PBL Netherlands Environmental
Assessment Agency

International cooperation for the **Sustainable Development Goals** in 23 infographics

Sustainable development goals

End poverty in all its forms everywhere

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Ensure healthy lives and promote well-being for all at all ages

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Achieve gender equality and empower all women and girls

Ensure availability and sustainable management of water and sanitation for all

Ensure access to affordable, reliable, sustainable and modern energy for all

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

Reduce inequality within and among countries

Make cities and human settlements inclusive, safe, resilient and sustainable

Ensure sustainable consumption and production patterns

Take urgent action to combat climate change and its impacts

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Strengthen the means of implementation and revitalise the global partnership for sustainable development

Foreword

This ‘storyboard’ depicts scenes of human–nature interdependency and cooperation that we need to address in order to attain a more sustainable development. On the one hand, we are harming our natural environment due to growing developmental pressure, while, on the other, we are increasingly recognising that our natural capital must and can be part of the solutions we seek. This interrelationship between People and Earth is at the core of this PBL report. It uses visual representations to communicate the challenges we are facing and the options for making progress towards the objectives of the UN’s 2030 Agenda for Sustainable Development.

The 2030 Agenda aims for an economically, socially, and environmentally sustainable world. The corresponding objectives are laid down in the Sustainable Development Goals. Several of these goals strongly emphasise the importance of managing the environment and natural resources to further both human development and the well-being of the global population. The issues involved are broad and concern multiple interrelated relationships. But, as the saying has it, a picture is worth a thousand words. With this publication, we hope to have succeeded in conveying straightforward images of some of the relevant global–regional interdependencies driving the basic interrelationship between People and Earth, especially with regard to food, water, energy and land.

The Sustainable Development Goals generate momentum for joint action, not only on the transition towards a more sustainable society in individual countries, but also on forging relationships between economies around the world. The Netherlands, with its open economy built on and shaped by international trade, is particularly facing the strategic urge to redefine its development within an international context. This could be achieved, for instance, by taking responsibility for improvements in supply chains, for developing relevant knowledge on global challenges and options, and for stimulating the development of globally applicable solutions.

The knowledge, models and tools available at PBL Netherlands Environmental Assessment Agency have been the drivers of a close cooperation between PBL and the Dutch Ministry of Foreign Affairs. It gives us great satisfaction to be in the position to impart our knowledge and provide input for enhancing international policies. To underline our fruitful collaboration, we present this storyboard to the Ministry, in the hope that it will inspire and enlighten the discussion on present and future international challenges.

Professor Hans Mommaas,
PBL Director-General

Introduction

In 2015, the global community committed itself to the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs). This global agenda for people and the planet aims to eradicate poverty in all its forms and dimensions by 2030 and works towards an economically, socially, and environmentally sustainable world. The Sustainable Development Goals (SDGs) put strong emphasis on the importance of the environment and our natural resources for human development and the well-being of all people worldwide.

All countries, from the most prosperous to the most underprivileged, have agreed to shift their policies onto pathways towards more inclusive and green development. While this is not the first time that countries have made such global commitments, the new 2030 Agenda is different in its universal application and aim for transformation of production processes and consumption of resources. The interwoven nature of the goals and the tight links between people and nations require integrated approaches which are able to make workable connections between various areas of concern (food, water and energy security, natural disaster risk and environmental degradation), stakeholders (governments, businesses, cities and civil society) and governance levels (global, regional, national and sub-national). Integrated, cross-sectoral and multi-level thinking is therefore crucial to realise sustainable development for present and future generations.

Coupling development goals and environment goals in a single, global policy framework inevitably brings the issue of equity and fairness to the fore. To achieve the 2030 Agenda, a revitalised global partnership for sustainable development is needed. This partnership must cover finance, technology, capacity building, trade, policy coherence, data and monitoring. The 2030 Agenda also recognises that international cooperation is no longer limited to national governments. International partnerships will therefore necessarily depend on global engagement, and on cooperation between governments, civil society, businesses, cities and other stakeholders in order to mobilise necessary efforts and capacities.

