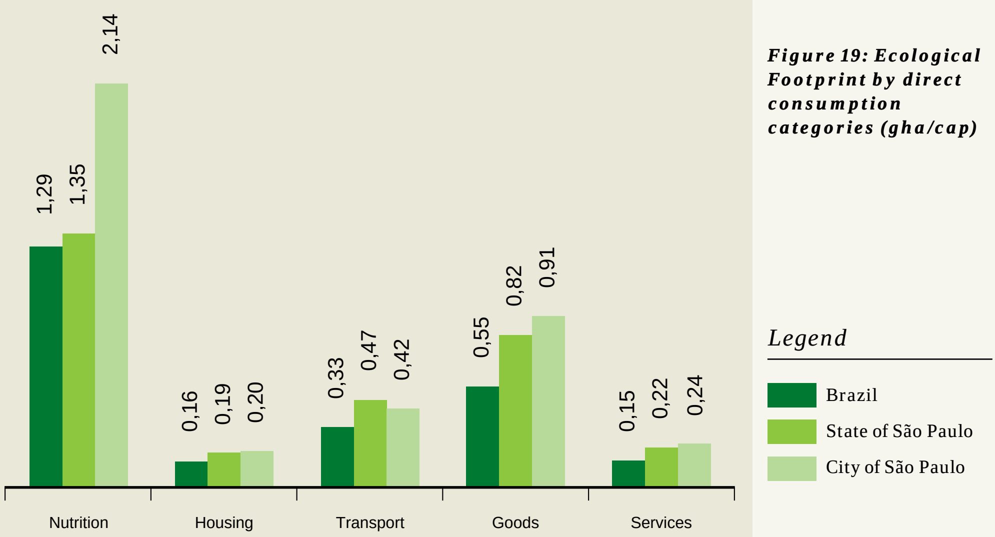


Figure 19: Ecological Footprint by direct consumption categories (gha/cap)

The Ecological Footprint by consumption categories

To gain a better understanding of exactly how São Paulo state and capital residents consume ecological resources we have elaborated a detailed report segregating consumption by categories. In that way it is possible to identify which resources are being most heavily consumed and elaborate strategies to reduce the impacts of consumption by means of different mitigation actions.

The classes of consumption fall into four main blocs: direct consumption by individuals, consumer goods, household based consumption (food, housing, transport, goods and services), and indirect consumption embracing the categories Government (government expenditure on goods and services) and Gross Fixed Capital Formation (capital goods and infrastructure).

Domestic expenditures have been regionalised according to the consumption patterns of the populations involved. The category government is analysed at the federal level and is therefore the same for all Brazilian as is the Gross Fixed Capital Formation. The Footprint calculation methodology is constantly being further developed and in future footprint studies, it may be possible to regionalise these latter indirect consumption categories as well.

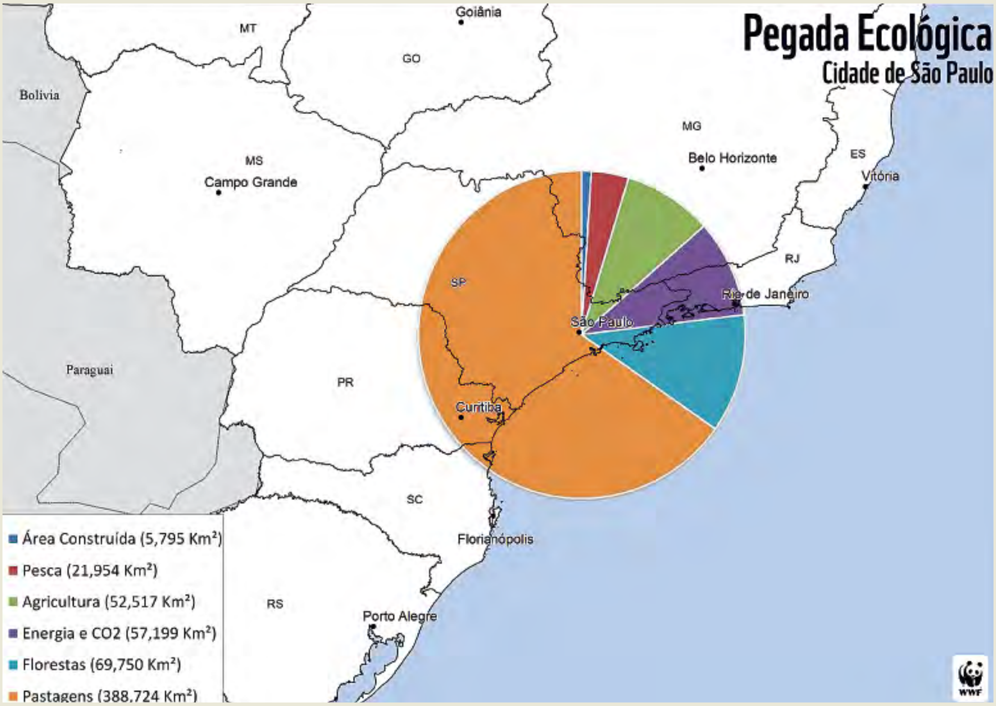
Converting global hectares to real hectares

Although the standard unit of measurement for the Ecological Footprint is the global hectare per capita (gha/cap.), in order to make comparisons of the footprints of different cities or nations easier, irrespective of the actual productivity of their respective lands, we can re-convert global hectares into real hectares and thereby visualise more clearly their demands for land.

In this case the decision was taken to make use of average global production figures to measure the real areas of the São Paulo state and São Paulo city populations' Ecological Footprints because we cannot be sure that all the ecological resources consumed have their origins in Brazilian territory.

To exemplify, we know that Brazilian forests are more efficient absorbers of CO_2 than the global average for forests but because we cannot guarantee that all the CO_2 emitted by the population is absorbed in Brazilian territory we have decided to convert those figures to global averages and not Brazilian averages. See the Chapter headed 'Harmonising bio-productive Areas –from hectares to global hectares – page 110.

In the example shown we have a map that can be interpreted as representing the area that would be needed by the populations of the Capital and state of São Paulo to produce all the goods and services stemming from the use of renewable natural resources as well as the areas needed to absorb all the CO_2 emissions generated in them. The state of São Paulo would need an area of 1,658,571 Km^2, almost seven times the official size of the entire state. In turn, the city of São Paulo would need an area of 595,939 Km^2 (see map) to be self-sufficient so that its current consumption patterns require an area 390 times the size of the entire municipality.



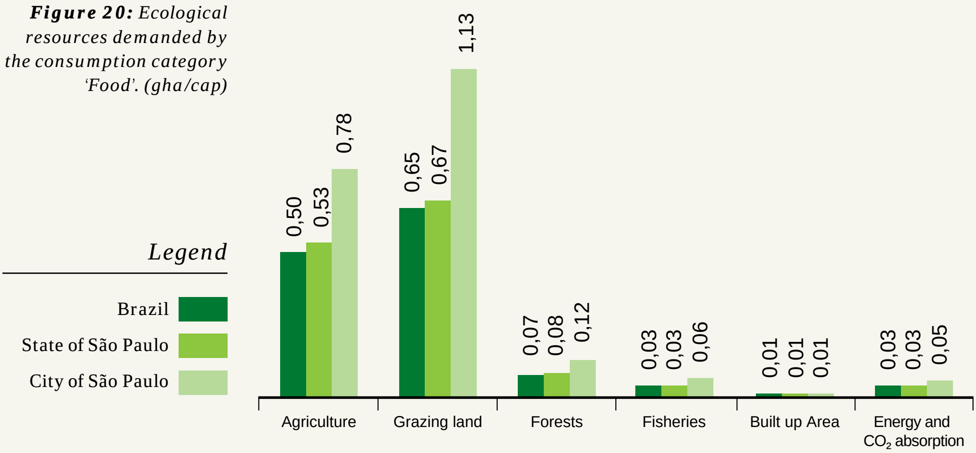
Obviously we have had to make various suppositions but nevertheless, the map illustrates very well the relationship between consumption concentrated in the cities and the areas theoretically necessary to sustain that consumption, especially in the case of the state of São Paulo and its capital City of São Paulo which have very high population densities compared to other parts of Brazil.

In the texts that follow each category of state and capital residents' consumption will be analysed regarding the demands they make on natural resources. This kind of analysis makes it easier to devise mitigation strategies or other strategies associated to improving public administration.

Food

Food is the consumption category that makes the heaviest demands on ecological resources and that goes for both state and capital city populations. In the case of the average capital city dweller the food category is responsible for almost half his or her footprint while for those living in the state the food category is responsible for 38% of their total ecological footprints.

Figure 20: *Ecological resources demanded by the consumption category 'Food'. (gha/cap)*



The greatest pressure stemming from the consumption category 'food', is obviously placed on agriculture and grazing land resources especially in view of Brazilian's dietary habits which include a high meat intake, particularly of beef and that is one of the factors that expands the footprint caused by food consumption (Figure 20).

The state of São Paulo shows a pattern very similar to the Brazilian national average but in the capital city, although the distribution patterns among the categories are similar, the footprints themselves are considerably larger boosted mainly by the higher consumption levels of red meat, milk and dairy products. It is also interesting to note that the São Paulo city dwellers consume a lot more pork than the average Brazilian but the impact of pig production is much heavier on agriculture than any other resource because the animals are fed on agricultural products. Another interesting fact is that the part of São Paulo inhabitants' footprint that is the result of fish consumption is twice as large as in the average national footprint.

Alcoholic and non-alcoholic beverages are also accounted for under the consumption category 'food' and the impacts associated to alcoholic drinks are greater than other drinks, not because they are consumed on a larger scale but because they demand more resources for their production than juices, soft-drinks and infusions. São Paulo state inhabitants have a footprint associated to alcoholic beverages very close to the national average, slightly less in the case of beers and 'draft beer' and slightly more in the case of wines and spirits. The City dwellers in turn show a similar pattern but with a slightly higher preference for alcoholic beverages (figure 21).

