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AFRICA ECOLOGICAL FOOTPRINT REPORT

Green Infrastructure for Africa's Ecological Security



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FOREWORD

In response to the broader decline of the global environment, the concept of “green economy” is now evolving from being just an ideal, to a concrete and achievable approach to growth that is gathering more and more support from countries worldwide

Around the world, nature and natural resources are under more pressure than ever before – and nowhere is this more striking than in Africa. The principal driver behind Africa’s growing ecological footprint is growing consumption, driven by population increase and the robust expansion of the regional economy. The region’s per capita income has gone up and poverty rates have declined in some countries, giving rise to a growing, and increasingly urbanised, middle class. These changes are resulting in greater consumption of resources in Africa and beyond, and increasingly impact the natural environment, degrading the ecosystems that underpin the economy and sustain life itself.

Africa has choices. Embracing a more sustainable approach to development can generate benefits in terms of environmental security, human well-being and increased competitiveness. The choices made today about infrastructure, energy and food production will shape our opportunities and options far into the future.

In response to the broader decline of the global environment, the concept of “green economy” is now evolving from being just an ideal, to a concrete and achievable approach to growth that is gathering more and more support from countries worldwide.

For us the lessons and messages are clear: as the world develops, greater attention must be paid to improving the livelihoods of the poor, reducing the excessive consumption of the rich, and sustaining the natural fabric of life on

Earth. Our ecological infrastructure – terrestrial, freshwater and marine ecosystems and biodiversity – is as essential to inclusive human development and improved quality of life as are industrial and social infrastructures such as roads, schools, hospitals and energy provision.

Investment in natural capital can help drive the development of a green economy and secure ecosystem services on which we all depend. These services provide food, water and energy, support our livelihoods, and help us stay resilient to the uncertain conditions of a changing climate.

In Africa the sustainable use of natural resources needs to be mainstreamed in economic

development. Governments and businesses need to make green economies a reality, and excellent initiatives have already been started both by individual countries and by regional groups. Making economies more efficient in terms of how they use resources and invest in new technologies and innovation will help these initiatives further. With their relatively low footprints, African countries, their governments, business leaders and investors need to show ever greater leadership if the continent’s natural resources are to be used sustainably.

This report presents examples of solutions that promote the creation of wealth and alleviation of poverty through more sustainable management of the natural capital of the continent. These strategies focus on reducing the detrimental effect of human consumption on the Earth’s resources;

maintaining natural capital with additional and targeted investment; and highlighting the very real socio-economic benefits brought by investment in natural capital and natural resource management. We are proud to share some of our experiences on sustainable development in the run up to Rio+20 and especially thank the Government of Brazil for supporting production of this joint report.

The African Development Bank and WWF, together with their partners, are committed to supporting countries in Africa in transitioning towards a future of sustainable development – with healthy people thriving on a healthy planet.



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Donald Kaberuka
President
African Development
Bank



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Jim Leape
Director General
WWF International



Children walking near the forest landscape restoration nursery in Kasese District, Rwenzori Mountains, Uganda

INTRODUCTION

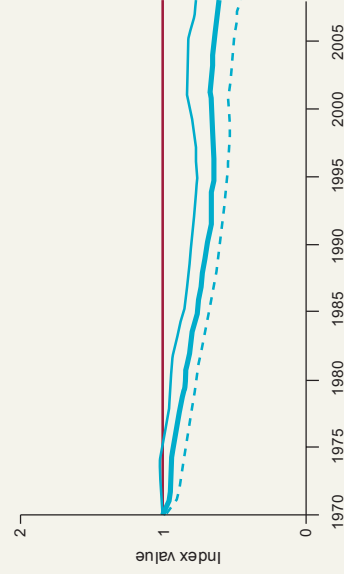
Fundamentally we all depend on nature: the ecological infrastructure of the planet that provides the flow of goods and services upon which our livelihoods and economies are built.

Yet Africa's ecosystems are changing faster than ever before through the combined impact of global and local pressures. Loss of ecosystem services is compromising future security, health and well-being and effects are being borne disproportionately by the poor.

The Living Planet Index reflects the state of the planet's ecosystems. Published for the first time in this volume, the Africa Living Planet Index (Figure 1) shows a reduction of 39 per cent in

Figure 1. Africa's Living Planet Index (1970 – 2008).

The final index value indicates there has been an overall reduction of 39 per cent in animal populations over the 38-year period (WWF/ZSL, 2012)



animal populations over the 38 year period between 1970 and 2008.

Much of the pressure on ecosystems can be traced to humanity's voracious demand for goods and services which is now exceeding the planet's capacity to regenerate resources and absorb the wastes we produce. Humanity's demand on the world's living resources, its Ecological Footprint, has more than doubled since 1961 and now overshoots the planet's regenerative capacity – or biocapacity – by about 50 per cent.

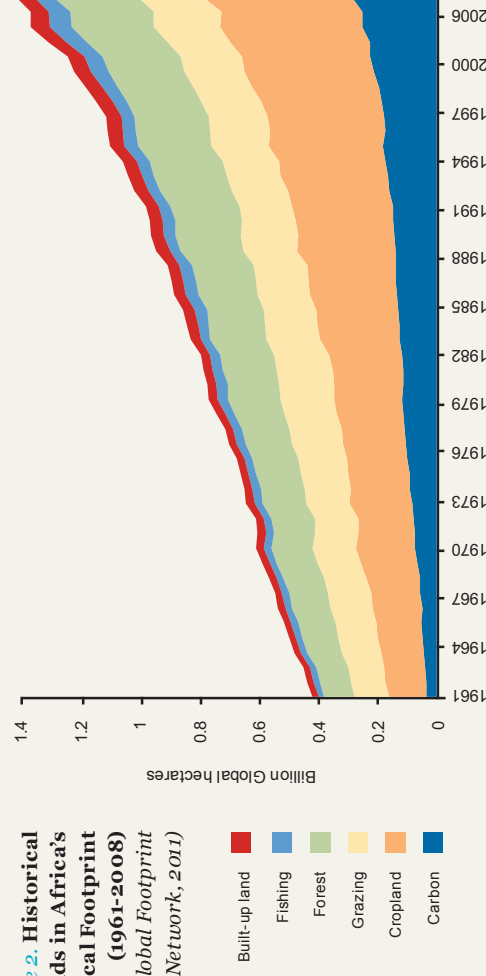
The Ecological Footprint of all African countries increased by 240 per cent between 1961 and 2008 (Figure 2) as a result of growing populations as well as increased per capita consumption in a minority of countries.

The average per capita footprint in Africa in 2008 is rapidly approaching the available biocapacity within Africa's borders of 1.5 global hectares per person.

Looking ahead, Africa as a whole is projected to be in biocapacity deficit, where its footprint exceeds the biocapacity available within its borders, by 2015. Already today, nearly 400 million people living in Africa's 36 largest river basins experience water scarcity for at least one month each year. Many African countries compensate for biocapacity and water shortfalls by importing goods and services from elsewhere.

The combined measures of Ecological Footprint, Water Footprint and Living Planet Index show us that Africa is now at a crossroad in terms of

Figure 2. Historical trends in Africa's Ecological Footprint (1961-2008)
(Global Footprint Network, 2011)



STEADY ADVANCES IN HUMAN DEVELOPMENT IN SUB-SAHARAN AFRICA COULD STALL AND EVEN REVERSE – UNLESS BOLD STEPS ARE TAKEN TO REDUCE ENVIRONMENTAL RISKS AND INEQUALITIES IN THE REGION AND AROUND THE WORLD (UNDP, 2011)

its development options. Pursuing the resource-intensive pathways taken by other parts of the world will accelerate its path to biocapacity deficit, with associated environmental degradation. However, with its relatively low per capita footprint, Africa is well placed to develop more resource efficient pathways than those seen in other regions, using known and cost effective technologies.

Pursuing a more sustainable approach to development than those taken elsewhere can generate benefits in terms of environmental security, human well-being and increased competitiveness. In this report we explore a two-fold path to sustainable development on Africa, identifying options to reduce growth in Ecological Footprint and to protect and restore Africa's ecosystems.

Arid vegetation, trees under heavy sky in the Sahel Zone, Niger



New perspectives

Hailed by President Goodluck as “another milestone in our nation’s effort to solve national problems through space technology”, Nigeria’s June 2011 launch of two Earth observation satellites will enrich our understanding of climate change and human vulnerability in the Sahel, one of Africa’s most sensitive regions. In a year in which drought has wreaked havoc across the Sahel, this effort to reinforce our understanding of the forces shaping Africa’s fragile environment could not have been timelier.

1

ECOLOGICAL WEALTH AND HUMAN PROSPERITY

INTRODUCTION

Without ecosystems, there would be no life. Ecosystems provide the food we eat and the materials we use for shelter and fuel, and they ensure the quality of the air we breathe and the water we drink. Yet in Africa and around the world we are seeing an unprecedented decline in the state of our environment as a result of humanity's escalating demand for natural resources. Erosion of natural capital is endangering our future prosperity and undermining efforts to enable Africa's growing population to move out of poverty.

In the following pages we examine the nature of and trends in the demands humanity is placing on renewable resources globally and in Africa using the complementary measures of Ecological Footprint and Water Footprint. We look at the ecosystem services that underpin human livelihoods and well-being, and explore how these are being degraded as a result of human pressures – using the Living Planet Index as a measure to reflect changes in the health of our ecosystems. We identify some key factors and drivers that are shaping our demand for renewable resources and identify opportunities to manage these in order to improve the sustainability of development in Africa.



1.1 INTRODUCING THE ECOLOGICAL FOOTPRINT

The Ecological Footprint shows humanity's competing demands on the biosphere by comparing the renewable resources people are consuming to the regenerative capacity of the planet – or biocapacity.

1.5
IN 2008 WE USED
THE EQUIVALENT
OF 1.5 EARTHS
TO SUPPORT OUR
CONSUMPTION



The Ecological Footprint measures the amount of biologically productive land and water area required to produce all of the resources an individual, population, or activity consumes, and to sequester the carbon dioxide they generate, given prevailing technology and resource management practices. This area can be compared with biological capacity or biocapacity; the amount of productive area that is available to generate these resources and to absorb wastes.

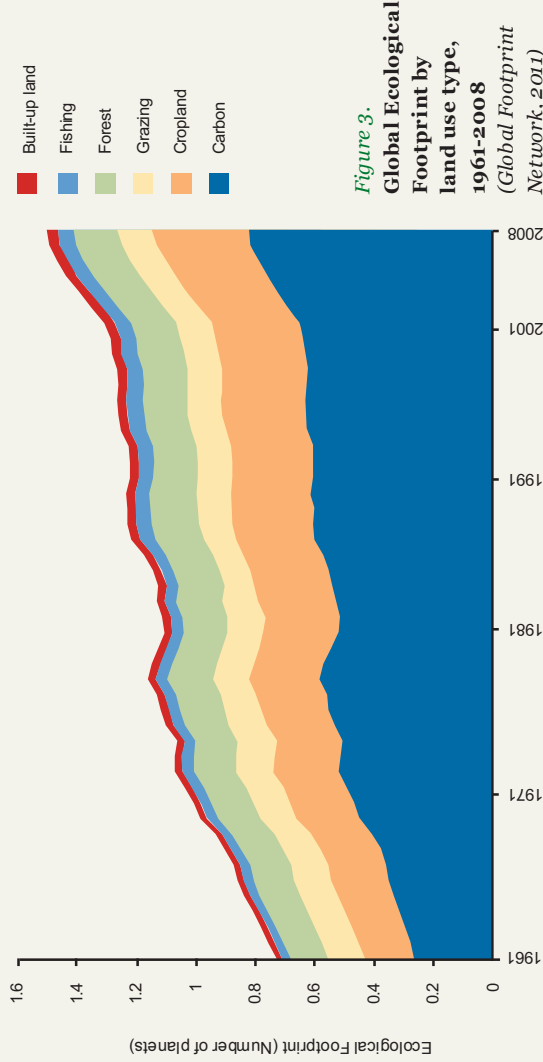
In 2008, the total productive area, or biocapacity, of the planet was 12.0 billion global hectares (gha) or 1.8 gha per capita. Humanity had an Ecological Footprint of 18.2 billion gha, equivalent to 2.7 gha per capita.

This overshoot of approximately 50 per cent means that in 2008 we used the equivalent of 1.5 Earths to support our consumption, or in other words, it would have taken the Earth

approximately a year and a half to regenerate the resources used by humanity in that year. This means that in order to sustain humanity's current pattern of lifestyles we drawing on resources at a faster rate than they can be renewed and eating into our ecological reserves.

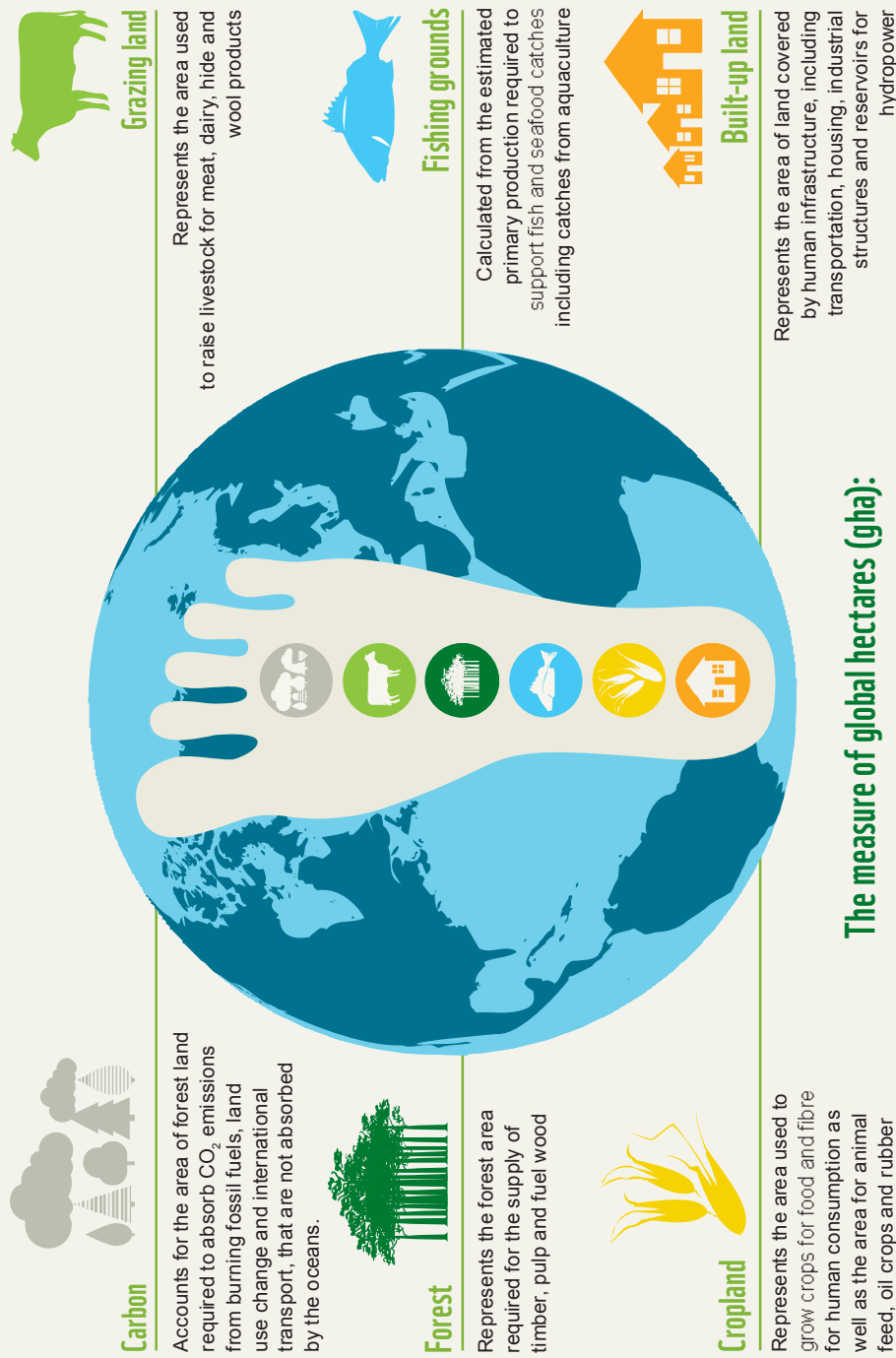
Ecological Footprints vary enormously among individuals and countries, and reflects different consumption patterns and lifestyles. If everybody on the planet lived the lifestyle of the average citizen of the United Arab Emirates, then in 2008 we would have needed more than four and a half planets to support the global population.

Exploring the Ecological Footprint provides an understanding of how the Ecological Footprint is made up of land use components – and how these relate to human demands on the biosphere. It provides an understanding the concept of global hectares (gha)



EXPLORING THE ECOLOGICAL FOOTPRINT

Figure 4.
Components of
Footprint



1.2 AFRICA ECOLOGICAL FOOTPRINT OF NATIONS

Africa's total footprint in 2008 was 1.41 billion gha or 7.7 per cent of humanity's total footprint. This is equivalent to an average per capita Footprint of 1.4 gha.

The footprint of many African citizens reflects a level of consumption that is insufficient to meet their needs

Although this is far lower than the global average per capita footprint of 2.7 gha, it is close to the globally available biocapacity of 1.8 gha per person and is rapidly approaching the biocapacity available within Africa's borders.

Mauritius has the highest per capita footprint at 4.6 gha and, together with Libya, Mauritania and Botswana, is one of four countries with an average per capita Ecological Footprint greater than the global average. Ten of the 45 countries

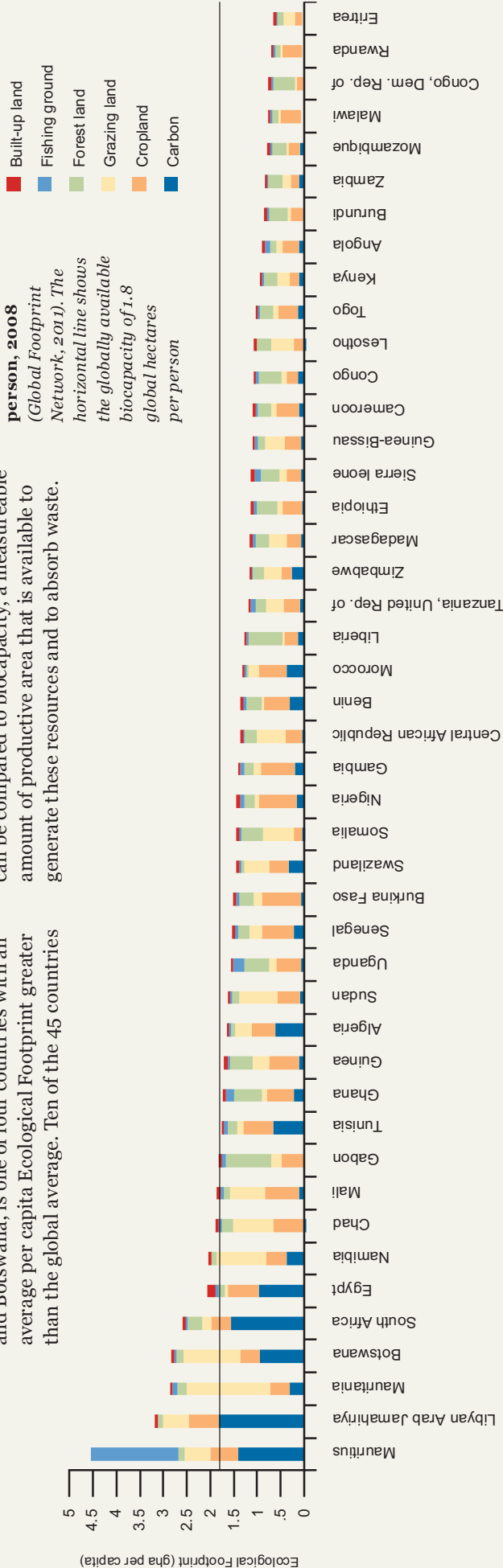
shown in Figure 5 have an Ecological Footprint greater than the global per capita available biocapacity of 1.8 gha. In 2008, Eritrea had the lowest per capita footprint at 0.7 gha.

As well as variation in average per capita footprint amongst countries, there is also considerable variation amongst individuals within countries. The footprint of many African citizens reflects a level of consumption that is insufficient to meet their needs.

The Ecological Footprint, as a measure of a population's utilization of renewable resources, can be compared to biocapacity, a measureable amount of productive area that is available to generate these resources and to absorb waste.

4.6 GHA
MAURITIUS HAS
THE HIGHEST PER
CAPITA FOOTPRINT
IN AFRICA AT 4.6 GHA

Figure 5. Ecological Footprint per country, per person, 2008 (Global Footprint Network, 2011). The horizontal line shows the globally available biocapacity of 1.8 global hectares per person



1.2 AFRICA'S BIOCAPACITY

The biocapacity of an area, country or region is a function of its bioproductive area and of the productivity of that area. Africa comprises 2,960 million hectares of land, of which 1,873 million hectares are bioproductive or used as built-up land. Of this bioproductive land area, 681 million hectares are forested, 251 million are cropland, and 909 million are grasslands. Africa has 192 million hectares of fishing grounds encompassing its continental shelf and inland waters.