The Netherlands is committed to full implementation of the 2030 Agenda – both for the global public good as for its own interests. A small country with an open economy, it has made its living from trading with other countries. For many of its economic activities, such as food production, it depends on natural resources imported from abroad. This connectedness implies a shared responsibility for sustainable management of production systems. As a low-lying, coastal country, the Netherlands is particularly vulnerable to the impacts of climate change and the associated sea level rise, and consequently, it depends on collective international efforts to limit climate change to safe levels.

This book contains stories of international cooperation required to tackle environmental challenges in 23 infographics, grouped into three sections. The first of which deals with trends in economic, social and environmental development, the global challenges, humanity's critical dependence on the Earth and the recently formed global visions and agreements about sustainable development. The second section presents examples of how inclusive and green growth strategies can help achieving the SDGs by contributing to sustainable development in the interconnected areas of food, water, energy and land. The last section illustrates how new partnerships are emerging between governments, civil society, cities, businesses, and financial institutions and highlights the collectively undertaken efforts to make the achievement of the SDGs a reality. A book such as this using infographics is not intended to be comprehensive – its ambition is to enlighten and inspire discussions on ways forward.

Human development and **dependencies on the Earth**

The current geological epoch is characterised by increasing human pressures on the environment. Negative impacts on the natural resource base will become more and more evident if we continue to follow current development pathways. The natural resource base – our natural capital – provides many benefits to humanity including the provision of food, fibre, fuel, clean water and energy, in addition to services such as carbon sequestration, pollination and protection against natural disasters.

Those who depend most on natural resources, developing countries and their poverty-stricken citizens, are also the most vulnerable to local and global environmental changes.

The critical challenge for countries worldwide is to engage in safe and just development strategies to ensure the well-being of the global population, particularly those groups that are most vulnerable. Safe, in order to avoid the negative impacts of global environmental change. And just, in order to ensure that all people can enjoy access to the resources that underlie human well-being.

The required strategies will also have to take spatial developments into account. With more and more people living in cities and increasing national and international trade, the locations of production and consumption processes are becoming more and more separated. As a consequence, the impacts of production remain out of sight of consumers, and this brings the need for international environmental governance to the fore.

