ASIA-PACIFIC 2005

The Ecological Footprint and Natural Wealth

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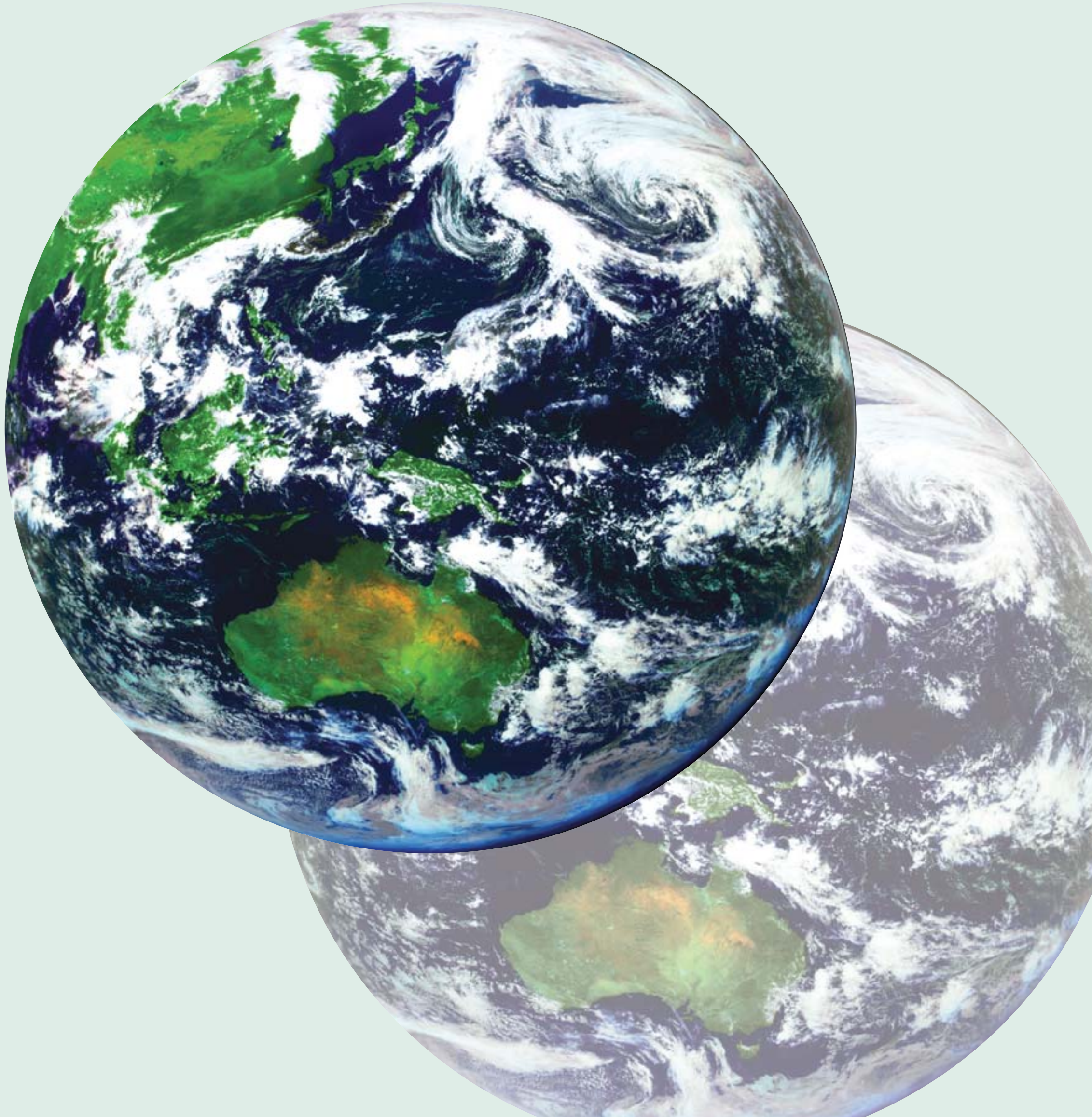

Global Footprint Network

ASIA-PACIFIC 2005

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WWF for a living planet®

Countries in Asia and the Pacific have made a firm commitment to sustainable development. We want a better quality of life for all, while safeguarding the Earth's capacity to support life in all its diversity and respecting the limits of the planet's natural resources. How can we achieve this in the face of growing populations and changing consumption patterns, both within the region and the world?

As a first step to answering this question, we need to know where we are today. How does the Asia-Pacific region's current demand for ecological resources compare to the region's (and the planet's) supply? How does it compare to other regions? How do countries in the region differ from one another in both demand for and supply of ecological resources? We can begin to address the sustainability challenge by exploring the implications of our current and proposed future development paths for regional and global ecosystems.

The results of the Ecological Footprint analysis presented in this report are an invitation to look harder at humanity's and the Asia-Pacific region's critical dilemma. It is also a poignant reminder that consumptive lifestyles in North America and Europe, largely based on cheap fuel and exporting environmental costs, cannot be maintained nor extended worldwide without causing additional life-threatening damage to the global environment and increasing social inequity.

This report is a call for action, not just for the policy community, but for the scientific and business communities as well. It echoes what the Millennium Ecosystem Assessment found: that the health of natural systems has a profound impact on our quality of life, but 60 percent of the ecosystem services that support life on Earth are being degraded or used unsustainably. This report provides a frank assessment of what is at stake for Asia and the Pacific and for the rest of the world. The Millennium Development Goals will not be achieved if we do not address sustainability in development.

Many still believe that the environment is some kind of separate luxury item that can be addressed after economic development. This is the opposite of the truth. The environment is the base of all human activities, and the ultimate source of all our wealth. Poverty, environment and consumption are all linked. How much nature does it take to support us? This is a question we can no longer afford to ignore.

To pose a hypothetical question: "How many planets would it take if everybody in Asia and the Pacific consumed like an average American or European?" We have only one planet, yet all people want, and have the right to, fulfilling lives. The challenge for high income countries is to radically reduce footprint while maintaining quality of life. For lasting improvements in their quality of life, lower income countries are facing the complementary challenge of finding new paths to development that can provide best living conditions without liquidating their ecological wealth.

The Asia-Pacific region is in a unique position to shape the development model for the whole world in the coming decades. I support this report's attempt to establish a quantitative link between ecosystem health and human prosperity, and I welcome forward-thinking initiatives and actions such as this one by WWF.

Professor Emil Salim
Former Indonesian Minister of State

Global Footprint Network

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NOTE ON "ASIA-PACIFIC"

Throughout this report, except where otherwise stated, "Asia-Pacific" refers to: Australia; Bangladesh; Cambodia; China; India; Indonesia; Japan; Korea, DPR; Korea, Rep; Lao PDR; Malaysia; Mongolia; Myanmar; Nepal; New Zealand; Pakistan; Papua New Guinea; Philippines; Sri Lanka; Thailand; and Viet Nam.

The material and the geographical designations in this report do not imply the expression of any opinion whatsoever on the part of WWF concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries.

WWF
(also known as World Wildlife Fund in the USA and Canada) is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

GLOBAL FOOTPRINT NETWORK
promotes a sustainable economy by advancing the Ecological Footprint, a tool that makes sustainability measurable. Together with its partners, the Network coordinates research, develops methodological standards, and provides decision makers with robust resource accounts to help the human economy operate within the Earth's ecological limits.

KADOORIE FARM AND BOTANIC GARDEN
KFBG exists to increase the awareness of our relationship with the environment and bring about positive change in the world through conservation and education.

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MEASURING PROGRESS TOWARDS SUSTAINABILITY

As a planet, we are living beyond our ecological means. Although the global economy and population continue to grow, our planet remains the same size.

Over 30 years ago, the report *Limits to Growth* created an international controversy when its computer-generated scenarios suggested that the human economy would soon exceed the Earth's carrying capacity, leading to a decrease in industrial output and a decline in well-being in the mid-21st century.

Overshoot is no longer an hypothesis but a reality. As shown in WWF's *Living Planet Report,* humanity's annual demand for resources is now exceeding the Earth's regenerative capacity by more than 20 per cent. Humanity can maintain this overdraft only by liquidating the planet's natural resources.

The Asia-Pacific region will play an increasingly central role in addressing overshoot as the region's population and economy continue to grow in a world with limited resources. The statistics reinforce this notion: more than 50 per cent of the world's population live in Asia and the Pacific, and the region's use of world ecological capacity is expanding rapidly, growing from 15 per cent in 1961 to 40 per cent in 2001.

Increasing human demand presents many challenges for Asia and the Pacific. The region is not alone in meeting growing ecological demand by relying on ecological capacity outside its borders and, simultaneously, drawing down its own stocks of ecological assets. Reversing these trends means shifting to sustainable development — improving the quality of human life while remaining within the carrying capacity of our supporting ecosystems.

Reducing pressure on ecosystems, however, is only possible if done in fair and just ways — the alternative is increasing local, regional, and global conflict. The resource crunch may not be felt yet in the wealthy centres of the Asia-Pacific region, where resource consumption is still increasing. Many of the 5.2 billion people living in low- and middle-income countries, including 3.3 billion in Asia and the Pacific, however, have been facing an involuntary decline in their quality of life. Addressing this growing social disparity is critical to achieving the Millennium Development Goals, improving global security and ensuring the well-being of all.

But in an increasingly globalized economy, responsibility for re-shaping Asian growth trajectories to address environmental constraints must also be borne internationally. Those countries – in North America and Europe – which have the highest per capita footprints today, bear a particular moral responsibility to assist in effecting the transitions to a more sustainable economy.

Time is critical. The sooner the Asia-Pacific region begins to rigorously manage the use of its ecological resources, the less expensive the future investment required to maintain these assets will be. Prompt action also reduces the risk that critical ecosystems will be eroded beyond the point at which they can easily recover. If overshoot continues and both the Asia-Pacific region's and the world's ecological debt keeps accumulating, choices narrow. A vicious cycle ensues, with continuing resource use becoming ever more dependent on the liquidation of shrinking ecological assets.

There are opportunities to break out of this downward spiral. The right kind of investments can encourage innovations for sustainability in the areas of food, health, nature management, transportation and shelter. A green-energy future and resource efficient urban design will play an increasing important role in achieving a thriving Asia-Pacific region.

As we embark on this path of sustainable development, we need ways to know how far we have come and how far we still need to go. The measurement tools presented in this report are one way to help all our countries determine if our actions are bringing us closer to these essential goals.

Fig. 1: **HUMANITY'S ECOLOGICAL FOOTPRINT,** 1961–2001

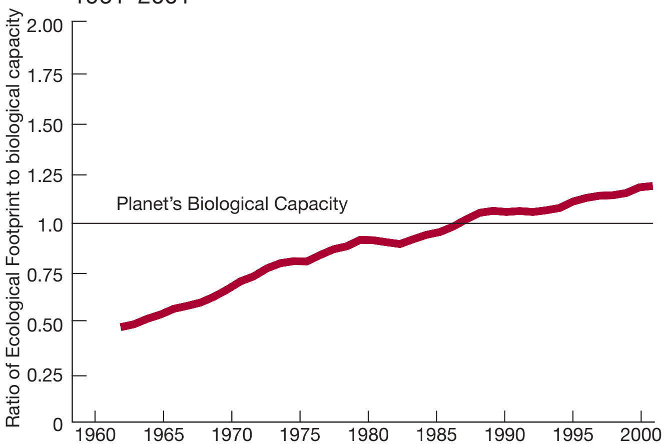


Fig. 2: **ASIA-PACIFIC'S ECOLOGICAL FOOTPRINT,** 1961–2001

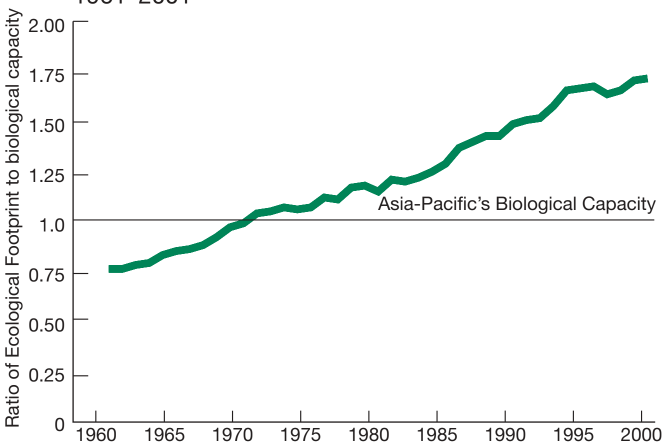


Figure 1: Humanity's Ecological Footprint, which measures people's use of renewable natural resources, is shown in comparison with the total biologically productive capacity of the Earth. In 2001, humanity's Ecological Footprint was 2.5 times larger than in 1961, and exceeded the Earth's biological capacity by about 20 per cent. This overshoot is possible only for a limited period of time.

Figure 2: The per person Ecological Footprint of the Asia-Pacific region has risen by more than 130 per cent since 1961, now requiring 1.3 global hectares of biologically productive area per person. With a supply of only 0.7 global hectares per person, the region is now seeing growing imports of ecological capacity, damaged ecosystems and an increasing portion of the popoulation living in degraded environments.

THE GLOBAL CONTEXT: HUMANITY'S ECOLOGICAL FOOTPRINT

The Ecological Footprint measures humanity's demand on nature. The footprint of a country is the total area required to produce the food, fibre and timber that it consumes, absorb its waste and provide space for its infrastructure. A nation consumes resources and ecological services from all over the world and its footprint is the sum of these areas, wherever they are located on the planet.

In 2001, the global Ecological Footprint was 13.5 billion global hectares, or 2.2 global hectares per person (a global hectare is a hectare whose biological productivity equals the global average).

This demand on nature can be compared with the Earth's biocapacity, a measure of nature's ability to produce resources from its biologically productive area. In 2001, the Earth's biocapacity was 11.3 billion global hectares, a quarter of the planet's surface, or 1.8 global hectares per person.

The global Ecological Footprint decreases with a smaller population size, lower consumption per person, and higher resource efficiency. The Earth's biocapacity increases with a larger biologically productive area and higher productivity per unit area.

In 2001, humanity's Ecological Footprint exceeded global biocapacity by 0.4 global hectares per person, or 21 per cent. This global overshoot began in the 1980s and has been growing ever since (see Figure 1). In overshoot, nature's capital is being spent faster than it is being regenerated. If continued, overshoot may permanently reduce ecological capacity.

Figure 3: The Ecological Footprint per person for countries with populations over 1 million.

Figure 4: Humanity's Ecological Footprint grew by about 160 per cent from 1961 to 2001, faster than population, which doubled over the same period.

Figure 5: Ecological Footprint by region in 2001. The height of each bar is proportional to each region's average footprint per person, the width is proportional to its population, and the area of the bar is proportional to the region's total footprint.