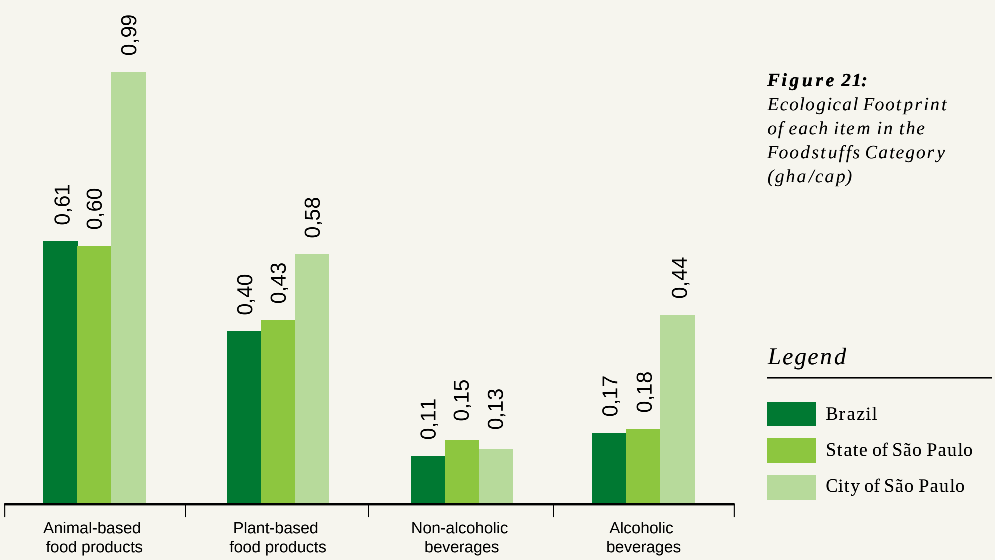


Figure 21: *Ecological Footprint of each item in the Foodstuffs Category (gha/cap)*

Meat Free Monday

The São Paulo populations' consumption of meat by both state and city dwellers has a considerable participation in the composition of their Ecological Footprint. Since 2009 the municipal authority's Greenery and Environment Department has been supporting the international Meat Free Monday drive in a partnership arrangement with the Brazilian Vegetarian Society.

It may not seem like much at first sight but that attitude could actually reduce the average city dwellers foodstuffs footprint size by 5%.[7]

CONEXÕES SUSTENTÁVEIS: São Paulo ↔ Amazônia

Another important factor relating meat production and consumption to the Ecological Footprint is the steady decline in Brazilian biocapacity. When areas of forest are substituted by grazing land, especially in the Amazon region, the country's overall production of ecological resources is reduced.

The 'Sustainable Connections: São Paulo – Amazon' initiative is a bid to mobilise the value chains associated to livestock, wood and soy production by establishing sector-based pacts designed to foster the preservation of the Amazon and its peoples. The documents that are drawn up impose an obligation on their signatories to only finance, trade in, or distribute duly certified products (or that are in the process of certification and regularisation) not originating from suppliers that are on the Slave Labour Laundry List or from areas under IBAMA embargoes. In the case of the Soy Pact, they must originate form areas liberated by the Round Table on Responsible Soy.[8]

7 http://www.segundasemcarne.com.br/

8 http://www.conexoessustentaveis.org.br/

Housing

The housing sector answers for 6% of the São Paulo city citizens' Ecological Footprint and for 5% of São Paulo state inhabitants' footprint. The biggest impact is on Forests and Energy and CO2 absorption mainly due to electricity consumption and repairs and refurbishing of homes (Figure 22).

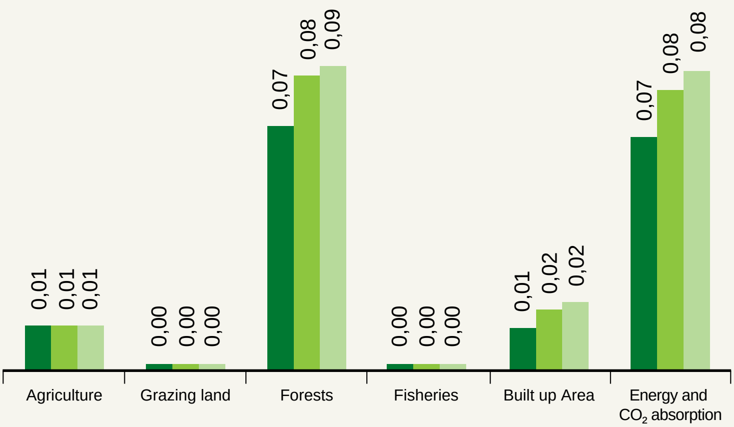


Figure 22: *Ecological Resources required by the consumption category Housing (gha/cap)*

Legend

- Brazil
- State of São Paulo
- City of São Paulo

Sustainable Housing

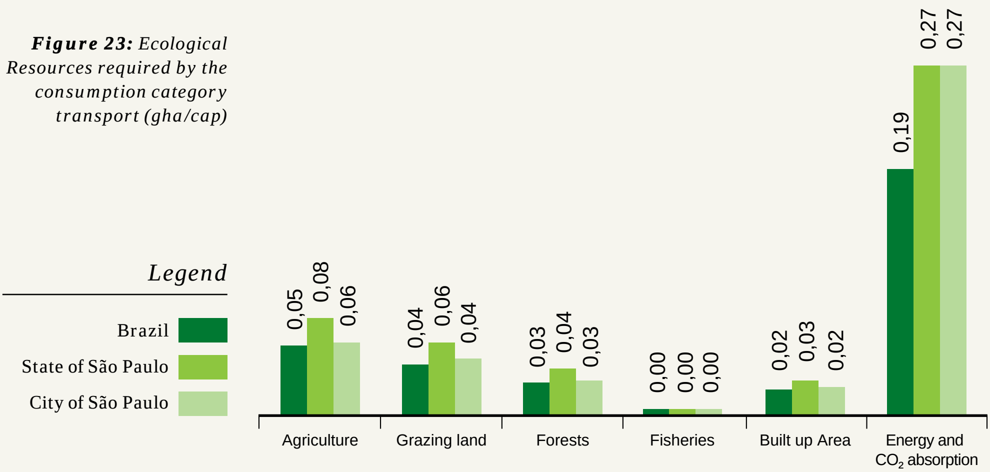
The principle of sustainable housing is not achieved merely by using recycled materials or materials with low environmental impacts. Sustainable buildings need to be energy-efficient and to that end they must embody engineering and architectural principles that maximize the use of natural light the free circulation of air, thermal insulation, and rationalized use of water throughout the useful life of the building.

It is important to reiterate that the Ecological Footprint does not include non-renewable natural resources in its accounts. As an example, the iron used to produce the steel elements used in construction is not accounted for considering that it is a material that cannot be regenerated on the time scale associated to human life spans. However, the charcoal that is used in the steelworks furnaces that produce the steel that goes into construction is accounted for in the category of forest-based ecological resoucers.

Transport

This category represents 14% of the average São Paulo state citizen's Ecological Footprint and 10% of that of the average citizen living in the state capital. The main ecological resources drained by this consumption category are areas for the absorption of greenhouse gases resulting from fuel combustion (Figure 22).

Figure 23: *Ecological Resources required by the consumption category transport (gha/cap)*



Among the component items that make up the transport category is 'Transport Equipment Operation' (fuels, maintenance and accessories), which was the biggest single contributor to footprint size, followed by transport services (urban and collective transport, trips) and finally by Vehicle Purchase (buying new vehicles) (Figure 23).

One interesting fact the study revealed is that although the Ecological Footprint for transport of the São Paulo city dweller is 27% greater than that of the average Brazilian, it is actually 10% less than that of the average São Paulo state dweller. It can be seen that capital city residents tend to consume more public or collective transport for their mobility needs and also that they tend to invest less in brand-new vehicles than their fellow state dwellers or average Brazilians. Another noteworthy fact is that although they may spend less on new cars than their fellows, when São Paulo city residents do make use of this means of transport , they consume more fuel than their national or state counterparts thereby increasing their Ecological Footprint in areas for CO_2 absorption.

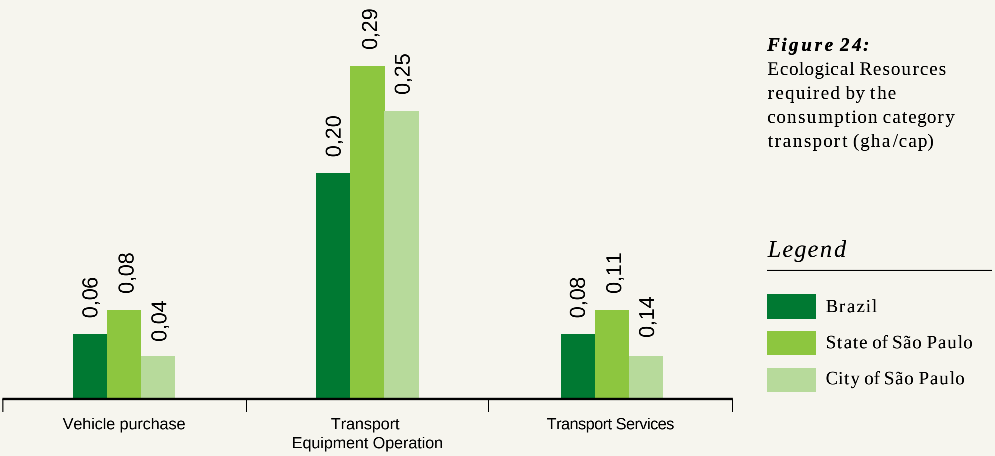


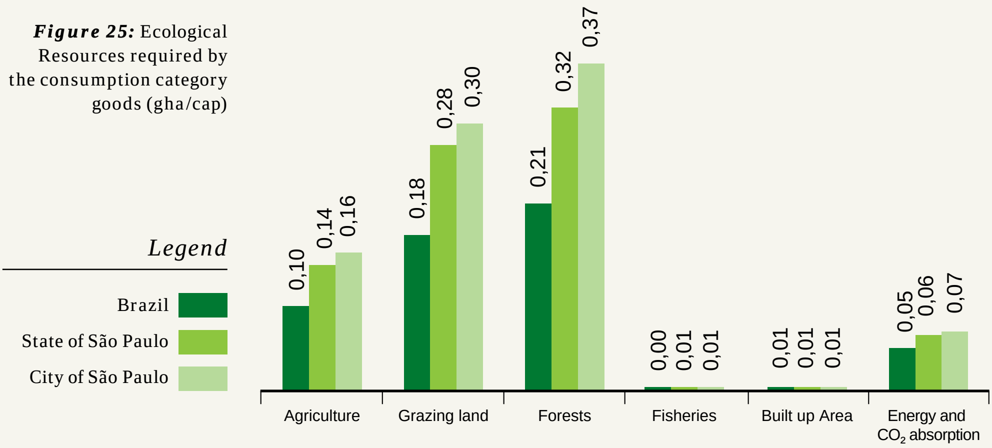
Figure 24: Ecological Resources required by the consumption category transport (gha/cap)

It is important to bear in mind that we are evaluating the consumption of ecological resources, and not evaluating urban mobility as such, far less the quality of transport services used by the populations studied. Public investments in collective transport, cycle-ways and infrastructure for other means of transport could lead to a significant reduction in the footprint associated to this particular consumption category both in the capital and on the coast and in the interior of the state.

Goods

Consumer goods represent 23% of the average São Paulo city dweller's Ecological Footprint. Goods are the second most important consumption category in composing the Ecological Footprint of Brazilians in general and even more so, that of the citizens of São Paulo city. For state residents the figure is 50% higher than the national average for this category but for the capital city's inhabitants it is 67% higher.