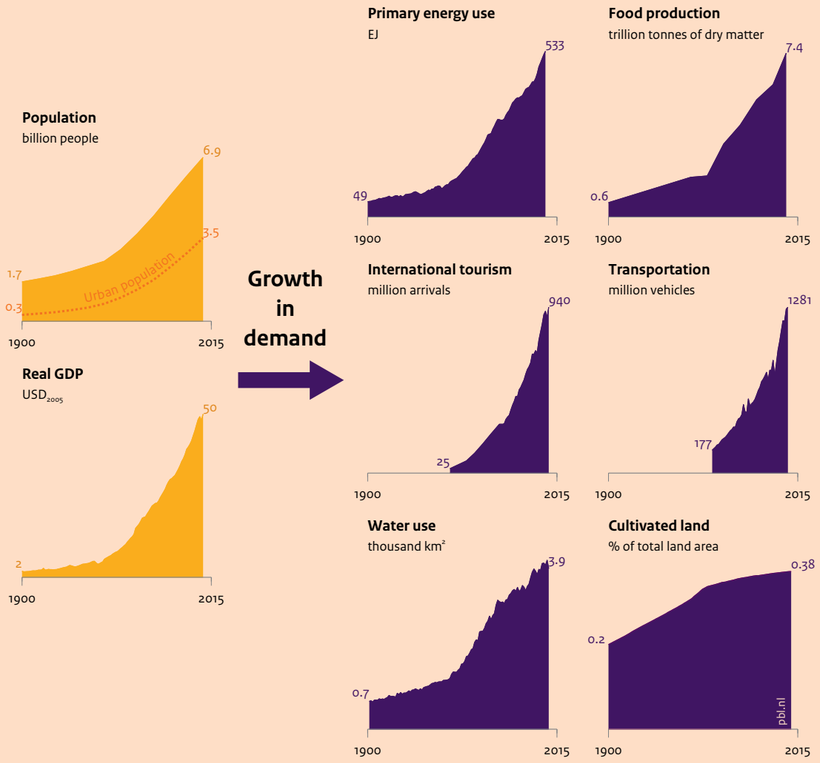
Welcome to the **Anthropocene**

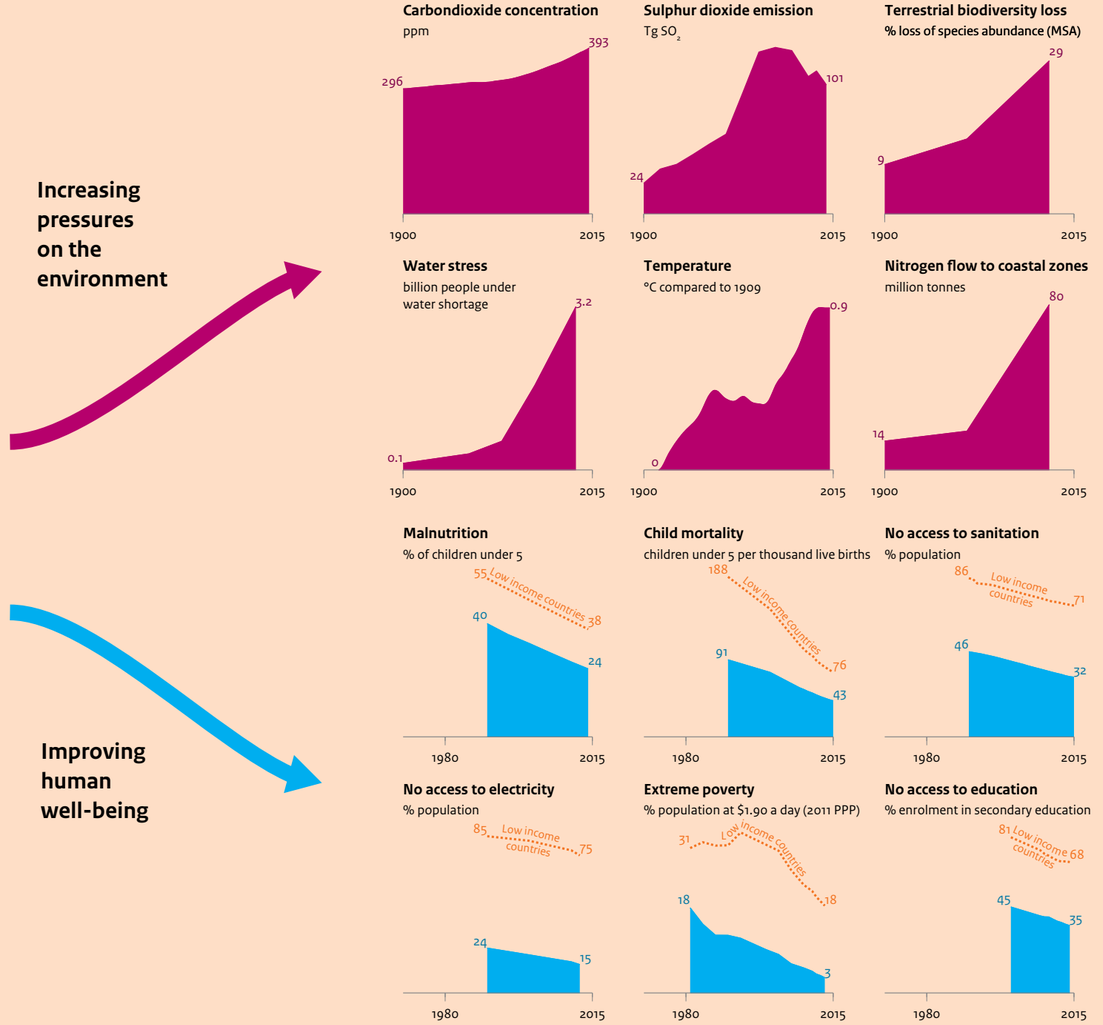
Trends in human development and environmental pressures

Twentieth century human development has brought the Earth into the Anthropocene, the proposed new geological epoch defined by humanity's impact on the planet.