Fig. 3: **ECOLOGICAL FOOTPRINT PER PERSON,** by country, 2001

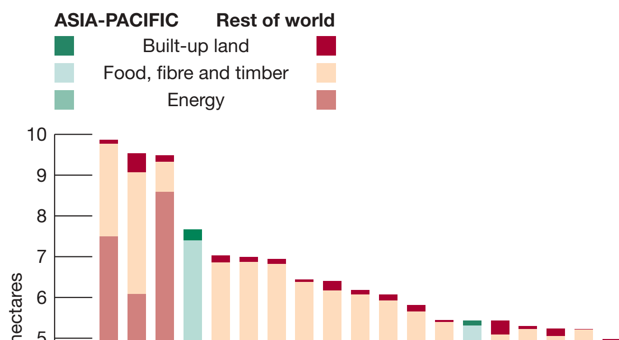
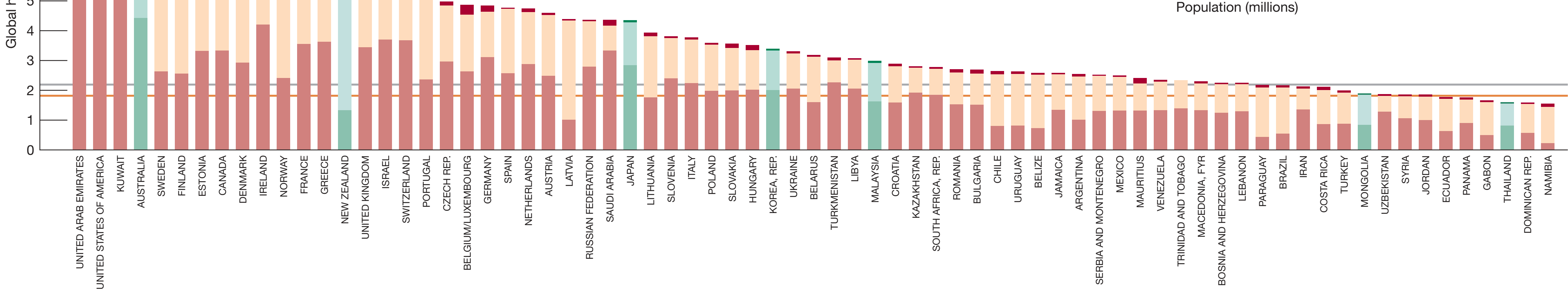



Fig. 4: **HUMANITY'S ECOLOGICAL FOOTPRINT,** 1961–2001

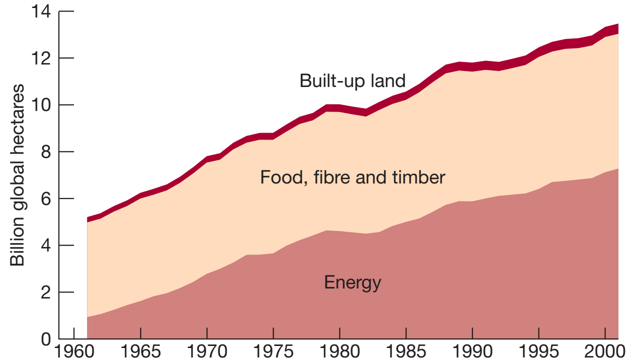
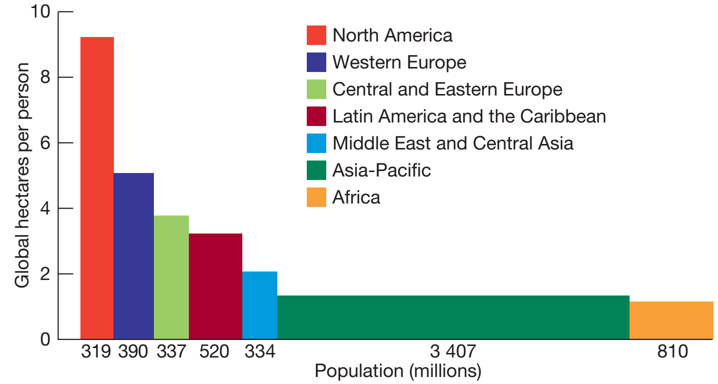
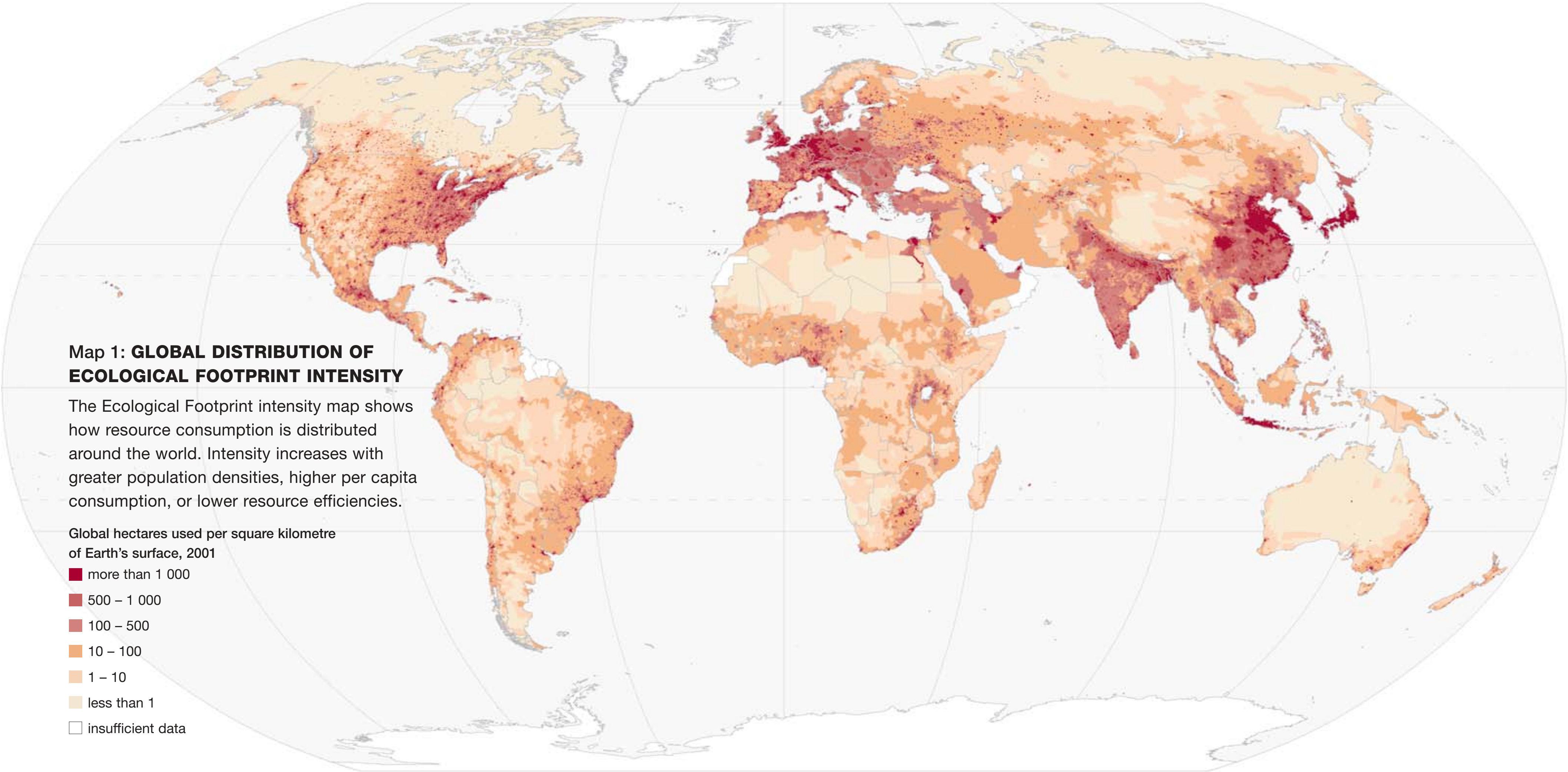


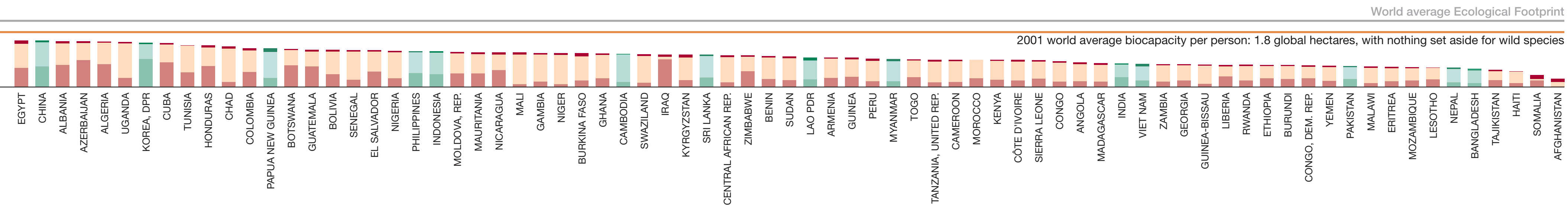
Fig. 5: **ECOLOGICAL FOOTPRINT BY REGION,** 2001



Map 1: **GLOBAL DISTRIBUTION OF ECOLOGICAL FOOTPRINT INTENSITY**

The Ecological Footprint intensity map shows how resource consumption is distributed around the world. Intensity increases with greater population densities, higher per capita consumption, or lower resource efficiencies.





THE LIVING PLANET INDEX

The Living Planet Index (LPI) is an indicator of the state of the world's biodiversity and natural ecosystems. It is calculated as the average of three separate indices that track trends in the populations of vertebrate species living in terrestrial, freshwater and marine ecosystems around the world (Loh et al. 2005).

The LPI currently incorporates data on approximately 3,000 population trends for more than 1,100 species from around the world. The terrestrial index measures changes in the abundance of 562 forest, grassland, savannah, desert and tundra species. The freshwater index comprises populations of 323 species from lakes, rivers and wetland ecosystems. The marine index tracks 267 species from marine and coastal ecosystems worldwide.

Between 1970 and 2000, the LPI fell by some 40 per cent, the terrestrial index by about 30 per cent (Figure 6), the freshwater index by about 50 per cent (Figure 7), and the marine index by around 30 per cent (Figure 8). These downward trends can be compared with increases in the global Ecological Footprint, which grew by 70 per cent, and in the world's human population, which grew by 65 per cent, over the same time period.

Map 2 (right) shows remaining wilderness areas using distance from human settlements, roads, or other infrastructure as a proxy. It assumes that the degree of disturbance or transformation of natural landscapes by humans increases with the ease of access from places where people live. The greater the density of population centres or road networks, the lower the wilderness value. After the rapid development of previous decades, wilderness areas in the Asia-Pacific region are now largely restricted to parts of central Australia, Indonesia, Mongolia and Papua New Guinea.

Figure 6: The terrestrial species index shows a decline of about 30 per cent in 562 species of mammals, birds and reptiles living in terrestrial ecosystems.

Figure 7: The freshwater species index shows a decline of approximately 50 per cent in 323 vertebrate species found in rivers, lakes and wetland ecosystems.

Figure 8: The marine species index shows a decline of about 30 per cent in 267 species of mammals, birds, reptiles and fish occurring in the world's ocean and coastal ecosystems.

Fig. 6: **TERRESTRIAL SPECIES POPULATION INDEX,** 1970–2000

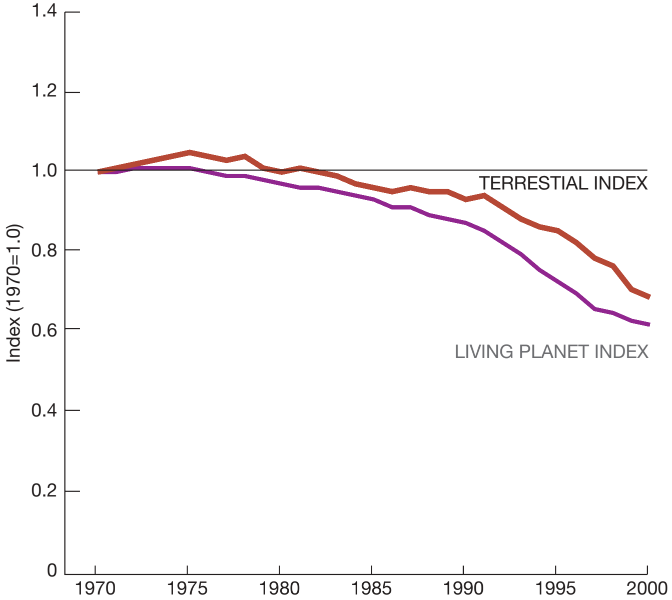


Fig. 7: **FRESHWATER SPECIES POPULATION INDEX,** 1970–2000

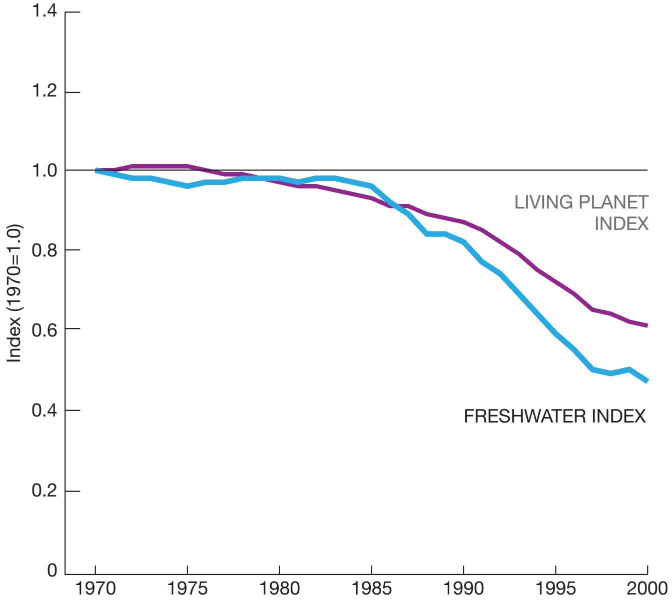
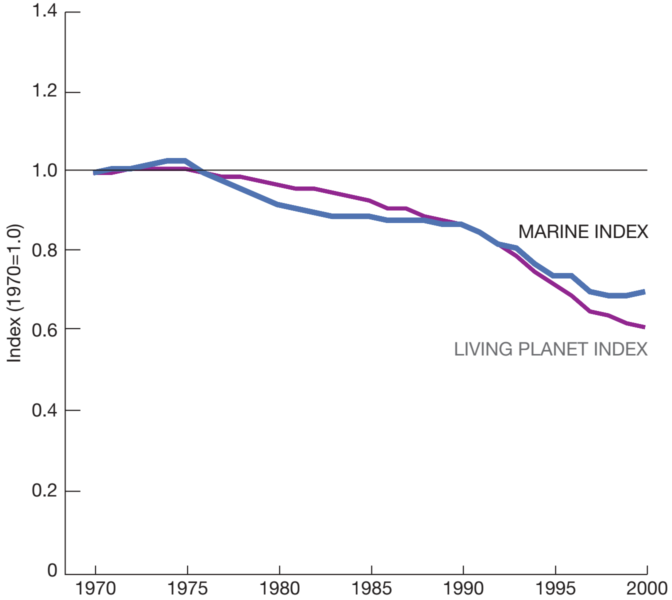
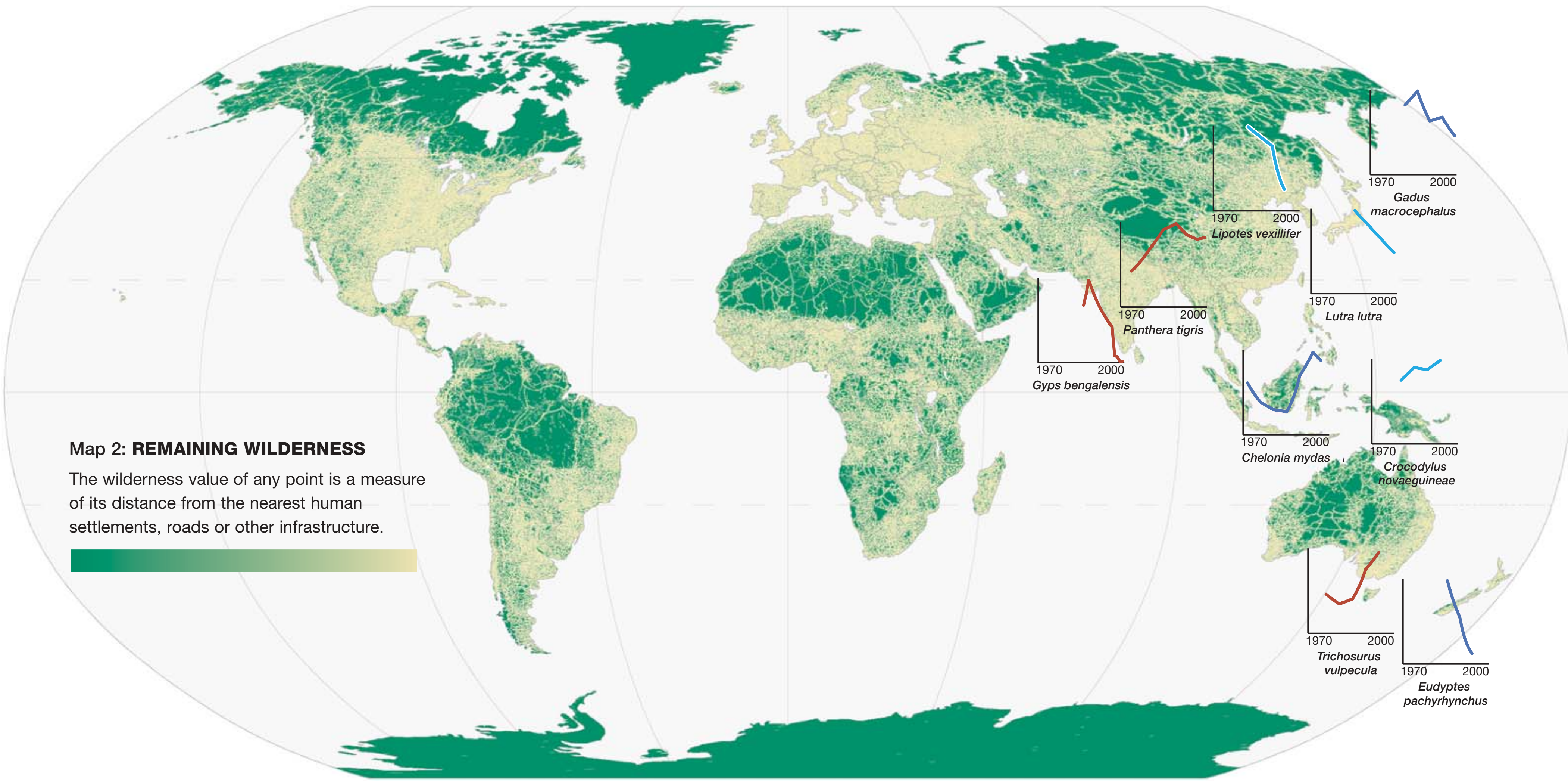


Fig. 8: **MARINE SPECIES POPULATION INDEX,** 1970–2000





Map 2: **REMAINING WILDERNESS**

The wilderness value of any point is a measure of its distance from the nearest human settlements, roads or other infrastructure.