Figure 25: Ecological Resources required by the consumption category goods (gha/cap)



Most of the demand stemming from goods consumption puts pressure on forest resources like wood, paper, cardboard and other materials used to manufacture the goods and also in packaging. There is also a lot of pressure on grazing lands due to the associated consumption of animal-based derivatives (hides, wool, animal fibres, glues, waxes and collagen) and on agricultural land (cotton, vegetable fibres, vegetable oils etc.) (Figure 24).

It is also interesting to note that the Ecological Footprint of a given item is not necessarily related to its relative importance in household budget and supply.

Sometimes even a small quantity of a certain product that is consumed may have a quite a large influence on footprint size because of the intense consumption of natural resources that went into its manufacture.

For example, spending on clothing by the average citizen of the City of São Paulo represents around 5% of current spending but only 1% of his or her total Footprint. On the other hand, spending on tobacco only represents 1% of expenditure but is responsible for 9% of a citizen's Ecological Footprint.

Working on the indicator

Generally speaking São Paulo State and City residents show that they have a greater appetite for consumer goods than the average Brazilian with the capital city inhabitants in the lead.

Brazil is currently experiencing a strengthening of its national economy accompanied by a strong wave of social ascension involving the low-income populations that has facilitated their access to credit and to contracting debt and that situation will most certainly expand the Ecological Footprint resulting from goods consumption by the average Brazilian. There is an urgent need to reflect on the way Brazil intends to take its place among the world's largest economies. A new economic development model should not limit itself to ensuring cleaner and more efficient forms of production but should be guided by a clear understanding that human and economic development cannot be represented merely in terms of the expansion of the population's consumption levels.

No Smoking

Tobacco has a great impact on the formation of the Brazilian national Ecological Footprint, accounting for 6% of its total footprint. In the case of São Paulo state and city dwellers the figures are 10 and 9% higher respectively.

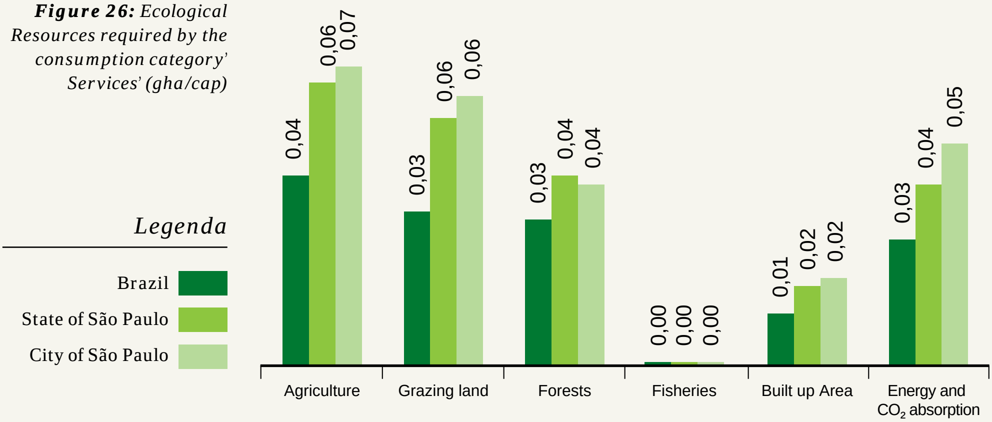
The consumption patterns revealed by the study showed that both state and city dwellers spend more than the national average on tobacco. Ministry of Health studies show that 20% of adults living in the capital, São Paulo city, are smokers; the second largest smoker population of all Brazilian state capitals.

São Paulo state legislation prohibits smoking in closed collective areas and that has an influence on restricting the habit and consequently the consumption of tobacco in both state and capital. That in turn will lead to a reduction in the footprint associated to cigarettes.

Services

The consumption category services is responsible for 6% of the average state citizen's footprint and 5% of the average capital city resident's footprint and those are 46% and 58% higher than the Brazilian national average, respectively. The pressure on natural resources caused by services consumption falls mainly on agricultural and grazing lands, forests and areas for CO2 absorption (Figure 26).

Figure 26: *Ecological Resources required by the consumption category' Services' (gha/cap)*



Financing and insurance services (social security, health insurance, other forms of insurance, credit, bank accounts, etc.) are the other items that most contribute to the services footprint and they are considerably greater for São Paulo state and city residents than the national average.

Personal care (personal appearance, personal hygiene, maintenance of articles for personal use, etc.) and Cultural and Recreational service (recreation, sports, cinema, theatres, music, exhibitions etc.) also make their mark in the services footprint.

Although the contribution of the footprint stemming from average citizen's services consumption is relatively small its significance tends to increase in the higher income bracket. (See the chapter 'The Ecological Footprint by Household Income Brackets')

Indirect Consumption Categories

Two classes involving indirect consumption have been added to those where consumption is made directly by the individual citizen (Domestic Consumption), they are 'Government' and 'Gross Fixed Capital Formation'.

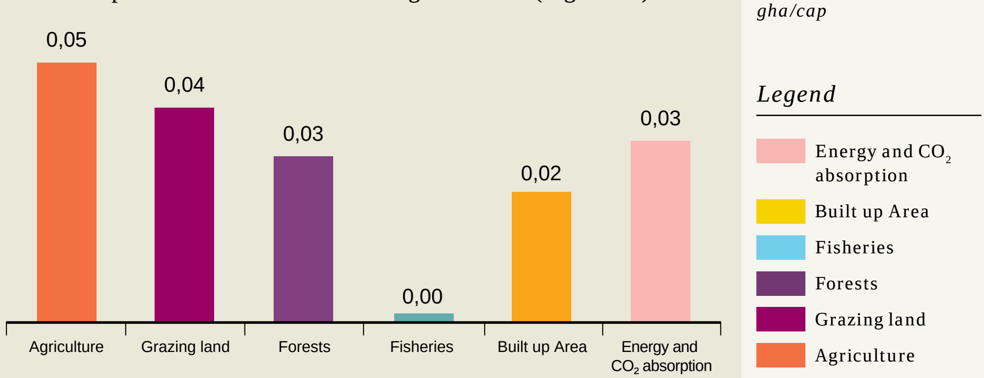
These two extra categories, albeit they represent indirect consumption, do actually influence consumption insofar as they provide governability and infrastructure that contribute to the maintenance of the population's living standards and conditions and accordingly they are part of the citizen's Ecological Footprint.

It must also be stressed that for lack of reliable data and appropriate methodology, these categories have not been scaled down to regional or local scales, in other words it has been assumed that they are the same for all Brazilians and that all Brazilian citizens have equal access to the resources they provide.

Government

In the context of Ecological Footprint studies the consumption category 'government' should take into account the demands of federal, state and municipal spheres but in fact it is being taken here on the Federal scale only. This category includes all goods and services consumed by the three branches of power (paper, electricity, light machines and equipment, vehicles, and services in general) but it does not include infrastructure and non-disposable goods. The consumption of ecological resources on the part of 'Government' adds on 0.17gha/cap to the average Brazilian citizen's Ecological Footprint and its composition can be seen in the figure below. (Figure 27)

Figure 27: *Comparison of ecological resources in gha/cap*



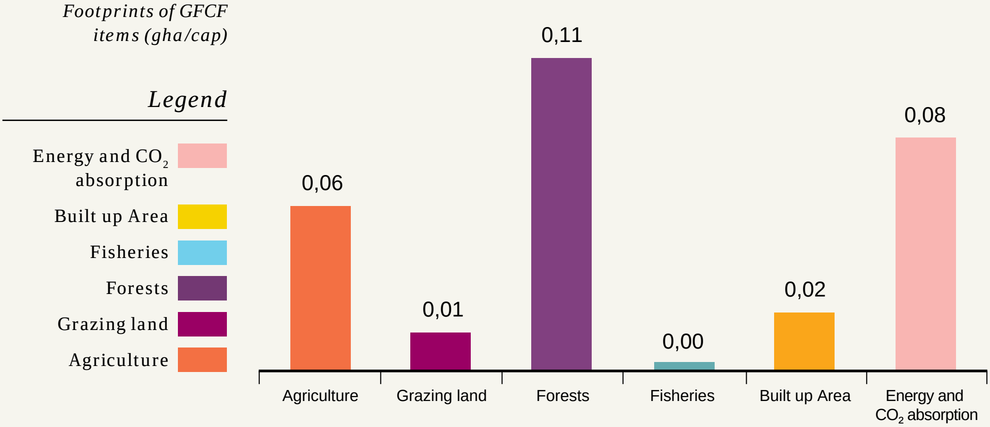
Efforts to reduce the amount of material demanded by public services can lead to a reduction in their consumption of ecological resources. Also, the adoption of purchasing policies whereby governments only purchase products with certified sustainability standards can ensure that the acquisition of resources by governments have a much lesser impact on the environment.

Gross Fixed Capital Formation

Gross Fixed Capital Formation (GBCF) is a new Category of Consumption that has been incorporated into Ecological Footprint studies (see the chapter 'New Consumption and Land Use Matrix for Brazil). It seeks to make a better redistribution of the pressures brought about by the categories of direct consumption by accounting for the resources used up by investments in permanent goods in a category of their own, allocating them in the country's production processes instead of associating them to domestic consumption.

The GFCF adds 0.29 gha/cap to the average national footprint and the pattern of ecological resource use by this category can be seen in the graph below (Figure 28).

Figure 28: *Ecological Footprints of GFCF items (gha/cap)*



Forests are the resource that GFCF consumes most, especially for infrastructure construction. Appropriate policies and regulations for the construction sector covering both public and private works could go a long way towards reducing impacts stemming from GFCF.

São Paulo state and city - Biocapacities

Biocapacity is the counterpart of the Ecological Footprint. While the Ecological Footprint measures the amount of ecological resources that the population of a given region consumes, Biocapacity measures the amount of ecological resources that same region produces.

In the present study we determined the biocapacities of the state of São Paulo and of its capital city. When we compare the Ecological Footprint and Biocapacity of a region we can find out whether it is a debtor or a creditor in regard to ecological resources (Figure 29)

***Figure 29:** Comparison between Ecological Footprint and Biocapacity (gha/cap)*

In a similar way to the Ecological Footprint, Biocapacity is expressed in global hectares per person (gha/cap). Thus we take the total Biocapacity of a region and divide it by the number of inhabitants. Obviously regions with a very high population density like the state and city of São Paulo will have a very low Biocapacity.

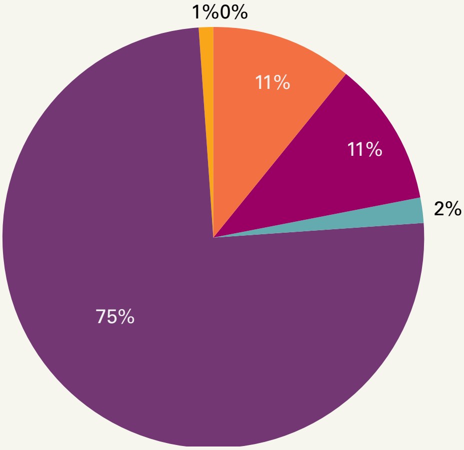
Brazil is one of the world's greatest ecological creditors and in that context, the forests are the greatest natural capital answering for 75% of Brazil's total Biocapacity (Figure 29).