A sharply increasing population, especially in urban areas, alongside strong economic growth, has resulted in a rising demand for natural resources, including food, water and energy. Although economic growth has improved human well-being, growth in the demand for resources is putting increasing pressure on the environment, though there are major differences between regions.

Both human well-being and the environment need to be taken into account, if we are to arrive at a sustainable future. Maintaining the balance between these two domains depends on the way we address and steer growth in production and consumption. An important question is how we support human well-being without compromising the Earth's capacity to provide the resources that human societies need.





Source: PBL compilation

Earth matters

People depend on the many goods and services that nature provides

The biosphere is valuable to us in many ways, some of which are more easily visible than others. Human beings are an integral part of it and fundamentally depend on the Earth's capacity to provide services for human development and well-being from local community levels to the global level of the biosphere.

The benefits that nature provides are called Ecosystem Services, and they can be divided into several categories. The most visible ones are the provisioning services which deliver the resources we use on a daily basis, such as food and clean water. The Earth also provides us with abiotic resources, such as (renewable) energy and minerals in the soil.

Regulating services, which aid in the delivery of provisioning services, include pollination, production processes taking place in healthy soils, and also less visible processes, such as carbon sequestration. Nature also provides recreational space and carries parts of our cultural history and identity.

However, while the consciousness about our dependency on the Earth and its interlinked ecosystem services is growing, we are still running the risk of dealing with the rapidly rising demand for some resources in ways that may be detrimental to others. Sustainable management of the natural resource base is required to support the future delivery of services to people all over the world.

Ecosystem Services: the service that nature provides us

Provisioning services
All tangible material and outputs from ecosystems that can be traded or consumed, such as food, materials and energy sources, both biotic (blue) and abiotic (yellow).

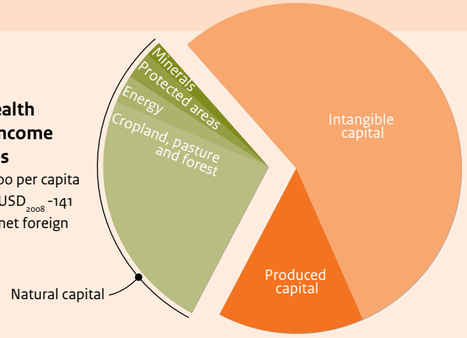
Regulating services
Ecosystem outputs that are not consumed, but that control or modify biotic or abiotic conditions in the environment.