TRENDS IN SELECTED SPECIES POPULATIONS, ASIA-PACIFIC, 1970–2000

Terrestrial Species	Location	Freshwater Species	Location	Marine Species	Location
Oriental white-backed vulture (*Gyps bengalensis*)	Keoladeo National Park, India	Baiji (*Lipotes vexillifer*)	Yangtze River, China	Green turtle (*Chelonia mydas*)	Turtle Islands, Sabah
Tiger (*Panthera tigris*)	India, all states	Otter (*Lutra lutra*)	Korea	Fiordland penguin (*Eudyptes pachyrhynchus*)	Southern New Zealand
Common brush-tailed possum (*Trichosurus vulpecula*)	Tasmania	New Guinea crocodile (*Crocodylus novaeguineae*)	Papua New Guinea	Pacific cod (*Gadus macrocephalus*)	Aleutian Islands, Bering Sea

ASIA-PACIFIC'S ECOLOGICAL FOOTPRINT

The large population and rapidly increasing levels of consumption in Asia and the Pacific make the region a significant contributor to the global Ecological Footprint. With 55 per cent of world population, the Asia-Pacific region's footprint occupies 40 per cent of available world biocapacity.

Today, the footprint of the Asia-Pacific region is 1.7 times as large as its own biological capacity. This means that, at its current rate of consumption, the region needs more than one and a half times its own land and sea space to support its resource demands. This compares with the situation in 1961, when the region's total resource demand was 76 per cent of local biocapacity.

The Asia-Pacific region compensates its deficit in two ways: firstly, by importing resources and using the ecological production of other countries and the global commons; and, secondly, by liquidating the region's natural capital.

Notwithstanding the global significance of the overall Asian footprint, on a per capita basis the average footprint of an Asian resident is still far smaller than the average footprint of people living in Europe or North America.

Moreover, in many Asian countries, the per capita footprint is relatively stable – the growth in footprint being attributable largely to population growth. In light of humanity's footprint having exceeded global limits, areas with high per capita footprints like Europe, North America, Australia and Japan will have to find ways to reduce their own footprints – and all need to build active partnerships for developing ways of improving the quality of all people's lives, while moving out of global overshoot.

Figure 9: The height of each bar is proportional to a nation's footprint per person, the width is proportional to its population, and the area is proportional to the country's total footprint.

Figure 10: The Asia-Pacific region's population and Ecological Footprint per person both continue to grow rapidly. In 2001, the Ecological Footprint of Asia and the Pacific represents 40 per cent of the planet's available biocapacity, more than double its share in 1961.

Fig. 9: **ECOLOGICAL FOOTPRINT IN THE ASIA-PACIFIC REGION**
Width of bar is proportional to population (shown in millions)

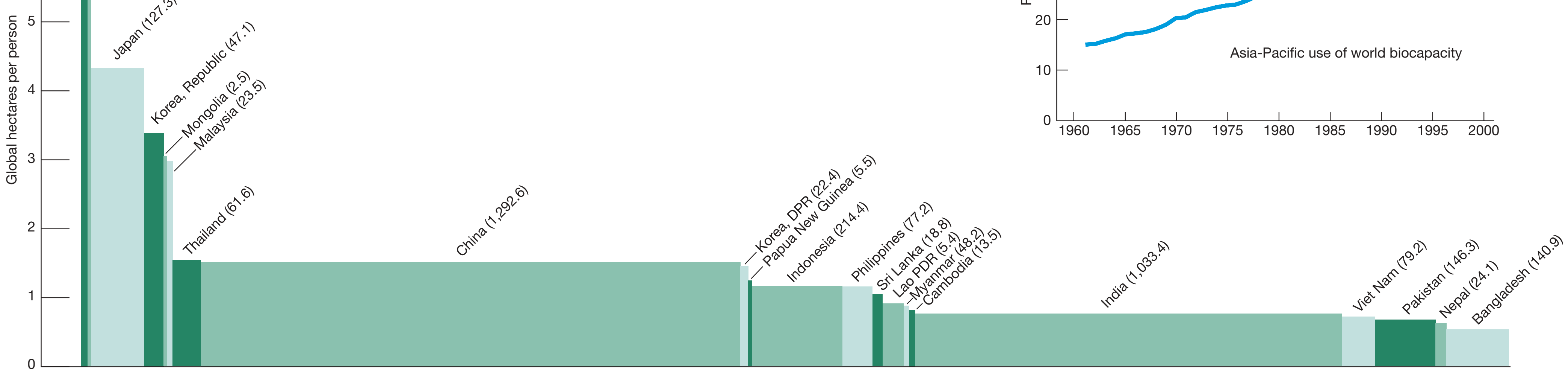
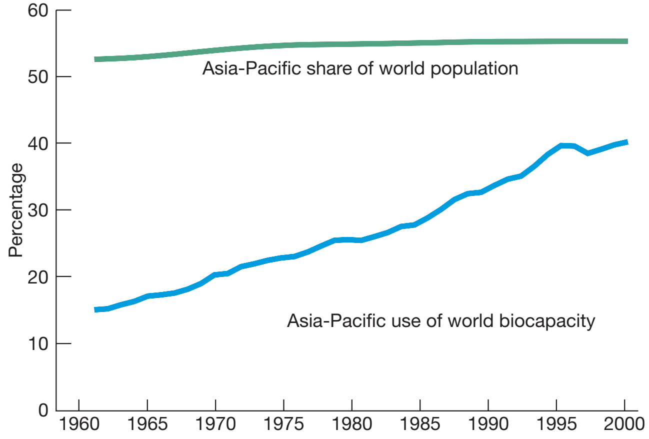
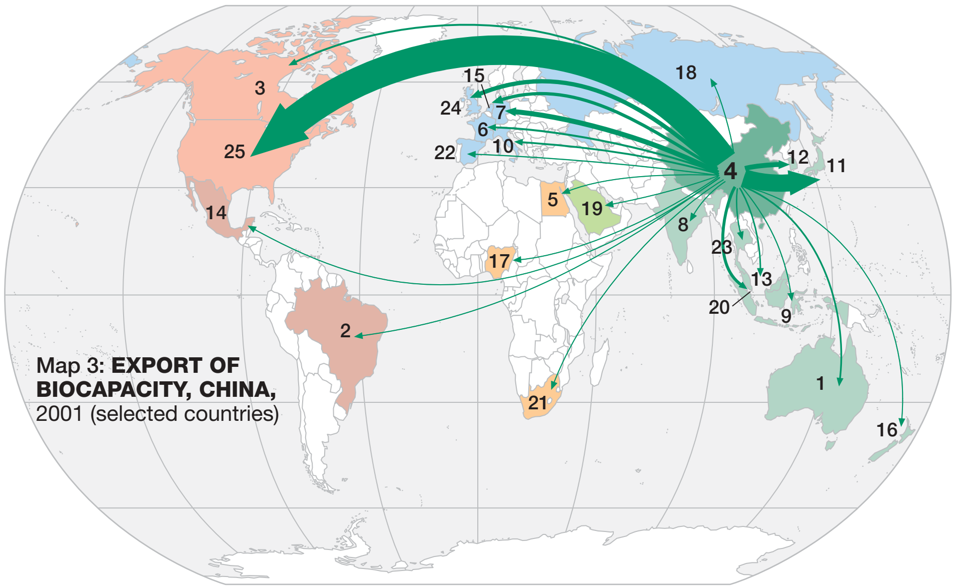
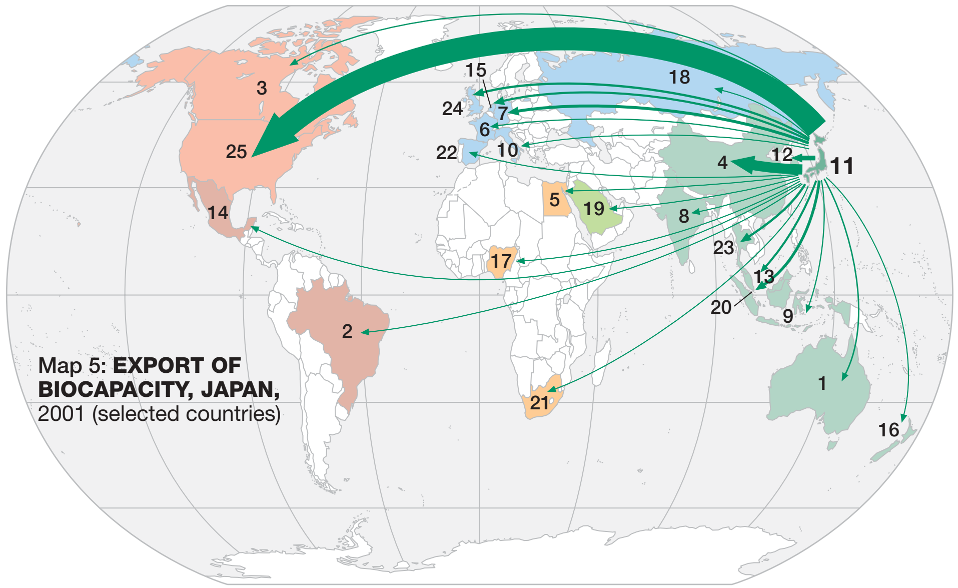


Fig. 10: **ASIA-PACIFIC'S USE OF WORLD BIOCAPACITY** 1961–2001

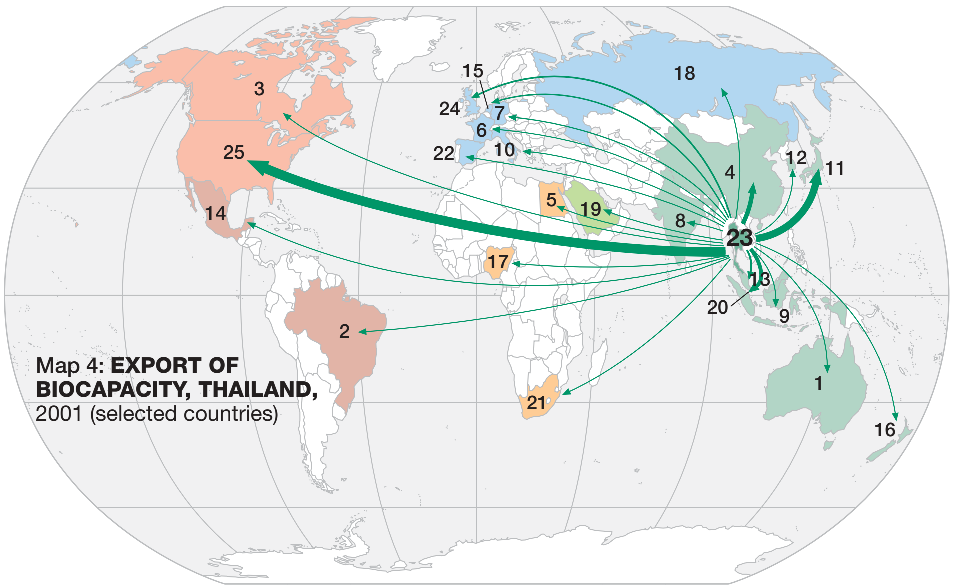




Map 3: **EXPORT OF BIOCAPACITY, CHINA,** 2001 (selected countries)



Map 5: **EXPORT OF BIOCAPACITY, JAPAN,** 2001 (selected countries)



Map 4: **EXPORT OF BIOCAPACITY, THAILAND,** 2001 (selected countries)

Table 1: **EXPORT OF BIOCAPACITY FROM THREE ASIA-PACIFIC COUNTRIES**
2001, million gha

The maps show flows in biocapacity particularly to the high income countries of Europe, Japan and North America. While some of this biocapacity comes directly from the exporting country, significant amounts originate in other countries, many in the developing world.

EXPORT			
From	**China**	**Japan**	**Thailand**
To			
1 Australia	2.5	2.1	1.4
2 Brazil	0.9	0.7	0.2
3 Canada	2.8	1.8	0.8
4 China	–	6.5	6.5
5 Egypt	0.5	0.2	0.2
6 France	3.0	1.7	0.9
7 Germany	7.3	4.3	1.7
8 India	1.4	0.5	0.5
9 Indonesia	1.6	1.8	1.5
10 Italy	2.7	1.3	0.7
11 Japan	25.1	–	10.6
12 Korea, Rep.	7.1	6.9	1.3
13 Malaysia	2.2	3.0	2.9

EXPORT			
From	**China**	**Japan**	**Thailand**
To			
14 Mexico	1.3	1.1	0.5
15 Netherlands	4.7	3.2	2.2
16 New Zealand	0.3	0.3	0.2
17 Nigeria	0.5	0.1	0.4
18 Russian Fed.	1.3	0.2	0.1
19 Saudi Arabia	0.8	1.0	0.4
20 Singapore	4.3	4.0	5.6
21 South Africa	0.9	0.4	0.3
22 Spain	1.7	0.8	0.6
23 Thailand	1.9	3.3	–
24 UK	6.2	3.3	2.5
25 USA	43.2	33.6	14.1

Numbers refer to map locations only.

COUNTRY PROFILES

Many nations of the Asia-Pacific region have experienced dynamic change over the last 40 years – overall the most successful globally in reducing poverty. But while per capita GDP increased, so has the region's demand on nature. The examples given here illustrate the range of environmental trends and challenges within the region, where the footprint ranges from 0.5 global hectares per Bangladeshi to 7.7 global hectares per Australian.

In the Asia-Pacific region, 13 countries are currently running ecological deficits, with their footprints greater than their biocapacity, and six countries, including Australia, Japan and the Republic of Korea, have per person footprints exceeding world average available biocapacity per person.

The graphs show trends in per person Ecological Footprint (green), biocapacity (red) and GDP (purple) for the world and for nine countries in the Asia-Pacific region from 1961 to 2001. Greater economic activity will increase the Ecological Footprint unless value creation decouples from resource use. As populations grow, the available biocapacity per person diminishes – the downward trend of per capita biocapacity in the Asia-Pacific region and the world is driven mostly by population growth.

Table 2: **GROWTH IN THE ASIA-PACIFIC REGION,** 1991–2001, national totals for selected countries

	Population	GDP	Ecological Footprint
World	**15%**	**32%**	**13%**
Australia	13%	47%	22%
China	10%	158%	23%
India	20%	78%	18%
Indonesia	16%	44%	15%
Japan	3%	12%	7%
Korea, DPR	11%	n.a.	-25%
Korea, Rep.	9%	71%	37%
Philippines	23%	40%	40%
Thailand	12%	46%	16%

Fig. 11: **WORLD,** 1961–2001

In 1961, the Earth's biocapacity was more than double its global footprint. Forty years later, the footprint exceeded available biocapacity by 21 per cent – and the world's population has more than doubled in the period, from 3 billion in 1961 to over 6 billion in 2001.