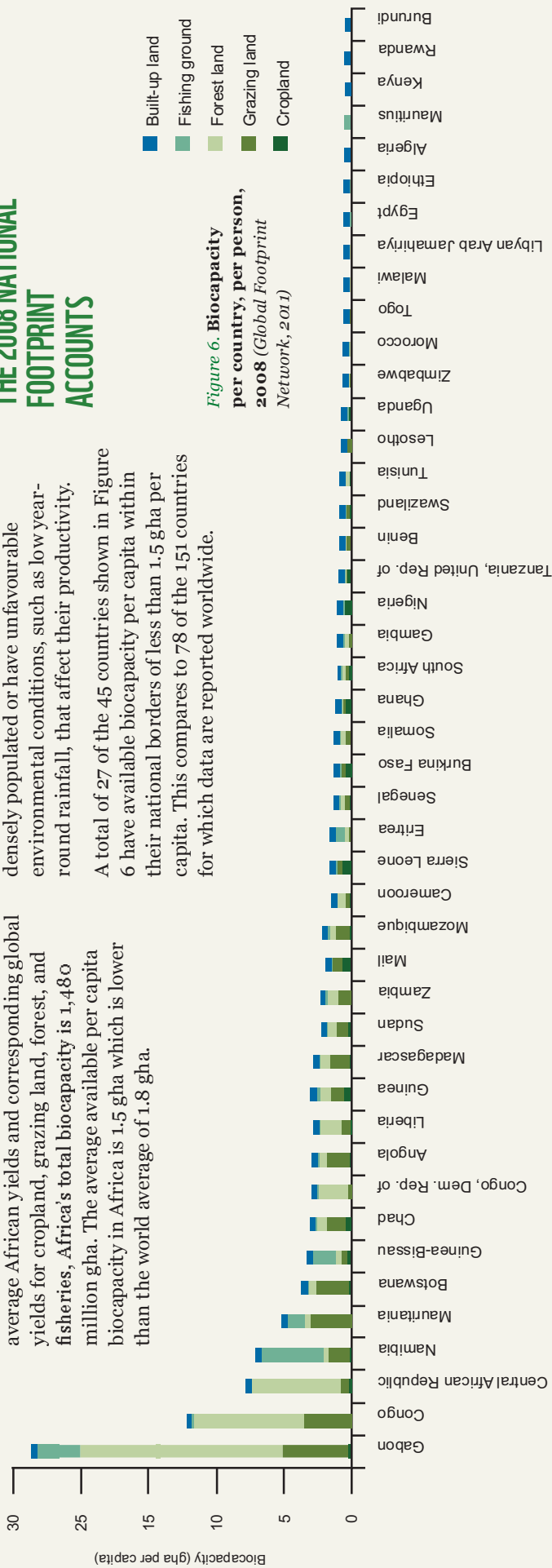
Taking into account differences between average African yields and corresponding global yields for cropland, grazing land, forest, and fisheries, Africa's total biocapacity is 1,480 million gha. The average available per capita biocapacity in Africa is 1.5 gha which is lower than the world average of 1.8 gha.

The biocapacity profiles of African countries differ significantly. Figure 6 illustrates that nations with high per capita biocapacity such as the Republic of Congo and Central African Republic have a profile dominated by forest areas. Gabon – the country with the highest biocapacity on a per person basis – also has major fishing grounds and grazing lands. Grazing land makes a significant contribution in other biocapacity leaders like Mauritania and Botswana while fishing grounds predominate in Namibia.

At the other end of the scale, countries with lowest per capita biocapacity are often relatively densely populated or have unfavourable environmental conditions, such as low year-round rainfall, that affect their productivity.

A total of 27 of the 45 countries shown in Figure 6 have available biocapacity per capita within their national borders of less than 1.5 gha per capita. This compares to 78 of the 151 countries for which data are reported worldwide.

2,960
AFRICA COMPRISES
2,960 MILLION
HECTARES OF LAND,
1,873 MILLION
OF WHICH ARE
COUNTED AS
BIOPRODUCTIVE IN
THE 2008 NATIONAL
FOOTPRINT
ACCOUNTS



1.3 FOOTPRINT HAS CHANGED OVER TIME

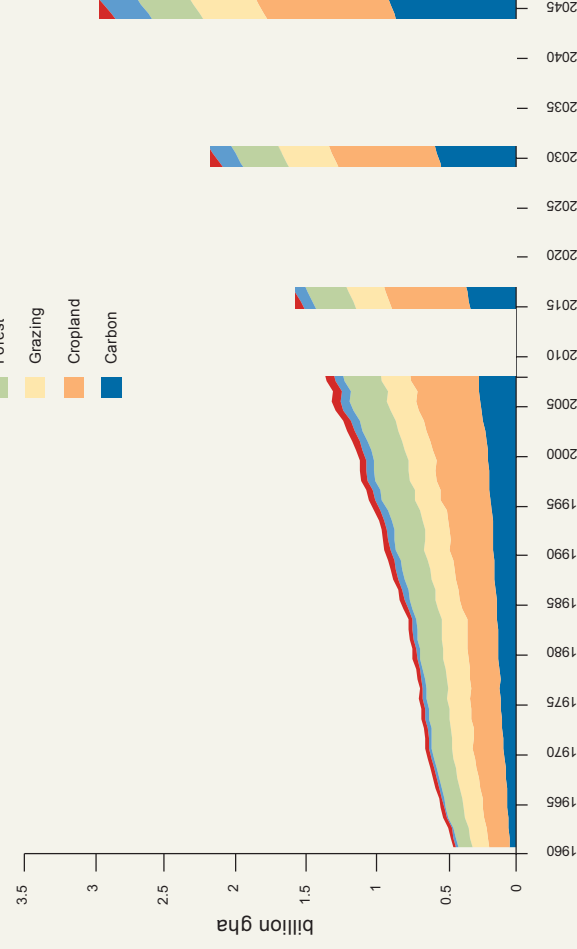
Humanity's Ecological Footprint more than doubled between 1961 and 2008, taking the world as a whole into ecological overshoot in the early 1970s.

EVEN THOUGH BIOCAPACITY AVAILABILITY IN AFRICA HAS INCREASED IN ABSOLUTE TERMS, THE AVAILABLE PER CAPITA BIOCAPACITY HAS DECLINED LARGELY DUE TO POPULATION INCREASE

Figure 7 shows how Africa's demand for goods and services has changed between 1961 and 2008, and how it is projected to change between 2008 and 2050 based on a "business as usual" scenario. The figure draws attention to both the ongoing growth in Ecological Footprint and the change in the composition of Ecological Footprint.

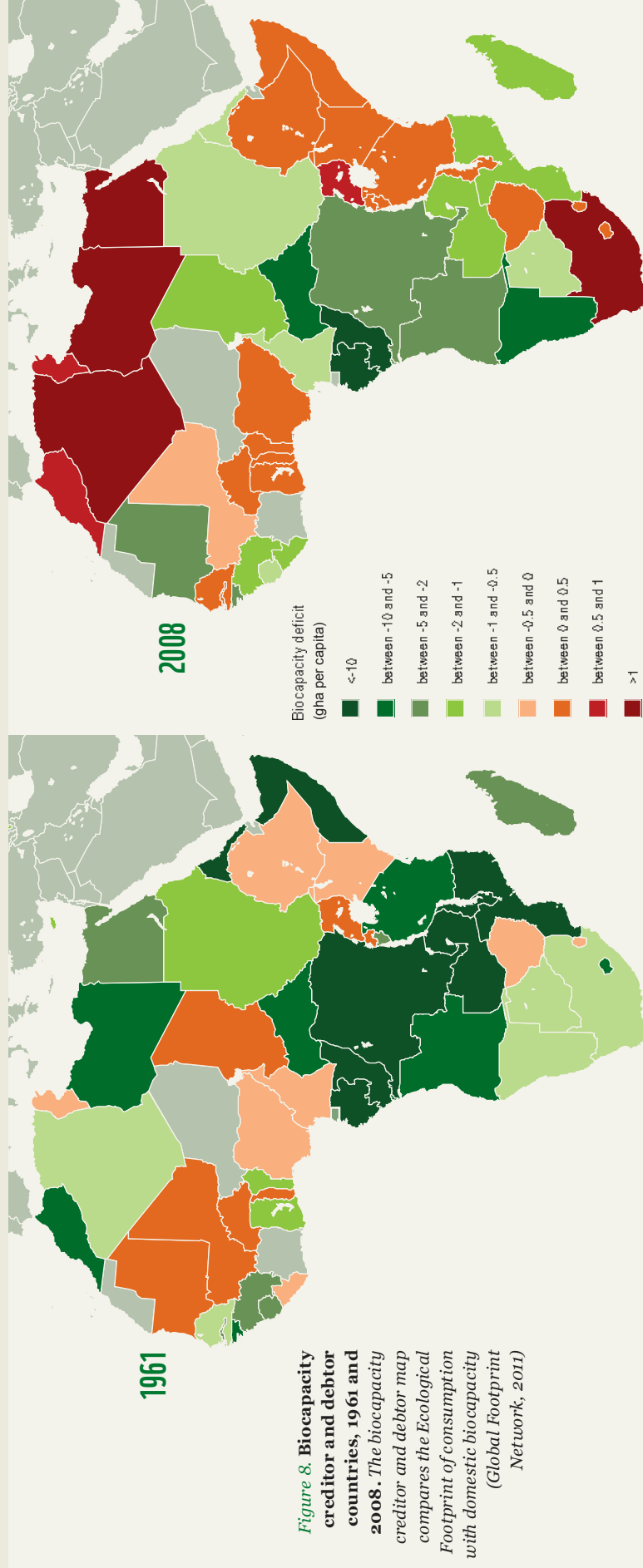
The Ecological Footprint of all African countries taken together increased by 238 per cent between 1961 and 2008. This increase is largely a result of population increase over the same period. The average per capita footprint on Africa has actually declined by about 5 per cent over the same period, while in all other regions of the world it has increased.

Figure 7. Historical trends in footprint by land use type (1961-2008) showing "business as usual" projections for 2015, 2030, and 2045 (billion gha) (Global Footprint Network, 2011)



The small reduction in per capita footprint masks an increase of 122 per cent in the per capita carbon footprint, representing an eight-fold increase in Africa's overall carbon footprint between 1961 and 2008. Carbon now accounts for 20 per cent of Africa's Ecological Footprint compared to a global average of 55 per cent. The per capita cropland footprint increased by 15 per cent, representing a four-fold increase in Africa's total cropland footprint. Cropland accounts for 35 per cent

of Africa's Ecological Footprint compared to 22 per cent globally. Looking ahead and assuming that growth is not curbed by resource constraints, Africa's total Ecological Footprint is projected to double by 2040. Based on 2008 bioproductivity values, Africa as a whole is projected to be in biocapacity deficit where its footprint exceeds the biocapacity available within its borders, by 2015.



30% TOTAL BIOCAPACITY IN AFRICA HAS INCREASED BY ABOUT 30 PER CENT BETWEEN 1961 AND 2008

Several countries in Africa like many elsewhere in the world are already “biocapacity debtors” – countries whose consumption patterns cannot be supported by their internal biocapacity.

Africa has experienced an increase in total biocapacity of about 30 per cent between 1961 and 2008, mainly as a result of increased agricultural production. However, these production gains have not kept pace with increasing demand and available per capita biocapacity has declined by dramatically over

the same period – to just 37 per cent of its 1961 value.

Of the 45 countries for which data was available, 25 had a biocapacity deficit in 2008, compared to just seven in 1961. Africa’s 20 biocapacity creditors have also seen a sharp reduction in the gap between available biocapacity and Ecological Footprint.

A total of 37 countries in Africa have a cropland deficit where their consumption of crop-based biocapacity exceeds their domestic production. 24 have a forest land deficit; 17 have a grazing land deficit; and 15 have a fishing ground deficit.

Some countries and regions compensate for biocapacity shortfalls by importing goods and services from elsewhere. However, in a context of global overshoot, natural resources in many countries are being depleted and the environment is degraded as a result of over-extraction.

1.4 TRADE AND ECOLOGICAL SECURITY

Biocapacity debtor and creditor countries alike are increasingly relying on international trade to support their consumption patterns and preferences.

Trade data allow us to explore to what extent Africa is dependent on imported biocapacity to support its consumption patterns and whether demand placed on Africa's resources by other countries is contributing to ecological deficits

Globally, the footprint of goods and services traded between nations represented more than 40 per cent of humanity's total Footprint in 2005, compared to 8 per cent in 1961 (WWF, 2008). Africa's biocapacity imports and exports have both increased substantially since 1961 (Figure 9).

At the regional level, Africa has been a net importer of biocapacity since the mid-1970s and by 2008, biocapacity imports of an average of 0.29 gha per person were more than twice the magnitude of exports of 0.14 gha per person. At 0.15gha per person, Africa's net biocapacity of imports totaled 145 million gha in 2008 and were equivalent to 10.3 per cent of its total Ecological Footprint.

Biocapacity imports and exports have both experienced growth in Southern and Central Africa with imports gradually catching up with exports between 1961 and 2008. In contrast, a roughly ten-fold increase in imports by East and North Africa over the same period means imports

have substantially outstripped exports; a trend that has accelerated in the 21st century. West Africa has also seen imports outpace exports particularly in the first decade of this century.

Figure 10 shows a breakdown by land use component of biocapacity imports and exports for each sub-region. Cropland accounts for the largest share of Africa's net biocapacity imports and totaled a massive 53.5 million gha in 2008, with the majority of imports destined for North Africa where water scarcity limits crop production. Importing substantial embodied carbon and grazing land imports, North Africa accounted for two-thirds of Africa's net biocapacity imports in 2008. Ranking second in total net imports, West Africa's net imports included 18 million gha of embodied carbon and a similar amount in fish products. The latter reflects a deliberate strategy by major importers such as Nigeria, Ghana and Côte d'Ivoire to enhance protein supply by exporting fish with a high market value and importing larger quantities with a lower market value. In contrast, the Southern Africa sub-region is a net exporter of biocapacity with exports of carbon, forest and fish products exceeding imports.

This information is based on official trade statistics and probably underestimates the extent to which other countries are drawing on Africa's biocapacity. For example, illegal, unreported and unregulated (IUU) fishing in Africa's waters was estimated in 2005 to represent a cost of almost US\$1 billion dollars a year (MRAG, 2005) equivalent to over 25 per cent of the value of Africa's fish exports in 2005. Illegal timber extraction and trade is also costing African countries many millions of dollars each year.

From a strategic perspective, importing embedded footprint through trade can help individual countries facing biocapacity deficit to meet their demand for goods and services without drawing down their natural capital, or experiencing local effects of overshoot. Three biocapacity debtor countries – Gambia, Senegal, and Somalia – have net imports that exceed their biocapacity deficit, and many other countries are using imports to meet shortfalls in particular biocapacity components. However, this dependence on other countries to meet consumption patterns is increasingly risky in a resource-constrained world – particularly where commodity prices are volatile and subject to increased speculation.



GIVEN THE SHARPLY RISING DEMAND FOR FOOD AND WATER BY AFRICA'S RAPIDLY GROWING POPULATIONS, THE WISDOM OF SELLING OFF AGRICULTURAL AND FRESHWATER RESOURCES TO SATISFY FOOD SECURITY ELSEWHERE IN THE WORLD IS A MATTER THAT MAY NEED CAREFUL RECONSIDERATION (UN HABITAT AND UNEP, 2010)

Conversely, export of goods and services places additional demand on renewable resources that many countries can ill-afford to spare. Only two of Africa's 25 biocapacity debtors – South Africa and Swaziland – are currently net exporters of biocapacity, but in the face of growing domestic and international demand for goods and services, the trade-off between generating revenues from exports and meeting local demand will become increasingly acute in the coming decades.

Commercial land leasing, or "land grabs", represent another way by which countries can appropriate biocapacity and associated water resources from other parts of the world, often with long-term obligations. The High Level Panel of Experts on Food Security and Nutrition (HLPE, 2011) reported that two-thirds of the estimated 50–80 million hectares acquired as investments in recent years are in sub-Saharan Africa. Other studies place this as high as 134 million ha in the decade to 2010 (Anseeuw et al., 2012), a figure that can be compared to the 251 million ha of cropland exploited in 2008. Much of this land remains underdeveloped and related exports are not yet reflected in trade statistics.

Figure 9.
Biocapacity imports and exports (1961–2008) for Africa. 40 of the 45 reported countries were net biocapacity importers in 2008.
(Global Footprint Network, 2011)

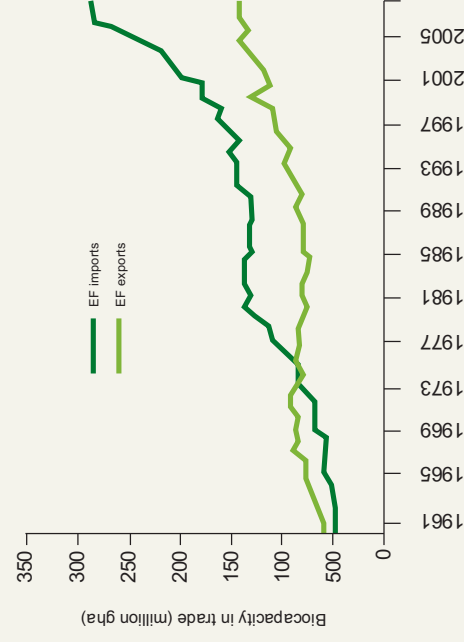
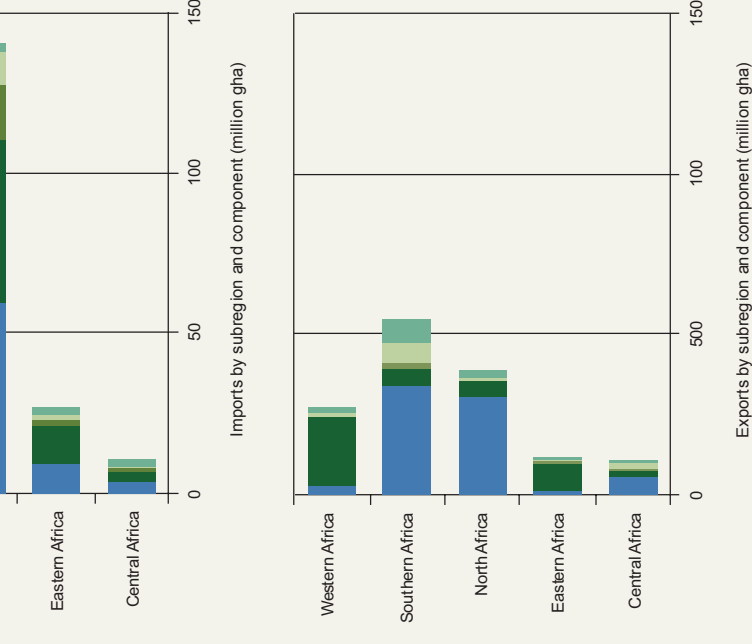


Figure 10.
Biocapacity imports and exports by sub-region, 2008 (Global Footprint Network, 2011)



Although water availability is vital to bioproductivity, its use is not measured directly in the Ecological Footprint accounts.

the variation between countries is accounted for by differences in water use in agricultural products. This reflects differences in diet as well as in the origin of goods being consumed – since water intensity in crop production varies greatly between countries.

as in the origin of goods being consumed – since water intensity in crop production varies greatly between countries.



EXPLORING THE WATER FOOTPRINT

The calculation of Water Footprint is based on the Water Footprint of Production or the volume of freshwater used by people to produce goods, as the water used in the full supply chain, as well as specified geographically and temporally. It has three components:

- **Green Water Footprint:** The volume of rainwater that evaporates during the production of goods; for agricultural products, this is the rainwater stored in soil that evaporates from crop fields.

- **Blue Water Footprint:** The volume of freshwater withdrawn from surface or ground water sources that is used by people and not returned: in agricultural products this is mainly accounted for by evaporation of irrigation water from fields.

- **Grey Water Footprint:** The volume of water required to dilute pollutants released in production processes to such an extent that the quality of the ambient water remains above agreed water quality standards.