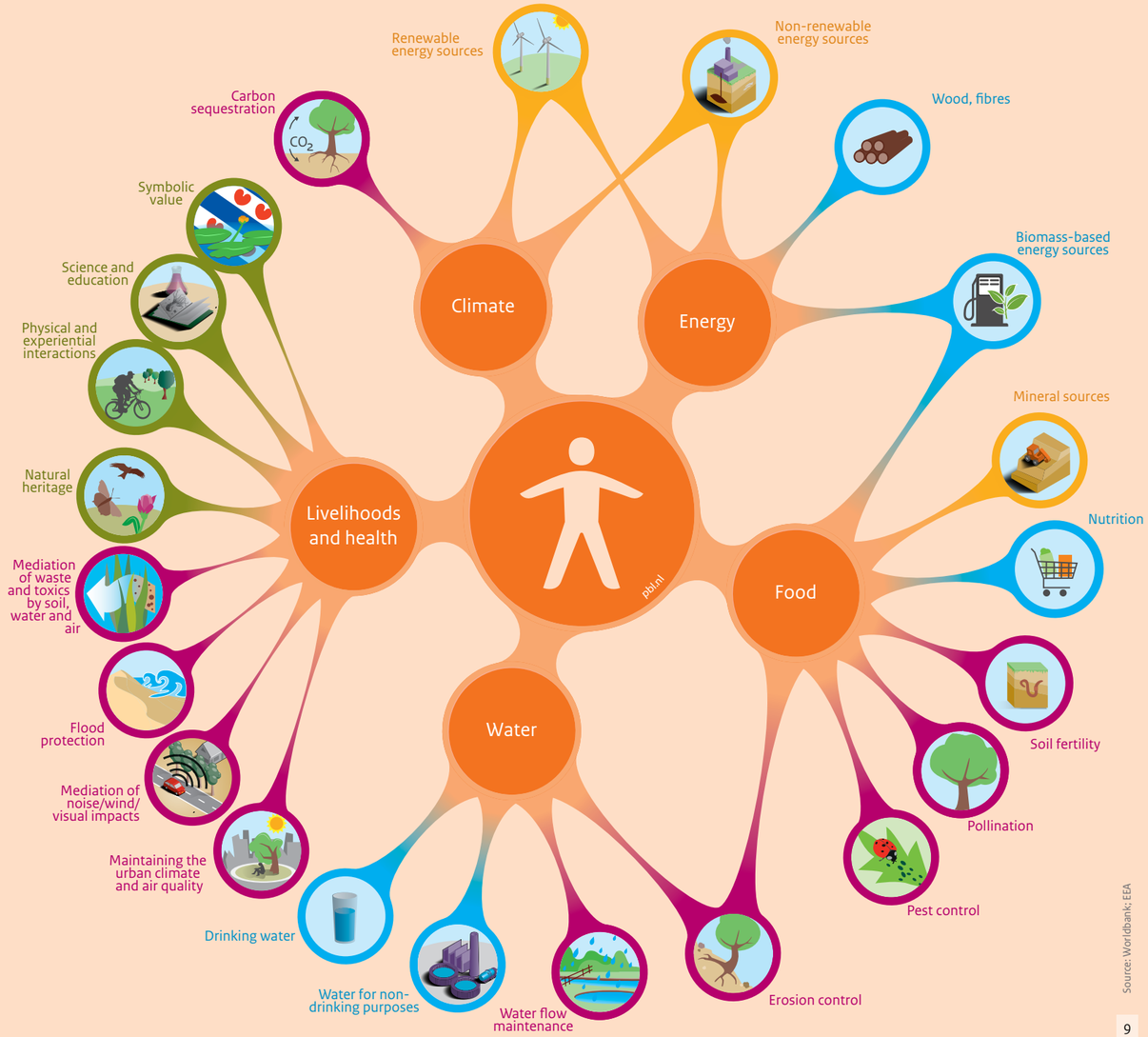
Cultural services
All non-material ecosystem outputs that have symbolic, cultural or intellectual significance.

Taking Natural Capital into account

Natural Capital Accounting integrates natural resources and economic analysis into the system of national accounts that provide a view on a nation's wealth. This expansion gives a broader picture of development progress than strictly monetary measures such as GDP. Such accounts, for example, show that wealth generated in low-income countries depends for more than 30% on natural capital.

Total wealth of low-income countries
USD_{2008} 7700 per capita (including USD_{2008} -141 per capita net foreign assets)





Source: Worldbank; EEA

The future is **now**

Global visions and agreements for sustainable development

Challenges relating to sustainable management of natural resources and the promotion of human well-being feature prominently in international discussions and global agreements. Global poverty has not yet been eradicated and environmental pressures are increasing rather than decreasing. The year 2015 was a landmark thanks to the formalisation of five global agreements. The five agreements stress the importance of proportionate contributions by all countries and all actors. They are the culmination of more than 40 years of UN conferences, summits and international agreements, and underscore the growing realisation that an integrated approach is vital for minimising trade-offs and capturing synergies in the broad range of entangled issues of sustainable development.

The 2030 Agenda conceptualises sustainable development through 17 Sustainable Development Goals (SDGs). Together, they formulate an ambitious and transformational vision for 2030 that links a broad range of issues with other global agreements, as well as with a series of earlier agreements and conventions, such as the Strategic Plan for Biodiversity 2010–2011.