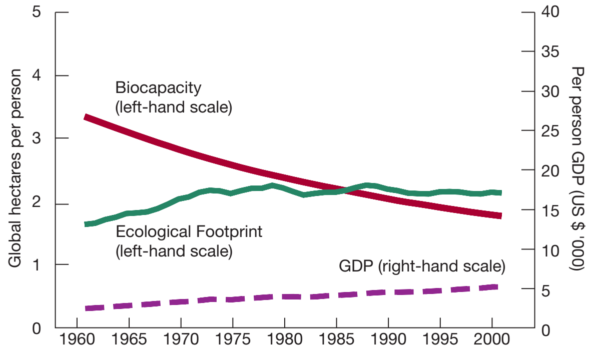


Fig. 12: **AUSTRALIA,** 1961–2001

Although Australia's national biocapacity exceeds its footprint, the average Australian's footprint is far greater than the average biocapacity available worldwide (1.8 gha per person). Since 1961 Australia's ecological remainder has shrunk by nearly 50 per cent as the population has risen from 10 million to 20 million.

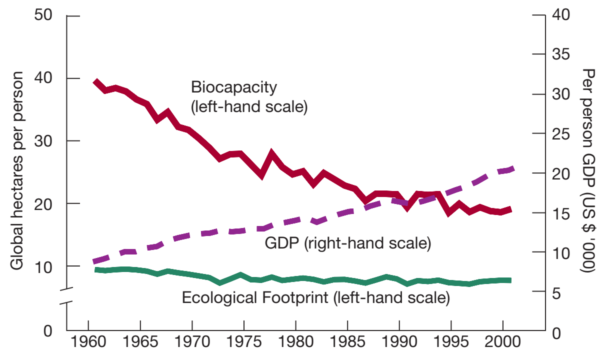


Fig. 13: **JAPAN,** 1961–2001

Japan's per person footprint is almost six times its biocapacity and more than double the world average. Although its footprint fell by 30 per cent in the early 1970s, demand is growing once more. The population increased by a third between 1961 and 2001, but demographers are forecasting a shrinking population.

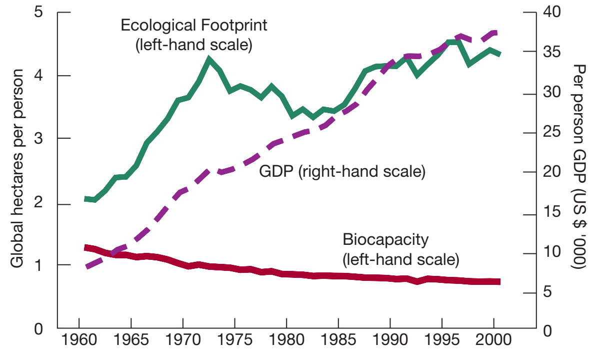


Fig. 14: **REPUBLIC OF KOREA,** 1961–2001

The trend of the Republic of Korea's footprint closely follows that of its GDP. Like Thailand, the Republic of Korea was seriously affected by the Asian financial crisis in the late 1990s. The population has grown from 26 million in 1961 to 47 million in 2001.

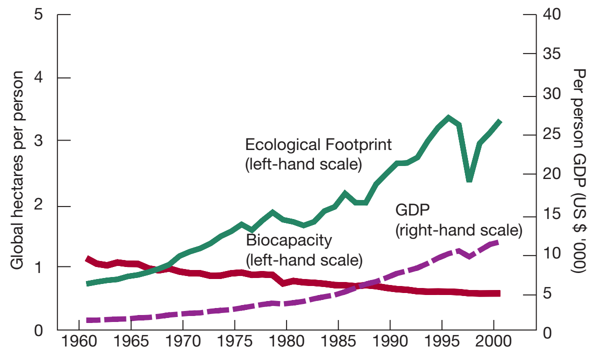


Fig. 15: **CHINA,** 1961–2001

Since 1961 China has grown faster than any other country in the region, nearly doubling its population and its per person footprint. In recent years the population, which has almost doubled to 1.3 billion, and footprint have remained relatively constant, though GDP continues to grow.

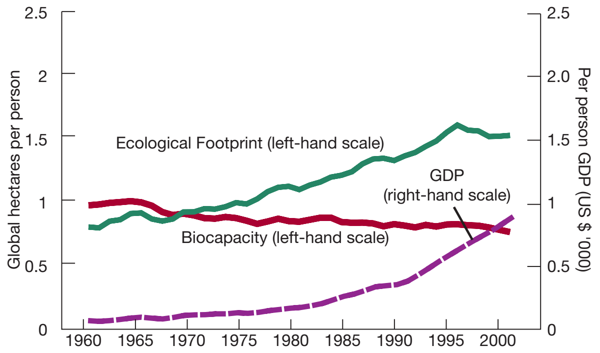


Fig. 16: **INDIA,** 1961–2001

While India's per person footprint has remained relatively constant over the last 40 years, available biocapacity per person has fallen as its population almost doubled to over 1 billion. The consumption patterns of its large middle class could shape the region's footprint in the future.

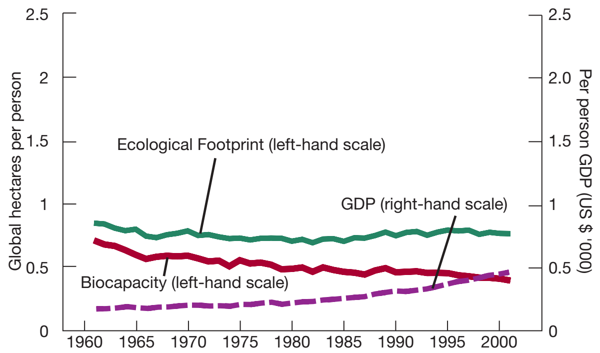


Fig. 17: **INDONESIA,** 1961–2001

Indonesia is an example of a country that has experienced rapid economic growth without an increase in its per person footprint. Indonesia was severely affected by the 1997–98 financial crisis as evidenced in the trend in GDP and its footprint. By 1961, its population had grown to 217 million.

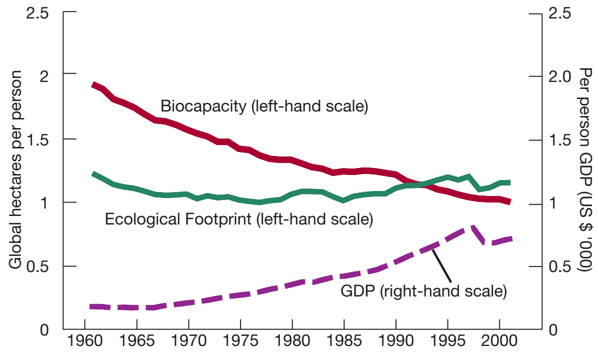


Fig. 18: **KOREA, DPR,** 1961–2001

As its ability to import biocapacity from abroad ended in the early 1990s, the footprint of Korea DPR declined sharply, with dramatic consequences for its population. Per person GDP data are not available, but poverty levels are increasing. Over the last four decades, population nearly doubled.

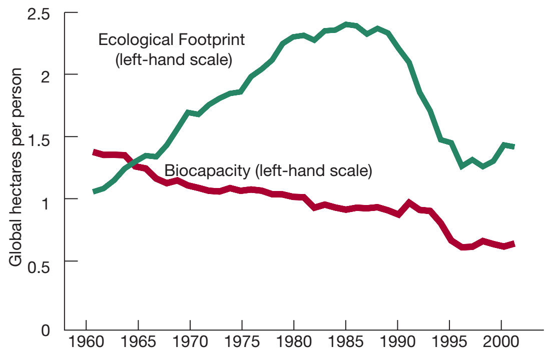


Fig. 19: **PHILIPPINES,** 1961–2001

Large fluctuations in Ecological Footprint, biocapacity, and GDP reflect the political and economic instability of the Philippines as well as inconsistencies in data reporting. The population of the Philippines has more than doubled since 1961 from 28 million to 79 million.

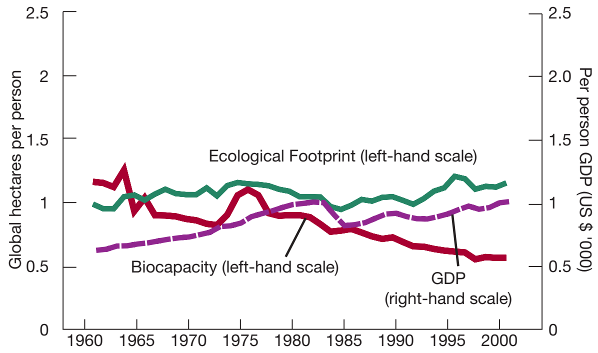
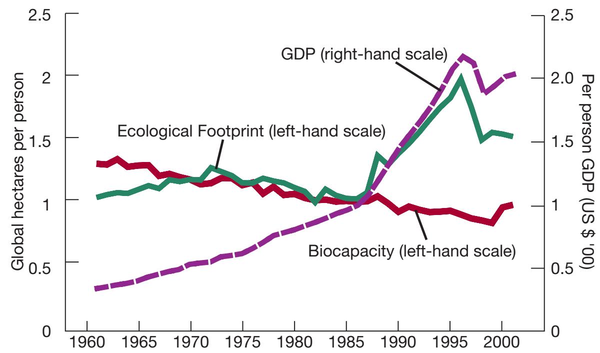


Fig. 20: **THAILAND,** 1961–2001

The dramatic increase in Thailand's footprint from the mid-1980s to mid-1990s reflects the country's rapid economic growth. The effects of the 1997–98 Asian financial crisis are reflected in the footprint. Thailand's population increased from 27 million in 1961 to 62 million in 2001.



LIVING ON ONE PLANET

At the turn of the 21st century, the Ecological Footprints of both the Asia-Pacific region and the world exceeded their available biocapacity. As in other regions, Asia and the Pacific is partially financing this overshoot by relying on biological capacity from outside the region.

At the global level, however, there are no additional planets from which to import biocapacity. Being in global overshoot inevitably means depleting the Earth's ecological capital, resulting in an overall deterioration of global ecosystems. The current state of overshoot will have to be eliminated for the world to reach sustainability. "One Planet Living" is an opportunity for countries to establish a sustainable, prosperous future for the long term. Some of the changes needed to meet this goal will involve increasing available global biocapacity. The balance must come from reducing the total global footprint. These reductions will have to go hand in hand with large portions of humanity increasing their footprint to meet their basic needs. Living up to this double challenge requires courageous leadership right across the globe.

Towards One Planet Living

Four factors determine the gap between the footprint and biocapacity:

1. **Biocapacity.** One challenge is to increase, or at least maintain, biocapacity. This means protecting soil from erosion and degradation, and preserving cropland for agriculture. It involves protecting river basins, wetlands, and watersheds to secure freshwater supplies, and maintaining healthy forests and fisheries. It includes taking action to protect ecosystems from climate change and eliminating the use of toxic chemicals that degrade ecosystems.

2. **Resource efficiency in producing goods and services.** Over the past 40 years, technological progress has increased the amount of goods and services that can be produced from a given amount of ecological resources. As a result, the average Ecological Footprint per person has stayed relatively constant. Despite these important efficiency gains, the total global Ecological Footprint has still grown (Pacala and Socolow 2004).

3. **Consumption of goods and services per person.** The potential for reducing per person consumption depends in part on the person's income level. People living at or below subsistence may need to increase their absolute consumption levels to move out of poverty. Wealthy individuals, however, could cut their consumption of goods and services with large footprints without seriously compromising the quality of their lives.

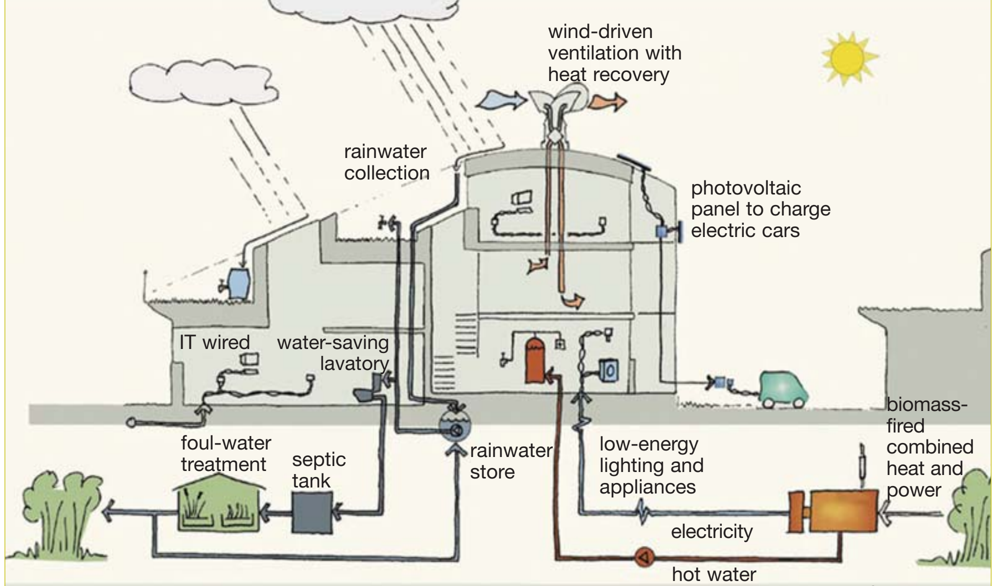
4. **Size of the population.** Addressing population growth will be especially critical for the Asia-Pacific region, which is already

WHAT IS ONE PLANET LIVING?

One Planet Living aims to demonstrate how it is possible to make the challenge of living on one planet achievable, affordable and attractive. It is also the name of a partnership between the BioRegional Development Group and WWF. One Planet Living is an initiative based on the experience of the Beddington Zero fossil Energy Development (BedZED). BedZED is a sustainable housing and work space project in London. Its homes and offices are highly energy efficient: it consumes 90 per cent less heating energy than average UK housing and less than half the water. Furthermore, it is designed so that all energy is generated in a renewable manner from wind, sun and biomass. Construction materials are from local, recycled or certified well-managed sources. And although it is a compact design, residents have private gardens and conservatories. Residents find BedZED a desirable place to live, contradicting the common but erroneous assumption that a smaller Ecological Footprint means a lower quality of life.

A goal is to establish One Planet Living communities on every continent by 2009, with projects under way or planned in Portugal, the United Kingdom, South Africa, North America and China (see www.bioregional.com).

How BedZED works



Source: ARUP

home to half the world's people. Population growth can be reduced by supporting measures that lead to families choosing to have fewer children. Offering women better education, economic opportunities and health care are three proven approaches.

Allocating biocapacity

Sustainability means living well for all, within the means of nature. But what does it mean for individual countries?

One answer could be to insist that each country lives, in net terms, within its own biological capacity. This may be too restrictive, however, since trade between nations, including trade in biocapacity, can increase the well-being of all involved.

A second solution could be to allocate a portion of global biocapacity to each global citizen. The portion could be defined as the total global biocapacity divided by the total global population. In 2001, this amounted to 1.8 global hectares per person. Living within each individual's portion would ensure ecological sustainability. High-footprint countries would have to reduce consumption, while low-footprint countries could expand their footprints. Some have suggested that access to biocapacity could also be traded among nations or individuals.

Sustainable well-being and Ecological Footprint

Hitherto, responses to environmental challenges are often couched in terms of 'delinking' GDP growth from environmental degradation. However, there is growing recognition that economic indicators like GDP provide a poor guide to human welfare. This is why increasing attention is being paid to alternative indicators – like 'green GDP'.

Although some Asian countries – China for example – are beginning to use 'green GDP' indicators, there is no systematic approach to the use of such indicators. The UN's Human Development Index (HDI) is a measure that captures how a given nation meets basic living standards through life expectancy, education and income. Although far from perfect, it represents one index that avoids some of the problems inherent to GDP, and for which global information is available. Some countries achieve higher levels of development (as measured by HDI) with relatively low footprints (as measured by the per person Ecological Footprint). Taking an HDI of 0.8 as the boundary between medium and highly developed countries and an 'average portion' of 1.8 global hectares per person as the highest globally replicable footprint divides Figure 21 into four quadrants. Only countries located in the upper right quadrant can be said to meet the minimum requirements for sustainability. Although no Asia-Pacific country today is in this area, some, like Thailand, are close (see Table 3). One Planet Living would mean moving the average of all countries into this 'sustainability quadrant' (Boutaud 2002).