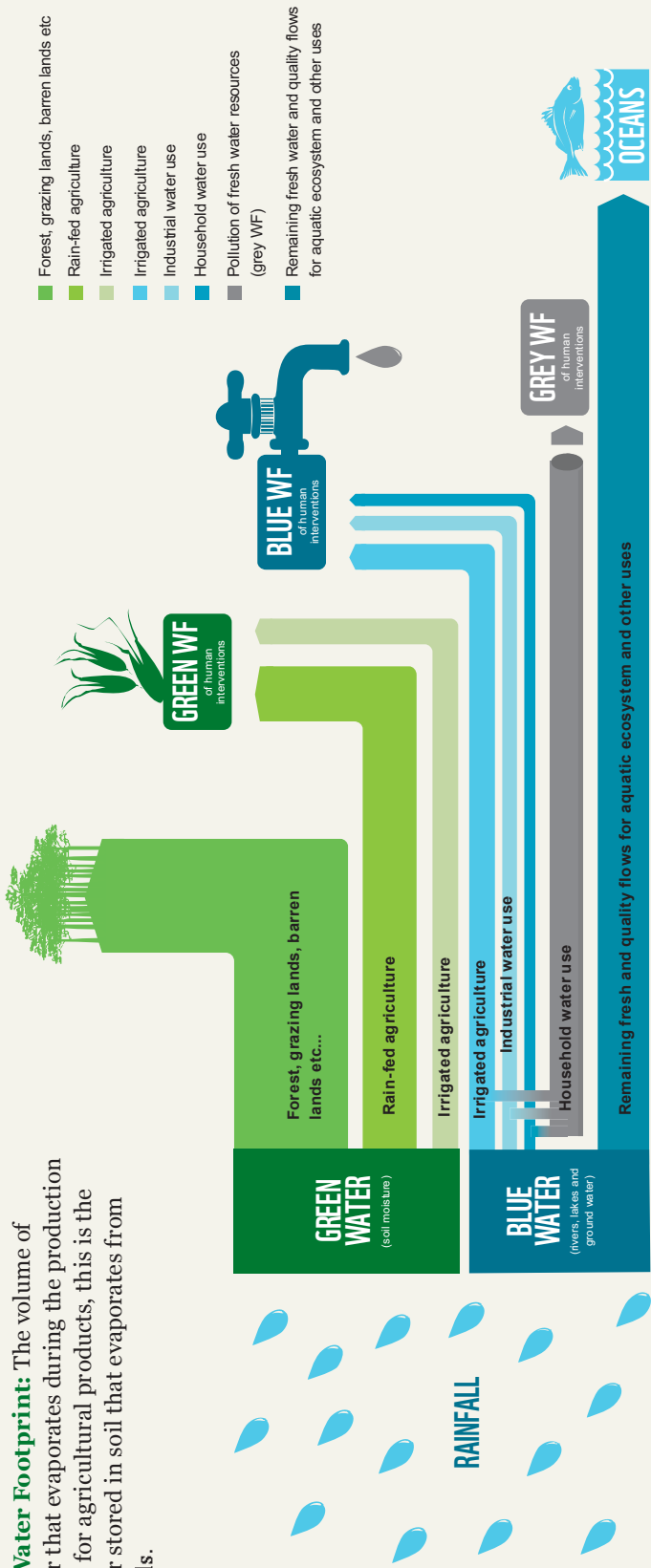


Figure 12. Components of the Water Footprint

1.7 WATER FOOTPRINT OF PRODUCTION

In a context of increasing competition for water resources, understanding the nature of water use provides a basis for effective water management and allocations.

The Water Footprint of Production allows us to look at the water being used by agriculture, industry and households in a given country or region – irrespective of where the resulting goods or services are consumed (Figure 13). Agriculture takes the largest share of water use in Africa, accounting for 97.5 per cent of water use. Industrial production uses 0.7 per cent of water, and domestic water uses 1.7 per cent.

A total of 91 per cent of water use in agriculture comprises “green water”, or soil moisture, which

is supplied by rainfall. At the same time there is substantial uncertainty around the effects of climate changes on precipitation and run-off in Africa. The Intergovernmental Panel on Climate Change (Bates et al, 2008) suggests it is likely that there will be an increase in the number of people experiencing water stress on an annual basis in southern and northern Africa, and a reduction in eastern and western Africa.

Blue water use in irrigation accounts for 32 per cent of agricultural water used in North Africa compared to just three per cent in sub-Saharan Africa – where just a handful of countries are utilizing extensive irrigation. With demand representing over 40 per cent of blue water supply (measured as internally renewable resources), the populations of the five North African countries

included in Figure 15, as well as Sudan, are facing acute water scarcity. South Africa and Mauritius are experiencing moderate water stress where blue water demand exceeds 20 per cent of supply.

Elsewhere in Africa year-round pressure on blue water resources remains low, suggesting there is potential to increase irrigation in suitable areas without seriously impacting downstream users and ecosystems. However, with increasingly erratic rainfall, efficient irrigation as well as strategies to optimize use of green water resources will both be required to ensure food security.

Figure 13. Blue, Green and Grey Water Footprints of Production in million cubic meters per year (average for the period 1996-2005)



WATER SCARCITY

Water availability varies on a seasonal basis in many river basins, and extracting water during periods of low flow can deprive downstream users of their livelihoods and damage or even destroy downstream ecosystems. Determining whether water withdrawals and demand for water uses are competing and likely to impact ecosystem services requires looking beyond the traditional measures of water scarcity to consider water availability on a year-round basis within individual basins.

A recent analysis by the Water Footprint Network, The Nature Conservancy and WWF (Hoekstra et al., 2012) analysed where and when blue water footprint exceeds blue water availability in the world's major river basins after setting aside a conservative allowance to ensure for environmental flows. The results (Figure 14) show that nine of Africa's eleven largest river basins (over 200,000 km²) experience blue water scarcity during at least one month of the year.

More northerly basins like the Senegal, Volta, Niger, Lake Chad, Nile and Shebelle suffer severe blue water scarcity in February or March due to low run-off while in other months scarcity is less serious. In the Orange and Limpopo River basins, water scarcity occurs in September and October, the period when the blue water extraction is highest while run-off is lowest.

These results underscore the importance of planning water allocations for irrigation and other purposes on a monthly rather than annual basis – in order to minimize conflicts between different water users and avoid major or irreversible changes in ecosystem structure and function.

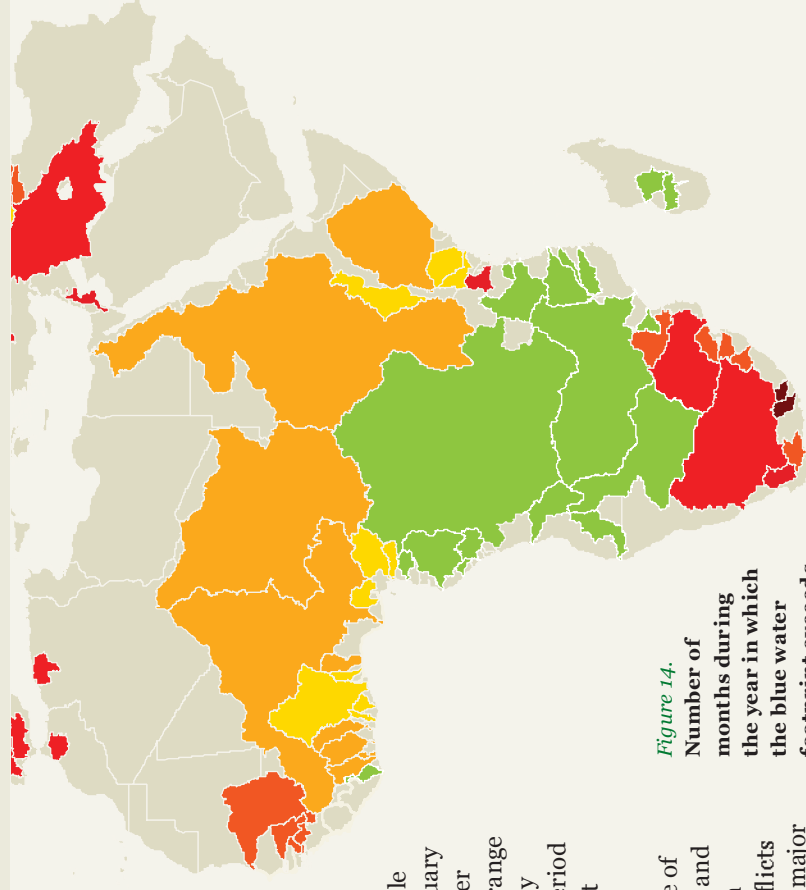


Figure 14.
Number of months during the year in which the blue water footprint exceeds blue water availability for Africa's major river basins, based on the period of 1996-2005. Some of these basins are in arid areas while others experience water scarcity because a significant quality of water is channelled into agriculture (Hoekstra et al., 2012)

GLOBALLY, WATER SCARCITY IMPACTS AT LEAST 2.7 BILLION PEOPLE IN 201 RIVER BASINS FOR AT LEAST ONE MONTH EACH YEAR (HOEKSTRA ET AL, 2012)

1.8 WATER AND TRADE

International trade statistics combined with Water Footprint data can be used to calculate the volume of embodied or virtual water used in trade.

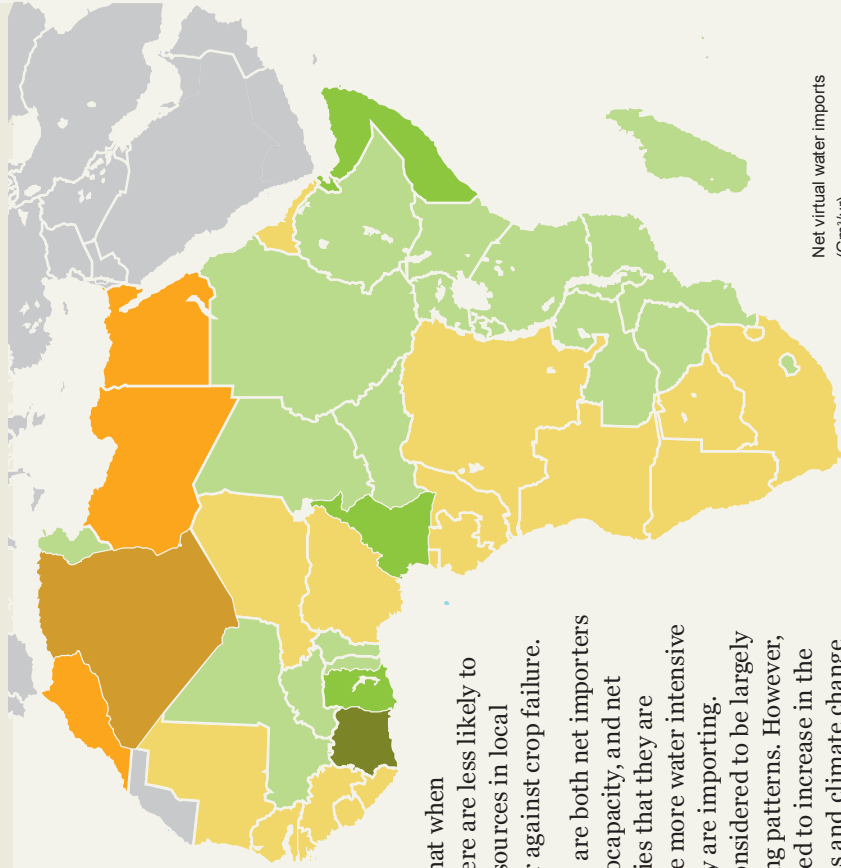
27 COUNTRIES IN AFRICA WERE NET IMPORTERS OF WATER OVER THE PERIOD 1996-2005



Figure 15 shows the “virtual water balance” of African countries over the period 1996 to 2005. Countries shown in red are net importers of virtual water, where imports exceed exports, while those in green are net water exporters. Agricultural products account for the largest share of virtual water globally, and it is not surprising to see that North and Southern Africa – the two sub-regions that import substantial large quantities of virtual water. Hoekstra and Mekonnen (2012) suggest that in water-scarce countries, import of virtual water is likely to have positive environmental, social and economic implications.

However relying on the water resources of other nations to meet their own domestic needs can also be viewed as a risk. D’Odorico et al. (2010) have argued that globalization of water resources through trade has reduced societal resilience to drought-induced crop failure since virtual water imports have allowed growth in dryland

populations. This means that when drought is experienced, there are less likely to be under-utilized water resources in local systems to provide a buffer against crop failure. Several countries in Africa are both net importers of cropland and grazing biocapacity, and net water exporters. This implies that they are exporting products that are more water intensive to produce, than those they are importing. Trade in virtual water is considered to be largely incidental in current trading patterns. However, as water scarcity is predicted to increase in the face of growing populations and climate change in Africa and around the world, water-wise trade can be expected to increasingly define the trade patterns of the 21st century.



Net virtual water imports (Gm³/yr)

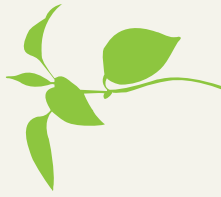
Figure 15. Virtual water balance for African countries related to trade in agricultural and industrial products, over the period 1996-2005 (Mekonnen and Hoekstra, 2011)

- between -35 and -15
- between -15 and -5
- between -5 and 0
- between 0 and 5
- between 5 and 10
- between 10 and 15
- between 15 and 50
- between 50 and 115
- No data

The countries shown in green have a negative balance, which means that they have net virtual water export. The countries shown in yellow to red are net importers of virtual water

700,000

700,000 TREES PLANTED TO REPLENISH BARE HILLS IN RWENZORI MOUNTAINS IN UGANDA



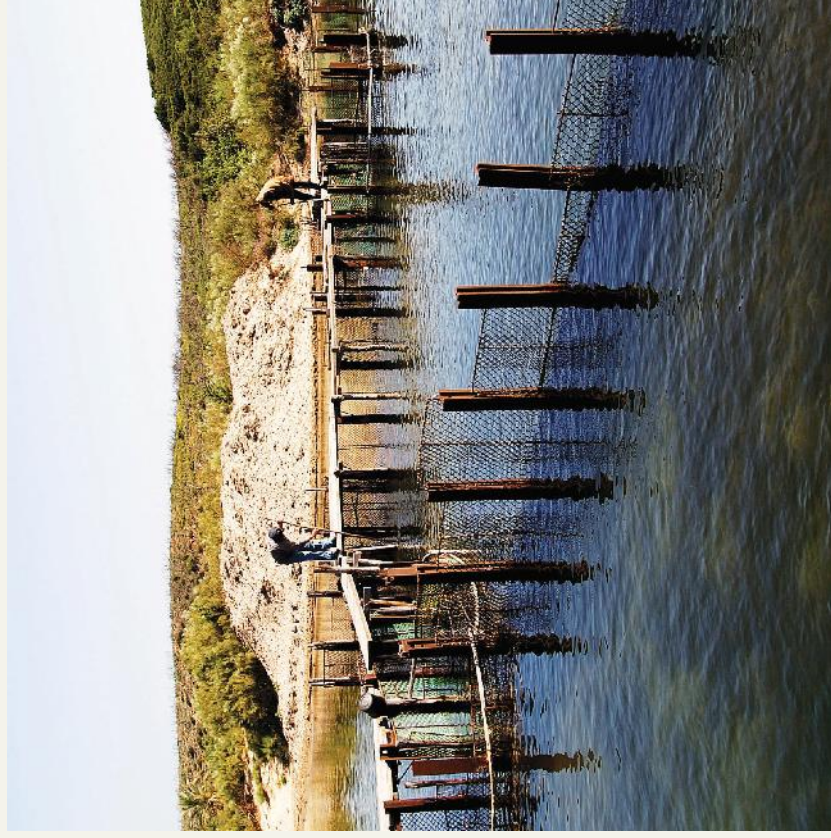
© WWF-Canon / Simon Rawles

Rwenzori Mountains, Uganda. WWF has helped 574 farmers in the region plant 700,000 trees in its 5-year programme to replenish the bare hills.

Many farmers in the region are switching to “drought-resistant” crops that include pineapple, mangoes, bananas, oranges and upland rice

1.9 ECOLOGICAL INFRASTRUCTURE AS THE BASIS FOR LIFE

Without ecosystems and the services they provide – such as water purification, climate regulation, and primary productivity – the Earth would be uninhabitable.



Fish farming in Mellah Lake, El Kala National Park, Algeria

© Michel Gunther / WWF-Canon

The Economics of Ecosystems and Biodiversity (TEEB) study referred to the nature's capacity to provide such services as "ecological infrastructure" and highlighted that ecosystem conservation and restoration support a range of policy goals – including food security, urban development, water treatment, regional development, and climate change mitigation and adaption (TEEB, 2010).

The Millennium Ecosystem Assessment described four categories of ecosystem services that contribute to human well-being and which underpin our livelihoods and economies. The assessment highlighted that, in a world in which inequities are growing, many people do not have a sufficient supply of, or access to, ecosystem services (MEA, 2005).

The harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor, and are sometimes the principal factor causing poverty and social conflict

Rural populations – particularly poorer households and women – are most directly reliant on ecosystem services and are particularly vulnerable to changes in ecosystem conditions. Ecosystem services underpin natural resource dependent industrial sectors such as agriculture, grazing, forestry and fisheries that provide the basis for rural livelihoods and resilience. In rural areas, ecosystems provide a wealth of everyday products including fuel wood, medicines, bushmeat and honey that are often overlooked in standard accounting systems and thus undervalued. Recognizing the important role ecosystem services play in rural development is critical to securing sustainable livelihoods.

The harmful effects of the degradation of ecosystem services are being borne disproportionately by the poor, and the Millennium Ecosystem Assessment found that these are sometimes the principal factors causing poverty and social conflict.



Ecosystem Services

Ecosystem services is the term used to describe the goods and services provided by ecosystems. The Millennium Ecosystem Assessment (MEA) describes four categories of ecosystem services:

- **Provisioning services:**

Products directly obtained from ecosystems such as food, medicine, timber, fibre, fuel wood and freshwater.



- **Regulating services:**

Benefits obtained from the regulation of natural processes such as water filtration, waste decomposition, climate regulation and crop pollination.



- **Supporting services:**

Basic ecological functions and processes that are necessary for the production of all other ecosystem services such as nutrient cycling, photosynthesis and soil formation.



- **Cultural services:**

Non-material benefits such as recreational, educational, aesthetic and spiritual benefits.



Water towers in Guinea
The Fouta Djallon highlands in Guinea are the source of half of West Africa's rivers, including seven international rivers



Fisheries

In 2008, inland capture fisheries in Africa yielded two and a half million tonnes, nearly a quarter of the world total



Coral reefs

support artisanal and commercial fisheries, protect coasts, absorb carbon dioxide and are the basis for a thriving recreational and tourism sector. The total economic value of the 12,000 km² of coral reefs in the Western Indian Ocean is estimated to be US\$7.3 billion per year



Medicine

Long used in traditional medicine, the Madagascar periwinkle (*Catharanthus roseus*) is the source of alkaloid compounds used in the treatment of numerous illnesses including diabetes and cancer. Survival rates for childhood leukaemia have increased from 20 to 80 per cent as a result of the plant's therapeutic properties



Forests

Africa's forests stock some 98 billion tonnes of carbon, equivalent to 145 tonnes per hectare. Fifty six billion tonnes is stocked in biomass, 34 billion in soil, and 8 billion in dead wood and litter



Mountain gorilla

Each mountain gorilla is estimated to generate \$1 million per year in tourist revenue for the Ugandan economy. (Source: <http://wwf.panda.org/?uNewsID=201576>)



Figure 16.

Ecosystem services in Africa

1.10 HOW HUMAN ACTIVITIES AFFECT ECOSYSTEM SERVICES AND BIODIVERSITY

“The loss of services derived from ecosystems is a significant barrier to the achievement of the Millennium Development Goals to reduce poverty, hunger, and disease” (MEA 2005).

Between 2000 and 2010, Africa lost an average of 3,414 ha of forests annually, equivalent to just under 0.5 per cent of its forest cover per year (FAO, 2010a)

Humanity’s appetite for goods and services has a range of impacts on ecosystems and species. The Millennium Ecosystem Assessment (2005) found that “over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre, and fuel”.



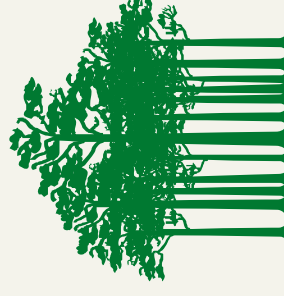
© Donald Miller / WWF-Canon

African Women mixing mortar for cistern Lake Nakuru, Kenya

The causes of biodiversity loss can be broadly grouped into five categories: habitat loss, fragmentation or change; overexploitation of species; pollution; the spread of invasive alien species; and climate change, all of which have their origins in human demands placed on the biosphere (Figure 17). The resulting erosion of ecosystem services has direct consequences on human well-being since it affects security such as access to resources; basic material needs such as food and shelter; and, health, such as access to clean water (MEA, 2005).

We take ecosystems for granted, overlooking environmental externalities and all too often we appreciate their values only after we have lost them. Yet it is usually much more expensive to replace or restore ecosystem services once they are lost, than to manage human activities to avoid or minimize impacts. Failure to account for the values of ecosystems and environmental externalities associated with human activities is viewed as a significant factor in loss and degradation of ecosystem services as well as a source of market failure (TEEB, 2010).

**-10%
MANGROVE
COVER IN AFRICA
DECREASED BY
10 PER CENT
BETWEEN 1990
AND 2010
(FAO, 2010A)**





© Jason Rubens / WWF-Canon

Species and ecosystems

Species are the building blocks of ecosystems, and the health of ecosystems depends on species diversity as well as the abundance of individual plants and animals and the relationships between these. Loss of biodiversity causes ecosystems to become stressed or degraded and ultimately to collapse with loss of the benefits provided to humans and other species. Conversely, more diverse systems are more resilient and better able to recover from natural shocks and anthropogenic pressures. As climate change compounds existing pressures on ecosystems, maintaining and enhancing the ability of ecosystems to withstand pressures is one of the foundations of climate adaptation strategies.



Figure 17. Human activities, biodiversity, ecosystem services and well-being (WWF, 2012; MEA, 2005)

1.11 INTRODUCING THE LIVING PLANET INDEX (LPI)

Tracking the health of the Earth's biodiversity is essential to understand how it is changing and devise effective ways to counter the impacts of humans on wildlife and ecosystems.

The Living Planet Index (LPI) reflects changes in the health of the planet's ecosystems by tracking the fate of more than 9,000 populations of vertebrate species to evaluate the change in size of wildlife populations over the past 38 years.

The latest Living Planet Index suggests that across the globe, vertebrate populations are on average a third smaller than they were 38 years ago. This is based on trends in 9,014 populations of 2,688 mammal, bird, reptile, amphibian, and fish species (Figure 18).

The Africa index includes all species populations with available data from the Afrotropical realm, populations from the Palearctic realm that are located in North Africa, and marine species populations from the southern Mediterranean Sea, western Indian Ocean and eastern Atlantic. The Africa index is based on 1,299 populations from 373 species. The Africa index shows a steady decline in vertebrate abundance from 1970 to 2008 (Figure 19).