UN Sustainable Development Summit — 2015
The 2030 Agenda for Sustainable Development + SDGs

A plan of action for people, planet and prosperity, concretised in 17 Sustainable Development Goals (SDGs) and 169 targets that are integrated and indivisible and balance the three dimensions of sustainable development

3rd UN Conference on Housing and Sustainable Urban Development — 2016
The New Urban Agenda

Provides a roadmap setting standards for sustainable urban development globally and implementing various SDGs, particularly SDG 11 'to make cities and human settlements inclusive, safe, resilient and sustainable'.

UN Conference on Climate Change COP 21 — 2015
Paris Agreement

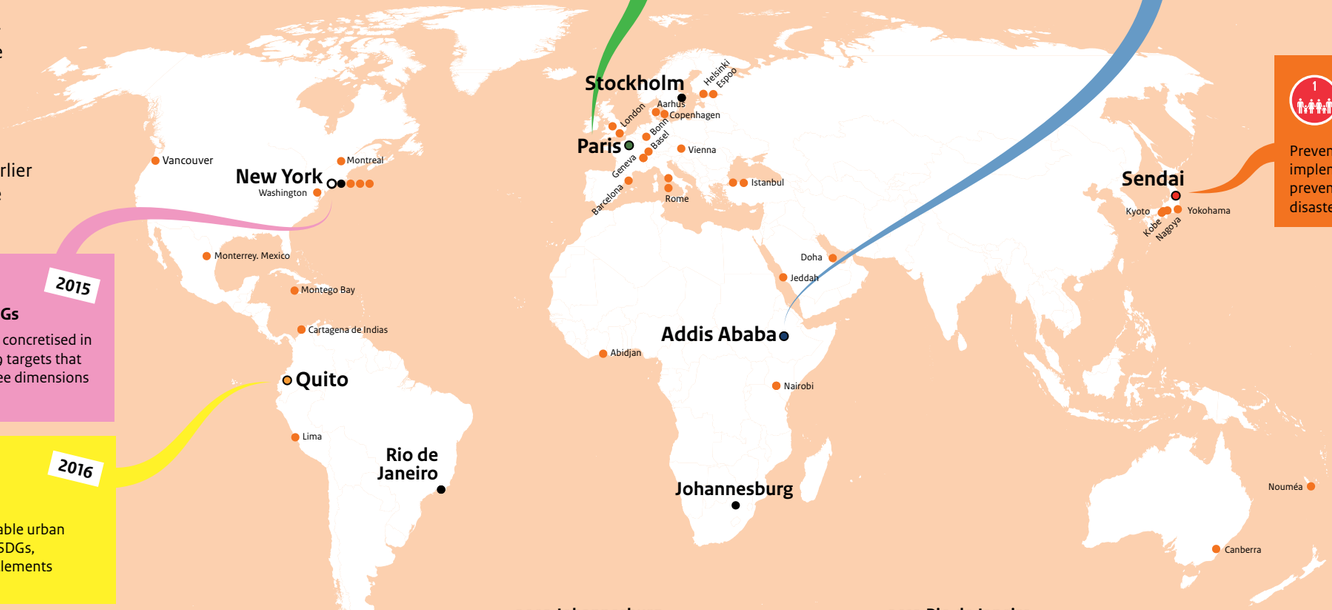
Strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by mitigation, adaptation and finance of climate change.

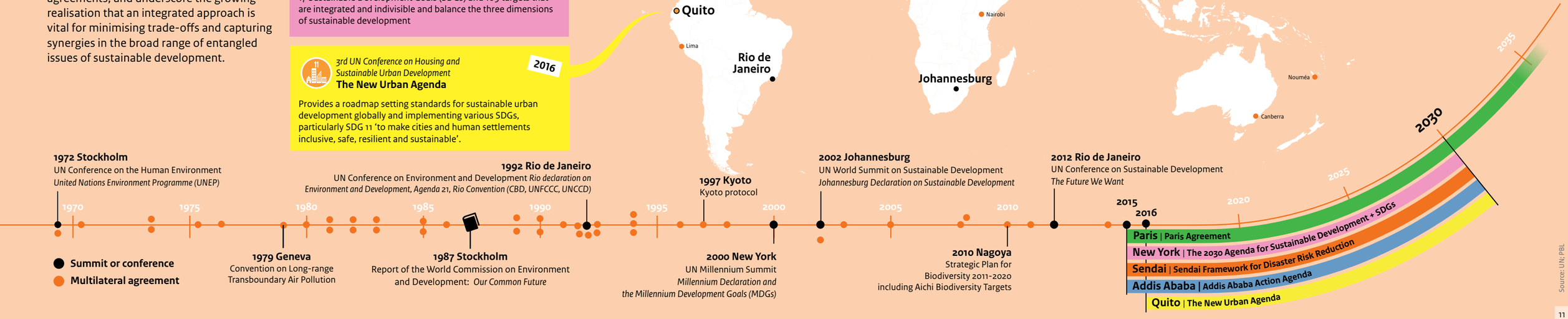
3rd UN International Conference on Financing for Development — 2015
Addis Ababa Action Agenda