The average productivity of Brazilian forests is 110% higher than average productivity of the world's forests, which means that each hectare of Brazilian forest is the equivalent of 2.65 global hectares in ecological resources. That underscores the fundamental importance of preserving Brazilian forests to ensure that we continue to be international ecological creditors and take on a leadership role in a new world scenario of ecological economics.

Figure 30: *Biocapacity by ecological resources in percentages - Brazil*

Legend

Hydroelectricity
Built up Areas
Forests
Continental Waters
Marine
Grazing land
Agriculture

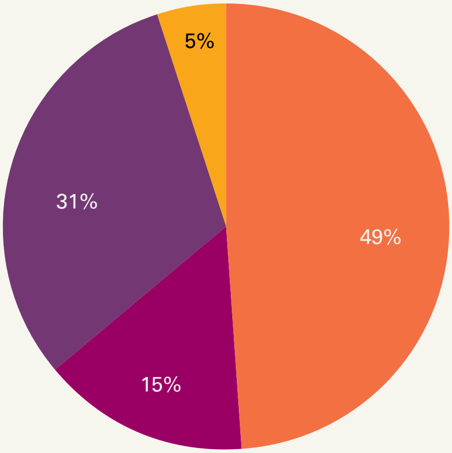


Almost half of the state of São Paulo's Biocapacity resides in its agricultural lands (Figure 31). The state's agriculture is highly productive and its yields are 35% higher than world average figures. Its forests too are on average 150% more productive than the global average for the world's forests based on their primary net productivity figures.

Figure 31: *Biocapacity by ecological resources in percentages – State of São Paulo*

Legend

Hydroelectricity
Built up Areas
Forests
Continental Waters
Marine
Grazing land
Agriculture



It is worth noting that the productivity of the forests is conditioned by local ecological conditions alone whereas the productivity of agriculture is high because of the addition of material and energy inputs and most of the energy is derived from fossil or mineral sources that are not renewable. One of the great challenges the world faces is how to maintain or even enhance Biocapacity while at the same time reducing dependence on non-renewable natural resources.

In the case of the capital city, São Paulo, although its Biocapacity expressed in gha/capita may be small, its total Biocapacity is over 450 thousand global hectares. Most of that consists of built up areas that provide shelter for its inhabitants, but it also has considerable Biocapacity in the form of forests distributed in its parks and Protected Areas (Figure 32).

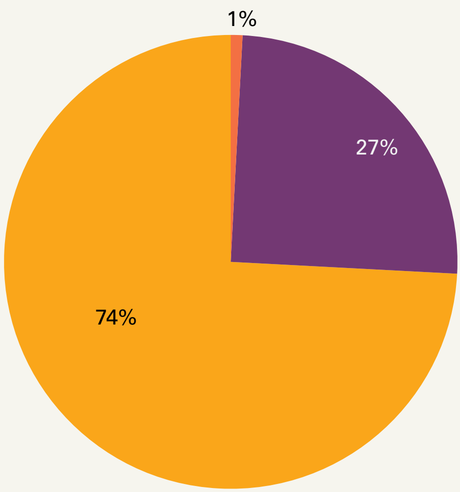


Figure 32: *Biocapacity by ecological resources in percentages – City of São Paulo*

Legend

- Hydroelectricity
- Built up Areas
- Forests
- Continental Waters
- Marine
- Grazing land
- Agriculture

The municipality (city) of São Paulo also has a small area dedicated to agricultural production that plays an important role in providing part of the city's population with foodstuff and agricultural products. According to the Municipal Supply Authority the city has 403 registered small farmers practicing family-based agriculture and there are various state and municipal programmes that stimulate conversion to low impact forms of agriculture such as the Guarapiranga Seal of Sustainability, the Urban and Peri-urban Agriculture Programme, as well as markets for organic and agro-ecological products and there are specific funds allocated such as the Special Environment and Sustainable Development

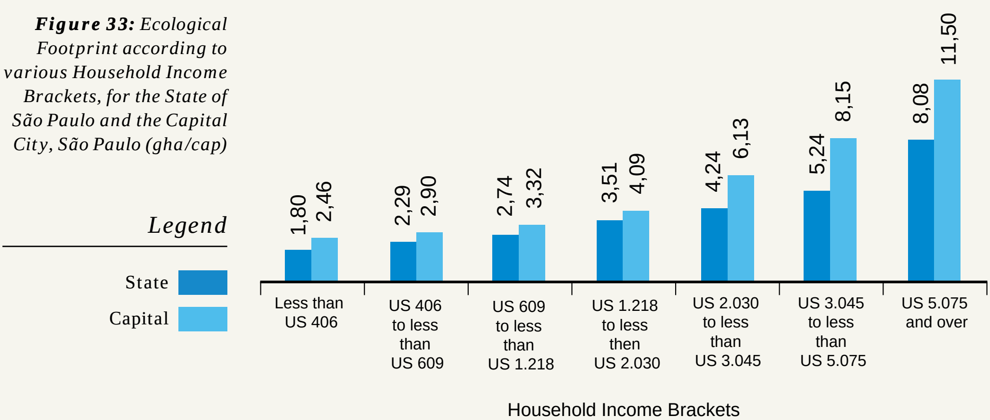
Fund and the Agro-ecological Agriculture Casas. In this context the practice of urban and peri-urban agriculture shows great promise and potential for expanding to become a consolidated, permanent, multi-functional activity.

The Ecological Footprint by household income brackets

During the planning stage of this project we raised the question of whether it would be possible to investigate the Ecological Footprint with data segregated according to household income brackets to get a better idea of how the different strata of São Paulo society (state and capital city) vary in their consumption of natural resources. Once we had the appropriate data in hand we found that it was indeed possible and so the footprint has been made for 6 different ranges of household income brackets up to a maximum of 40 times the national minimum salary as used by the Household Income Survey conducted by the Brazilian Geography and Statistics Institute (IBGE) for the state of São Paulo. For the city of São Paulo the data was adjusted by the FIPE to make it appropriate to the Municipality of São Paulo[9].

The illustration shows Ecological Footprint in global hectares for individuals in the respective family income ranges, for the city of São Paulo and the State of São Paulo (Figure 33).

Figure 33: *Ecological Footprint according to various Household Income Brackets, for the State of São Paulo and the Capital City, São Paulo (gha/cap)*



9 The Household Income Survey dates back to 2008 when the Official Brazilian Minimum Salary was 415 Brazilian reals (US 203).

Following the pattern shown by the average figures presented so far, the capital city residents have bigger footprints than the state residents in all income brackets. The difference is least in the income bracket ranging from 3 to 10 times the value of the official minimum salary and more accentuated in the income brackets above 10 times the official minimum salary.

Figure 34 shows the total population in millions for each income bracket and the corresponding total Ecological Footprint total for each one in millions of gha for the state population (in which the population of the capital is also included).

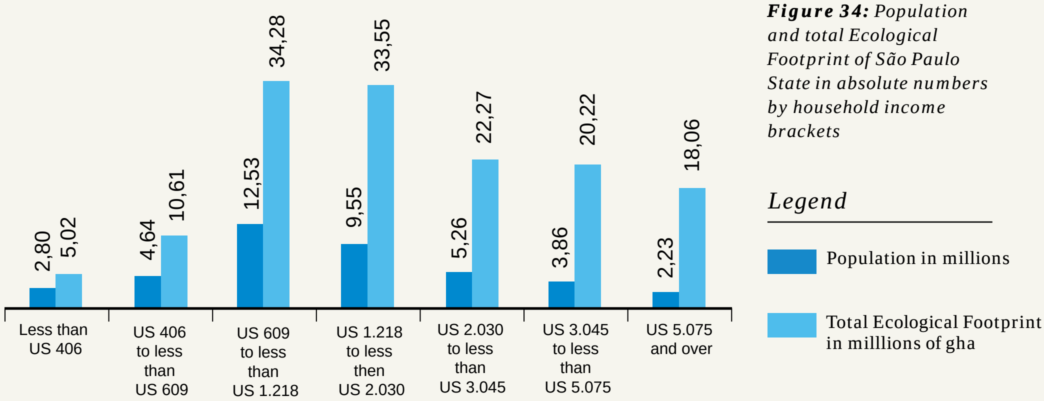


Figure 34: *Population and total Ecological Footprint of São Paulo State in absolute numbers by household income brackets*

It can easily be seen that 47% of the total São Paulo state Ecological Footprint is produced by the middle class and more precisely, the group earning from 3 to 10 times the official minimum salary which also represents the largest percentage of the state population (54%) (figure 35).

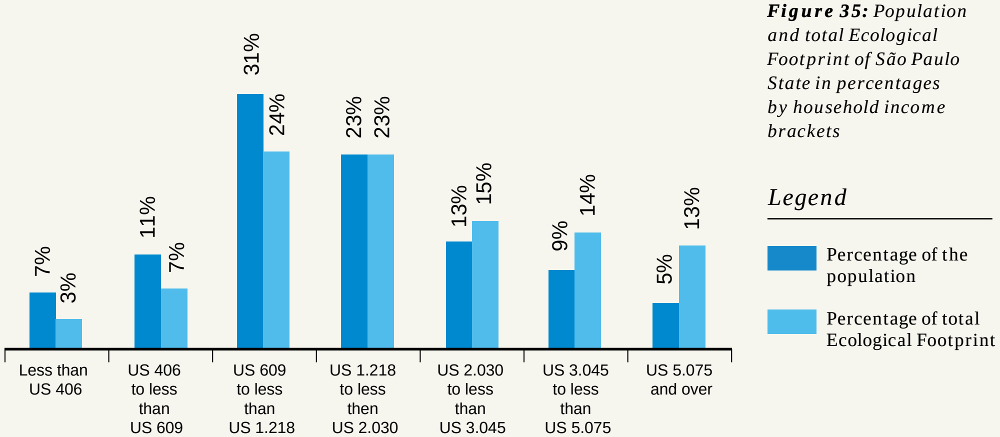


Figure 35: *Population and total Ecological Footprint of São Paulo State in percentages by household income brackets*

Although they only represent 28% of the population, those earning more than 10 minimum salary amounts are responsible for 42% of the State's total footprint.

The 18% of the population that are living with less than 3 minimum salaries answer for only 11% of the state of São Paulo's total Ecological Footprint.

This method of segregating the data according to household income brackets helps towards targeting campaigns and actions to encourage responsible consumption more specifically and reducing the footprint of different publics.