9,014
VERTEBRATE
POPULATIONS
ARE ON AVERAGE
A THIRD SMALLER
THAN THEY WERE
38 YEARS AGO

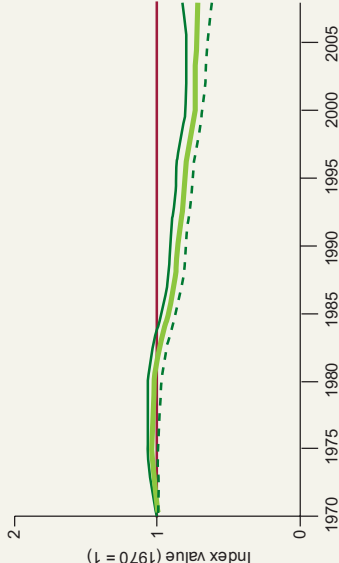


Figure 18.
The Global Living Planet Index (1970 – 2008). The index shows a decline of around 30 per cent from 1970 to 2008 (WWF/ZSL, 2012). Shading, on this and the Africa Index, represents the 95 per cent confidence limits surrounding the trend – the wider the shading, the more variable the underlying trend

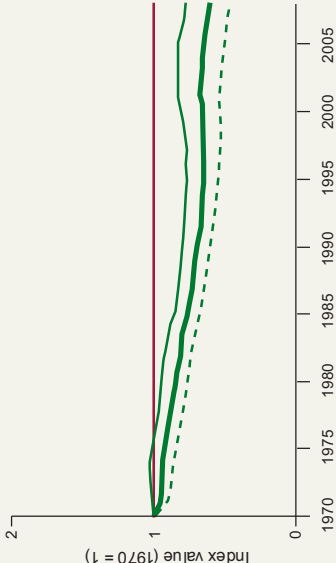
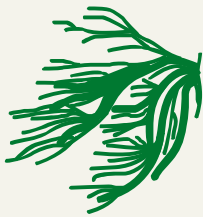


Figure 19.
Africa's Living Planet Index (1970 – 2008). The final index value indicates there has been an overall reduction of 39 per cent in animal populations over the 38 year period (WWF/ZSL, 2012)

The calculation for the Africa LPI followed the same process for that of the global biogeographic realms so that each species carries equal weight within the Africa index



EXPLORING THE LIVING PLANET INDEX

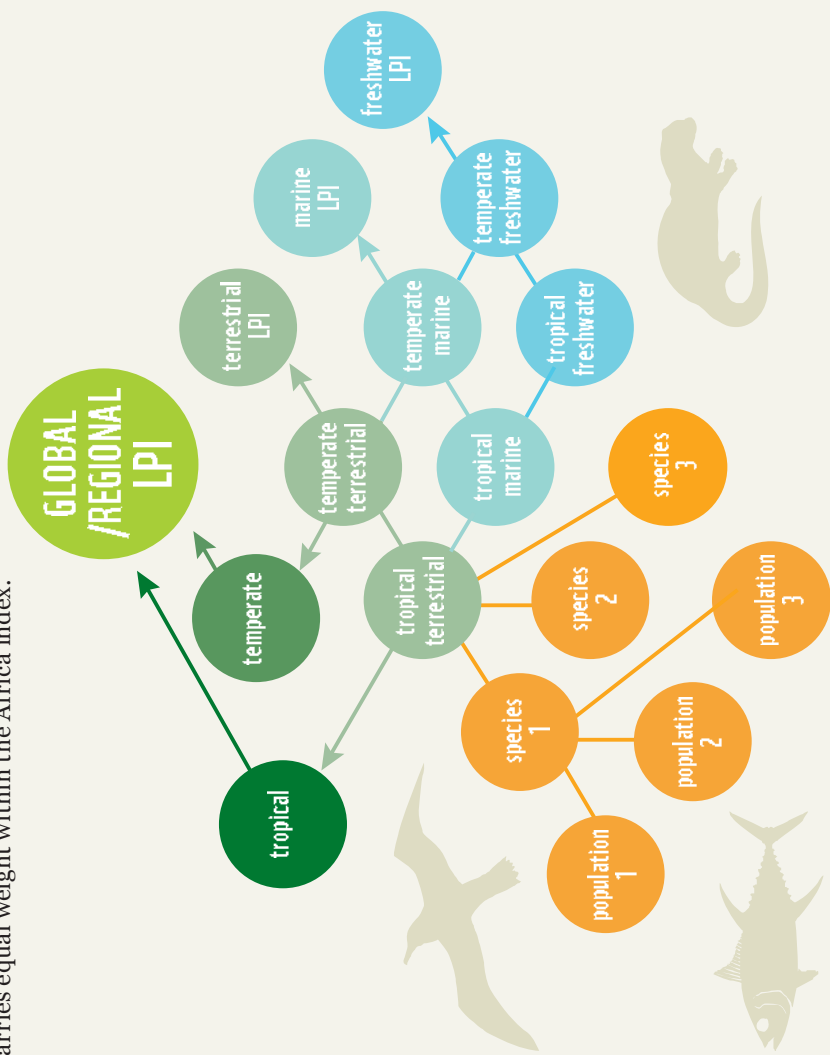
The Living Planet Index is a composite index that tracks trends in a large number of populations of species from around the world. The global Living Planet Index is an aggregate of two indices, the tropical index and temperate index, which are given equal weight.

The tropical index includes terrestrial and freshwater species, populations found in the Afrotropical, Indo-Pacific and Neotropical realms, and marine species, populations found between the Tropics of Cancer and Capricorn. The temperate index includes terrestrial and freshwater species, populations found in the Palearctic and Nearctic realms and marine species, populations to the north or south of the tropics.

Each of the individual populations within the Living Planet database is classified according to two characteristics: whether it is tropical or temperate; and whether it is freshwater, marine or terrestrial. These classifications are specific to the population rather than to the species, and some migratory species, such as freshwater mullet (*Myxus capensis*) may have both freshwater and marine populations, or may be found in both tropical and temperate zones.

Regional, biome and taxonomic indices can be built from the global dataset, where sufficient data are available. The calculation for the Africa LPI followed the same process for that of the global biogeographic realms so that each species carries equal weight within the Africa index.

Figure 20. Exploring the Living Planet Index



1.12 ILLEGAL WILDLIFE TRADE

1780
AFRICAN
VERTEBRATES
THAT ARE
CLASSIFIED AS
CRITICALLY
ENDANGERED (CR),
ENDANGERED (EN),
VULNERABLE (VU),
ON THE IUCN
RED LIST

Figure 21 provides an overview of identified threats to the 1,780 African vertebrates that are classified as critically endangered (CR), endangered (EN), or vulnerable (VU) on the IUCN Red List. Many populations and species are subject to more than one type of threat over their range. For example, the forest elephant (*Loxodonta cyclotis*) is primarily affected by habitat destruction and reduction of its range in West Africa, while poaching is a greater concern in Central Africa.

The top two threats to species in Africa, like the rest of the world, are agriculture and logging, both of which are associated with destruction or substantial alteration and fragmentation of natural habitats. Agricultural and forestry effluents are also the major source of pollution affecting threatened vertebrates, followed by industrial and military effluents, and domestic and urban waste water.

Also associated with habitat destruction, residential/commercial development is less frequently identified as a threat to species in Africa than in other parts of the world, but is expected to be a rising concern in view of rapid urbanization and expansion of cities in vulnerable areas such as coastal zones.

Hunting and trapping provides an important contribution to livelihoods in Africa but increasing demand combined with

commercialization of a formerly subsistence activity has put pressure on species in many countries, especially in peri-urban areas. Growing illegal wildlife trade is pushing some of Africa's most iconic species towards extinction.

Finally, climate change is an emerging threat to species throughout Africa, with substantial changes to habitats and water availability expected to compound the effects of reduced ranges and direct pressures on species.



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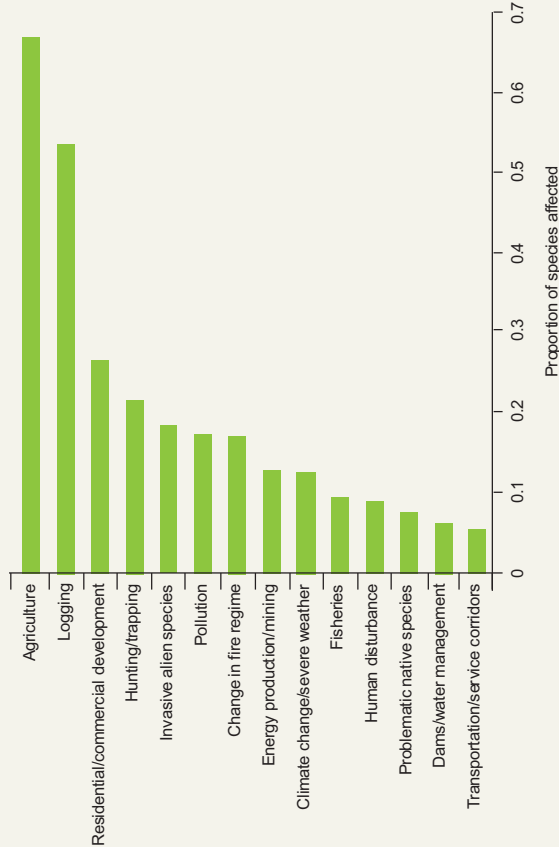


Figure 21: Proportion of vertebrate species affected by different types of threats in Africa. The figure is based on an assessment of 1780 species (962 terrestrial, 964 freshwater and 162 marine, with some species occurring in multiple systems) (ZSL, 2012 based on IUCN 2011)

ILLEGAL WILDLIFE TRADE

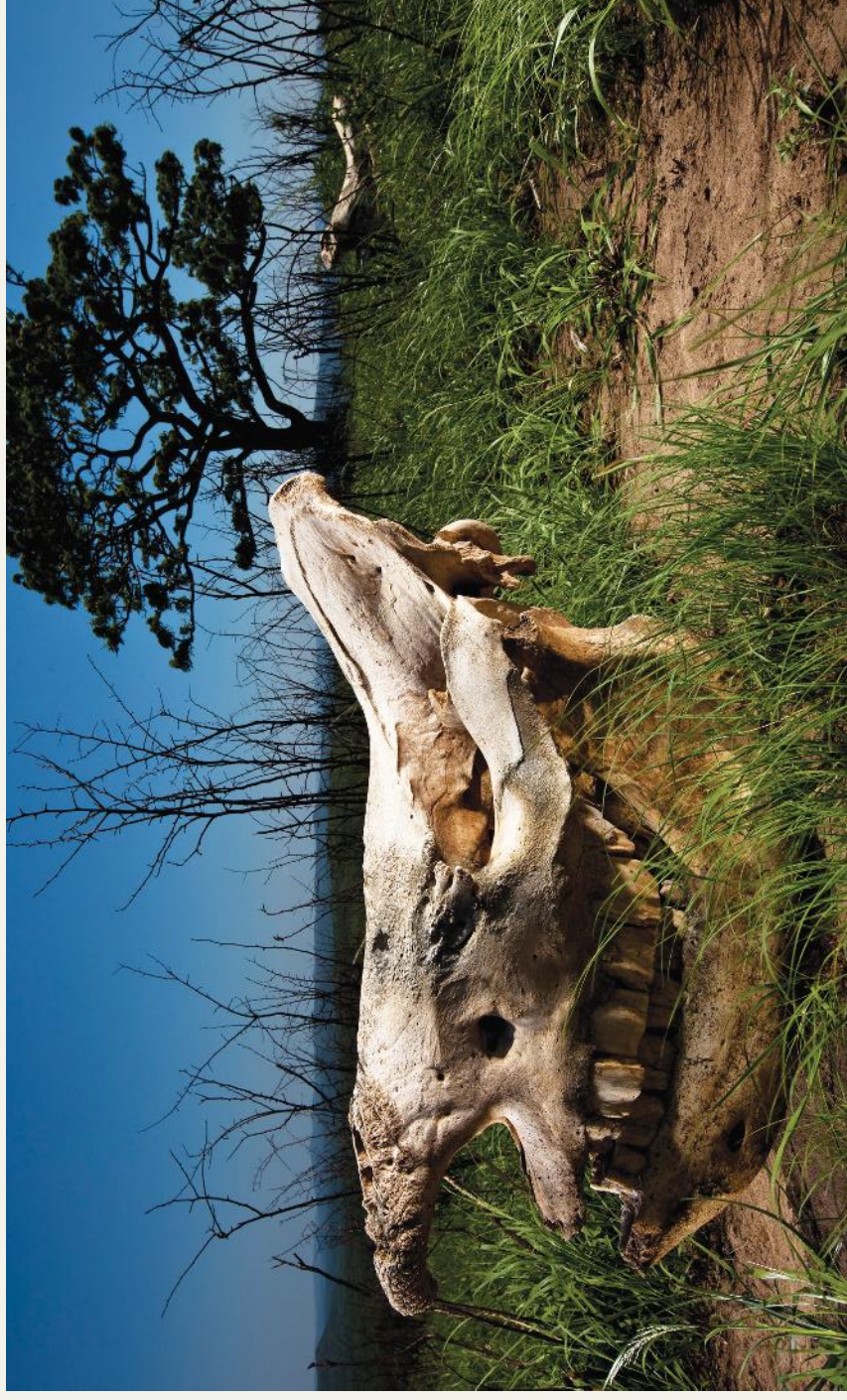
Poaching and illegal wildlife trade is one of the greatest threats to many of Africa's charismatic, valuable and ecologically important species. Products such as elephant ivory and rhino horn are in great demand in Asia for ornamental or medicinal purposes.

There has been a dramatic upsurge in poaching and illegal trade in recent years. Rhino poaching in South Africa increased by 3,000 per cent between 2007 and 2001. Large-scale ivory seizures in 2011 were the highest ever recorded.

The increasing large-scale ivory seizures are evidence of the growing involvement of well-organized criminal networks in illegal wildlife trade, now the 5th largest illicit transnational activity, worth US\$7.8-10 billion per year. As a result, populations of several African species are plummeting. Elephant populations in Central Africa alone are estimated to have declined by more than 50 per cent between 1995 and 2007, primarily due to poaching.

Wildlife crime undermines governments' efforts to halt other illicit trades, such as arms and drugs; facilitates the growth of organised crime; and can help finance regional conflicts. Solutions include increasing institutional capacity and resourcing for wildlife law enforcement, and ensuring wildlife criminals are penalized to the full extent of the law.

© Getty Images for WWF-UK



448 RHINOS WERE KILLED FOR THEIR HORNS IN SOUTH AFRICA IN 2011. THE LATEST STATISTICS FROM SOUTH AFRICA INDICATE THAT 150 RHINOS WERE POACHED IN THE FIRST THREE MONTHS OF 2012, WITH POACHING FUELLED BY THE GROWING DEMAND FOR RHINO HORN IN ASIA

1.13 TOWARDS SUSTAINABLE DEVELOPMENT

With their relatively low footprints, African nations are well-placed to fashion new development pathways that are more sustainable than those taken elsewhere.

Another path is possible that combines gains in HDI with limited growth in per capita footprint

However, achieving this will require a radical departure from “business as usual”. The following sections will explore the factors which determine Ecological Footprint and biocapacity, and explore the drivers that influence these. The alternative is one of foreclosed development options and lost potential.

In *Caring for the Earth*, published shortly before the 1992 Rio Conference on Environment and

Development, IUCN, WWF and UNEP defined sustainable development as a commitment to “improving the quality of human life while living within the carry capacity of supporting ecosystems”.

Countries’ progress towards sustainability can be assessed using the United Nations Development Programme’s (UNDP) Human Development Index (HDI), as a measure of quality of life, and Ecological Footprint, as a measure of demand on supporting ecosystems (Figure 23).

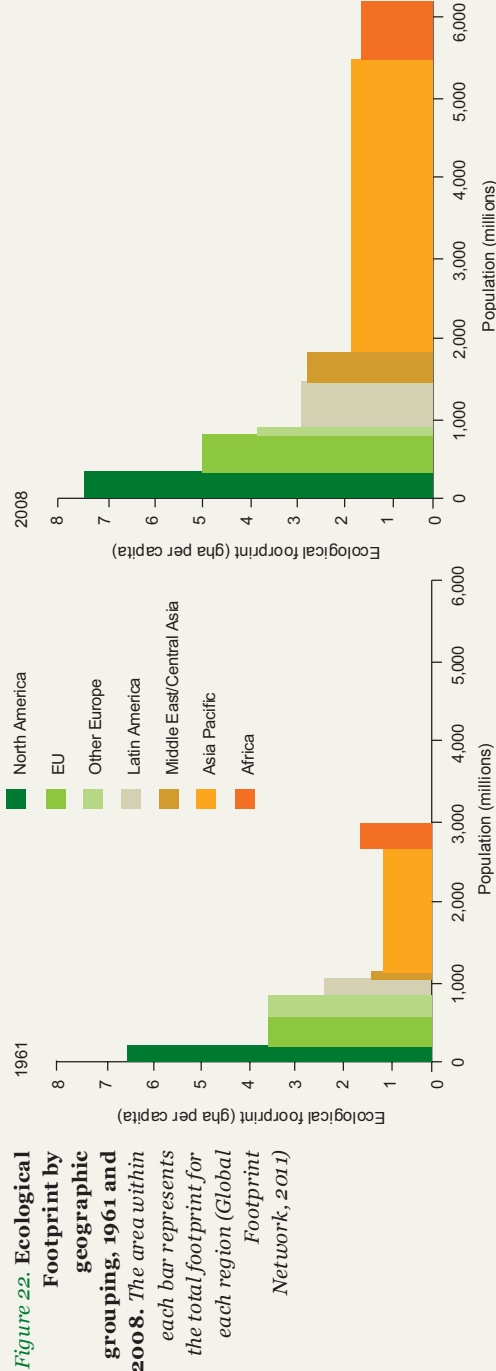
The HDI combines measures of income, life expectancy and educational attainment to compare countries’ economic and social

development. A more recent measure, the Inequality-adjusted HDI (IHDI) accounts for the inequality in attainment of education, life expectancy and income – which is greater in lower income countries than in higher income countries (UNDP, 2011). An HDI value of 0.8 or more in the 2007 Index is considered to represent “high human development” (UNDP, 2009).

At the same time, a per capita Ecological Footprint of less than 1.8 gha – the value corresponding to the available per capita biocapacity on the planet – meets the minimum condition for global sustainability in that it is replicable at the global level.

Figure 23 shows that many countries’ development trajectories have taken them away from sustainability, with crucial gains in IHDI achieved at the expense of substantial increases in footprint. Extended worldwide, these development pathways would lead to increased overshoot and further deplete the natural capital upon which human well-being depends. However, other countries, such as India, have achieved tremendous gains in HDI with a relatively small increase in per capita footprint.

Figure 22 shows the combined effects of change in per capita footprint and population on the total Ecological Footprint in different regions. Per capita footprint has increased in all regions except Africa, but Africa’s overall Ecological





© John E. Newby / WWF-Canon

Children present saplings from a WWF-funded nursery in the Udzungwa Mountains, Tanzania

Footprint has more that trebled as a result of population growth, and more and more countries are facing biocapacity deficit.

Sub-Saharan Africa's average HDI rating is projected to rise by 44 per cent by 2050 (UNDP, 2011). However probable environmental challenges – such as more severe water and air pollution and climate change effects – could reduce this growth to 32 per cent while an “environmental disaster scenario” shows human development progress halting or even declining by 2050.