Provides a global framework for financing sustainable development and achieving the SDGs. It addresses all sources of finance, and covers cooperation on a range of issues, including technology, science, innovation, trade and capacity building.

3rd UN World Conference on Disaster Risk Reduction — 2015
Sendai Framework for Disaster Risk Reduction

Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery





Source: UN; PBL

Human development in a **Safe** and **Just** Operating Space

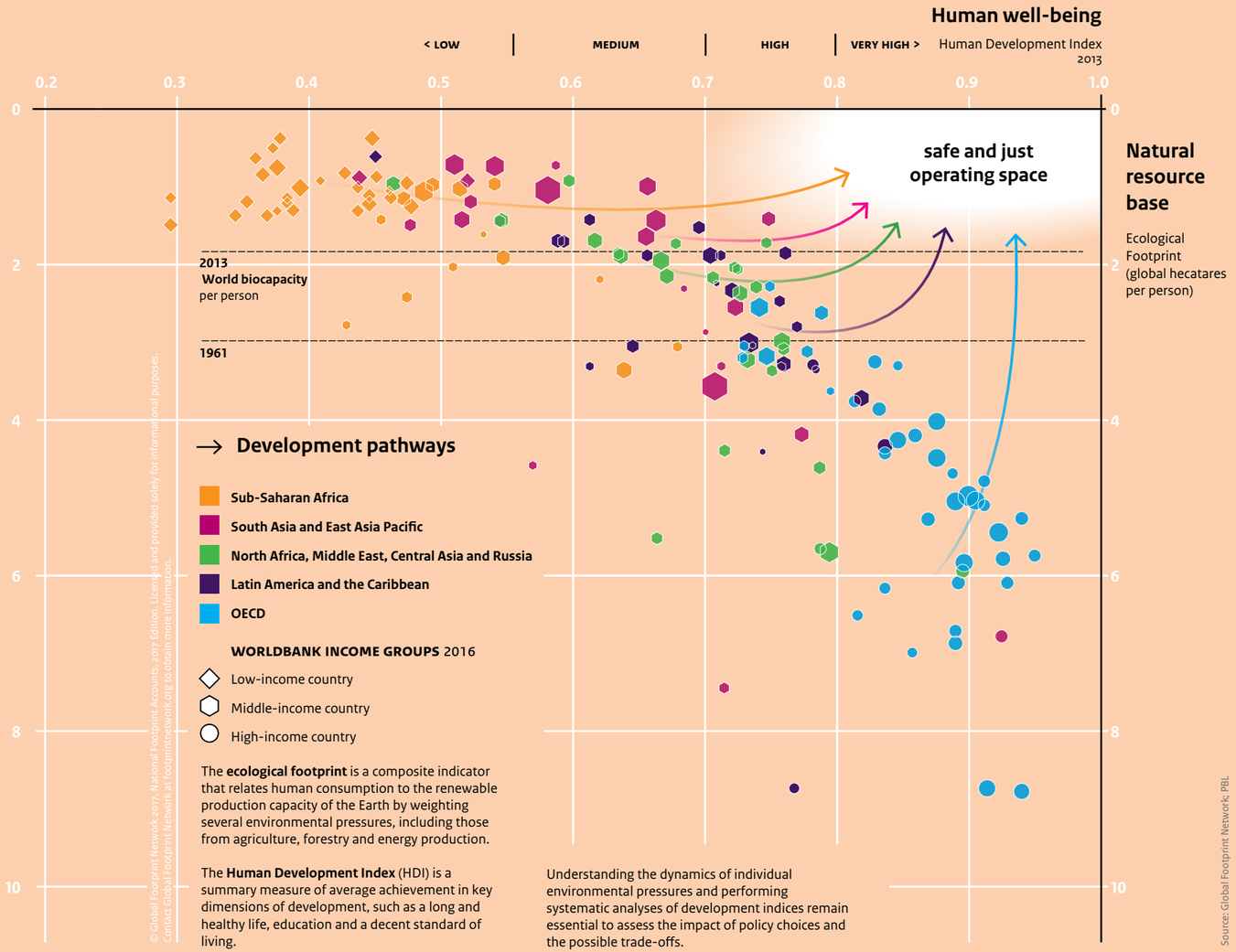
Common but differentiated pathways for development