Fig. 21: MATCHING HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS,
Asia-Pacific and selected countries, 2001

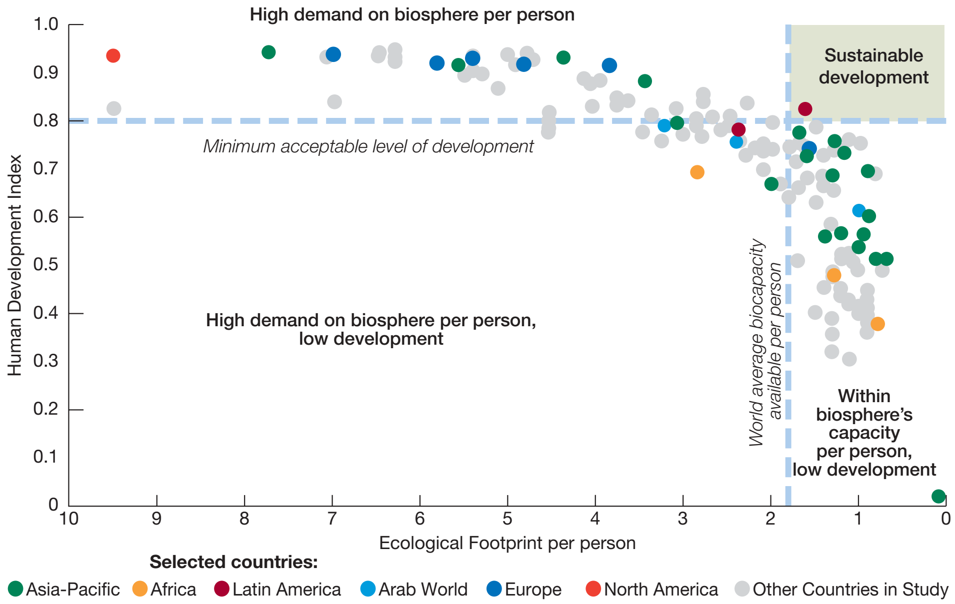


Figure 21: One Planet Living – living well, within the means of nature: the global challenge is how to move all countries into the 'sustainable development' quadrant (Boutaud 2002).

Table 3: HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS FOR SELECTED COUNTRIES, 2001

	Human Development Index	Ecological Footprint (gha/person)
Albania	0.74	1.5
Australia	0.94	7.7
Bangladesh	0.50	0.5
Brazil	0.78	2.2
Cambodia	0.56	0.8
China	0.72	1.5
Cuba	0.81	1.5
Ethiopia	0.36	0.8
France	0.93	5.8
Germany	0.92	4.8
India	0.59	0.8
Indonesia	0.68	1.2
Italy	0.92	3.8
Japan	0.93	4.3
Korea, Republic	0.88	3.4
Lao PDR	0.53	0.9
Lebanon	0.75	2.2
Libya	0.78	3.1
Malaysia	0.79	3.0
Mongolia	0.66	3.1
Morocco	0.61	0.9
Myanmar	0.55	0.9
Nepal	0.50	0.6
New Zealand	0.92	5.5
Nigeria	0.46	1.2
Pakistan	0.50	0.7
Papua New Guinea	0.55	1.2
Philippines	0.75	1.2
South Africa	0.68	2.8
Sri Lanka	0.73	1.1
Sweden	0.94	7.1
Thailand	0.77	1.6
United States of America	0.94	9.5
United Kingdom	0.93	5.5
Viet Nam	0.69	0.7

ASIA-PACIFIC: TRANSFORMATION TO SUSTAINABILITY

The Asia-Pacific region wants both to continue to develop its economies and to be competitive with the rest of the world in the short and the long terms. Economic development at the expense of continued depletion or degradation of natural resources and the environment, however, is not sustainable. This list identifies possible options that can reduce the region's demand on nature and improve development options for the region's 3.4 billion people. Globally, the countries of Europe and North America must take substantial action to reduce their footprints. Asia-Pacific countries are rightly focused on developing their emerging competitive economies, but they may not succeed without maintaining their ecological assets.

Regional security and global collaboration

Effective management of natural resources and reduction of environmental degradation that are transboundary in nature can contribute to 'regionalization' and improve national security. The progress made in lifting the region's poor out of poverty needs to recognize the strong links between poverty reduction and environmental quality. Tackling global environmental problems will require greater collaboration between states and that countries in the region take on a greater global leadership role by:

- Increasing efforts to reduce poverty both within low-income countries and economically marginalized areas, especially among the rural poor, by ensuring that the environmental base on which they depend is not depleted.
- Encouraging bilateral and multilateral initiatives through which South–South countries, within and beyond the region, could create a 'sustainable axis'. Under such initiatives energy efficiency solutions from one country could go one way, with systems for renewable energy travelling in the other, depending on competitive advantages and sustainable strategies.
- Improving regional natural resource management, for instance through increased and improved regional frameworks, such as the ASEAN Regional Action Plan on Trade in Wild Fauna and Flora 2005–2010. This collaboration on policy development and law enforcement could be extended throughout the region and greatly increase the sustainable management of the region's wildlife trade.
- Ensuring best practice in integrated river basin management supports the needs of people and maintains ecosystem services, as well as biodiversity, and promotes collaboration between countries using a 'whole of river' approach to water management.
- Challenging the industrial countries to support 'leaders' in sustainability within the region through different means such as public procurement, regulation and cooperation, for example by twinning sustainable cities between North and South that support a two-way flow of ideas and innovations.
- Using international fora to plan strategies that avoid technological transfers and leapfrog strategies from industrialized countries and multinationals that lead countries in Asia and the Pacific into unsustainable development patterns.

Providing affordable, reliable and environmentally friendly energy to all

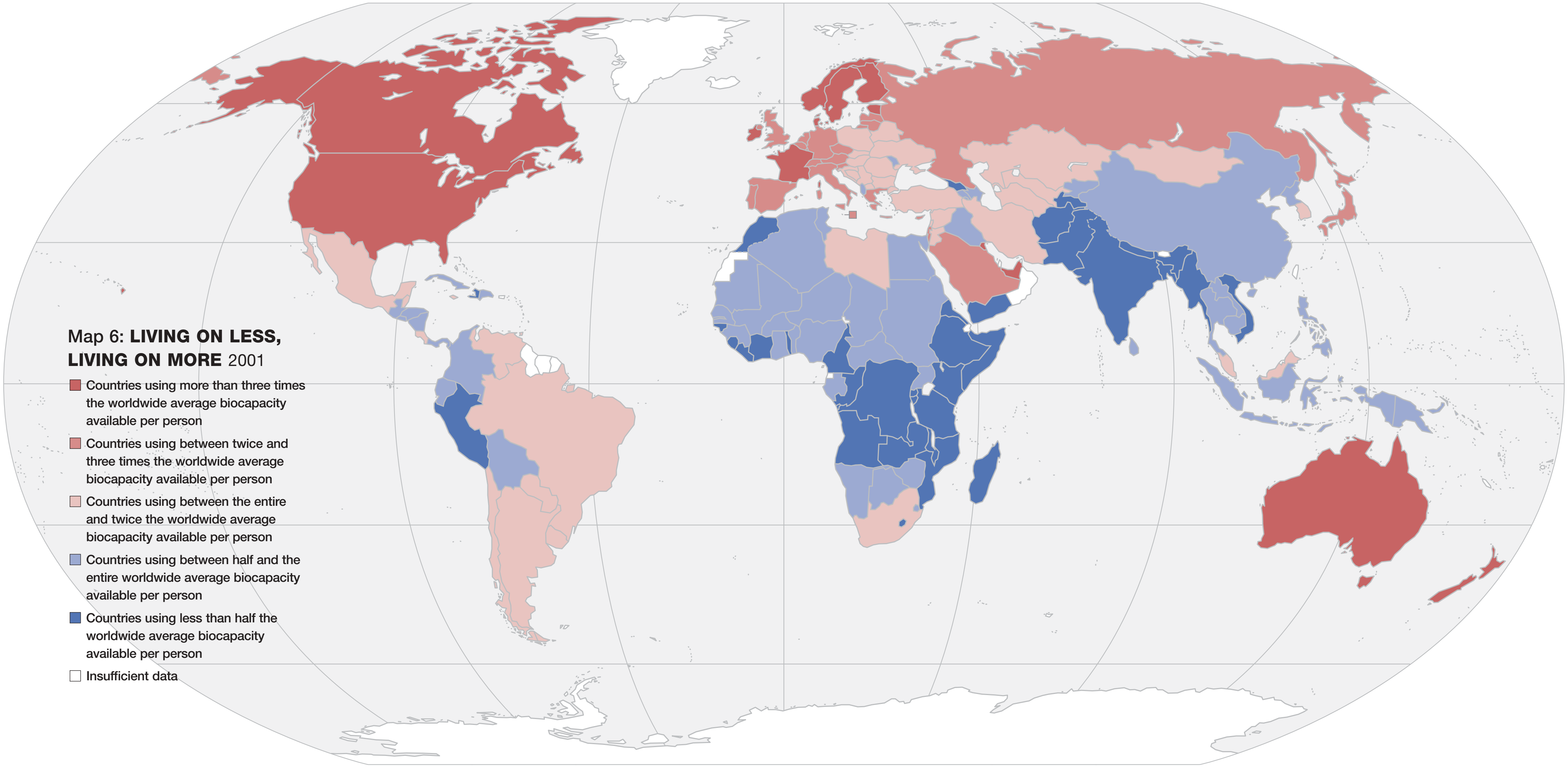
Environmental imperatives – such as tackling climate change and acid rain – coupled with social and economic factors including increasing fossil fuel prices, import-dependency risks and the provision of affordable energy services to the poor, provide a unique opportunity for a shift to sustainable energy. Factors that could contribute to making this change include:

- Switching the sectoral focus from energy supply to provision of energy services can unlock huge efficiency potential across the region. Much can be learned from existing initiatives – Japan's economy is already almost three times as energy efficient as that of the United States of America and almost eight times as efficient as China.
- Internalizing environmental costs using economic instruments – such as sulphur and carbon emissions trading and new regulations such as improved and enforced pollution controls and renewable energy targets – will drive new markets for clean technologies. Asia-Pacific region is already moving forward: China has the world's most ambitious national renewable energy target, India is the fifth largest generator of wind power in the world while the Philippines is the world's second largest generator of geothermal energy.
- Advancing innovation and know-how in sustainable energy technologies within the Asia-Pacific region using public-private partnerships. Such innovation could draw on experience within the region in such countries as China, India and Japan, as well as from the rest of the world.
- New models of participation in energy sector decision making, involving collaboration between consumer organizations, local government, local communities and the private sector, can provide new methods of governance and new business models to support the technology shift.
- Substantial and long-term investment in energy systems that reduce the region's dependency on expensive fossil fuel imports. This is important both for countries that will struggle to compete on global markets for higher priced fuels and for those, such as India and China, with enormous oil requirements to meet the current and future demand from industry and their growing consumer societies.

Provide accurate and relevant information for decision makers

Track all assets (economic, social and environmental) in order to better monitor consequences of present choices. Such options include:

- Strengthening the ability of national



Map 6: **LIVING ON LESS, LIVING ON MORE** 2001

Sustainability means providing well-being for all within the means of nature. Overusing the biosphere undermines its ability to provide resources and support a high quality of life for all of humanity. What does this mean for nations? Should we look at a country's Ecological Footprint, its ecological deficit, or both? Is Australia ecologically sustainable? Its residents' footprint is more than four times larger than what is available per person worldwide, but Australia's biological capacity is about twice its footprint. Is China ecologically sustainable? Its average resident lives on a footprint smaller than what is available per person globally, but China's total footprint exceeds the biocapacity available within its own borders. If everyone in the world led the same lifestyle as the average Australian, the Earth would not be able to sustain humanity for very long. Nor would humanity be sustainable if all countries ran an ecological deficit like China.

governments and regional institutions to keep track of their demand on and availability of biological capacity.

- Providing a better quality and quantity of information in the media. Governments and companies will not receive appropriate signals from citizens and consumers unless the public is well informed of the impact of their choices and purchasing decisions.

- Broadening the use of labelling and certification standards, for example the Forest Stewardship Council (FSC) and the Marine Stewardship Council (MSC), to allow customers to make choices about the products they buy, reduce their individual footprints and support more sustainable resource use.

- Encouraging wide use of corporate social responsibility (CSR) with better corporate environmental reporting to show which companies are making efforts to become sustainable, and how.

- Measuring and reporting on more comprehensive indicators of social, economic and ecological performance in governments to complement existing economic indicators such as GDP, trade balance and rate of inflation. Examples include green GDP in China, and gross domestic happiness in Bhutan.

Build and advance green infrastructure

Design more resource-efficient, smarter cities; transport networks and infrastructure in the Asia-Pacific region. This concerns particularly large infrastructure projects in rapidly transforming nations, such as China and India, where retro-fitting in the future will be enormously costly and inefficient. But it is also crucially important in other countries including Australia, Japan, New Zealand, the Republic of Korea, and Singapore, where new, green, energy-efficient infrastructure could become an asset, rather than continuing with existing resource-consuming traps. Possibilities include:

- Introducing mechanisms for rating buildings based on building design requirements and materials that lead to reductions in waste generation and energy use, thereby substantially increasing efficiency.

- Upgrading existing hydro-generation capacity in dams, rather than constructing new capacity, in countries such as Australia, China, India, Japan and New Zealand. When new dams are built, they should always meet the World Commission on Dams guidelines.

- Encouraging investment in public transport infrastructure, in both urban and rural areas, and making transport pricing reflect the full social and environmental costs of road and air travel.

- Investing in information and communication technologies to allow urban areas to be less dependent on traditional transport systems and to bring the benefits of better access to communications to poorer rural areas.

Markets, trade and investment

Governments should ensure that investments in the solutions needed for the transformation to sustainability are encouraged. Investments in industries that are obstacles to sustainability or that produce goods and services incompatible with a sustainable world should also be discouraged, with companies trying to go beyond traditional CSR standards and taking the lead in initiatives for sustainable development. Government measures could include:

- Developing systems that allow countries to differentiate between sustainable and unsustainable trade and investment flows. Where possible these should link to national sustainable development strategies and indicators such as green GDP.

- Providing incentives for financial markets to favour long-term sustainability over short-term gains. Commercial banks, pension funds and insurance companies in particular have opportunities to invest in an ecologically responsible manner and divest their interests in unsustainable activities.

- Supporting national fiscal policy initiatives and providing regulatory and fiscal incentives to encourage full-cost pricing and moves towards a lower resource-intense society.