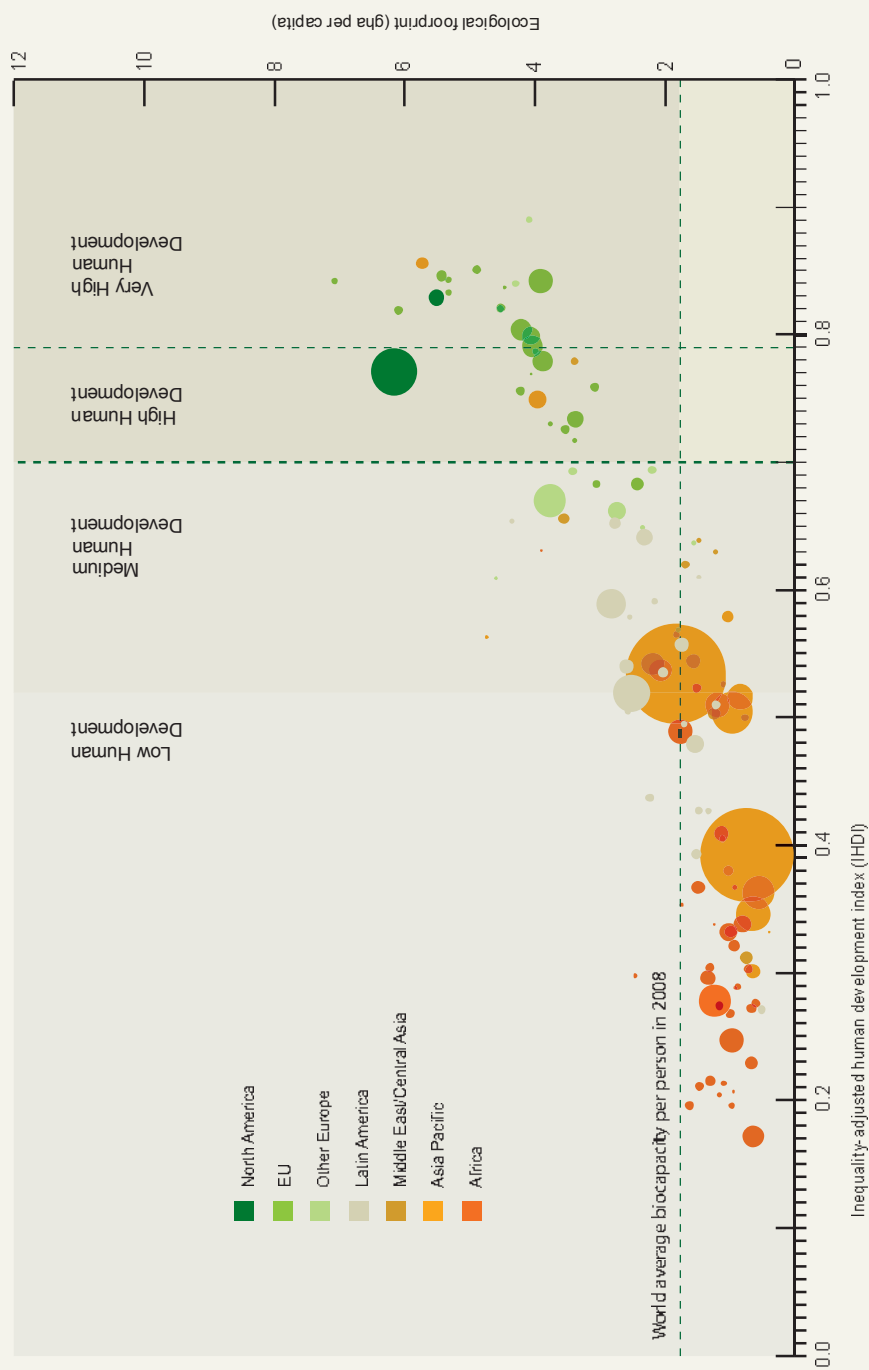


Figure 23. The Ecological Footprint for each country (in 2008) versus the Inequality-adjusted Human Development Index (in 2011). The dots representing each country are coloured according to their geographic region and are scaled relative to its population. The shading in the background of this figure indicates the HDI thresholds for low, medium, high and very high human development based on UNDP, 2011 (Global Footprint Network, 2011).

1.14 WHAT IS DRIVING FOOTPRINT & OVERSHOOT?

Bringing an end to global overshoot means closing the gap between humanity's footprint and available biocapacity. Five factors determine the size of this gap.

On the demand side, the footprint is a function of population size; the quantity of goods and services consumed by each person; and the resource and waste intensity associated with production of these goods and services. Lower population and individual consumption, more efficient use of resources, and reduction of waste emitted in production of goods and services all result in a smaller footprint.

On the supply side, biocapacity is determined by the amount of biologically productive area available, and the productivity of that area. However increases in either factor sometimes come at the expense of greater resource use or waste emissions, or attrition of ecological services.

The following pages look at these factors in more detail and identify some of the drivers associated with increasing footprint, and at the trade-offs involved in managing biocapacity.

Bioproductive area: The land and water (marine and inland) area that supports significant photosynthetic activity and accumulated biomass that is used by people.

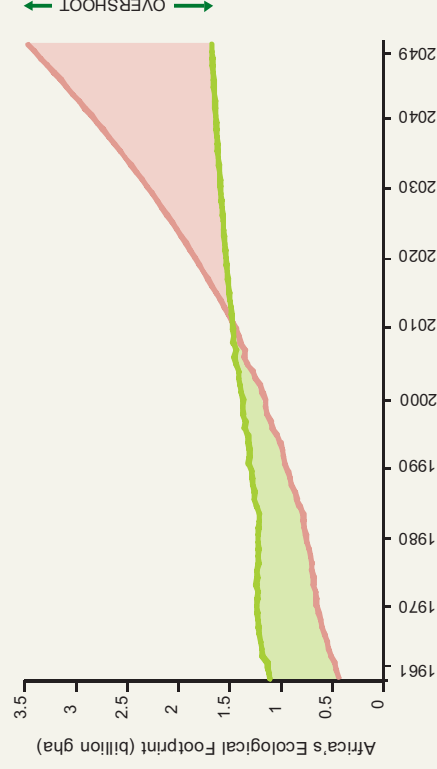
Bioproductivity per hectare: An area's productivity depends on the type of ecosystem and the way it is managed.

Population growth: The total number of people is one of the strongest drivers of the increasing global footprint.

Per capita consumption of goods and services: The basic necessities of life, such as food, shelter, fresh water and clean air are produced either directly or indirectly by ecosystems.

Footprint intensity: The efficiency with which natural resources are converted into goods and services affects the size of the footprint of every product consumed.

Figure 24. Factors driving Ecological Footprint and biocapacity (Global Footprint Network, 2011)



$$\text{BIOCAPACITY (SUPPLY)} = \text{Area} \times \text{Bioproductivity}$$

$$\text{ECOLOGICAL FOOTPRINT (DEMAND)} = \text{Population} \times \text{Consumption} \times \text{Footprint intensity}$$

1.15 POPULATION

There is substantial variation amongst countries and regions in the extent to which the relative growth in population and average per capita footprint contribute to the overall growth of demand.

Figure 25 shows the relative contributions of population and average per capita footprint in driving growth in the total footprint in African nations between 1961 and 2008. With the decline in per capita footprint, it is clear that the principal driver of change in Africa's Ecological Footprint is increasing population. In contrast, increasing individual consumption levels have played a more important role in driving the increase in footprint in high income countries (WWF, 2012).

By 2050, Africa's population is projected to reach between 1.93 and 2.47 billion people compared to 1.02 billion in 2010 and 0.294 billion in 1961 (Figure 26). As populations rise, there is less biocapacity available to meet the needs of each individual. The more than three-fold increase of Africa's population between 1961 and 2008 has been accompanied by a two-thirds reduction in the available per capita biocapacity. An increasing number of countries in Africa are facing the choice between meeting their biocapacity deficits by importing goods and services from other countries or overexploiting their natural resources, risking an associated decline in ecosystem services.

The growth in population has magnified the challenge faced by African governments and the development community in meeting the Millennium Development Goals. Important advances across a wide range of development fronts have been surpassed by the increase in demand for goods and services. For example, while net agricultural production in Africa has more than trebled since 1961 and per capita agricultural production has risen in North and West Africa, it has declined in Africa as a whole. In 2010, 239 million of the estimated 925 billion undernourished people in the world were in sub-Saharan Africa, equivalent to 30 per cent of the population in this region (FAO, 2010b).

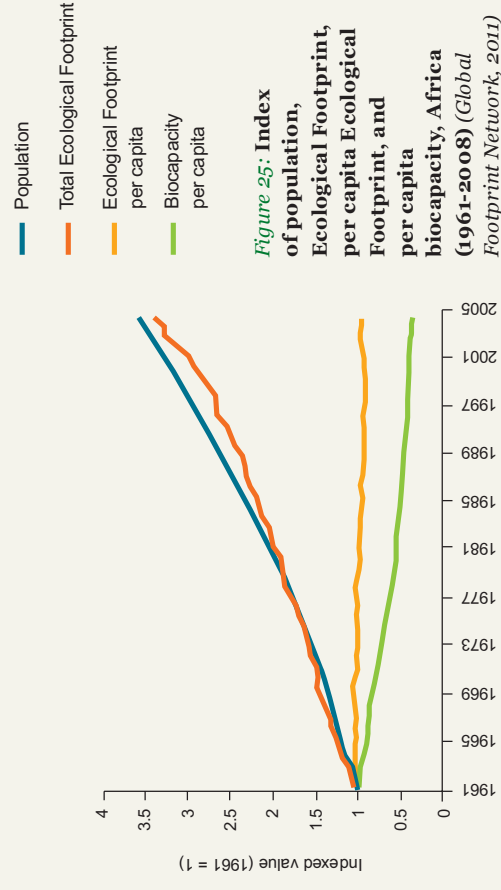


Figure 25: Index of population, Ecological Footprint, per capita Ecological Footprint, and biocapacity, Africa (1961-2008) (Global Footprint Network, 2011)

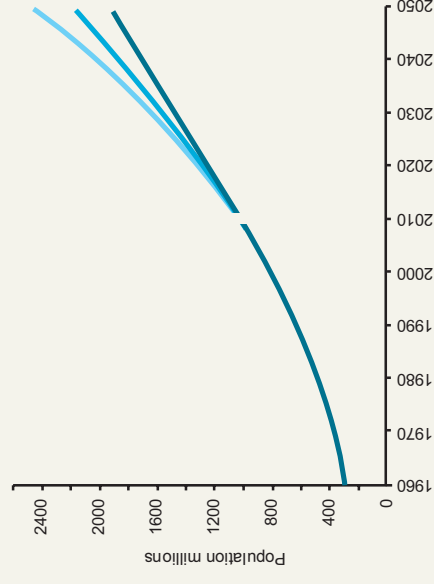


Figure 26. Population growth in Africa from 1960-200 and projected population growth from 2010 to 2050 based on low, medium and high population scenarios (UN DESA, 2011)

1.16 URBANIZATION

Urban populations are growing rapidly in Africa and will continue to do so as a result of intrinsic growth, displacement and migration (Parnell and Walawege, 2011).

The urban population in Africa is projected to reach 1.23 billion people in 2050; nearly three times its 2010 level of 413 million and equivalent to 61.6 per cent of Africa's total population (UN DESA, 2009b). By 2050, Africa will have a higher number of people living in cities than Europe, Latin America or North America.

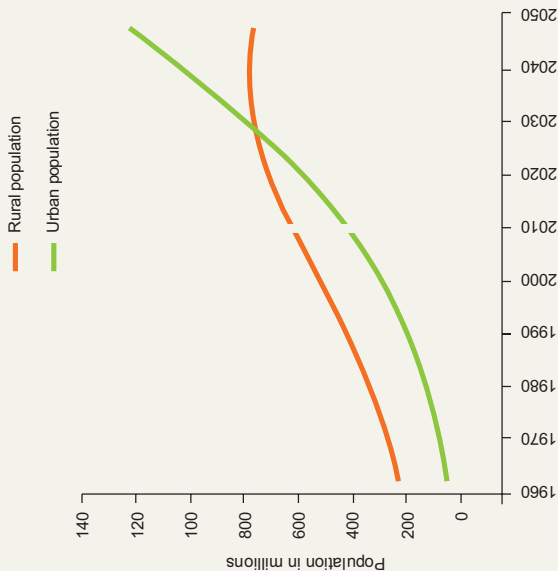
Urbanization is associated with changing lifestyles and demand for services. Around the world, the relative wealth of urban populations is associated with higher per capita carbon footprints, as a result of increased energy consumption and/or a shift to energy sources such as fossil fuels with higher carbon emissions (Poumanyvong and Kaneko, 2010). Urban demand for electricity will represent about 90 per cent of total power generation by 2030, but there is scope to meet much of this demand through renewable energies.

At the same time, with tens of millions of people living in unregulated and un-serviced slums, African cities have the highest level of inequality in the world (UN Habitat, 2010). The need to improve living standards for the roughly 72 per cent of urban dwellers in sub-Saharan Africa living in slum conditions (UN Habitat, 2003) is accentuated by their greater vulnerability to the effects of climate change .

2050
THE URBAN
POPULATION
IN AFRICA IS
PROJECTED
TO REACH
1.23 BILLION
PEOPLE IN
2050



Figure 27. Projected growth in urban and rural populations to 2050 (UNDESA, 2009)



Cities can also be part of the solution. The increasing concentration of growing demand for goods and services provides opportunities to manage footprint growth and achieve economies of scale in service delivery through urban planning and design measures and greener infrastructure – particularly in the building, transport, energy supply and waste management sectors.

In view of the pivotal role played by energy services, managing the Ecological Footprint of urban areas often goes hand in hand with greenhouse gas mitigation. Similarly, adaptation initiatives in cities, such as those designed to reduce vulnerability associated with development in sensitive areas or sourcing of materials, can reduce the impact of urban populations' footprint in their immediate and surrounding rural areas.

1.17 ENERGY

Globally, carbon is the most rapidly growing component of Ecological Footprint – with much of the increase driven by emissions from burning oil, gas and coal for energy generation.

3%

ELECTRICITY ACCOUNTS FOR LESS THAN 3 PER CENT OF TOTAL FINAL ENERGY CONSUMPTION IN AFRICA



In Africa, carbon represents the largest footprint component for five middle income countries whose energy economies are dominated by fossil fuels, and accounts for over 50 per cent of footprint in South Africa and Libya. Africa's CO₂ emissions from fossil fuels account for just 2.5 per cent of the global total.

Overall, however, Africa's citizens have lower average per capita energy consumption than any other region, and expanding access to modern and clean energy services is a development priority. Electricity accounts for less than 3 per cent of total final energy consumption in Africa. Consumption of electricity is projected to increase more than six-fold over the next decades with more than 80 per cent of the new demand in urban areas (AfDB, 2008).

Much of this demand could be met through renewable energies averting the carbon-intensive energy patterns seen in most industrialized countries (UN DESA, 2004). Development of a low carbon economy can create direct and indirect opportunities for entrepreneurship and employment and improve Africa's global competitiveness. Africa's renewable energy potential is largely untapped, and includes hydro-power, geothermal energy, solar and wind power,

and more efficient utilization of biomass (AfDB, 2008).

At the same time, Africa is among the regions with the highest energy intensity per unit of Gross Domestic Product (GDP) in the world (Enerdata, 2009), suggesting there is significant potential for energy savings. Increasing end-use efficiency would reduce energy users' costs and increase their competitiveness; provide savings for power systems in terms of managing peak loads; and, allow more users' needs to be met for each dollar invested in infrastructure (UNIDO and REEEP, 2009).

Biomass currently provides over 80 per cent of total primary energy supply to households across sub-Saharan Africa (excluding South Africa) (AfDB, 2008) and will continue to play an important role in the years to come. Fuelwood for household use and charcoal production is often harvested at unsustainable rates and has become a driver for forest degradation and conversion – especially around urban centres (Denruyter et al., 2010). A move away from traditional biomass towards other energy sources, including more sustainable wood supply chains, would reduce pressure on forests and cut CO₂ emissions related to land use change as well as black carbon emissions associated with global warming and health impacts. Known technologies including on-farm agroforestry woodlots, more efficient carbonization methods to produce charcoal and more efficient use of the biomass in improved stoves can help improve the entire biomass supply chain.

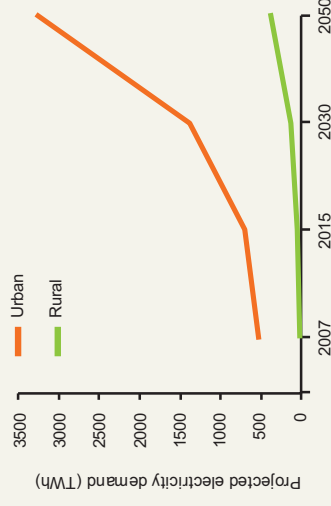


Figure 28.
**Projected growth
in demand for
electricity, 2007-
2050 (AfDB, 2008)**

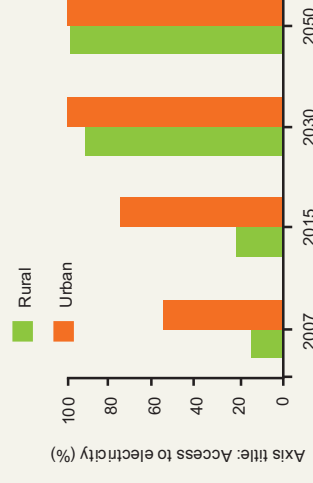


Figure 29.
**Rate of access to
electricity (per cent
of the population)
(AfDB, 2008).**

1.18 BIOCAPACITY AND FOOD SECURITY

The above sections have focused on the main drivers of footprint and identified opportunities for managing footprint intensity and growth in footprint.

Sustainable intensification of agriculture, including wise water use, can contribute to food security and maintenance of biocapacity

Managing these drivers is fundamental to halting and eventually reversing overshoot at the global level.

Overshoot can also be reduced by increasing the bioproductivity of ecosystems, and by extending the bioproductive area. Most of the past gains in biocapacity around the world have been associated with increased agricultural productivity, either by expansion in the area under agriculture or by increased yield and cropping intensity.

In Africa, the area under agricultural production increased by roughly 35 per cent between 1961 and 2005 (HLPF 2011), with the majority of expansion accounted for by forest conversion. Permanent and shifting agriculture is the principal driver for land use change and deforestation in Africa, and is largely responsible for the region's 17 per cent share of global CO₂ emissions from land use change (Denruyter et al., 2010).

Some estimates place the potential area for expansion of rainfed agriculture outside protected and forested areas in Africa as high as 200 million ha (e.g., Deininger and Byerlee,

2011). However this has been challenged in view of the assumptions related to low population density, the suitability of terrain and soils, water availability, and concerns about loss of ecosystem services (e.g., HLPF, 2011).

There is now a growing consensus that expansion of agriculture comes at the cost of loss of vital ecosystem services and that intensification of agriculture through increased yields and cropping intensity is the preferred option (e.g., Foresight, 2011a, HLPF, 2011, UN Habitat and UNEP, 2010). For example, current yields for maize, oil palm, soybean and sugar cane in Africa could be increased by two to five times their current values (Foresight, 2011b).

Agricultural intensification is often associated with increased use of costly and energy intensive fertilizers, with pollution from pesticides, and with increased water abstraction for irrigation, which can have negative environmental externalities. However there is a growing body of knowledge and good practice related to sustainable intensification that can minimize the need for these inputs and generate positive environmental externalities (e.g., Foresight 2011a).

In many areas bioproductive land has been depleted as a result of urbanization or desertification. Human activities contributing to land degradation and ultimately desertification include over-cultivation leading to soil exhaustion; overgrazing, leading to loss of

AGRICULTURAL PRODUCTION AND FOOD SECURITY IN MANY AFRICAN COUNTRIES AND REGIONS ARE LIKELY TO BE SEVERELY COMPROMISED BY CLIMATE CHANGE AND CLIMATE VARIABILITY

BONKOT ET AL., 2007



WHAT IS NOW CLEAR IS THAT EXPANDING THE AREA OF AGRICULTURE COMES AT CONSIDERABLE LOSS OF VITAL ENVIRONMENTAL SERVICES AND THAT GREAT BENEFITS ACCRUE IF AGRICULTURE IS ABLE SUSTAINABLY TO IMPROVE PRODUCTIVITY IN EXISTING LAND

FORESIGHT STUDY, 2011

vegetation cover and erosion; deforestation leading to soil loss; and inadequately drained irrigation systems that cause soil salinization (UNCCD, 2011).

Looking beyond cultivated areas, ongoing destabilization of ecosystems and attrition of ecosystem services, such as water regulation, are major challenges to maintaining biocapacity. Plant and animal populations are the building blocks of ecosystem services and one recent study suggests that by 2050 biodiversity decline will be the strongest negative influence on biocapacity as a result of the associated impacts on ecosystem functioning (Lenzen et al., 2007).

In terms of drivers, climate change – with associated changes in temperature, rainfall, and climate variability – is expected to have profound effects on ecosystems and food production in the coming years. There is still limited information on how these changes will be experienced at the local level in Africa, and maintaining, and where possible strengthening, resilience in ecosystems is a vital adaptation and coping strategy in the face of this uncertainty.

Man spraying crops,
Lake Bogoria, Kenya

© Brent Stirtan / Getty Images



The Water, Energy and Food Security Nexus

The “nexus” approach recognizes that achievement of societal goals related to water supply and sanitation, food security and energy access depends on underlying natural resources – water, soil and land and related ecosystems. Developments in one sector often have unintended consequences for other sectors – as a result of environmental externalities or competition for scarce resources.

At the same time, the data presented in this report on Ecological Footprint, Water Footprint and the Living Planet Index have highlighted that our demands on the biosphere are reaching – and in many cases have exceeded – the limits of sustainability.

By acknowledging and explicitly accounting for interdependency and trade-offs between the food, water and energy sectors in a framework that values ecological infrastructure, a nexus approach to water, energy and food security can generate efficiencies and multiple benefits.

Further information:
<http://www.water-energy-food.org/>

2

**AFRICA'S
ECOLOGICAL
INFRASTRUCTURE**

INTRODUCTION

Part 1 of this report has highlighted how Africa's ecosystems are being subjected to unprecedented stress as a result of humanity's escalating demand for goods and services. Environmental degradation, combined with inequality resulting from uneven access to resources, has become recognized as a very real constraint to development in the 21st century.

The pressures experienced by ecosystems reflect unsustainable levels of demand, as well as damaging methods of resource extraction and waste disposal.

Much of this can be traced to failures in markets, including price distorting subsidies; and the failure to account for environmental externalities. Governance failings related to inadequate land tenure and ownership of resources also act as powerful disincentives for better management of natural capital.

There is a growing body of knowledge and good practice related to more efficient production and better natural resource management in Africa. The case studies presented in this section reflect some of the challenges, trade-offs, and emerging good practice in managing Africa's "ecological infrastructure" or natural capital — in order to conserve ecosystem services and maintain resilience in the face of existing and emerging pressures. The emphasis is on local solutions — which directly involve some of the most vulnerable resource users and create incentives for better resource management in a framework of shared responsibility.

1

GREEN HEART OF AFRICA

Heads of States and Governments of the Amazonian, Congo and South-East Asia basins have undertaken to maintain close consultations and promote common interest related to forests, biological diversity and climate change.