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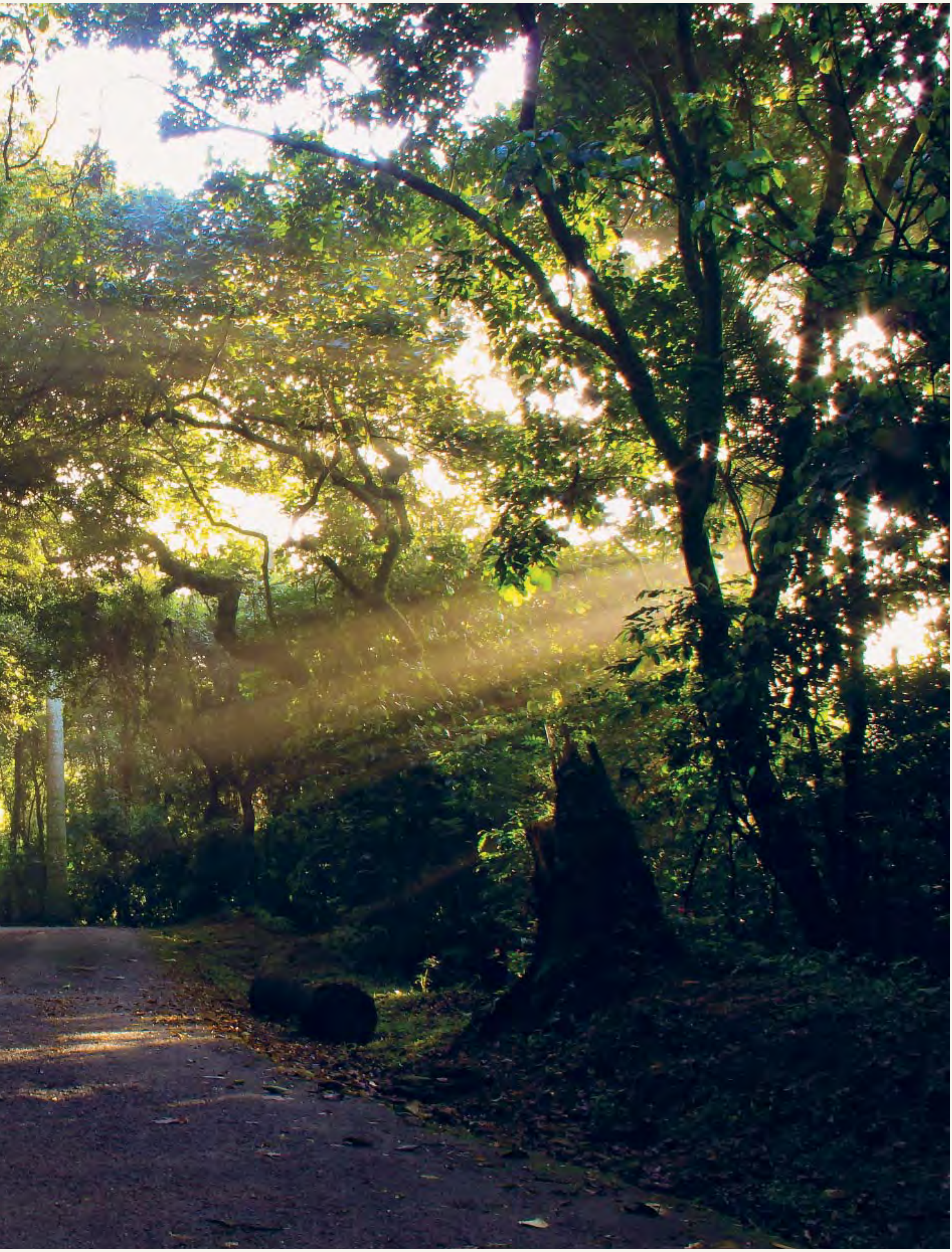
CONCLUSIONS



The calculation of the State and the city of São Paulo's Ecological Footprints is an invaluable urban management tool that points the way towards a better quality of life for their citizens. The footprint calculation, however, is just the first step and it needs to be followed by a discussion with all the local actors and the subsequent development of mitigation strategies to help reduce the footprint size.

There is a need for more intense engagement on the part of the public sector in the endeavour to mould the state and city's future. That participation however will be built up time as time goes by.

The Ecological Footprint is a cross-cutting tool, an important instrument to support urban planning policy insofar is it provides elements that help the public authorities to re-think and plan the future for the state and capital city residents alike. It also serves as a parameter for examining production chains of all that the population of the state and the capital consume since both of them make a huge demand on a wide range of raw materials that are not produced within their own territories but imported from other states.

There is a whole series of issues that can be addressed using this tool such as evaluating how natural resources are being used in agriculture and livestock production to meet the consumers' needs. In regard to transportation, it helps the analysis of emissions stemming from the vehicle fleets, and stimulates greater use of collective transport

By studying the consumption patterns revealed by the Ecological Footprint calculation, it is possible to identify natural resource use by the population, potential health problems, habits and routines and other aspects of great relevance for municipal management.

It must be stressed that the aim of the footprint calculation is not to paint a negative portrait of the city or the state. The idea is to offer them a tool for better public administration, mobilise the general public in regard its consumer habits and encourage it to choose more sustainable products, while at the same time opening up a dialogue with businessman to encourage them to improve their production chains. Above all, the Ecological Footprint is tool for debate and to orientate more responsible choices and indicate solutions that can help to model a sustainable future.

The Ecological Footprint offers decision makers the possibility of addressing questions related to the structure and functioning of local and national economies and it is an important tool in the discussions on sustainable production and consumption, energy and climate.

It not only serves the public administrator well but it is also useful to private company administrators enabling them to become more aware of the impacts caused by their production chains and it is useful to ordinary citizens that wish to improve the quality of life in their cities.

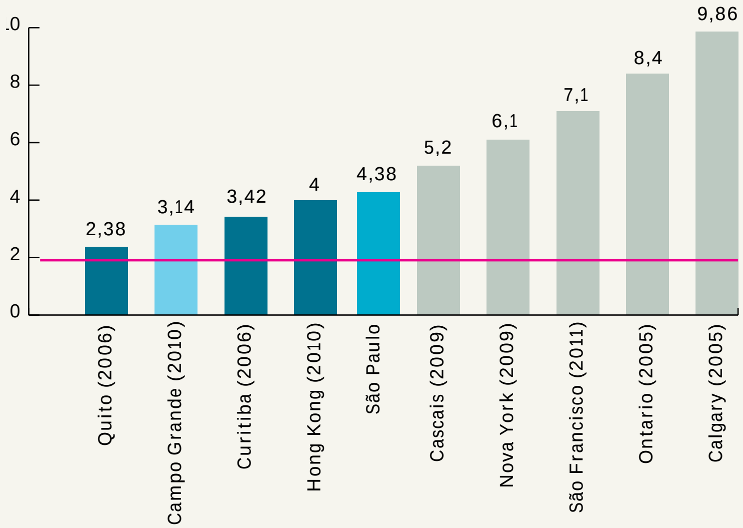


Figure 36: *The Ecological Footprints of various cities that have already made the calculations*

Legend

Footprint (gha)

Global Limit

As the chart shows (figure 36), other cities have also undertaken the calculation of their Ecological Footprint and are now developing their long-term mitigation plans to reduce their consumption of renewable natural resources. Now it will be up to the administrators of those cities to point the way in which the development of their municipalities needs to head.

Does São Paulo want to draw closer to those cities with even larger footprints, or would it prefer to maintain a smaller footprint and seek ways to achieve forms of development with lower environmental costs? It would definitely not be desirable to get closer to the situations of cities like Calgary or San Francisco and much better to make the effort to keep the footprint small. There is still a good chance for São Paulo to get its footprint down to the size that all cities need to try for in the long term namely: 1.8 gha – the global limit for our Ecological Footprint.

The Ecological Footprint basically points to the problems, it does not come up with immediate solutions for them.

We are well aware that there still some points that need to be improved so that we can make the calculations even more accurate.

The data sources can definitely be improved and the main constants introduced into the calculations need to be gradually revised[10].

Even so, we cannot expect this environmental indicator to solve all the problems that need to be addressed, or to bring about the transformation and changes towards becoming a more sustainable society. The Ecological Footprint is an excellent tool in helping us to change the perspective in which we view development and stimulating us to find solutions that will tailor our economic and social growth to be appropriate for the Earth's capacity to support them.

What we hope is that this Ecological Footprint study will inspire consistent long term planning that goes beyond the bounds of public administration and that will be maintained and continued regardless of which government is in power.

We are fully aware too that this is not the kind of work that can be done from one day to another. It is essentially a long-term work and there are many stages to be gone through. Nevertheless, it must be begun immediately and to that end it is important to verify what the numbers that are set out in this x-ray reveal, analyse the most critical points and implement an action plan in harmony and agreement with all the partners, so that when the next measurements of São Paulo state and city's impacts are made, they will have diminished and the city and the state will have become more sustainable, offering a better quality of life for their inhabitants.

10 Kitzes, J.,Galli, A., Bagliani, M., Barrett, J., Dige, G., Ede, S., Erb, K-H., Giljum, S., Haberl, H., Hails, C., Jungwirth, S., Lenzen, M., Lewis, K., Loh, J., Marchettini, N., Messinger, H., Milne, K., Moles, R., Monfreda, C., Moran, D., Nakano, K., Pyhälä, A., Rees, W., Simmons, C., Wackernagel, M., Wada, Y., Walsh, C., Wiedmann, T. (2009). A research agenda for improving national ecological footprint accounts. Ecological Economics 68(7), 1991-2007.

TECHNICAL NOTES

The New Brazilian Consumption and Land Use Matrix (CLUM)

Even though the main databases used to determine the National Footprints (FAOSTAT) are for the year 2008, specialists on this issue must have noticed that the Brazilian Ecological Footprint jumped from 2.91 to 2.93 from 2010 to 2011. A lot of changes can also be seen in the Footprint sizes discriminated by consumption categories. Those changes are due to three main methodological refinements with varying degrees of influence on the differences noted. There follows below a list of the methodological changes and their respective influences on the changes.

1. Single Input/Output Model by the Moderated IO Model – Both CLUMs, (2010 and 2011) were generated by applying Extended Input Output analysis for Ecological Footprint -EEIO-EF. However, in 2010 the single IO model was used whereas in 2011 the approach employed the Multi-Regional Input Output model. In the approach adopted, the Single IO is only applied to the Brazilian table published by the OECD[11]. That means presuming that countries from which Brazil imports have the same productivity as Brazil. When MRIO is used however it becomes possible to get a better idea of each country's productivity using economic structure data for Multi-Regional IO published by the Global Trade Analysis Project[12].

2. Emission allocation procedures for private transport (moderated) – in 2010, domestic emissions associated to private transport were estimated using NAMEA[13] databases. They refer mainly to European Union countries and are relatively out of date. ON changing to the MRIO model it was decided to use fixed percentage for emissions based on the intensity of each country's production until such time as NAMEA data for MRIO come to be published.