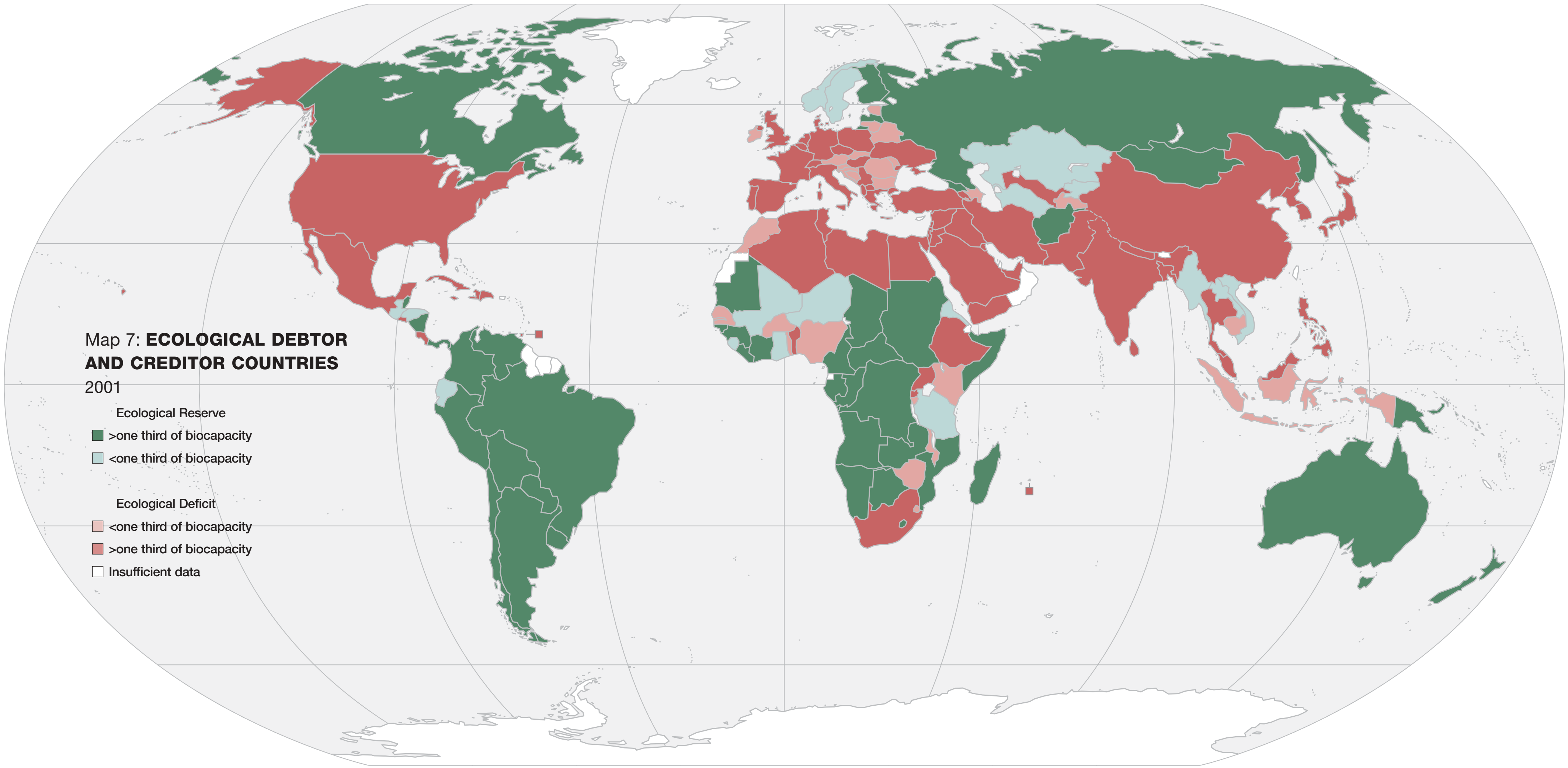
- Inviting the private financial sector and multilateral agencies to support their investment policies that favour sustainable innovations and green technology. For example, the Asia Development Bank and commercial banks could develop loans and investment strategies that encourage transformation and promote sustainability.

Recognize the increasing competitive advantage of ecological creditors

Prepare for the geopolitical shift to a division between ecological debtor and creditor countries (see Map 7). International cooperation can be enhanced by encouraging governments to move from short-term self-interests on common goods to long-term global common interests, including:

- Developing beyond unilateral action on international issues such as climate change, biodiversity conservation or management of the oceans.

- Exploring new international conventions and treaties that build on and develop further the existing commitments of the Millennium Development Goals, Kyoto and Doha that encourage equitable solutions to sustainability challenges.



Map 7: **ECOLOGICAL DEBTOR AND CREDITOR COUNTRIES**
2001

Countries with ecological deficits use more biocapacity than they control within their own territories. As ecological deficits continue to increase in many countries, the predominant geopolitical line may shift from the current division between developed and developing countries. Instead, the line will fall between ecological debtors, countries that depend on net imports of ecological resources or on liquidating their ecological assets to maintain their economies, and ecological creditors, countries still endowed with ecological reserves. As ecological deficits increase worldwide, both debtors and creditors will realize the significance of ecological assets and recognize the economic advantage of curbing their footprints.

Table 4: ECOLOGICAL FOOTPRINT AND BIOCAPACITY

2001 data *See notes on pages 21–25*	Population (millions)	Total Ecological Footprint (global ha/person)	Total food, fibre and timber footprint (global ha/person)	Included in total food, fibre and timber: Cropland (global ha/person)	Forest (global ha/person)	Grazing land (global ha/person)	Fishing ground (global ha/person)	Total energy footprint (global ha/person)	Included in total energy: CO_2 from fossil fuels (global ha/person)	Fuelwood (global ha/person)	Nuclear (global ha/person)	Hydro (global ha/person)
WORLD	**6 148.1**	**2.2**	**0.9**	**0.49**	**0.18**	**0.14**	**0.13**	**1.2**	**1.03**	**0.06**	**0.09**	**0.00**
High income countries	**920.1**	**6.4**	**2.2**	**0.82**	**0.80**	**0.26**	**0.33**	**4.0**	**3.44**	**0.02**	**0.49**	**0.01**
Middle income countries	**2 970.8**	**1.9**	**0.9**	**0.50**	**0.12**	**0.15**	**0.15**	**0.9**	**0.85**	**0.05**	**0.02**	**0.00**
Low income countries	**2 226.3**	**0.8**	**0.5**	**0.35**	**0.03**	**0.03**	**0.09**	**0.3**	**0.20**	**0.09**	**0.00**	**0.00**
ASIA-PACIFIC	**3 406.8**	**1.3**	**0.7**	**0.39**	**0.07**	**0.06**	**0.16**	**0.6**	**0.54**	**0.05**	**0.03**	**0.00**
Australia	19.4	7.7	3.0	1.09	0.77	0.78	0.34	4.4	4.34	0.07	0.00	0.01
Bangladesh	140.9	0.6	0.4	0.26	0.01	0.00	0.15	0.1	0.09	0.04	0.00	0.00
Cambodia	13.5	1.1	0.9	0.22	0.01	0.11	0.58	0.2	0.01	0.15	0.00	0.00
China	1 292.6	1.5	0.8	0.44	0.08	0.11	0.16	0.7	0.65	0.03	0.00	0.00
India	1 033.4	0.8	0.4	0.34	0.01	0.00	0.05	0.3	0.27	0.05	0.00	0.00
Indonesia	214.4	1.2	0.7	0.35	0.05	0.05	0.25	0.4	0.34	0.08	0.00	0.00
Japan	127.3	4.3	1.4	0.48	0.33	0.08	0.55	2.8	2.33	0.00	0.50	0.01
Korea, DPR	22.4	1.5	0.5	0.33	0.05	0.00	0.11	0.9	0.88	0.05	0.00	0.00
Korea, Rep.	47.1	3.4	1.3	0.54	0.24	0.00	0.54	2.0	1.54	0.01	0.46	0.00
Lao PDR	5.4	1.0	0.6	0.31	0.05	0.13	0.15	0.2	0.02	0.22	0.00	0.00
Malaysia	23.5	3.0	1.3	0.50	0.19	0.04	0.55	1.6	1.60	0.03	0.00	0.00
Mongolia	2.5	1.9	1.0	0.18	0.13	0.70	0.00	0.8	0.83	0.02	0.00	0.00
Myanmar	48.2	0.9	0.7	0.47	0.03	0.02	0.15	0.2	0.04	0.15	0.00	0.00
Nepal	24.1	0.6	0.4	0.32	0.04	0.06	0.02	0.2	0.04	0.11	0.00	0.00
New Zealand	3.8	5.5	4.0	0.62	1.45	1.05	0.86	1.3	1.33	0.00	0.00	0.00
Pakistan	146.3	0.7	0.4	0.31	0.02	0.00	0.06	0.3	0.22	0.04	0.00	0.00
Papua New Guinea	5.5	1.3	0.9	0.26	0.14	0.11	0.35	0.3	0.09	0.21	0.00	0.00
Philippines	77.2	1.2	0.7	0.32	0.04	0.02	0.30	0.5	0.34	0.11	0.00	0.00
Sri Lanka	18.8	1.1	0.7	0.30	0.05	0.03	0.34	0.3	0.25	0.06	0.00	0.00
Thailand	61.6	1.6	0.7	0.36	0.07	0.01	0.29	0.8	0.75	0.07	0.00	0.00
Viet Nam	79.2	0.8	0.5	0.31	0.05	0.01	0.10	0.2	0.14	0.07	0.00	0.00
OTHER NATIONS												
Brazil	174.0	2.2	1.5	0.58	0.35	0.53	0.09	0.5	0.35	0.16	0.02	0.02
Russian Federation	144.9	4.4	1.5	0.81	0.30	0.21	0.20	2.8	2.52	0.06	0.20	0.01
United Kingdom	59.1	5.4	1.7	0.69	0.44	0.27	0.25	3.4	3.13	0.00	0.31	0.00
United States of America	288.0	9.5	3.0	0.96	1.35	0.44	0.23	6.1	5.47	0.04	0.57	0.01

NOTES
World: Total population includes countries not listed below.
0.0 = less than 0.05
Totals may not add up due to rounding
High income countries: Australia, Austria, Belgium & Luxembourg, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Rep. Korea, Kuwait, Netherlands, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States of America.
Middle income countries: Algeria, Argentina, Belarus, Belize, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Czech Rep., Dominican Rep., Ecuador, Egypt, El Salvador, Estonia, Gabon, Georgia, Guatemala, Hungary, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Latvia, Lebanon, Libya, Lithuania, FYR Macedonia, Malaysia, Mauritius, Mexico, Morocco, Namibia, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Serbia and Montenegro, Slovakia, Rep. South Africa, Sri Lanka, Syria, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Uzbekistan, Venezuela.

Built-up land* (global ha/person)	Total biocapacity (global ha/person)	Included in total biocapacity: Cropland (global ha/person)	Grazing land (global ha/person)	Forest (global ha/person)	Fishing ground (global ha/person)	Ecological deficit** (global ha/person)	Ecological Footprint change per capita (change 1991-2001)	Biocapacity change per capita (change 1991-2001)	Human Development Index***	Gross domestic product (US $/person)	2001 data *See notes on pages 21–25*
0.07	**1.8**	**0.53**	**0.27**	**0.81**	**0.13**	**0.4**	**-2%**	**-12%**	**0.72**	**5 800**	**WORLD**
0.23	**3.3**	**1.12**	**0.33**	**1.57**	**0.31**	**3.1**	**8%**	**-7%**	**0.91**	**-**	**High income countries**
0.07	**2.0**	**0.51**	**0.30**	**1.07**	**0.13**	**-0.1**	**-5%**	**-10%**	**0.68**	**-**	**Middle income countries**
0.05	**0.7**	**0.32**	**0.19**	**0.13**	**0.07**	**0.1**	**-11%**	**-16%**	**0.44**	**-**	**Low income countries**
0.06	**0.7**	**0.34**	**0.11**	**0.16**	**0.09**	**0.6**	**6%**	**-11%**	**0.66**	**2 365**	**ASIA-PACIFIC**
0.26	19.2	4.46	8.26	3.47	2.73	-11.5	16%	-6%	0.94	20 886	Australia
0.05	0.3	0.19	0.00	0.01	0.08	0.3	0%	-11%	0.50	353	Bangladesh
0.03	1.0	0.31	0.12	0.19	0.37	0.1	9%	-3%	0.56	281	Cambodia
0.07	0.8	0.35	0.12	0.17	0.05	0.8	14%	-7%	0.72	899	China
0.04	0.4	0.29	0.00	0.02	0.03	0.4	1%	-15%	0.59	465	India
0.05	1.0	0.34	0.07	0.27	0.28	0.2	4%	-14%	0.68	725	Indonesia
0.07	0.8	0.14	0.00	0.42	0.13	3.6	6%	-6%	0.93	37 453	Japan
0.05	0.7	0.23	0.00	0.30	0.10	0.8	-37%	-33%	n/a	n/a	Korea, DPR
0.06	0.6	0.16	0.00	0.08	0.27	2.8	30%	-12%	0.88	11 276	Korea, Rep.
0.10	1.4	0.33	0.21	0.68	0.07	-0.4	-4%	-12%	0.53	335	Lao PDR
0.07	1.9	0.79	0.02	0.63	0.42	1.1	10%	-48%	0.79	3 857	Malaysia
0.04	11.8	0.25	11.04	0.47	0.00	-9.9	-33%	-11%	0.66	378	Mongolia
0.08	1.3	0.54	0.01	0.48	0.21	-0.4	10%	1%	0.55	n/a	Myanmar
0.05	0.5	0.27	0.06	0.08	0.01	0.2	-4%	-12%	0.50	241	Nepal
0.13	14.5	2.76	4.36	6.82	0.45	-9.0	16%	-13%	0.92	18 696	New Zealand
0.04	0.4	0.26	0.01	0.02	0.04	0.3	2%	-18%	0.50	511	Pakistan
0.12	2.6	0.33	0.05	1.15	0.90	-1.3	-8%	-16%	0.55	638	Papua New Guinea
0.04	0.6	0.28	0.02	0.12	0.12	0.6	-6%	-22%	0.75	1 013	Philippines
0.05	0.4	0.20	0.02	0.05	0.06	0.7	20%	-12%	0.73	857	Sri Lanka
0.06	1.0	0.59	0.01	0.19	0.14	0.6	20%	-1%	0.77	2 037	Thailand
0.08	0.8	0.36	0.01	0.14	0.17	0.0	14%	6%	0.69	421	Viet Nam
0.08	10.2	0.80	1.19	8.05	0.10	-8.0	9%	-10%	0.78	3 503	Brazil
0.05	6.9	1.18	0.35	4.95	0.39	-2.6	-21%	1%	0.53	1 884	Russian Federation
0.34	1.5	0.49	0.15	0.19	0.36	3.9	-1%	-12%	0.93	21 500	United Kingdom
0.45	4.9	1.76	0.28	2.01	0.36	4.7	7%	-11%	0.94	39 100	United States of Americaß

Low income countries: Afghanistan, Albania, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Rep., Chad, Congo, Dem. Rep. Congo, Côte d'Ivoire, Eritrea, Ethiopia, The Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Honduras, India, Kenya, DPR Korea, Kyrgyzstan, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Rep. Moldova, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Swaziland, Tajikistan, United Rep. Tanzania, Togo, Turkmenistan, Uganda, Viet Nam, Yemen, Zambia, Zimbabwe.

* Note that built-up land is part of both Ecological Footprint and biocapacity.
** If number for ecological deficit is negative, country has an ecological reserve.
*** High/medium/low income country classifications for the Human Development Index are taken from UNDP 2003.

FREQUENTLY ASKED QUESTIONS ABOUT THE FOOTPRINT

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 that are potentially sustainable and for which there are data that allow this demand on nature to be expressed in terms of the area required. Specific excluded components are listed in the technical appendix.

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

Footprint accounts also do not indicate the intensity with which a biologically productive area is being used and do not pinpoint specific biodiversity pressures. Finally, the Ecological Footprint does not evaluate the social and economic dimensions of sustainability.

How does the Ecological Footprint account for fossil fuels?

The Ecological Footprint measures humanity's past and present demand on nature. Although fossil fuels such as coal, oil and natural gas are extracted from the Earth's crust and not regenerated in human timescales, their use still requires ecological services. Burning these fuels puts pressure on the biosphere through the release of greenhouse gases such as CO_2. The Ecological Footprint includes the biocapacity needed to sequester this CO_2, less the amount absorbed by the ocean. One global hectare can absorb the CO_2 released from consuming approximately 1,450 litres of gasoline in a year.

The fossil fuel footprint does not suggest that carbon sequestration is the key to resolving global warming. Rather, it points out the lack of ecological capacity for coping with excess CO_2 and underlines the importance of reducing CO_2 emissions. The sequestration rate used in Ecological Footprint calculations is based on an estimate of how much human-induced carbon emissions the world's forests can currently remove from the atmosphere and retain.

Energy efficiency or new renewable energy technologies, such as wind or solar, may be the most cost-effective way to reduce the energy footprint (see Figure 23). As the Ecological Footprint measures the current state of resource demand and availability, however, these technologies are only included in the accounts according to their usage today, not their possible growth in the future.

Are current biological yields likely to be sustainable?

In calculating a nation's footprint, yields for forests and fisheries as reported by the Food and Agriculture Organization of the United Nations (FAO) are used. These are estimates of the maximum amount of a single species stock that can be harvested without reducing the stock's productivity over time. If current overuse leads to lower yields in the future, this will be reflected in future biocapacity assessments.