33

THE

RAINFOREST

BASINS OF

THE AMAZON,

CONGO BASIN AND

SOUTH EAST ASIA

ACCOUNT FOR

33 PERCENT OF

GLOBAL FOREST

COVER



convergence, a priority action plan to harmonize the forest sector's legal and regulatory framework, and catalyse sustainable management of the region's ecosystems.

Congo Basin Forest Fund

Launched in 2008 and housed in the AfDB, the Congo Basin Forest Fund (CBFF) is designed to support implementation of the COMIFAC plan de convergence. The current portfolio includes 41 projects. Recently approved projects include support to member countries in developing national REDD processes and establishing national and regional systems for measuring, reporting and verifying carbon forest stocks and fluxes.

TRIDOM – Planning economic development and conservation at scale

Covering nearly 10 per cent of the Congo basin rainforest, the Tri-National Dja-Odzala-Minkebe (TRIDOM) trans-border forest is recognized by the Governments of Cameroon, Congo, and Gabon as an area of globally outstanding biodiversity values. TRIDOM includes nine protected areas, covering 20 per cent of the forest surface, and serves as a stronghold for the largest remaining forest elephant population in the basin.

Logging concessions cover 60 per cent of the landscape, which is also an emerging iron ore area, with at least seven mining companies currently prospecting. The mining industry poses a substantial threat to areas of high biodiversity value as a result of habitat fragmentation and disturbance – caused by the mining activities themselves as well as access roads and mining camps. Wildlife poaching, including ivory poaching, has been exacerbated by increased accessibility. Companies have expressed a strong interest in contributing to conservation of the area and some are developing biodiversity “offset” activities.

Close cooperation between the governments, private sector, local populations and conservation NGOs has enabled an integrated approach to management of the area that takes into account its exceptional biodiversity – as well as the interests of rural populations, indigenous peoples and the private sector – to ensure that logging and mining proceed in an environmentally – and socially – responsible manner.

Reconciling development and conservation interests in the area, in the context of logging and emerging mining interests, requires participatory approaches to infrastructure planning and development (including railways, roads and hydropower), to minimize habitat fragmentation and disturbance; use of state of the art technology

and internationally applied standards at mining sites and facilities to minimize impacts such as water pollution; and, coordinated efforts to ensure effective wildlife protection and anti-poaching operations in and around the extractive zones.

Mai-Ndombe – firefront or firewall for the Congo rainforests

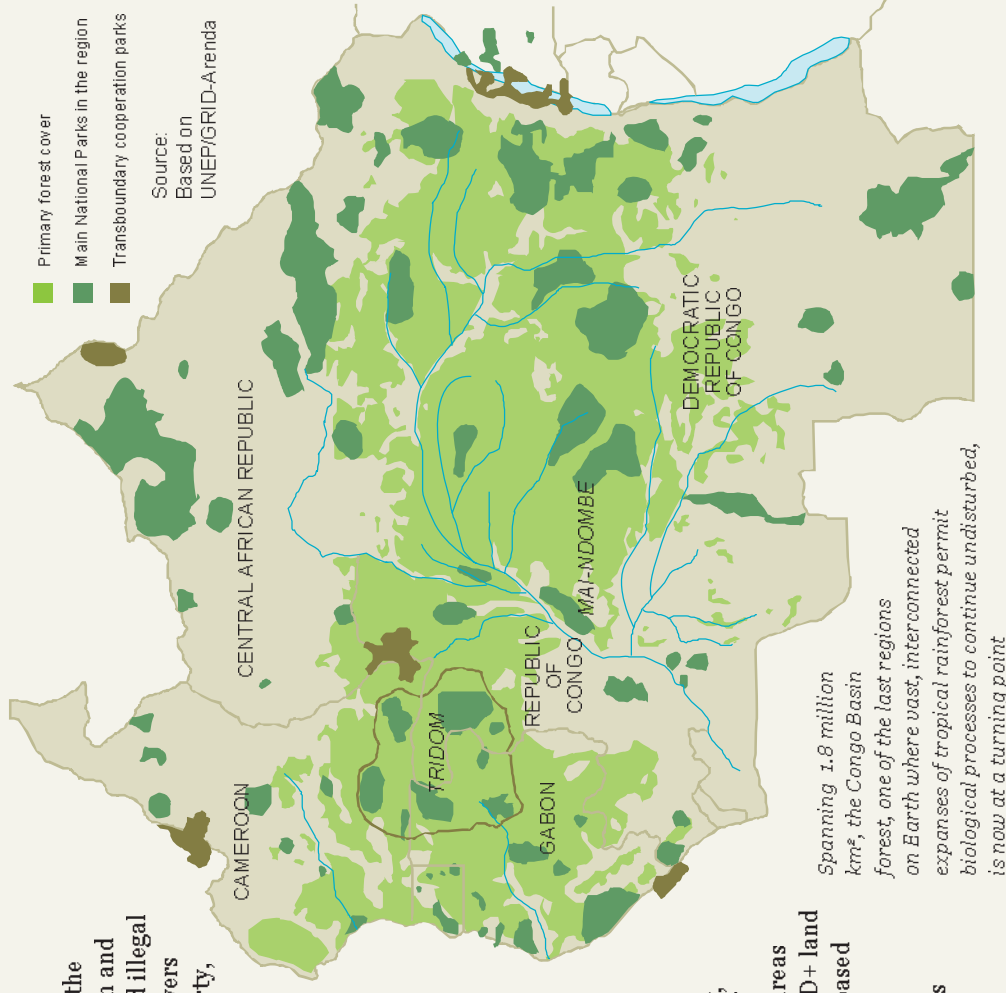
International commitment to reduce carbon emissions from deforestation and forest degradation, and to conserve, sustainably manage and enhance forest carbon stocks (REDD+), offers the potential for significant funding for forest conservation, bringing global and local benefits. However to date, implementation of REDD+ in Africa has proved to be an expensive experiment facing a number of serious challenges such as complex governance mechanisms, and failure to deal with multiple threats to forest landscapes. A programme recently launched in the Bandundu province in the Democratic Republic of Congo is exploring solutions to these challenges.

Spanning more than 3 million hectares, the Mai Ndombe region lies between the Congo River, Kasai River and Lac Mai-Ndombe at the point where savanna transitions to rainforest, and is home to elephant, bonobo and chimpanzee. Isolated by distance and river barriers until

recently, the area is now one of the most important “firefronts” of deforestation in the Congo and under serious threat from slash and burn agriculture, charcoal production and illegal forest exploitation. The main indirect drivers of deforestation in Mai-Ndombe are poverty, lack of employment, traditional agricultural practices, population growth and unclear forest tenure.

The Mai-Ndombe Integrated REDD+ Programme is pioneering an approach that aims to both stabilize forest loss and emissions from land use change in the territory and to establish a model of low carbon sustainable development consistent with national REDD+ and climate strategies.

The programme will help local forest users to define allocation and use of land that reflects a common vision for the sustainable management of their territory, while addressing the underlying causes of deforestation. The three complementary areas of action are delineation of a simple REDD+ land use plan; establishment of a community-based payment for environmental services (PES) system; and promotion of multi-stakeholders local development projects as alternatives to deforestation.



2

COMMUNITY BASED NATURAL RESOURCE MANAGEMENT IN SOUTHERN AFRICA

Spanning the border areas of Angola, Botswana, Namibia, Zambia and Zimbabwe, the Kavango Zambezi Transfrontier Conservation Area (KAZA) is the world's largest international conservation area covering 44 million hectares.

71
SINCE 1998, 71
CONSERVANCIES
HAVE BEEN
ESTABLISHED IN
NAMIBIA



KAZA has the potential to address several key issues that impact wildlife populations, including poaching and range fragmentation. By joining forces, the five countries can more effectively combat international wildlife trade and poaching through information sharing, joint patrols and surveillance, and harmonized law enforcement policies. Wildlife movements may be facilitated by removal of some of the thousands of kilometres of fences that impede the historical movement of animals. Critically this will depend on attracting investors to provide an economic boost to the people who live within the conservation areas and sharing tourism benefits amongst the local communities.

Community based natural resource management (CBNRM) programmes across southern Africa have demonstrated that by empowering rural communities and sharing benefits from tourism and sustainable use of wildlife, it is possible to achieve the joint objectives of biodiversity conservation and improved livelihoods.

The creation of the Mufunta Game Management Area (GMA) project covering 541 thousand hectares to the west of the Kafue National Park in Zambia has opened new economic opportunities for communities living around

this heavily poached and degraded area and is enabling recovery of wildlife populations. A partnership between the Zambia Wildlife Authority, private sectors, NGOs and local communities is now bearing dividends. The community wildlife institution, Kahare Community Resources Board, received US\$ 20,000 as its inaugural share from hunting revenues in the new GMA, a figure expected to treble in 2012.

NAMIBIA'S CONSERVANCY MODEL

Namibia's 1996 Conservation Amendment Act empowered rural communities to take responsibility for and benefit from wildlife resources – by providing rights to revenues from hunting and tourism on communal lands.

The results have exceeded all expectations. Since 1998, more than 71 natural resource management institutions, known as conservancies, have been established in order to manage wildlife resources on communal lands in Namibia. Rural communities have now taken on responsibility for sustainable management of wildlife across nearly 15 million ha of land, equivalent to around 18 per cent of the country's area.

The results have been impressive – with wildlife populations having recovered to healthy numbers across large areas (Figure 30) and revenues from CBNRM ventures both in and outside conservancies amounting to more than 45 million Namibia dollars or US\$6.4 million in 2010 (Figure 31). With growing investment in joint venture tourism between private companies and communities, local people are enjoying a range of social and economic opportunities and benefits from the wildlife resource – including development of skills and livelihoods, employment and improved nutrition.

Initiatives in many areas are now self-sustaining and the programme is expanding into new areas, including across Namibia's borders to south-western Zambia and Botswana.

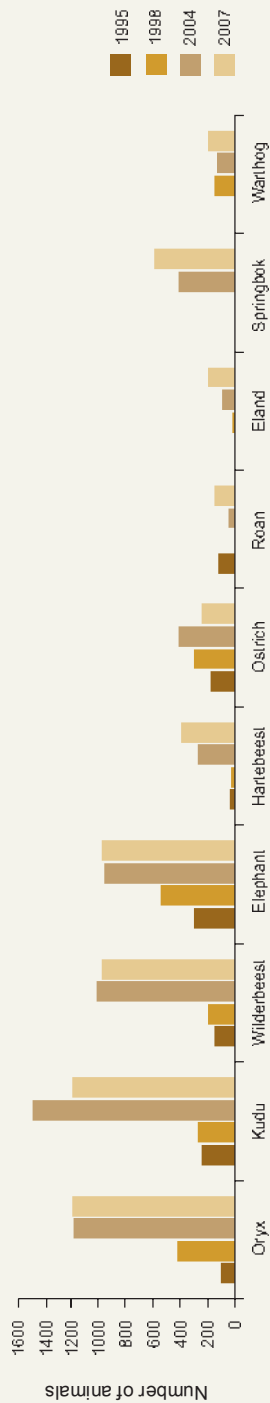


Figure 30. Estimated game populations in Nyae Nyae Conservancy from aerial game censuses (1995, 1998, 2004), water point counts, and local knowledge from 1995-2007 (NACSO, 2008)

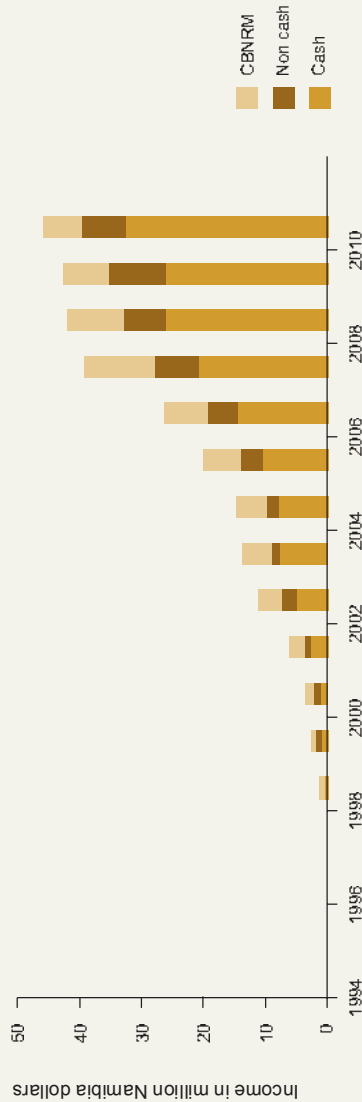


Figure 31. Income from CBNRM in Namibia rose from zero in 1994 to almost N\$46 million in 2010 (NACSO, 2011)

3

AFRICA'S FLAGSHIPS: CONSERVATION SUCCESSSES AND CHALLENGES

Conservation action is yielding results amongst some of Africa's best known and iconic species – but threats remain, and some remain critically endangered.

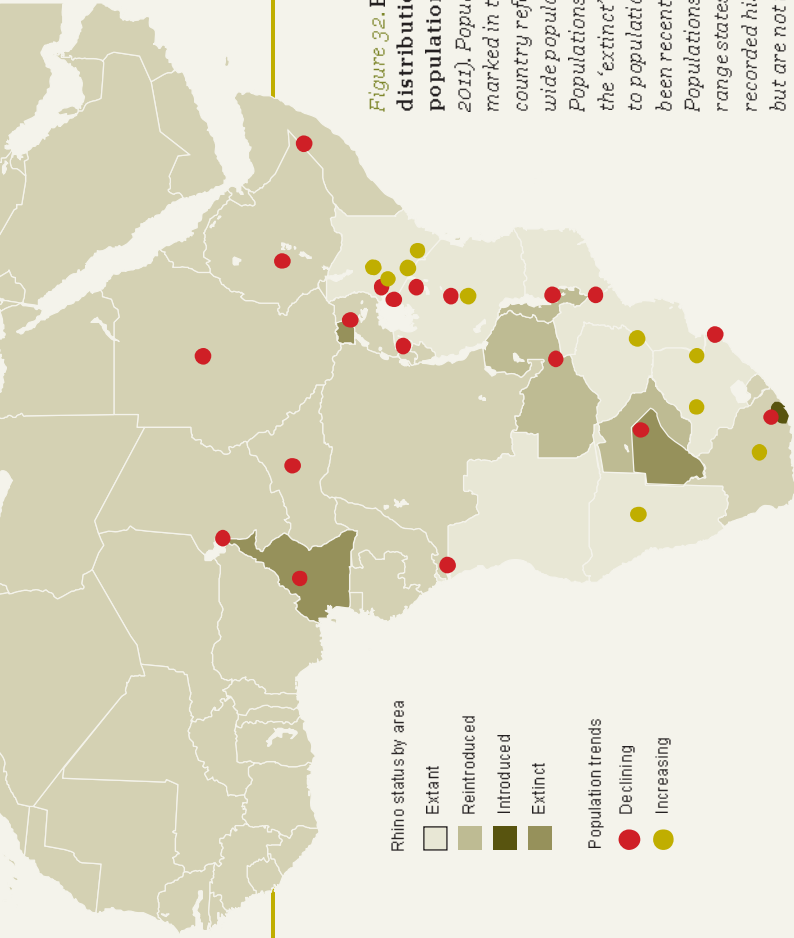


Figure 32. Black rhino distribution and populations (Emslie 2011). Populations marked in the centre of a country refer to country wide population trends. Populations identified in the 'extinct' range refer to populations that have been recently extirpated. Populations outside the range states have been recorded historically but are not represented in IUCN's current distribution maps

MOUNTAIN GORILLAS (*Gorilla beringei beringei*)

The two remaining populations of mountain gorillas (*Gorilla beringei beringei*) are found in national parks straddling the borders of Uganda, Rwanda and Democratic Republic of the Congo. The area surrounding the parks is the most densely populated area in Africa resulting in a conflict for space and resources between people and wildlife (Blomley et al, 2010).

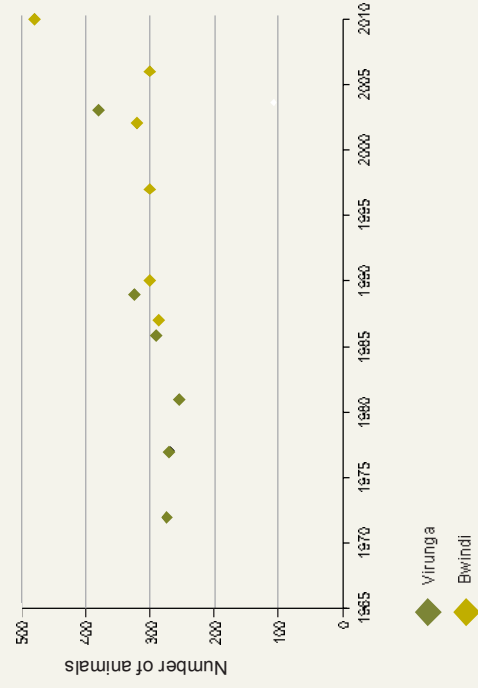
Listed as Critically Endangered on the IUCN Red List, there are estimated to be fewer than 790 individuals remaining in the wild (IGCP, 2012). Gorillas are threatened by poaching and habitat loss and degradation; pressures that are exacerbated by their small and fragmented range. Individual population declines in recent years have occurred primarily amongst unhabituated groups forming approximately 30 per cent of



Young mountain gorilla, Rwanda

© Martin Harvey / WWF-Canon

Figure 33. Change in abundance of Mountain Gorilla populations from 1972 to 2010 (Based on Pomeroy and Tushabe, 2004; Pomeroy, 2006, 2010; and Arinaitwe, Pomeroy and Tushabe, 2000)



790

IT IS ESTIMATED
THAT LESS THAN
790 GORILLAS
REMAIN IN
THE WILD

the population that are not being utilized for tourism or research (Robbins, 2008). The mountain gorilla remains in a fragile position due to resurgence in poaching and killing in recent years, while oil exploration is emerging as a new threat in Virunga National Park.

Encouragingly, numbers started to increase from the late 1980s (Figure 33), as intensive monitoring of the populations offered protection from poachers. This increase is also due to veterinary intervention and the local community's change in perception of the value of the species. Authorities and NGOs in Uganda have taken a community development approach to gorilla conservation to resolve significant conflicts which arose in the 1990s due to displacement of people following the gazettement of the national parks. Local communities are allowed restricted access to forest resources such as timber, and receive a share of profits from gorilla trekking permits that provides revenues for building schools, infrastructure and healthcare facilities. The approach has led to an increase in positive perception of the parks by local people and has been integral towards mitigating threats to gorillas (Blomley et al., 2010). Mountain gorilla tourism is now the highest contributor to tourism revenues in Uganda.

BLACK RHINOCEROS (*Diceros bicornis*)

The black rhino is one of the "big five" species at the heart of Africa's thriving wildlife-tourism industry. However, despite an almost two-fold increase since 1991, black rhino numbers are alarmingly low with fewer than 5,000 of this Critically Endangered species alive today (IUCN SSC AFRSG, pers.comm.). Population trends vary across Africa (Figure 32). Many populations in central and western African countries have declined into extinction whereas others, particularly in South Africa and Namibia are showing signs of increase and recovery. The West African sub-species (*D. bicornis longipes*) was recently declared extinct (Emslie, 2011).

The black rhino is threatened by poaching and by habitat loss and degradation leading to fragmentation of their ranges. Demand for rhino horn for traditional and non-traditional uses has magnified as Asian economies have boomed, and Africa lost 1,439 rhino horns to the illegal markets between 2006 and 2009 (Milliken et al., 2009).

Encouraging local stewardship through investment in areas hosting core rhino populations has proven successful in continuing to increase black rhino numbers across Africa. Public-Private Partnerships – such as those being implemented in South Africa, Kenya and Namibia – are providing community benefits and encouraging local people to appreciate their vested interest in the ecosystem and its associated services.



2011

THE SUB-SPECIES
OF BLACK
RHINO FOUND IN
WEST AFRICAN
COUNTRIES
WAS DECLARED
EXTINCT IN 2011



Black rhinoceros, Etosha National Park, Namibia

© naturepl.com / Tony Heald / WWF

4 ENVIRONMENTAL FLOWS IN THE ZAMBEZI BASIN

The Zambezi basin is the fourth largest of Africa's 60 international river basins, with a catchment of 1.3 million square kilometres spanning eight countries: Angola, Botswana, Zambia, Zimbabwe, Tanzania, Malawi, Mozambique, and Namibia.