11 http://www.oecd.org/document/3/0,3746,en_2649_34173_38071427_1_1_1_1,00.html

12 https://www.gtap.agecon.purdue.edu/#1

13 http://stats.oecd.org/glossary/detail.asp?ID=6508

3. Internalization of the (significant) Gross Fixed Capital Formation - up until 2010 the Gross Fixed Capital Formation (GFCF) was accounted for at the beginning of the calculation procedures as part of the productive processes (intermediate sectors) and accordingly the Ecological Footprint values associated to the category were allocated as Direct Consumption (Domestic Consumption). In 2011 the GFCF was no longer internalised in those processes but treated as a category on its own.

   Handling the GFCF as a separate category makes it possible to visualise the associated demands as production process demands and not direct domestic consumption demands. That makes it easier to distinguish the footprint stemming from domestic consumption and the that stemming from investments made , which in turn contribute to enhancing policy formulation and more precise targeting of campaigns to raise awareness on the issues involved.

   "the of consumption has three main components. The first component consists of consumer goods acquired by families (called Domestic Expenditure). This component includes foodstuffs , housing maintenance and operations, personal transport, goods and services. The second component is government consumption (Category 'government') which includes short-lived consumer goods, public services, public schools, police services, administration and defence. The third component is the consumption of lasting goods (Gross Fixed Capital Formation) that may be paid for by families (new housing) companies (new factories and machines) or governments (new transport infrastructure for example)." Internal Document of the Global Footprint Network.

   For further details on EEIOO and MRIO see bibliographic references 45 and 51.

Temporality and fundamental sources of study data

This study made use of the National Footprint Account (NFA) 2008/2011, which means that most of the data is for 2008, whereas the methodology to calculate the Footstep on the basis of those data is for 2011.

Among the most important sources of data for calculating the Ecological Footprint of the State of São Paulo and its capital city, São Paulo were the Household Budget Surveys conducted by the Brazilian geography and Statistics Institute – IBGE for 2008/2009 and the Family Budget Surveys conducted by the FIPE for the same period.

Biocapacity studies made use of data from the IBGE's Municipal Agricultural Production 2010 which was a survey of agricultural production units in the state of São Paulo – LUPA 2007/2008; Forest Inventory of Native Vegetation for the State of São Paulo – Forest Institute 2007/2009 and various other sources involving satellite image analysis with dates ranging from 2007 to 2011.

That means that this study portrays São Paulo's Ecological Footprint for 2008 using methodology updated in 2011 and a publication date in 2011. Accordingly it was decided to standardise the publication date as 2008/2011.

Variance and error possibilities identified

1. **Non-correlated databases**

   Regional Ecological Footprint studies are preferably undertaken in a Top Down manner. Thus in order to determine the Ecological Footprint of a given region, first the National Footprint must be calculated and then the calculation can be regionalized in scale. By obeying that principle we can ensure the comparability of the calculations at both regional and international levels and increase the reliability of the study.

   The ideal scenario for that regionalisation of the scale would be to make use of the same data sources for the international, national and regional spheres thereby ensuring the data gathering methods and the statistical analyses of the samples are the same, but that is not always possible.

It proved possible to abide by that ideal precept in regard to the most important database for the calculation of the Ecological Footprint of the State of São Paulo insofar as the same sources used for the national calculation were used for the state (POF/ IBGE 2008/2009). However the IBGE survey could not be used for the municipal calculation because the number of sampling points was insufficient. Accordingly, the calculation for the capital city was made using the database of the FIPE household survey specially treated for study purposes to adjust them as far as possible to the items and timeframes of the IBGE survey so that comparisons could be made with a reasonable level of reliability. However it must be underscored that the resolution of the FIPE survey is far greater than that of the POF/IBGE and that difference of resolution may well introduce some discrepancies between the capital city residents consumption patterns and those of their fellows in the state and the nation at large, but they are acceptable discrepancies and do not jeopardise the validity the of the footprint indicator for the city.

The same difficulty affected the Biocapacity calculations of state and capital city and it proved necessary to capture data from several different sources databases like PAM/IBGE 2010 and the LUPA/CATI 2009 to acquire information on areas and crop production.

For the data on built up urban areas in the state we used the s *INPE-12912-RPQ/251 Uso de Imagens de Satélite Como Subsídio ao Estudo do Processo de Urbanização* (Use of Satellite Images to support Urbanization Process Studies) and for the built up area of São Paulo city data from the PMSP / SVMA / DEPLAN-3. For bodies of water in the state of São Paulo data was gathered from the *Mapeamento* das APP *hídricas* do Estado (Mapping of State Water PPAs) (*FUNCATE -Contract CBRN 012/2009*) and for the capital city, data supplied by the Greenery and Environment Department of the Municipal Government / *Planning and Landsat-5 – 2006 Satellite Images Division*. However those apparent differences in the databases were not significant either because of the way the Biocapacity calculations and equations are structured. The Data on Net Primary Forest and Grazing land Productivity were all taken from the same source:, *NASA Earth Observations in* http://neo.sci.gsfc.nasa.gov/Search.html?datasetId=MOD17A2_M_PSN.

2. **Purchasing Power Parity:**

Given that the data on consumption patterns makes use of currency values, the differences in prices in force in different regions could introduce errors into the calculations of Ecological Footprint dimensions. The solution found was to correct the errors using multi-lateral partity indexes and purchasing power figures for the regions studied. However that valuable index is not frequently published in Brazil. The most recent and most interesting publication consulted was the *Comparações da Paridade do Poder de Compra entre Cidades:Aspectos Metodológicos e Aplicação ao Caso Brazileiro** (Comparison of Purchasing Power Parity among cities: methodological aspects and its application to the Brazilian case) http://ppe.ipea.gov.br/index.php/ppe/article/viewFile/87/62, the index we are interested in was actually estimated on the basis of data for 1999.

Due to that great time gap it was decided not to use that indicator. If it had been applied however, the Ecological Footprint of the City of São Paulo would have shown itself to be 2% smaller than the figure obtained in this study and fall from 4.38 gha/cap to 4.29/cap.

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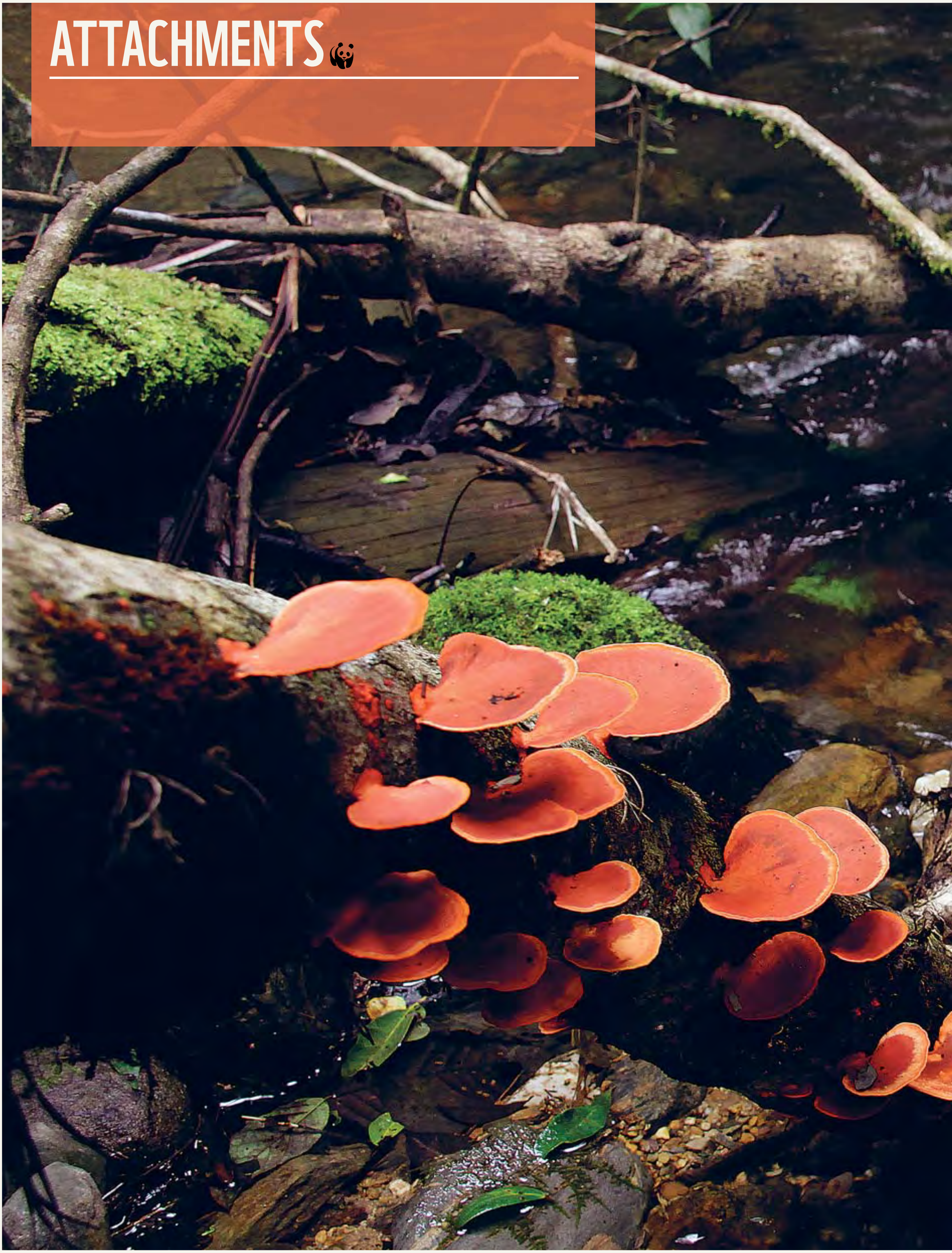
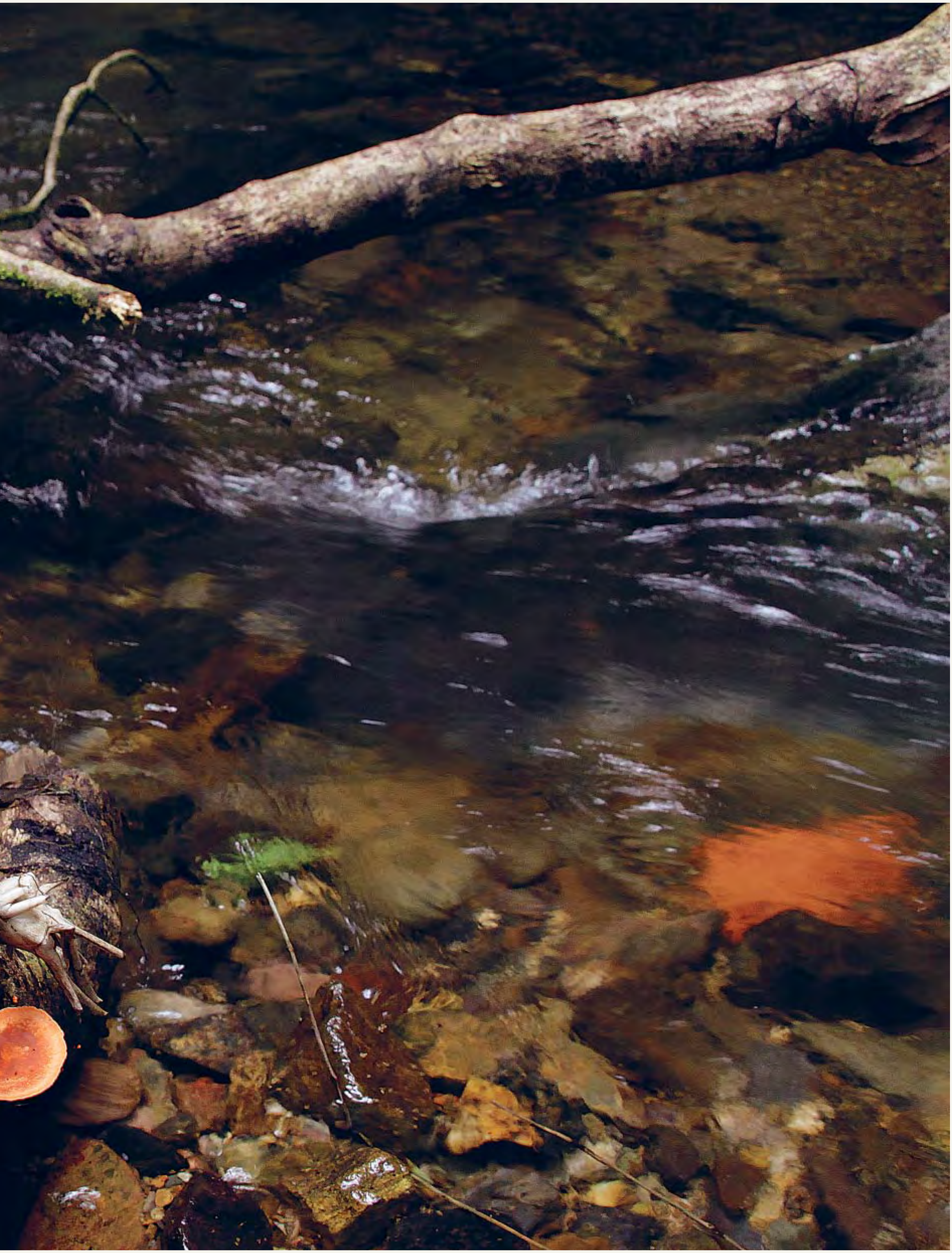
ATTACHMENTS