How is international trade taken into account?

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

The resulting footprint of apparent consumption can be distorted, since the waste generated in making products for export is not fully documented. This can exaggerate the footprint of countries whose economies produce largely for export, and understate that of importing countries. While these misallocations may distort some national averages, they do not bias the overall global Ecological Footprint.

Fig. 22: **ASIA PACIFIC'S ECOLOGICAL FOOTPRINT,** 1961–2001

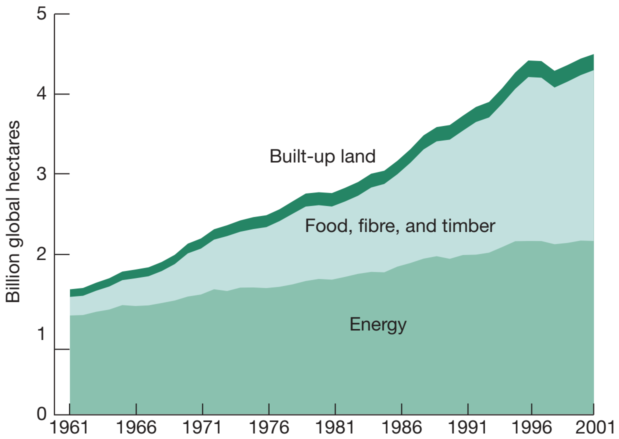


Fig. 23: **COMPARING THE FOOTPRINTS OF ENERGY TECHNOLOGIES**

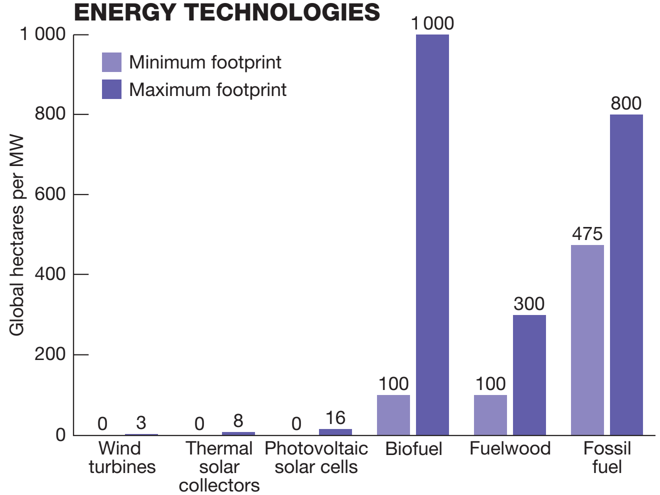


Figure 22: The Asia-Pacific region's total Ecological Footprint nearly trebled from 1961 to 2001. Population increased by around 17 per cent over the same period.

Figure 23: Range of footprints of renewable energy technologies in comparison with fossil fuels.

TECHNICAL NOTES

LIVING PLANET INDEX

Data collection

The species population data used to calculate the Living Planet Index were gathered from a variety of sources including publications in scientific journals, literature from non-governmental organizations, and the internet. All data used in constructing the index are a time series of either population size or a proxy of population size. Direct population size trends included total population estimates, such as counts of an entire species; density measures, for example the number of birds per kilometre of transect; and biomass or stock estimates, particularly for commercial fish species. Other proxies of population size were also used, such as the number of nests of marine turtle species on various nesting beaches.

All population time series have at least two data points, and most have more. Only data collected by methods that are comparable across years are included – a population estimate taken at one point in time would not be used with a second estimate from another survey of the same population at another point in time, unless it was clear that the second estimate was meant to be comparable with the first. Plants and invertebrates are excluded, as few population time series data were available. It is assumed, therefore, that trends in vertebrate populations are indicative of overall trends in global biodiversity.

Calculation of the indices

For each species, the ratio between its population in each pair of consecutive years is calculated. To calculate the index in a given year, the geometric mean of all the ratios of species populations in that year and the previous year is multiplied by the index value of the previous year. The index value is set equal to 1 in 1970. From this baseline, the index changes from year to year in line with the geometric mean of all the changes in population of species with population data in both years.

In cases where data exist for more than one population of a single species, or where more than one time series was collected for the same population, the geometric mean of all ratios for that species was used in the index calculations rather than all measurements for that species.

More species population data are available from temperate than tropical regions of the world, and species richness is higher in the tropics. Thus, if the Living Planet Index were calculated simply as described above, it would be unrepresentative of global biodiversity. To address this issue, before carrying out any calculations, the data were divided into biomes (terrestrial, freshwater or marine) depending on the principal habitat of the species. Where a species commonly occurs in more than one biome, its breeding habitat was used to determine its biome.

Within each biome, species were divided according to the biogeographic realm or ocean they inhabit: Afrotropical, Australasian, Indo-Malayan, Nearctic, Neotropical, or Palearctic realms for terrestrial and freshwater species, and Atlantic/Arctic, Indian, Pacific, or Southern Oceans for marine species. For some species, different populations occur within different realms or oceans, in which case the populations would be divided accordingly. The total numbers of species contributing to each realm/ocean and biome are given in Table 5.

Separate indices were calculated for each biogeographic realm and ocean. The terrestrial and freshwater species indices were then calculated as the geometric mean of the six biogeographic realm indices within each biome, and the marine species index was calculated as the geometric mean of the four ocean indices. The terrestrial species index includes 562 species of mammals, birds and reptiles found in forest, grassland, savannah, desert or tundra ecosystems worldwide. The freshwater species index comprises 323 species of mammals, birds, reptiles, amphibians, and fish living in rivers, lakes or wetland ecosystems. The marine species index includes 267 species of mammals, birds, reptiles and fish from the world's oceans, seas and coastal ecosystems.

The Living Planet Index is the geometric mean of the terrestrial, freshwater and marine species indices. The hierarchy of indices is shown in Figure 24. Each biome carries equal weight within the overall Living Planet Index. Each realm or ocean carries equal weight within each biome. Each species carries equal weight within each realm or ocean. Each population carries equal weight within each species.

ECOLOGICAL FOOTPRINT and BIOCAPACITY

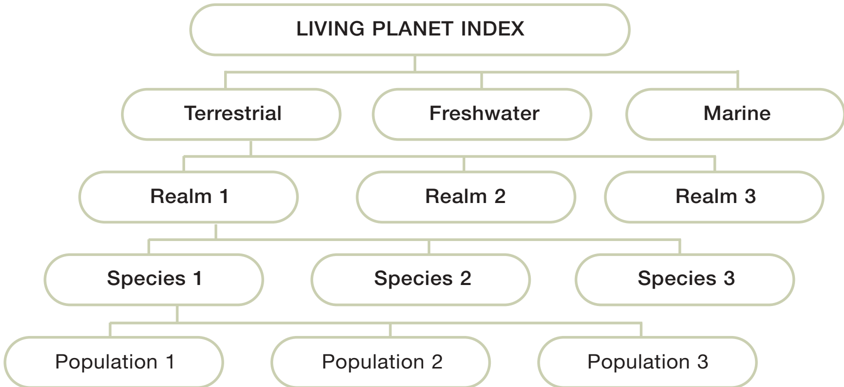
1. The Ecological Footprint

The **Ecological Footprint** is a measure of how much biologically productive land and water area

Table 5: **NUMBERS OF SPECIES INCLUDED IN THE LIVING PLANET INDEX BY REALM/OCEAN AND BIOME**

Realm or ocean	Terrestrial	Freshwater	Marine
Afrotropical	72	12	
Australasian	15	11	
Indo-Malayan	28	19	
Nearctic	269	168	
Neotropical	19	12	
Palearctic	159	101	
Atlantic/Arctic Ocean			117
Indian Ocean/Southeast Asia			15
Pacific Ocean			105
Southern Ocean			30
World	**562**	**323**	**267**

Fig. 24: **HIERARCHY OF INDICES WITHIN THE LIVING PLANET INDEX**



an individual, a city, a country, a region or humanity uses to produce the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management schemes. This land and water area can be physically located anywhere in the world.

This report documents national, per person footprints for consumption. Footprints can be calculated for any activity of organizations and populations or for urban development projects, services and products.

The Ecological Footprint is measured in global hectares. A **global hectare** is 1 hectare of biologically productive space with world average productivity. In 2001 (the most recent year for which consistent data are available), the biosphere had 11.3 billion hectares of biologically productive area, corresponding to roughly one quarter of the planet's surface. These 11.3 billion hectares include 2.3 billion hectares of water (ocean shelves and inland water) and 9.0 billion hectares of land. The land area is composed of 1.5 billion hectares of cropland, 3.5 billion hectares of grazing land, 3.9 billion hectares of forest land and 0.2 billion hectares of built-up land.

In this report, the Ecological Footprint of consumption is calculated for each country. This includes the embodied resources contained within the goods and services that are consumed by people living in that country, as well as the associated waste. Resources used for the production of goods and services that are later exported are counted in the footprint of the country where the goods and services are finally consumed.

The **global Ecological Footprint** is the area required to produce the material throughput of the human economy under current management and production practices. Typically expressed in global hectares, the Ecological Footprint can also be measured in number of planets, whereby one planet represents the biological capacity of the Earth in a given year. Results could also be expressed, for example, in Austrian or Danish hectares (hectares with average Austrian or Danish productivity), just as financial accounts can express the same total value in different currencies.

Ecological Footprint and biocapacity analyses are based primarily on **data** published by the Food and Agriculture Organization of the United Nations (FAO), the International Energy Agency (IEA), the UN Statistics Division (UN Commodity Trade Statistics Database – UN Comtrade), and the Intergovernmental Panel on Climate Change (IPCC). Other data sources include studies in peer-reviewed science journals and thematic collections.

2. Biocapacity and bioproductivity

Biocapacity (biological capacity) is the total usable biological production capacity of a biologically productive area in a given year. Biocapacity can also be expressed in global hectares.

Biologically productive area is land and sea area with significant photosynthetic activity and production of biomass. Marginal areas with patchy vegetation and non-productive areas are not included in biocapacity estimates. There are 11.3 billion global hectares of biologically productive land and sea area on the planet. The remaining three quarters of the Earth's surface, including deserts, ice caps and deep oceans, support comparatively low levels of bioproductivity, too dispersed to be harvested.

Bioproductivity (biological productivity) is equal to biological production per unit area per year. Biological productivity is typically measured in terms of annual biomass accumulation.

Biocapacity available per person is calculated by dividing the 11.3 billion global hectares of biologically productive area by the number of people on Earth (6.15 billion in 2001). This ratio gives the average amount of biocapacity that exists on the planet per person: 1.8 global hectares.

3. Assumptions underlying the calculations

Ecological Footprint calculations are based on the following assumptions:

- It is possible to track the majority of the resources people consume and the wastes they generate.
- The majority of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain these flows.Those resource and waste flows that cannot be measured are excluded from the assessment. This approach tends to underestimate the true Ecological Footprint.
- By weighting each area in proportion to its usable bioproductivity, different types of areas can be converted from *hectares* to *global hectares*, land of average productivity. 'Usable' refers to the portion of biomass used by humans, reflecting the anthropocentric assumptions of the Ecological Footprint measurement.
- Since these different areas represent mutually exclusive uses and each global hectare represents the same amount of biomass production potential for a given year, they can be added up. This is the case for both the aggregate human demand (the Ecological Footprint) and the aggregate supply of biocapacity.
- Human demand expressed as the Ecological Footprint and nature's supply expressed in global hectares of biocapacity can be directly compared.
- Area demanded can exceed area supplied. For example, the footprint of forest products harvested from a forest at twice its regeneration rate is twice the size of the actual forest. Use that exceeds the regeneration rate of nature is called **ecological overshoot**.

4. What is NOT counted

The results presented tend to underestimate human demand on nature and overestimate the available biocapacity by:

- choosing more optimistic bioproductivity estimates when in doubt (e.g. carbon absorption)
- excluding human demands on the biosphere for which there are insufficient data (e.g. acid rain)
- excluding those activities that systematically erode nature's capacity to regenerate, such as:
  - uses of materials for which the biosphere has no apparent significant assimilation capacity (e.g. plutonium, polychlorinated biphenyls (PCBs), dioxins, chlorofluorocarbons (CFCs))
  - processes that irreversibly damage the biosphere (e.g. species extinction, fossil-aquifer depletion, deforestation, desertification).

The national footprint and biocapacity accounts also do not directly account for freshwater use and availability, since withdrawal of a cubic metre of freshwater affects biocapacity differently depending on local conditions. Removing one cubic metre from a wet area may make little difference to the local environment, while in arid areas every cubic metre removed can directly compromise ecosystem production. Hence, water assessments require very specific data on local circumstances, and such data are not available for global comparison. The accounts reflect freshwater use and availability indirectly, however, since this affects biocapacity through changes in crop and forest yields.

For consistency and to keep the global hectares additive, each area is only counted once in Ecological Footprint and biocapacity estimates, even if an area provides two or more ecological services. Also, the accounts include the productivity of cropland at the level of current yields, with no deduction for possible degradation. If degradation takes place, however, this will be reflected as reductions in future biocapacity assessments.

Ecological Footprint calculations avoid double counting – counting the same area twice. Considering bread, for example, wheat is first farmed, then milled, baked and finally eaten. Economic data can track these sequential processes and report the amounts of materials and their financial values at each stage. However, the same wheat grain appears throughout the production process before finally ending up as human consumption. To avoid double counting, the wheat is counted at only one stage of the process, while energy consumed at each stage of the process is added to the footprint.

5. Methodology

The Ecological Footprint methodology is in constant development and continually incorporates more detail and better data as they become available. Coordination of this task is being led by the Global Footprint Network, Oakland, California. This report uses the most current national footprint and biocapacity accounts methodology, building on Monfreda et al. (2004). An electronic copy of a sample data sheet and its underlying formula along with a detailed description of the calculation methodology are available at www.footprintnetwork.org. New features in the 2004 edition include:

- a simplification of the pasture calculation that assumes full use of existing pasture areas unless livestock density is lower than half the carrying capacity of the pasture as calculated from net primary productivity estimates
- a refined calculation of CO_2 sequestration and forest productivity using FAO's Global Fibre Supply Model (FAO 2000) and complementary FAO sources
- a more complete data source for CO_2 emissions (IEA 2003)
- new data sources for built-up area (FAO/IIASA 2000, EEA 1999).

This analysis reports the footprint of consumption for nations and the world. Although, globally, the footprint of all goods and services produced must equal the footprint of all goods and services consumed, this is not the case at a national level. A nation's footprint of consumption equals that nation's footprint of production plus imports and minus exports (assuming no significant change in stocks). Domestic production is adjusted for production waste and, in the case of crops, the amount of seed necessary for growing the crops.

The footprint of consumption is computed for all countries that are represented in UN statistical data from 1961 to 2001. The analysis uses approximately 3,500 data points and 10,000 calculations per country in each year. More than 200 resource categories are included, among them cereals, timber, fishmeal and fibres. These resource uses are translated into global hectares by dividing the total amount consumed in each category by its global average yield and then multiplying by the equivalence factor for the land type that produces those resources. Biomass yields, measured in dry weight, are taken from international statistics (FAO 2004b). Equivalence factors are explained in more detail in Section 7.

Manufactured or derivative products, for example furniture or bread, are converted into parent product equivalents, in this case raw timber or wheat, for footprint calculations. For example, if 1 tonne of bread is exported, the amount of cereals and energy required to produce this tonne of bread are estimated. These quantities of primary products are then translated into a corresponding biologically productive area, then subtracted from the exporting country's footprint and added to that of the importing country.

Due to data limitations, a few categories of consumption activities, such as tourism, are attributed to the country in which they occur rather than to the consumer's country of origin. This distorts the relative size of some countries' footprints but does not affect the global result.

Table 6: THE WORLD'S LARGEST HYDRO DAMS

Aguamilpa, Mexico	Guavio, Colombia	Samuel, Brazil
Akosombo, Ghana	Guri, Venezuela	Sao Simao, Brazil
Aswan High Dam, Egypt	Ilha Solteira, Brazil	Sayanskaya, Russian Federation
Balbina, Brazil	Itaipu, Brazil and Paraguay	Sobradinho, Brazil
Brokopondo, Suriname	Jupia, Brazil	Three Gorges, China
Carbora Bassa, Mozambique	Kariba, Zimbabwe and Zambia	Três Marias, Brazil
Churchill Falls, Canada	Paredao, Brazil	Tucurui, Brazil
Curua-una, Brazil	Paulo Alfonso, Brazil	Urra I and II, Colombia
Furnas, Brazil	Pehuenche, Chile	
Grand Coulee, USA	Rio Grande II, Colombia	

Source: Goodland 1990 and WWF International 2000.