Local villager riding a makoro boat, Zambezi river

SHARED WATER RESOURCES

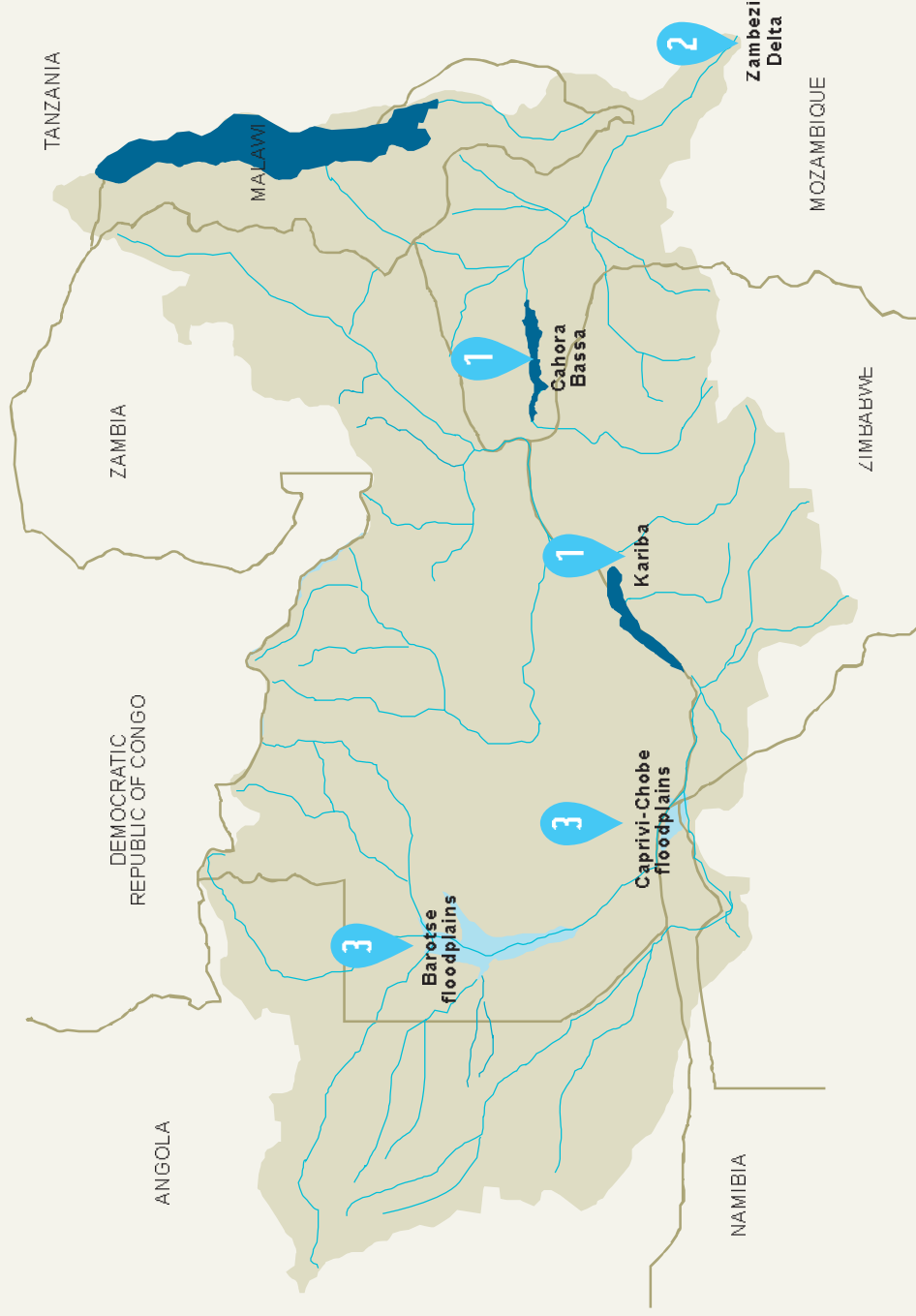
The Zambezi River provides vital services for the populations of the basin countries, including supporting floodplain agriculture; freshwater and offshore fisheries; water extraction for manufacturing and domestic water supply; and electricity generation.

The need to “maintain a proper balance between resource development for a higher standard of living for their people and conservation and enhancement of the environment to promote sustainable development” has been recognized by the signatories to the Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC) Region.

The Joint Zambezi River Basin Environmental Flows Programme is a partnership

initiative that was developed in the context of an integrated approach to water resources management. Its objective is to re-establish environmental flows in the Zambezi River system in order secure freshwater and estuarine ecosystems and the human benefits derived from these ecosystems. Specifically, this means modifying the operating rules of hydropower dams in the Zambezi River basin in order to generate Environmental Flows Releases (EFR) that mimic natural flow patterns in the river basin as well as protecting and managing the basins' freshwater resource areas (infiltration areas, retention areas and floodplains) in order to ensure integrity of the ecosystem.

Technical studies indicate that it is possible to implement environmental flows without jeopardizing hydropower production, with its significant socio-economic benefits, including through better control of the periodic floods that currently represent a major source of risk in the basin. This case study highlights the potential for regional cooperation to lead to a win-win outcome in allocation of water to different users and functions in a transboundary basin.



1 Construction of dams for power generation, including at Kariba and Cahora Bassa on the main stem of the river, has substantially altered the basin hydrology and flow regimes with significant ecological, economic and social consequences. Further hydropower dams are planned in view of the growing regional demand for electricity.

2 Zambezi Delta: The change in river discharge following closure of the Cahora Bassa dam in 1974 led to a dramatic reduction in offshore shrimp catches. Managing dam releases to reduce dry season flows and increase wet season flows would improve recruitment of juvenile shrimps to the Sofala Bank with a resulting increase in productivity of the fishery worth as much as US\$30 million per annum within two years (at 1997 prices) (Hogane 1997).

3 Major riverine wetlands in the Zambezi basin include the Kafue Flats and Upper Zambezi Floodplains, including the Barotse and Caprivi-Chobe plains. These vast wetlands support fisheries; recession agriculture; and grazing; as well as important wildlife populations and major congregations of waterbirds. In 1999, the direct economic value based on consumptive use of the extended Barotse wetlands complex was estimated to be US\$400 per household (Turpie et al., 1999).

5

LAKE NAIVASHA

One of few freshwater lakes in Eastern Africa, Lake Naivasha, located high in Kenya's Great Rift Valley, is at the heart of a thriving agricultural economy centred on its prized water resources.



© Simon Rawles / WWF-Canon

Planting tree seedlings in the upper catchment

SHARING BENEFITS AND RISKS

From the upper catchment to the lake and its wetlands, water in the lake basin is a shared resource – to which numerous stakeholders lay claim, from small-holders, horticulturalists and flower growers; to cattle ranchers and wildlife. The shallow lake and surrounding swamplands host more than 350 species of waterbirds and have been recognized under the Ramsar Convention as a wetland of international importance since 1995.

Agricultural activity in the basin has expanded dramatically, in both the rural small-holder farms in the upper catchment and the commercial horticulture farms around the lake. The sector anchors a local economy that supports almost 650,000 people.

A combination of factors makes Lake Naivasha one of the best sites in the world to produce cut flowers and fresh vegetables. Its altitude and climate, its access to a reliable supply of high-quality fresh water, low rainfall, fertile soils and its proximity to an international airport that can easily reach European markets have enabled the



development of the Naivasha region into what is now considered the heartland of Kenya's horticulture and floriculture sector (Becht et al., 2006). Commercial farming has become a mainstay of the local economy, attracting tens of thousands of local and migrant workers and contributing hundreds of millions of dollars each year to Kenya's economy. The area accounts for more 70 per cent of Kenya's cut flower exports while horticulture activities in the basin account for some 20 per cent of its vegetable exports.

Over the past 50 years the upper catchment has experienced significant land use change including conversion of indigenous forest and open woodland into agricultural smallholdings. Increasing subdivision of plots over generations, together with deforestation, has magnified pressure on the natural resource base – leading to a decline in land productivity, increasing sediment run-off and altered hydrology. With declining land productivity and lack of access to know-how, farmers have been unable to invest in much-needed changes in farming practices. At the same time, discharge of municipal waste water and irrigation return-flows from commercial farms pose threats to the water quality in the lake.

Changes in lake levels, including as a result of natural fluctuation and occasional but acute pollution events, have highlighted how basin stakeholders are bound by a fabric of interwoven risks associated with water services in the basin.

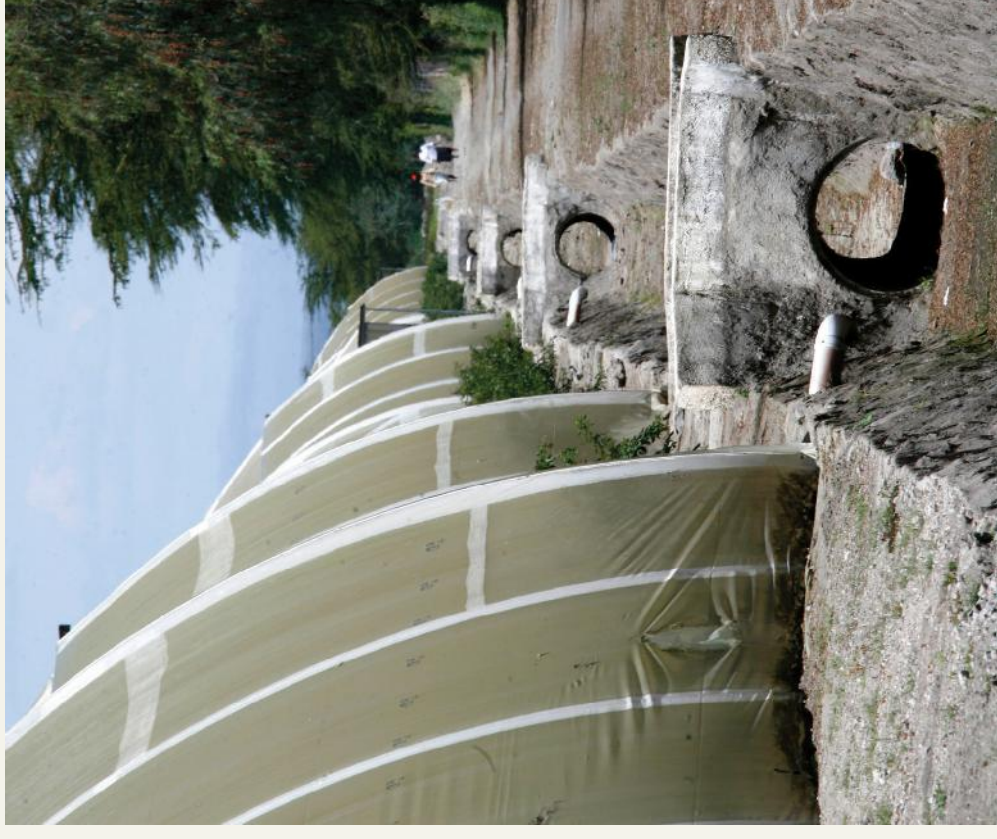
Increasing urban and agricultural abstraction, together with increasing temperatures and climate variability, are highly likely to impact the recurrence and severity of crisis periods.

The basin stakeholders are exploring new ways to work together under the framework of Kenya's 2002 Water Management Act, which emphasizes that water management be locally driven and provides for creation of water resource user associations (WRUAs).

One successful project in the region is the pilot project for "Equitable Payment for Watershed Services" project which was jointly facilitated by CARE and WWF, and linked the commercial water users around the lake with 565 smallholder farmers via the WRUAs. The Lake Naivasha Water Resources User Association (LANAWRUA) members sponsored the Wanjohi and Upper Turusha WRUAs to rehabilitate and maintain the riparian zones, plant trees and reduce fertilizer use.

The 565 upper catchment farmers who undertook these activities were rewarded with vouchers that could be used to purchase agricultural inputs and basic household goods. This has allowed them to further transform the way in which they farm, with benefits to themselves, to other water users, and to the environment.

Although still a pilot, the project is an example of the effective coordination of different water users to manage water resources from the top of the catchment to the end user.



Irrigation water from green houses is being collected in run-off channels, Lake Naivasha region, Kenya

6

AFRICA'S MARINE PROTECTED AREAS

Around Africa, a new generation of multi-purpose marine protected areas (MPAs), ranging in size from just a few hectares to many thousands of square kilometers, is providing biodiversity conservation, tourism revenues, and improved fisheries.

59,000 TRADITIONAL COASTAL FISHERIES PROVIDE 59,000 LIVELIHOODS IN MADAGASCAR

Acclaimed MPAs gazetted in the last decade include Saint-Louis, Cayar, Joal-Fadiouth, Bamboung and Abéné in Senegal, created under the auspices of PRCM, the regional marine and coastal conservation programme, in close cooperation with the Subregional Fisheries Commission, Quirimbas National Park in Mozambique, and Prince Edward Islands belonging to South Africa. Less formal management regimes established at local level are also bearing dividends.

Locally-managed marine areas in southwestern Madagascar

An estimated 59,000 fishermen and women are involved in traditional marine fisheries in Madagascar's coastal waters, mostly operating within 10 kilometers of the coast. The globally important coral reefs of southwestern Madagascar support one of the most productive fisheries and provide the principal source of income for local populations – especially in times of drought. However economically valuable species, such as octopus and lobster, are now in danger of overexploitation, while others, such as sea cucumbers, have virtually disappeared from some areas.

AfDB is supporting pilot initiatives in community fisheries management in the southwestern area are now beginning to yield results that will inform Madagascar National Parks' efforts to establish a large multi-use MPA to the south of Toliara, as well as development of a regional legal framework. Facilitated and supported by NGOs such as WWF, Blue Ventures and the Wildlife Conservation Society, the locally-managed marine area (LMMA) approach combines community planning and regulation of resource use with strong monitoring, to track changes in fisheries' productivity and the state of the reef.

A steady process of community empowerment has been central to the improved management of fisheries in four pilot areas covering about half of the 200km coastal strip from Maromena/Befasy to Ambohibola. Resident facilitators worked with communities over several years to understand their needs and concerns, leading to the organization of management committees representing different family lineages. The committees have taken on activities such as sanitation and communication at village level, and are reaching out to neighbouring communities.

The improvement of the health of the reef ecosystem since local management measures were put in place in 2009 is reflected in the reappearance of lost fish species and by the reduction in species associated with unhealthy reefs. Fishers have reported that catches of prized species such as lobster have increased by 1.5 to 4 times. Infractions fell by 75 per cent between 2009 and 2010, and destructive fishing practices has disappeared in two areas.

PIONEERING "BLUE CARBON" CREDITS

The growing appreciation of carbon sequestration by coastal ecosystems presents an opportunity to manage and restore mangrove



forests and to enhance the coastal livelihoods through payments for environmental services. Mangroves sequester and store five times more carbon than productive terrestrial forests, and coastal wetlands (mangroves, sea grasses and salt marshes) account for as much as 71 per cent of all carbon storage in ocean sediments (Nellemann et al., 2009).

“Mikoko Pamoja” is a small-scale feasibility project at Gazi Bay in Kenya designed to enhance mangrove productivity and integrity and benefit local communities. The project partners plan to replant 0.4 ha/yr in degraded intertidal areas over the next 20 years, generating blue carbon credits to finance the restoration efforts and support community development projects, and to protect 107 ha of natural and 10 ha of replanted mangrove forests.

Implemented by the Kenya Marine Fisheries Services and partners, the Gazi Bay project is at the forefront of efforts to generate credits for blue carbon. WWF and partners are exploring opportunities to scale up this pioneering work in the western Indian Ocean region and beyond, bringing benefits to coastal people and the wider global community.

© Edward Parker / WWF-Canon



Mangroves, a vital system

Africa's coasts are home to around 15 per cent of the world's mangroves, located on approximately 10,000 km² of coastlines bordering the Indian Ocean coast and Mozambique Channel (Spalding et al., 1997) and 20,000 km² bordering the Atlantic coast (UNEP, 2007). As well as providing for carbon sequestration, mangroves play a crucial role in the region's economy as fish nursery zones, sources of wood, poles and non-timber forest products, and buffers against coastal erosion.

7

TOWARDS A LOW CARBON FUTURE - RENEWABLE ENERGIES IN AFRICA

Renewable projects are being planned and implemented throughout Africa, bringing both immediate and long-term solutions to Africa's energy poverty, while minimizing greenhouse gas emissions.

19 SOUTH AFRICA PLANS TO ADD 19 GW OF RENEWABLE ENERGY TO THE NATIONAL GRID BY 2030



LOW-CARBON ACTION PLAN

As a country extremely vulnerable to the impacts of climate change, South Africa has identified water, disease, food security and environmental migration as key areas where climate change will exacerbate existing development challenges. At the same time, with an economy powered by coal-generated electricity and with energy-intensive industry and mining contributing significantly towards GDP, there are fears it will be penalized by global markets that are starting to shun carbon intensive goods and services.

The South African Renewables Initiative (SARI) aims to support the rapid development of large-scale renewable energy in fulfilment of South Africa's Integrated Resource Plan (IRP, 2010) that envisages adding up to 19 GW of renewable energy to the national grid by 2030. The initiative has set out to solve the incremental cost challenge and to help catalyse green growth

through job creation and through stimulation of off-grid renewable energy in the wider economy. It intends to mobilize and channel international public finance into the development of renewable energy capacity and the delivery of green energy.

In parallel, the South African Low Carbon Action Plan (WWF, 2011) is a proposed framework or national planning tool designed to unpack the what, when and how of creating a low carbon economy. The allocation of the carbon budget will involve trade-offs between different activities, which will have far-reaching implications. It is being undertaken through a collaborative process involving all stakeholders. Contribution to development will be a primary consideration in determining which emitting activities are afforded space in the national carbon budget.

Concentrated solar energy

Electricity consumption in the Middle East and North Africa (MENA) region is among the fastest growing in the world. At the same time, the region has huge potential in concentrated solar power (CSP) generation that could serve its own and wider regional needs. The vision of the Mediterranean Solar Plan (MSP), under the Union for Mediterranean (UfM) initiative is to exploit the renewable energy potential of

North Africa and become a global powerhouse for green energy. CSP can help meet growing demand in the region and beyond, enhance energy security and diversify the energy mix for power generation. It can also fuel green growth opportunities through local sourcing of equipment, components and services.

Morocco has the largest proposed capacity of the MENA countries and is now planning one of the largest CSP plants in the world. The Morocco Solar Plan, launched in November 2009, is the cornerstone of the country's renewable energy and climate change mitigation strategy. The US\$9 billion Solar Plan calls for the commissioning of five solar power generation plants between 2015 and 2020 – with a total capacity of 2000 MW. With investment from AfDB, the Phase One of the ambitious Ouarzazate 500 MW CSP project aims to develop 125-160 MW of CSP of a total 500 MW planned in a public private partnership with MASEN, the Moroccan public solar agency.

Hydropower

With the help of AfDB, the privately-owned and operated Sahanivotry Hydroelectric Power Plant in Madagascar has been helping the country meet its significant and growing power needs in a reliable and cost-effective manner since 2008.

CDM CDM CAN GENERATE FINANCE FOR CLEANER ENERGY IN AFRICA

Located on the Sahanivotry River in the province of Antananarivo, the Sahanivotry hydropower plant has an installed capacity of 15 MW and an average gross electricity generation of 90 GWh. It provides 10 per cent of the island's electricity from hydropower, feeding the Antsirabe and Antananarivo grid, which in turn, feeds the regional grid of Antananarivo, Madagascar's capital. With lower costs than an equivalent sized thermal plant, Sahanivotry has facilitated a 50 per cent increase in new consumer connections at an affordable price.

In August 2010, the Sahanivotry Plant was granted approval to sell carbon credits through the UNFCCC Clean Development Mechanism (CDM): the first registered CDM project in Madagascar, and one of only 48 projects registered in Africa. The African Development Bank, which provided half of the €1.3 million needed for the plant's construction in 2007 and 2008, guided the operating company, Hydelec, through the rigorous CDM registration process.

Improved Fuelstoves

Over one million sacks of charcoal are burned each year for household energy needs in the city of Goma, in the eastern Democratic Republic

of Congo. While there are promising long-term solutions for electrification, the magnified demand for fuelwood as a result of influx of refugees and internally displaced persons (IDPs) called for a more immediate solution to growing deforestation. Conservation and development partners working with UNHCR have adopted a two-fold strategy.

On the demand side, local craftsmen have been trained in the production of fuel-efficient woodstoves made from metal barrels and clay. Over 7,500 stoves have been manufactured since November 2008 for distribution to IDP camps and for sale in Goma at a price of at US\$5 per stove. Manufacturing of stoves has created some 160 jobs, with further benefits in maintenance, distribution and sale.

On the supply side, WWF's EcoMakala programme has worked with local communities to plant forestry plantations on their land for commercial fuelwood as a viable alternative to illegal extraction of fuelwood. Approximately 6,000 ha of woodlots have been planted over the past five years.



© AfDB

AfDB has supported development of the Ain Beni Mathar Integrated Solar Thermal Combined Cycle Power Station in Morocco

3 CONCLUSIONS AND CALLS FOR ACTION



INTRODUCTION

The choices made today about infrastructure, energy and food production will shape humanity's opportunities and options far into the future.



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Forest of the western Congo basin at the edge of Minkebe Reserve. Gabon

Africa has choices in terms of its development pathways. Pursuing a more sustainable and equitable approach to development than those taken in some other parts of the world can generate benefits in terms of environmental security, human well-being and increased competitiveness.

Humanity's demand on the world's living resources, its Ecological Footprint, has more than doubled since 1961 and now exceeds the planet's regenerative capacity by about 50 per cent. The ecosystem services on which we depend for our livelihoods and well-being are being degraded as a consequence of our escalating demand for natural resources, and this is increasing our vulnerability to economic and environmental shocks.

Africa is not yet in biocapacity deficit – where Ecological Footprint exceeds available domestic biocapacity – but if we continue with “business as usual” Africa as a whole faces deficit within a generation. While the impact of the average African citizen is lower than that of many of their global counterparts, a growing number of African countries are now using their natural resources more rapidly than they can be renewed and depleting their natural capital. The Millennium Ecosystem Assessment found that loss of ecosystem services is jeopardizing national and regional efforts to achieve the Millennium Development Goals to reduce poverty, hunger, disease and gender inequality.

The good news is that many of the solutions are already known. Based on the analyses and growing body of experience summarized in sections 1 and 2 of this report, the following section identifies complementary strategies for managing the growth and impact of the Ecological Footprint in Africa through resource efficient development while at the same time enhancing ecosystem resilience. The approaches and measures proposed in the following sections can also contribute to mitigation of carbon emissions and adaptation in the face of climate change.