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ECOLOGICAL FOOTPRINT: 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 it generates, 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 normalize countries' biological productivity to world averages (e.g. comparing tonnes of wheat per UK hectare versus per world average 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 countries are calculated annually by Global Footprint Network. Collaborations with national governments are invited, and serve to improve the data and methodology used for the National Footprint Accounts. To date, Switzerland has completed a review, and Belgium, Ecuador, Finland, Germany, Ireland, Japan and the UAE have partially reviewed or are reviewing their accounts. The continuing methodological development of the National Footprint Accounts is overseen by a formal review committee. A detailed methods paper and copies of sample calculation sheets can be obtained from *www.footprintnetwork.org*.

Footprint analyses can be conducted on any scale. There is growing recognition of the need to standardize sub-national Footprint applications in order to increase comparability across studies and longitudinally. Methods and approaches for calculating the Footprint of municipalities, organizations and products are currently being aligned through a global Ecological Footprint standards initiative. For more information on Ecological Footprint standards see *www.footprintstandards.org*.

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, toxic releases are not accounted for in Ecological Footprint accounts. Nor are freshwater withdrawals, although the energy used to pump or treat water is included.

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 current degradation of ecosystems, if this degradation persists it may be reflected in future accounts as a reduction in biocapacity.

Footprint accounts also do not indicate the intensity with which a biologically productive area is being used. Being a biophysical measure, it also does not evaluate the essential social and economic dimensions of sustainability.

How is international trade taken into account?

The National Footprint Accounts calculate the Ecological Footprint associated with each country's total consumption by summing the Footprint of its imports and its production, and subtracting the Footprint of its exports. This means that the resource use and emissions associated with producing a car that is manufactured in Japan but sold and used in India will contribute to India's rather than Japan's consumption Footprint.

National consumption footprints can be distorted when the resources used and waste generated in making products for export are not fully documented for every country. Inaccuracies in reported trade can signifcantly affect the Footprint estimates for countries where trade flows are large relative to total consumption. However, this does not affect the total global Footprint.

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 and are not renewable in ecological time spans. When these fuels burn, carbon dioxide (CO_2) is emitted into the atmosphere. There are two ways in which this CO_2 can be stored: human technological sequestration of these emissions, such as deep-well injection, or natural sequestration. Natural sequestration occurs when ecosystems absorb CO_2 and store it either in standing biomass such as trees or in soil.

The carbon footprint is calculated by estimating how much natural sequestration would be necessary to maintain a constant concentration of CO_2 in the atmosphere. After subtracting the amount of CO_2 absorbed by the oceans, Ecological Footprint accounts calculate the area required to absorb and retain the remaining carbon based on the average sequestration rate of the world's forests. CO_2 sequestered by artifcial means would also be subtracted from the Ecological Footprint total, but at present this quantity is negligible. In 2007, one global hectare could absorb the CO_2 released by burning approximately 1,450 litres of gasoline.

Expressing CO_2 emissions in terms of an equivalent bioproductive area does not imply that carbon sequestration in biomass is the key to resolving global climate change. On the contrary, it shows that the biosphere has insuffcient capacity to offset current rates of anthropogenic CO_2 emissions. The contribution of CO_2 emissions to the total Ecological Footprint is based on an estimate of world average forest yields. This sequestration capacity may change over time. As forests mature, their CO_2 sequestration rates tend to decline. If these forests are degraded or cleared, they may become net emitters of CO_2.

Carbon emissions from some sources other than fossil fuel combustion are incorporated in the National Footprint Accounts at the global level. These include fugitive emissions from the faring of gas in oil and natural gas production, carbon released by chemical reactions in cement production and emissions from tropical forest fres.

Does the Ecological Footprint take into account other species?

The Ecological Footprint compares human demand on nature with nature's capacity to meet this demand. It thus serves as an indicator of human pressure on local and global ecosystems. In 2007, humanity's demand exceeded the biosphere's regeneration rate by more than 50 per cent. This overshoot may result in depletion of ecosystems and fill-up of waste sinks. This ecosystem stress may negatively impact biodiversity. However, the Footprint does not measure this latter impact directly, nor does it specify how much overshoot must be reduced by if negative impacts are to be avoided.

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

The Footprint documents what has 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. While Footprint accounting can determine the average biocapacity that is available per person, it does not stipulate how this biocapacity should be allocated among individuals or countries. However, it does provide a context for such discussions.

How relevant is the Ecological Footprint 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 demands on ecosystems exceed the ability of ecosystems to meet these demands? Footprint analysis reflects both increases in the productivity of renewable resources and technological innovation (for example, if the paper industry doubles the overall effciency of paper production, the Footprint per tonne of paper will halve). Ecological Footprint accounts capture these changes once 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.

For additional information about current Ecological Footprint methodology, data sources, assumptions and results, please visit:www.footprintnetwork.org/atlas

For more information on the Ecological Footprint at a global level, please see: Butchart, S.H.M. et al., 2010; GFN, 2010b; GTZ, 2010; Kitzes, J.,2008; Wackernagel, M. et al., 2008; at a regional and national level please see: Ewing, B. et al., 2009; GFN, 2008; WWF, 2007; 2008c; for further information on the methodology used to calculate the Ecological Footprint, please see: Ewing B. et al., 2009; Galli, A. et al., 2007.

GLOSSARY

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. Biocapacity is measured in global hectares (GFN 2012).
Biocapacity per person	This is calculated by dividing the number of productive global hectares available by the number of people living on the planet in that year.
Biodiversity	Shorthand for biological diversity. Variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD and UNEP)
Biome	A major portion of the living environment of a particular region characterized by its distinctive vegetation and maintained by local climatic conditions
Carbon Footprint	When used in Ecological Footprint studies, this term is synonymous with demand on carbon uptake land. NOTE: The phrase “Carbon Footprint” or “carbon footprint” has been picked up in the climate change debate. There are several calculators that use the phrase “Carbon Footprint”, but many Just calculate tonnes of carbon, or tonnes of carbon per euro, rather than demand on bioproductive area.
Carbon uptake 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 (GFN 2012).
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 the world. Ecological Footprint is often referred to in short form as Footprint and is calculated for a given year. (GFN 2012).

Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecosystem services	The Millennium Ecosystem Assessment distinguished supporting, provisioning, regulating and cultural services that contribute to human wellbeing (Millennium Ecosystem Assessment, 2005a, b). These services are defined as: **Provisioning services:** Goods obtained directly from ecosystems (e.g. food, medicine, timber, fibre, biofuel) **Regulating services:** Benefits obtained from the regulation of natural processes (e.g. water filtration, waste decomposition, climate regulation, crop pollination, regulation of some human diseases) **Supporting services:** Regulation of basic ecological functions and processes that are necessary for the provision of all other ecosystem services (e.g. nutrient cycling, photosynthesis and soil formation). **Cultural services:** Psychological and emotional benefits gained from human relations with ecosystems (e.g. enriching recreational, aesthetic and spiritual experiences).
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 (GFN 2012).
Human Development	Human development is a process of enlarging people's choices. Enlarging people's choices is achieved by expanding human capabilities and functioning. At all levels of development the three essential capabilities for human development are for people to lead long and healthy lives, to be knowledgeable and to have a decent standard of living. If these basic capabilities are not achieved, many choices are simply not available and many opportunities remain inaccessible. But the realm of human development goes further: essential areas of choice, highly valued by people, range from political, economic and social opportunities for being creative and productive to enjoying self-respect, empowerment and a sense of belonging to a community. The concept of human development is a holistic one putting people at the centre of all aspects of the development process. It has often been misconstrued and confused with the following concepts and approaches to development This definition is taken from the Human Development Report webpage and the latest report can be found here: http://hdr.undp.org/en/.