6. Area types of the Ecological Footprint and biocapacity accounts

The accounts track six main bioproductive area types. Once the human impacts are expressed in global hectares for each area type, these components are added together to obtain an aggregate footprint or biocapacity estimate.

Cropland

Crops for food, animal feed, fibre and oil require cropland, the most productive land type. The FAO estimates that there are about 1.5 billion hectares of cropland worldwide (FAO 2004b). Using FAO harvest and yield data for 74 major crops (FAO 2004), the cropland area corresponding to a given amount of crop production can be calculated. The accounts do not track possible decreases in long-term productivity due to degradation, however, as many impacts of current agricultural practices, such as topsoil erosion, salination and contamination of aquifers with agro-chemicals are not accounted for. Still, such damage will affect future bioproductivity as measured by these accounts.

Grazing land

Grazing animals for meat, hides, wool and milk requires grassland and pasture area. Worldwide, there are 3.5 billion hectares of natural and semi-natural grassland and pasture. The analysis assumes that 100 per cent of pasture is utilized, unless pasture is estimated to produce more than twice the feed requirement necessary for the grass-fed livestock. In this case, pasture demand is counted at twice the minimum area requirement. This means that the pasture footprint per unit of animal product is capped at twice the lowest possible pasture footprint per unit of animal product. This may lead to an underestimate of pasture demand since, even in low productivity grasslands, grazing animals are usually afforded full range and thus create human demand on the entire available grassland.

Diet profiles are created to determine the mix of cultivated food, cultivated grasses, fish products and grazed grasses consumed by animals in each country. Each source of animal food is charged to the respective account (crop feed to the cropland footprint, fish-based feed to the fishing area footprint, etc.). For imports and exports of animal products, the embodied cropland and pasture is used with FAO trade data (FAO 2004b) to charge animal product footprints to the country consuming the livestock products.

Forest area

Harvesting trees and gathering fuelwood require natural or plantation forests. The FAO's most recent survey

Table 7: **EQUIVALENCE FACTORS,** 2001

Area type	Equivalence factor (global ha/ha)
World average productivity	*1.00*
Primary cropland	2.19
Marginal cropland	1.80
Forest	1.38
Pasture	0.48
Marine	0.36
Inland water	0.36
Built-up land	2.19

Table 8: **SAMPLE YIELD FACTORS FOR SELECTED COUNTRIES,** 2001

	Primary cropland	Forest	Pasture	Ocean fisheries
World average yield	*1.0*	*1.0*	*1.0*	*1.0*
Algeria	0.5	0.1	0.7	0.7
Guatemala	1.0	1.4	2.9	0.2
Hungary	1.5	2.9	1.9	1.0
Japan	1.6	1.6	2.2	1.4
Jordan	0.9	0.0	0.4	0.7
Laos	0.8	0.2	2.7	1.0
New Zealand	1.8	2.4	2.5	0.2
Zambia	0.5	0.3	1.5	1.0

indicates that there are 3.9 billion hectares of forests worldwide (FAO 2003). Forest productivities are estimated using a variety of sources (FAO 1997b, FAO 2000, FAO/UNECE 2000). Consumption figures for timber and fuelwood come from FAO data as well (2004b). The footprint of fuelwood consumption is calculated using timber growth rates that are adjusted upward to reflect the fact that more forest biomass than roundwood alone is used for fuel and that less-mature forests with higher productivity can be used for fuelwood production.

The dividing line between forest areas and grasslands is not sharp. For instance, FAO has included areas with 10 per cent of tree cover in the forest categories, while in reality these may be primarily grazed. While the relative distribution between forest and grassland areas may not be precisely determined, the accounts are constructed to ensure no single area is counted in more than one category of land.

Fishing ground

Catching or harvesting fish products requires productive freshwater and marine fishing grounds. Most of the ocean's productivity is located on continental shelves, which, excluding inaccessible or unproductive waters, total 1.9 billion hectares. Although this is a only a fraction of the ocean's 36.3 billion hectare area, continental shelves provide more than 95 per cent of the marine fish catch (Postma and Zijlstra 1988). Inland waters comprise an additional 0.4 billion hectares, making 2.3 billion hectares of potential fishing grounds out of the 36.6 billion hectares of ocean and inland water that exist on the planet.

FAO fish catch figures (FAO 2004a, FAO 2002) are used to estimate demand on fishing grounds, which is compared with FAO's 'sustainable yield' figure of 93 million tonnes per year (FAO 1997a). The accounts include both fish catch for fishmeal and fish for direct human consumption. Adjustments for bycatch are added to each country's reported fish catch to account for discarded fish.

Built-up land

Infrastructure for housing, transportation and industrial production occupies built-up land. This space is the least documented, since low-resolution satellite images are not able to capture dispersed infrastructure and roads. Data from CORINE (EEA 1999), GAEZ (FAO/IIASA 2000), and GLC (JRC/GVM 2000) are used to estimate existing built-up land areas. Best estimates indicate a global total of 0.2 billion hectares of built-up land. Built-up land is assumed to have replaced cropland, as human settlements are predominantly located in the most fertile areas of a country. As such, the 0.2 billion hectares of demanded and supplied built-up land appear in the Ecological Footprint accounts as 0.44 billion global hectares.

Areas occupied by hydroelectric dams and reservoirs, used for the production of hydropower, are also counted as built-up land.

'Energy' land

Burning **fossil fuels** adds CO_2 to the atmosphere. The footprint of fossil fuel consumption is calculated by estimating the biologically productive area needed to sequester enough CO_2 to avoid any increase in atmospheric CO_2 concentration. Since the world's oceans absorb about 1.8 gigatonnes of carbon every year (IPCC 2001), only the remaining carbon emissions are counted in the Ecological Footprint. To the extent that oceanic absorption negatively impacts the productivity of marine habitats, this approach underestimates the true footprint of carbon emissions.

The current capacity of world average forests to sequester carbon is based on FAO's Global Fibre Supply Model (FAO 2000) and corrected where better data are available from other FAO sources such as FAO/UNECE 2000, FAO 1997b and FAO 2004b. Sequestration capacity changes with both the maturity and composition of forests and with shifts in bioproductivity due to higher atmospheric CO_2 levels and associated changes in temperature and water availability. Other possible methods to account for fossil fuel use result in larger footprint estimates (Wackernagel and Monfreda 2004, Dukes 2003).

Each thermal unit of **nuclear energy** is counted as equal in footprint to a unit of fossil energy. This parity was chosen to reflect the possibility of a negative long-term impact from nuclear waste.

The **hydropower** footprint is the area occupied by hydroelectric dams and reservoirs, and is calculated for each country using the average ratio of power output to inundated reservoir area for the world's 28 largest dams (Table 6).

Embodied energy is the energy used during a product's entire life cycle for manufacturing, transportation, product use and disposal. The net **embodied energy in each product category** is calculated with the COMTRADE database from the United Nations Statistical Department, classified by four-digit SITC code with 609 product categories. The energy intensities (embodied energy per unit) for each product category are drawn from a variety of sources (IVEM 1999, Hofstetter 1992).

7. Normalizing bioproductive areas

Cropland, forest, grassland and fishing grounds vary in bioproductivity. In order to produce Ecological Footprint results in a single unit, global hectares, the calculations normalize areas across nations and area types to account for differences in land and sea productivity. Equivalence factors and yield factors are used to convert the actual areas in hectares of different land types into their equivalents in global hectares. These factors are used to calculate both footprints and biocapacities.

Equivalence factors relate the average primary biomass productivities of different types of land (i.e. cropland, pasture, forest, fishing ground) to the global average primary biomass productivity of all land types in a given year. In 2001, for example, primary cropland had an equivalence factor of 2.19 (Table 7), indicating that primary cropland was more than twice as productive as a hectare of land with world average productivity. That same year, pasture had an equivalence factor of 0.48, showing that pasture was approximately half as productive as the average bioproductive hectare on Earth. Equivalence factors are calculated on a yearly basis, since the relative productivity of land-use types varies due to change in technology and resource management schemes.

Yield factors account for the difference in productivity of a given type of land across nations. For example, a hectare of pasture in New Zealand produces more meat than a hectare of pasture in Jordan. To account for these differences, the yield factor compares the production of a national hectare to a world average hectare of a given land type. Each country and each year has its own set of yield factors. For example, Table 8 shows that New Zealand's pastures are 2.5 times as productive as the world average.

To calculate the total **biocapacity** of a nation, each of the different types of bioproductive area within that nation's borders, cropland, forest area, inland fisheries, ocean fisheries, pasture and built-up land, is multiplied by the equivalence factor for that land type (the same for every country in a given year) and the yield factor for that land type (specific for each country in a given year).

These conversions produce a biocapacity or footprint in terms of **productivity adjusted area,** biologically productive area expressed in world average productivity. The unit for productivity adjusted area in the accounts is the global hectare. Worldwide, the number of biologically productive hectares and the number of global hectares are the same.

8. Natural accounting

Natural capital is the stock of natural assets that yield goods and services on a continuous basis. Major functions of natural capital include resource production (such as fish, timber or cereals), waste assimilation (such as CO_2 absorption, sewage decomposition) and life support services (UV protection, biodiversity, water cleansing, climate stabilization).

An ecological deficit is the amount by which the Ecological Footprint of a population exceeds the biocapacity of the population's territory. A national ecological deficit measures the amount by which a country's footprint exceeds its biocapacity. A national deficit can be covered either through trade or offset by the loss of national ecological capital. A global ecological deficit cannot be offset through trade, however, and leads to depletion of natural capital – a global **ecological overshoot.**

Ecological debt is the accumulated annual global deficit. Debts are expressed in planet-years, with one **planet-year** equal to the annual production of the global biosphere.

Countries with footprints smaller than their locally available biocapacity have an **ecological reserve,** the opposite of an ecological deficit. This reserve is not necessarily unused, however, but may be occupied by the footprints of other countries through production for export.

10. Contraction & Convergence and Shrink & Share

Contraction & Convergence (C&C), as proposed by Aubrey Meyer (2001) of the Global Commons Institute, provides a simple framework for globally allocating the right to emit carbon in a way that is consistent with the physical constraints of the biosphere. The approach rests on two principles:

- contraction – reducing humanity's emissions to a rate that the biosphere can absorb;
- convergence – distributing total emissions in a way that is considered fair to all.

Although C&C focuses exclusively on CO_2 emissions, which are responsible for about 50 per cent of humanity's Ecological Footprint, the C&C framework can be extended to other demands on the biosphere as measured by the Ecological Footprint.

We call this concept **Shrink & Share**. Shrinkage would occur when nations, organizations and individuals reduce their footprints so that consumption, production, investment and trade activities do not exceed the regenerative capacity of the globe's life-supporting ecosystems. Sharing occurs if these reductions are allocated in ways considered equitable by participants.

There are many ways to Shrink & Share. This approach might imply that consumption, production, investment and trade patterns change such that the per person footprints in various nations deviate less and less from each other, so that there is a more equitable distribution of the rights to use resources. Resource consumption rights could also be more closely tied to the resources a region or nation has available.

Further discussion on Shrink & Share and how this concept can support risk assessments and eco-insurance schemes can be found in Lovink et al. (2004) and in the *Living Planet Report 2004* (WWF 2004).

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Map 1

Global Footprint Network and SAGE, University of Wisconsin. Distribution builds on Gridded Population of the World (version 2) from CIESIN at Columbia University (http://sedac.ciesin.columbia.edu/plue/gpw/index.html?main.html&2. 1995 population distribution is scaled to each country's 2001 population.

Map 2

UNEP-WCMC. GIS analysis by R. Lesslie (ANU), method developed for the Australian Heritage Commission.

Maps 3, 4 and 5

Moran, D, Global Footprint Network and LUMES, Lund University.

Map 6

Global Footprint Network, 2004. *Living on Less, Living on More.* www.footprintnetwork.org

Map 7

Global Footprint Network, 2004. *Ecological Debtors and Creditors.* www.footprintnetwork.org

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WWF

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WWF is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by:
– conserving the world's biological diversity
– ensuring that the use of renewable natural resources is sustainable
– promoting the reduction of pollution and wasteful consumption.

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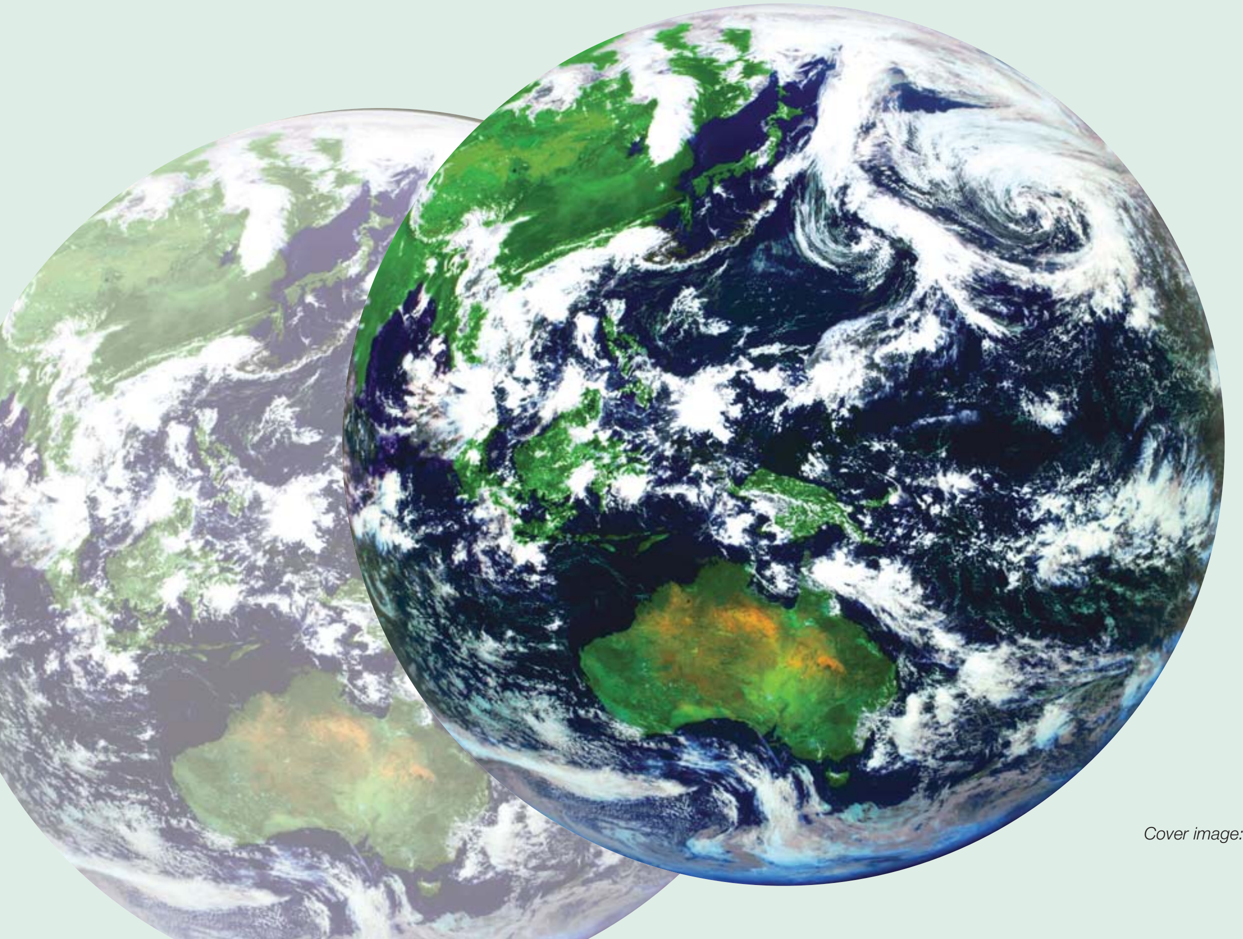

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