Building a sustainable economy will require concerted efforts from local to national levels and across all sectors, changing the way our institutions work together and plan together. Many of the actions and strategies described in the following pages will require action by governments ranging from policy guidance to enabling legislation and improved governance. Others may find their starting points in local innovation, in the expressed preferences of buyers, consumers or investors, or in the private sector.

Green Growth

Green Growth is about quality of growth.

The enabling conditions and realities for development are vastly different in the 21st century from those of the 20th century.

Increasingly inter-connected and knowledge-based economies present new opportunities and avenues for development, while pollution, waste, environmental degradation and climate change pose growing challenges. As the Ecological Footprint report shows, on a global scale, development processes need to become more resource efficient and growth processes more resilient, if the needs of a growing world population are to be met. This requires the shift towards a greener, more sustainable and inclusive development model.

For Africa, the priority is to develop, building livelihood security and economic prosperity.

Promoting Green Growth in Africa means addressing existing and emerging development challenges without locking into development pathways which deplete Africa's natural capital and leave economies and livelihoods more vulnerable to climate change and other environmental, social and economic risks. It is about turning Africa's existing biocapacity into an asset and advantage for sustainable development and prosperity.

The African Development Bank is currently in the process of refining its strategic approach towards Green and Inclusive Growth in Africa. Emphasis is being placed on tailoring the concept of Green Growth to specific development context of the African continent. The development of the strategic approach is focused on providing sustainable infrastructure, managing Africa's resources in an efficient and sustainable manner, and strengthening the resilience of livelihoods and economic sectors to environmental and socioeconomic changes. The Green Growth concept for Africa must be guided by a development centered emphasis on growth, poverty alleviation and sustainability, with a strong client orientation. Core operating principles for enabling green growth are inclusiveness, promoting gender and pro-poor economic growth, and embracing a participatory approach, which seeks to align skills and comparative advantages of various stakeholders at country, regional and global levels. Within this setting, the African Development Bank must act as a catalyst and champion for enabling a transition towards Green Growth in Africa, by facilitating access to information and knowledge, training and financial resources.



Woman watering plants at tree nursery, Shimba Hills, Kenya

ENHANCING BIOCAPACITY WHILE ENSURING ECOLOGICAL SECURITY

Ecological resilience and biocapacity can be enhanced through a suite of measures including good agricultural practice, restoration of degraded lands, careful use of limited water resources in the context of river basin management, and ecosystem management.

Entrenching good governance principles and practice is a precondition for Africa's development. The initiatives illustrated in case studies above have highlighted how stronger regional integration, inter-ministerial coordination, community empowerment and involvement of non-state actors can mobilize stakeholders at all levels to better manage natural capital. It is clear that particular attention needs to be paid to ensure Africa's natural resources provide sustainable and equitable benefits. The Africa Forest Law Enforcement and Governance process exemplifies the high-level commitment needed to tackle illegal resource use.

Invest in Africa's ecological infrastructure

Humanity's long-term food, water and energy security is contingent on the sustainable and equitable management and conservation of the world's natural capital – including forests, wetlands, grasslands, savannas, oceans and coasts, freshwater systems, and biodiversity.

FORESTS IN AFRICA SUPPORT TENS OF MILLIONS OF LIVELIHOODS



Measures to secure access to natural resources for future generations and ensure adequate security for all include:

- Promoting integrated approaches to planning and management at all scales in order to reconcile and balance development and conservation while conserving vital ecosystem services.
- Preserving and protecting ecosystems that provide key ecosystem services necessary to achieve food, water and energy security.
- Significantly strengthening and investing in government processes responsible for the allocation and sustainable management of resources, for example by land-, sea- and water-use planning within and between countries, as well as on the high seas.
- Encouraging investment in restoration and rehabilitation of the ecological and natural resource base of our economies, for example eroded soils, degraded water bodies, degraded forests and savannas, overexploited fish stocks and degraded lands.
- Promoting reform to secure equitable access and sustainable utilization of natural resources.
- Enhancing resilience by putting in place effective protected area systems, integrated into surrounding landscapes, with the effective participation of local communities.

Halt and reverse forest loss

Forests in Africa support tens of millions of livelihoods and provide vital environmental services that benefit local and more distant populations. If forests are to continue to provide the goods and services upon which we depend, we urgently need to stop deforestation and forest degradation.

Measures that can help to halt and reverse forest loss include:

- Investing in sound stewardship of forests in order to secure goods (food, medicine, timber, construction materials, etc.) and services (preserving watersheds, stabilizing soil and preventing erosion, and carbon sequestration).
- Collaborating in the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation) under the UNFCCC.
- Promoting the use of sound environmental and social standards including through certification schemes such as the Forest Stewardship Council, and bringing an end to trade in illegal timber.

Manage water as the crucial link in the water, energy and food security nexus

Water is the lifeblood of ecosystems, but in Africa and around the world, there is growing competition for scarce water resources.

Measures that can help ensure that adequate and reliable supplies of clean water are available to all without undermining ecosystem services include:

- Managing inland water ecosystems so that water availability, flows, connectivity, and quality are adequate to sustain biodiversity and ecosystem services.
- Restoring and safeguarding ecosystems that provide essential services related to water, including along rivers, around lakes, in mountains and steep slopes and in coastal areas, such as headwaters, floodplains, flooded forests, wetlands, aquifers' recharge zones, riparian vegetation and mangroves.
- Governing, managing and allocating water within the framework of integrated, participatory river basin management, including through creation and strengthening of river basin organizations.
- Building and investing in institutions and capacity for integrated water resources management including water allocation to meet the needs of all relevant sectors.
- Reiterating a commitment to transboundary water cooperation including by joining and effectively implementing the UN Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Watercourses Convention) as a global framework for

guiding and supporting transboundary water cooperation.

- Providing greater protection and support for inland water fisheries and fisheries-dependent livelihoods and investing in sustainable fishing practices and policies to prevent, control or reverse overexploitation.

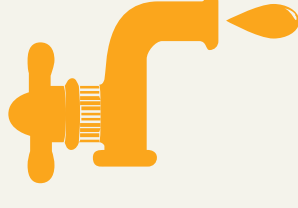
Enable sustainable production and access to markets

Investing in sustainable production will be vital to meet Africa's food security needs and put an end to food shortages currently affecting up to a third of Africa's population.

Measures to improve food security without undermining the ecological services on which this depends include:

- Prioritizing sustainable intensification and improved yields over agricultural expansion into new areas.
- Investing in rehabilitation of degraded, abandoned or underperforming lands. Related measures to reduce impacts such as erosion and soil loss include construction of terraces, planting of trees and grasses, rehabilitating waterways and cleaning-up pollution, and adoption of agroforestry techniques to improve soil fertility.

IN AFRICA AND AROUND THE WORLD, THERE IS GROWING COMPETITION FOR SCARCE WATER RESOURCES



- Transforming current unsustainable agricultural systems by closing nutrient cycles, increasing resource efficiency, and eliminating unsustainable practices that harm the environment and lead to biodiversity loss.
- Promoting better management practices and knowledge transfer in order to reduce impacts and expand production knowledge that helps maintain and restore healthy ecosystems.
- Investing in support to small-scale farmers to enable them to maximize their contribution to food and water security, environmental protection, and climate adaptation. Measures would include dissemination of knowledge and information including through extension services, early warning systems related to extreme weather events, and appropriately designed technological assistance to increase yields and diversify rural incomes.
- Empowering producers to produce sustainably through support for certification standards and schemes.
- Increasing efficiency in the food system by reducing post-production losses – including through investment in storage, processing and improved access to markets.
- Promoting water economy by encouraging the treatment and re-use of wastewater for agricultural purposes.

LIVING WITHIN PLANETARY LIMITS

The three main drivers for increased footprint in Africa have been identified as population growth, increased demand for energy, and urbanization. With its relatively low per capita footprint, Africa is well-placed to develop more resource efficient pathways than those seen in other regions by using known and cost-effective technologies.



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Water collection on the outskirts of Nairobi, Kenya

Put clean / renewable energies at the heart of a green economy

In view of the urgent need to provide access to clean and reliable energy for households, businesses and industry, energy will take centre stage in the low-carbon economy of the future. Investment in low-carbon energy development provides opportunities for job creation, innovation and entrepreneurship as well as increased productivity and competitiveness.

The following measures can help secure reliable energy access in a carbon and footprint efficient manner:

- Developing a long-term vision for Africa's energy future based upon energy efficiency and renewable energies.
- Promoting national and regional planning to enable mainstream investment in low-carbon energy supply and distribution at local, national and regional scales.
- Establishing national targets to bring an end to energy poverty and vulnerability by achieving 100 per cent access to safe, clean and affordable energy services by 2030.
- Promoting clean development and contributing to global emissions reduction efforts, by steadily raising energy efficiency on the supply side and encouraging a culture of energy saving on the demand side.

- Increasing the contribution of clean renewable energy sources and paying close attention to environmental and social externalities of energy production.

- Investing in sustainable biomass supply and utilization through multi-purpose agro-forestry, efficient and clean cookstoves and biogas digesters.

- Adopting, enforcing and complying with laws, regulations, policies and standards on sustainable hydropower, including with respect to environmental flows, cross-sectoral integration, and public participation in decision-making.

- Adopting and adapting leapfrogging technologies and promoting technology cooperation.

Invest in sustainable urban lifestyles

By 2050, over 60 per cent of Africa's population will live in urban areas and there is an urgent need to introduce footprint-efficient lifestyles in existing and new cities; to reduce the footprint intensity of GDP; and to manage the impact of footprint on surrounding areas. Greening of cities requires long-term planning and significant investment, but can bear dividends in terms of the well-being of citizens, enabling them to contribute effectively to social and economic development.

The following measures can guide the transition to greener and healthier cities:

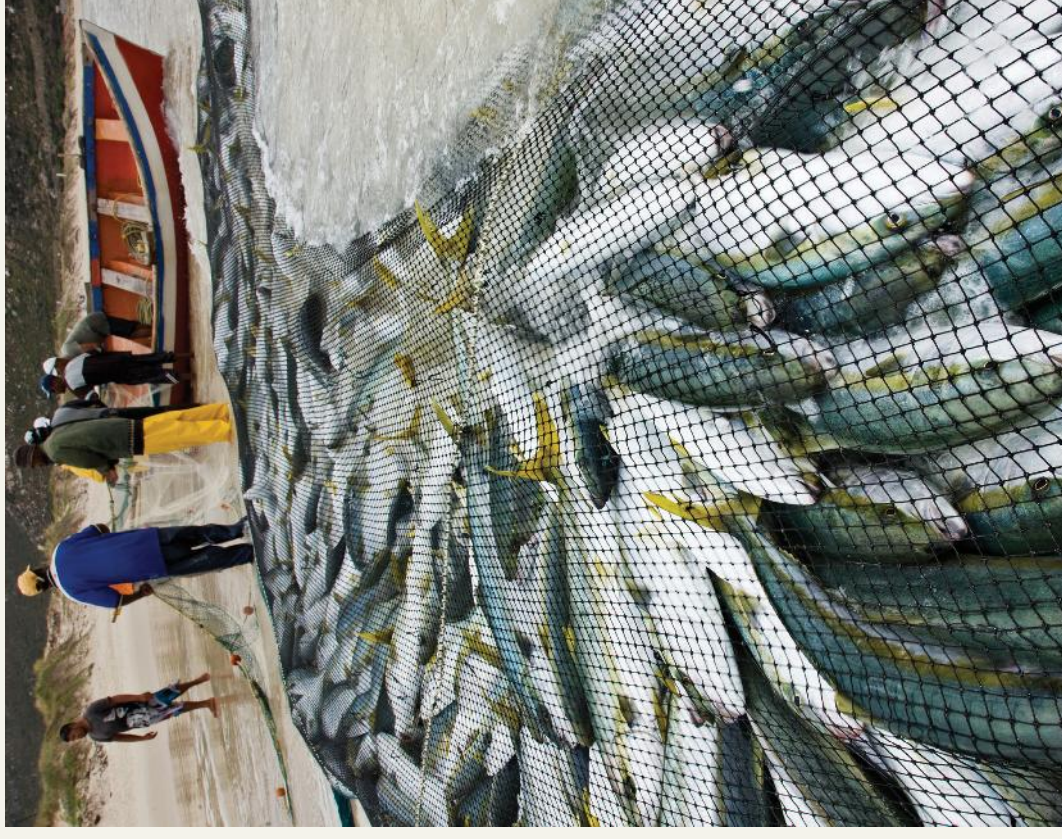
- Designing compact or multi-centred cities and generating economies of scale by clustering services and infrastructure.
- Enforcing planning and zoning regulations to limit urban sprawl and avoid construction in areas vulnerable to sea level rise, flooding or landslides.
- Investing in mass transit systems to reduce pollution and congestion.
- Promoting use of energy-efficient building materials and design of energy-efficient buildings.
- Promoting urban agriculture and sustainable waste water management to support peri-urban agriculture, thus increasing urban food security and reducing cost and wastage of water and nutrients.
- Managing water consumption in cities and reducing water risks in urban settings, including through the protection of upstream ecosystem.
- Promoting energy efficient appliances – including for heating, cooling and lighting – through pricing incentives, labeling and awareness building.
- Integrating recycling into waste management systems.

Enable choices about population

Population growth has been identified as the greatest single driver for footprint growth in Africa and in many other parts of the world.

Meeting human needs and enabling the right to a fulfilling life are all the more challenging in a resource-constrained world, appropriate policy measures to achieve the goals set out in the Dakar/Ngor Statement on Population, Family and Sustainable Development should include:

- Promoting family planning services to provide a choice to families both in the spacing of their children and in the number of children they may wish to have.
- Promoting mother and child health care services, and, in particular, reproductive health services, to help lower maternal mortality rates; promoting child health care to reduce the number of children who die before they reach the age of five.
- Investing more in the education of girls in view of the high pay-offs in terms of both family welfare and reducing population growth rates.
- Promoting interventions to encourage and raise the opportunities and incomes of African women and youths and promote entrepreneurship.
- Ensuring that the benefits of economic growth are shared by all by pursuing pro-poor economic growth policies.



Landing Yellowtail fish in South Africa

KEEPING AN EYE ON THE BOTTOM LINE

The way we measure progress and manage our economies means ecological limits and the impacts we are having on ecosystems and the services they provide are overlooked in strategic decision-making and day-to-day transactions. The TEEB study identified failure to account for the values of ecosystems as a significant factor in their continuing loss and degradation.

We take ecosystems and the services that they provide for granted and all too often we recognize their values only after they have gone. The way we measure progress and manage our economies means that ecological limits, and the impacts we are having on ecosystems and the services they provide are overlooked in strategic decision-making and day-to-day transactions. Failure to account for the values of ecosystems is a significant factor in their continuing loss and degradation.

Use full-cost accounting to capture social and environmental externalities

Full-cost accounting models which capture social and environmental externalities associated with production and consumption would allow us to address the causes rather than simply the symptoms of environmental degradation, and to ensure these are captured in environmental assessments and market valuations.



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Develop and implement incentive frameworks to improve environmental performance

Economic instruments, alongside regulation, can help bridge the gap between the people who generate environmental externalities and those who feel the impacts; and between those who benefit from environmental conservation and those that forego opportunities. These include penalties for poor environmental behaviour ('polluter pays') and rewards for those who alter their behaviour to conserve or enhance ecosystem services and protect biodiversity ('payment for environmental services').

Incorporate environmental performance and resource scarcity in measures of societal progress

Existing measures of societal progress such as GDP and HDI fail to capture environmental performance and resource scarcity. At the national and global level, the use of Ecological Footprint, biocapacity, Water Footprint and the Living Planet Index as part of a suite of environmental indicators alongside more traditional measures that can help us measure our progress towards sustainability; and ensure that national development strategies take full account of the state of natural assets and ecosystems and their role in sustaining human well-being and economic activity.



Sand dune, Sossusvlei, Namib Desert, Namibia

ECOLOGICAL FOOTPRINT: FREQUENTLY ASKED QUESTIONS

LOCAL OVERSHOOT OCCURS WHEN A LOCAL ECOSYSTEM IS EXPLOITED MORE RAPIDLY THAN IT CAN RENEW ITSELF

How is the Ecological Footprint calculated?

The Ecological Footprint measures the amount of biologically-productive land and water area required to produce the resources an individual, population or activity consumes and to absorb the waste it generates, given prevailing technology and resource management. This area is expressed in global hectares (hectares with world average biological productivity). Footprint calculations use yield factors to normalize countries' biological productivity to world averages (e.g., comparing tonnes of wheat per UK hectare versus per world average hectare) and equivalence factors to take into account differences in world average productivity among land types (e.g., world average forest versus world average cropland). Footprint and biocapacity results for countries are calculated annually by the Global Footprint Network. Collaborations with national governments are invited, and serve to improve the data and methodology used for the National Footprint Accounts. To date, Switzerland has completed a review; and Belgium, Ecuador, Finland, Germany, Ireland, Japan and the UAE have partially reviewed or are reviewing their accounts. The continuing methodological development of the National Footprint Accounts is overseen by a formal review committee. A detailed methods paper and copies of sample calculation sheets can be obtained from www.footprintnetwork.org

What is Biocapacity?

Biocapacity is the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and extraction technologies. Biocapacity is measured in global hectares (Global Footprint Network, 2012).

What is a global hectare (gha)?

A productivity-weighted area used to report both the biocapacity of the Earth, and the demand on biocapacity (the Ecological Footprint). The global hectare is normalized to the area-weighted average productivity of biologically-productive land and water in a given year. Because different land types have different productivity, a global hectare of, for example, cropland, would occupy a smaller physical area than the much less biologically-productive pasture land, as more pasture would be needed to provide the same biocapacity as one hectare of cropland. Because world bioproductivity varies slightly from year to year, the value of a gha may change slightly from year to year (Global Footprint Network, 2012)

What is included in the Ecological Footprint?

What is excluded?

To avoid exaggerating human demand on nature, the Ecological Footprint includes only those aspects of resource consumption and

waste production for which the Earth has regenerative capacity, and where data exists that allow this demand to be expressed in terms of productive area. For example, toxic releases are not accounted for in Ecological Footprint accounts. Nor are freshwater withdrawals, although the energy used to pump or treat water is included. Ecological Footprint accounts provide snapshots of past resource demand and availability. They do not predict the future. Thus, while the Ecological Footprint does not estimate future losses caused by current degradation of ecosystems, if this degradation persists it may be reflected in future accounts as a reduction in biocapacity. Footprint accounts also do not indicate the intensity with which a biologically productive area is being used. Being a biophysical measure, it also does not evaluate the essential social and economic dimensions of sustainability.

Biocapacity deficit: The difference between the biocapacity and Ecological Footprint of a region or country. A biocapacity deficit occurs when the Footprint of a population exceeds the biocapacity of the area available to that population. Conversely, a biocapacity remainder exists when the biocapacity of a region exceeds its population's Footprint. If there is a regional or national biocapacity deficit, it means that the region is importing biocapacity through trade or liquidating regional ecological assets. In

LPI TECHNICAL NOTES

contrast, the global biocapacity deficit cannot be compensated through trade, and is therefore equal to overshoot

Overshoot: Global overshoot occurs when humanity's demand on the natural world exceeds the biosphere's supply, or regenerative capacity. Such overshoot leads to a depletion of Earth's life-supporting natural capital and a build up of waste. At the global level, biocapacity deficit and overshoot are the same, since there is no net-import of resources to the planet. Local overshoot occurs when a local ecosystem is exploited more rapidly than it can renew itself (Global Footprint Network, 2012).

How is international trade taken into account?

The National Footprint Accounts calculate the Ecological Footprint associated with each country's total consumption by summing the Footprint of its imports and its production, and subtracting the Footprint of its exports. This means that the resource use and emissions associated with producing a car that is manufactured in Japan, but sold and used in India, will contribute to India's rather than Japan's consumption Footprint. National consumption Footprints can be distorted when the resources used and waste generated in making products for export are not fully documented for every country. Inaccuracies in reported trade can significantly affect the

Footprint estimates for countries where trade flows are large relative to total consumption. However, this does not affect the total global Footprint.

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

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

Global Living Planet Index

The Living Planet Index is a composite index that tracks trends in a large number of populations of species around the world. The species population data used to calculate the index are gathered from a variety of sources published in scientific journals, NGO literature, or on the worldwide web. All data used in constructing the index are time series of either population size, density, abundance or a proxy of abundance. The period covered by the data runs from 1970 to 2008.

Annual data points are interpolated for time series with six or more data points using generalized additive modeling, or by assuming a constant annual rate of change for time series with less than six data points, and the average rate of change in each year across all species is calculated. The average annual rates of change in successive years are chained together to make an index, with the index value in 1970 set to 1. Additional details are available in Collen et al., 2009.

Africa LPI

The Africa index includes all species populations from the continent of Africa, and marine species populations from the Exclusive Economic Zones of African countries in the southern Mediterranean Sea, western Indian Ocean and eastern Atlantic. The African index was calculated by giving equal weight to each species

Threats to Vertebrate Species

The threat data contains the proportion of vertebrate species affected by each threat type. We included African vertebrates that were assessed as threatened with extinction (CR, EN, VU) on the IUCN Red List (IUCN, 2012).

Not all African vertebrate species have been assessed by IUCN, but representative samples are available for all groups. In order not to bias the figure towards those groups that have been comprehensively assessed, all classes were given equal weight, an average proportion was taken from the individual proportions for each group – mammals, birds, reptiles, fishes and amphibians.

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