Human Development Index (HDI)	The HDI – human development index – is a summary composite index that measures a country's average achievements in three basic aspects of human development: health, knowledge, and a decent standard of living. The HDI contains three components: 1) Health: life expectancy at birth (The number of years a newborn infant would live if prevailing patterns of mortality at the time of birth were to stay the same throughout the child's life). 2) Knowledge: a combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrolment ratio; 3) Standard of living: GDP per capita (PPP US$). This definition is taken from the Human Development Report webpage and the latest report can be found here: http://hdr.undp.org/en/.
Inequality adjusted Human Development Index (IHDI)	The IHDI is a measure of the level of human development of people in a society that accounts for inequality. Under perfect equality the IHDI is equal to the HDI, but falls below the HDI when inequality rises. In this sense, the IHDI is the actual level of human development (taking into account inequality), while the HDI can be viewed as an index of the potential human development that could be achieved if there is no inequality. The IHDI accounts for inequality in HDI dimensions by "discounting" each dimension's average value according to its level of inequality. The average loss in the HDI due to inequality is about 23 percent—that is, adjusted for inequality, the global HDI of 0.682 in 2011 would fall to 0.525. Countries with less human development tend to have greater inequality in more dimensions—and thus larger losses in human development. This new version of the HDI was developed or the 2011 Human Development report (UNDP, 2011) and at the time of publication, the adjustment has been applied to 134 countries. For this definition and more information see the IHDI homepage found here: http://hdr.undp.org/en/ .
National Accounts Committee	Global Footprint Network's of scientific advisors who develop and endorse recommendations for methodological changes to the Ecological Footprint accounts (GFN 2012).
National Footprint Accounts	The central data set that calculates the Footprints and Biocapacities of the world and roughly 150 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 70 plus partners (GFN 2012).
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 CO2 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 (GFN 2012).
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Virtual water	The 'virtual water content' of a product is the same as its 'water footprint' .he water footprint of a product (a commodity, good or service) is the volume of freshwater used to produce the product, measured at the place where the product was actually produced. It refers to the sum of the water use in the various steps of the production chain.
Water Footprint	The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. The Water footprint of a nation is defined as the total amount of water that is used to produce the goods and services consumed by the inhabitants of the nation.

ATTACHMENT A: METHODOLOGY – ECOLOGICAL FOOTPRINT AND BIOCAPACITY

This section has been taken from the 2010 edition of the Calculation Methodology for the National Footprint Accounts, 2010 Edition[14].

Footprint and Biocapacity Calculations

The Ecological Footprint measures appropriated biocapacity and biocapacity represents the availability of bio-productive areas. For any type of land use the Ecological Footprint of a country, expressed in global hectares is given by:

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

Equation 1a

Where P is the amount of a product harvested or Carbon Dioxide emitted, YN é is the national average yield for P and YF and EQF are the yield factor and the equivalence factor respectively for the land use type in question.

A country's biocapacity (BC) for any land use type, is calculated as follows:

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

Equation 2

Where A is the area available for a given land use type.

Derived Products

Summing the footprints of all the primary products and the ecosystems capacity to absorb residues we obtain the total footprint of a country's national production. In some cases however it is necessary to know the Ecological Footprints of products derived from the flows of primary goods from the ecosystems. Primary and derived goods are related by product specific extraction rates.

14 Ewing B., A. Reed, A. Galli, J. Kitzes, and M. Wackernagel. 2010. Calculation Methodology for the National Footprint Accounts, 2010 Edition. Oakland: Global Footprint Network. Available at http://www.footprintnetwork.org/images/uploads/National_Footprint_Accounts_Method_Paper_2010.pdf

The extraction rate of a derived product $EXTR_D$, é is used to calculate its effective yield in the following way:

$$Y_D = Y_P \cdot EXTR_D \qquad \text{Equation 3a}$$

Where Y_D and Y_P are the yields for the primary product and the effective yields for the derived product respectively.

Normally, $EXTR_D$ is simply the mass ratio of derived product to primary input required. This ratio is known as the technical conversion factor for the derived product and is denoted by TCF_D below. There are a few cases where multiple products are derived simultaneously from the same primary product. Soybean oil and soybean cake are both extracted simultaneously from the same primary product, in this case soybean. Summing the primary product equivalent of the derived products would lead to double counting so the primary product footprint must be shared between the simultaneously derived goods. The general formula for the extraction rate for a derived good (D) is:

$$EXTR_D = \frac{TCF_D}{FAF_D} \qquad \text{Equation 3b}$$

Where FAF_D is the Footprint allocation factor. This allocates the Footprint of the primary product between the simultaneously derived goods according to the TCF-weighted prices. The prices of derived goods represent their relative contributions to the incentive for the harvest of the primary product. The equation for the Footprint allocation factor of a derived product is:

$$FAF_D = \frac{TCF_D V_D}{\sum TCF_i V_i} \qquad \text{Equation 3c}$$

Where V_i is the market price of each simultaneously derived product. For a production chain with only one derived product then, FAF_D is 1 and the extraction rate is equal to the technical conversion factor.

Normalising bio-productive areas from hectares to global hectares

Average bio-productivity differs between various land use types as well as between countries for any given land use type. For comparability across countries and land use types, Ecological Footprint and Biocapacity are usually expressed in units of world-average bio-productive areas. Expressing Footprint in world-average hectares also facilitates tracking the embodied bio-productivity in international trade flows.

Yield Factors

Yield factors account for countries' differing levels of productivity for particular land-use types. Yield factors provides comparability of the Ecological Footprint and biocapacities of various countries. Each year each country may have a different yield factor for cropland, pastures, forests and fisheries. Usually Yield factors for built-up areas are assumed to be the same as cropland given that urban areas tend to be built on or near productive agricultural lands. Natural factors such as differences in rainfall or soil quality or even management practices all determine different levels of productivity.

The weight of productivity factors in the different areas of the earth vary according to their relative productivities. For example the average hectare of pasture in New Zeeland produces more grass than a world average grazing land hectare and is potentially capable of supporting more meat production.

The table below shows the yield factors calculated for various countries as it appeared in the Global Footprint Network's 2010 edition of the National Footprint Accounts.

	Agriculture	Forests	Pastures	Fisheries
World Average Yields	1.0	1.0	1.0	1.0
Algeria	0.3	0.4	0.7	0.9
Guatemala	0.9	1.1	2.9	1.1
Hungary	1.1	2.6	1.9	1.0
Japan	1.3	1.4	2.2	0.8
Jordan	1.1	1.5	0.4	1.0
New Zeeland	0.8	2.0	2.5	1.0
Zambia	0.2	0.2	1.5	1.0

The yield factor is the ratio of national average to world average yields . It is calculated in terms of annual availability of usable products. For any given land use type *L*, .a country's yield factor YF_L is given by:

$$YF_L = \frac{\sum_{i \in U} A_{W,i}}{\sum_{i \in U} A_{N,i}} \qquad \text{Equation 4a}$$

Where U is the set of all useable primary products that a given land use type yields and Aw,i Aand An,i are the areas necessary to furnish that country's annual available amounts of products *i* at world and national yields respectively. Those areas are calculated as follows:

$$A_{N,i} = \frac{P_i}{Y_N} \quad \text{Equation 5a} \qquad A_{W,i} = \frac{P_i}{Y_W} \quad \text{Equation 56}$$

Where Pi is the total national annual growth of product i and YN and YW are national and world yields respectively. Thus, ANi is always the area that produces i within a given country while AW,i gives the equivalent of world-average land yielding i.

Most land use types included in Footprint accounts provide only a single primary product such as wood from forest land or grass from grazing land. For these land use types the equation simplifies to:

$$YF_L = \frac{Y_N}{Y_W} \qquad \text{Equation 4b}$$

For those types of land use with a single product, by combining equations 4b and 1a we obtain a simplified formula for Ecological Footprint calculation in global hectares:

$$EF = \frac{P}{Y_W} \cdot EQF \qquad \text{Equation 1b}$$

In practice cultivated arable land is the only land use type where the extended version of the calculation is actually applied.

Equivalence Factors

In order to combine the Ecological Footprints or biocapacities of different land use types a second coefficient is necessary. Equivalence factors convert real areas of different land use types in hectares into their equivalent in global hectares. Equivalence factors and Yield factors are used in both footprint and biocapacity calculations to provide consistent results expressed in comparable units.

Equivalence factors translate the area supplied or demanded for a given type of land use (world average for cropland, grazing land, forest, fisheries and land for carbon absorption or built-up land) into average world measurements of biologically productive area, namely, global hectares.

The equivalence factor for built-up land is set equal to that for cropland while that of carbon uptake land is set equal to that of forest land. That is based on the suppositions that infrastructure tends to be built on or near productive agricultural land and that carbon absorption occurs in forest areas. The equivalence factor for hydroelectric reservoir area is set equal to one reflecting the assumption that hydroelectric reservoirs flood world average land The equivalence factor for marine area is calculated such that a single global hectare of pasture will produce an amount of calories of beef equal to the amount of calories that can be produced by a global area of fisheries in fish. The equivalence factor for waterways is equal to the equivalence factor for marine areas.

In 2005, for example, the equivalence factor for cultivated agricultural areas was 2.64 showing that the average productivity of cultivated land in the world was more than double the average productivity of all land types considered together. For that same year the equivalence factor for grazing land was 0.40 showing that the pastures were, on average 40% of the productivity of a global hectare. Equivalency factors are calculated every year and for a given year they are the same for all countries.

Area Type	Equivalence Factor gha/hectare
Agriculture	2.51
Forests	1.26
Grazing land	0.46
Marine and Inland water	0.37
Built-up land	2.51

Equivalency factors are calculated using suitability indexes from the Global Agro-ecological Zones model combined with data on the actual areas of cropland, forest land and grazing land area from FAOSTAT (FAO and IIASA Global Agro-Ecological Zones 2000 FAO Resource STATStatistical Database 2007). The GAEZ model divides all land globally into five categories based on calculated potential crop productivity. All land is assigned a quantitative suitability index that varies from 0.9 (very suitable) top 0.1 (Not suitable).

The calculation of the equivalence factors assumes that the most suitable land available will be used for the for the most productive form of land use. The equivalence factors are calculated as the ratio of the world average suitability index for a given land use type to the average suitability index for all land use types.

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THE ECOLOGICAL FOOTPRINT OF SÃO PAULO

BIOCAPACITY X CONSUMPTION

Currently the world average for the Ecological Footprint is 2.7 global hectares per person while the available biocapacity for each human being is only 1.8 global hectares.

OVERLOAD

In the mid-1980s, humanity began consuming more than the planet naturally had to offer and has been consuming above the necessary one-planet level ever since. Predictions for the year 2050 suggest that, if we carry on like this, we will need two planets to maintain our consumption patterns.

MOBILISATION

The footprint calculation is a tool to improve public administration, and mobilise the general public to review its consumer habits and choose more sustainable products, while at the same time establishing a dialogue with businessman, encouraging them to improve their production chains.

ECOLOGICAL FOOTPRINT

If everyone in the world consumed the way São Paulo state people do, almost two planets would be needed to sustain their lifestyles. If they consumed like people in the capital city of São Paulo do, then almost two and a half planets would be needed.

WWF

Why we are here
To halt environmental degradation on the Planet and construct a future where human beings live in harmony with Nature.

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