The 2030 Agenda for Sustainable Development provides a global framework that aims to steer towards a safe and just operating space for society to thrive in. A society in which every person has the resources to meet their individual needs and aspirations, while collectively living within the carrying capacity of the planet. The 17 SDGs address the interrelated challenges of eradicating poverty and improving human well-being and social equity, reducing environmental risks and ecological scarcities by changing unsustainable patterns of consumption and production and promoting sustainable alternatives, and protecting and managing the natural resource base on which people's wealth and well-being is built.

An integrated approach is vital for minimising trade-offs and capturing synergies between the broad range of objectives it sets out. The challenges differ significantly between countries, depending on their human development level, consumption level, production methods and the resulting environmental footprint.

safe and just operating space

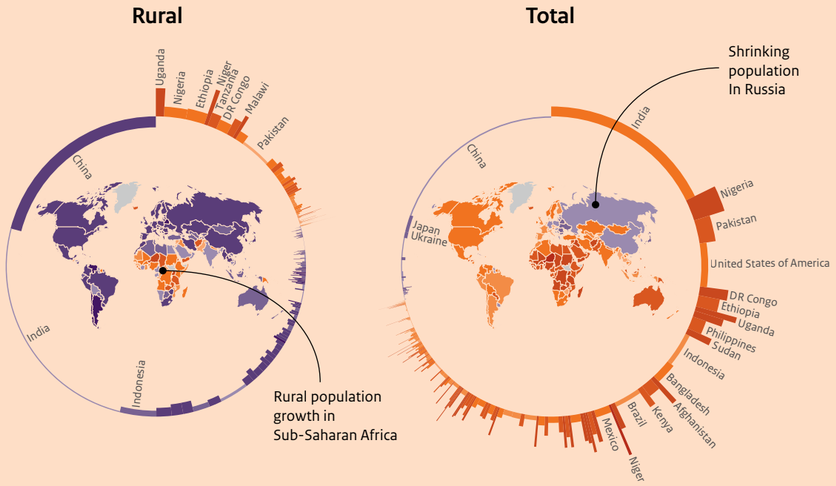
Achieving the SDGs collectively requires differentiated pathways. Low-income countries should significantly improve human well-being and avoid resource lock-ins, middle-income countries should aim for a relative decoupling of economic growth from environmental degradation, and high-income countries should aim for absolute decoupling of economic growth from environmental degradation.



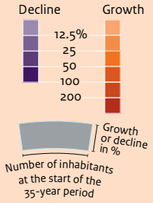
An **urbanizing** world

Estimates predict the total world population to grow by almost 2 billion people to over 9 billion by 2050. At present, around 50% of the world population lives in an urban environment, and the percentage is also expected to increase, reaching around 70% by 2050. Most of the population growth and the population shift to large cities will take place in developing countries. A dramatic example is Sub-Saharan Africa, where currently two thirds of all new city dwellers move into informal settlements or slums, and half of these people are expected to remain there in the long term. Worldwide, almost 1 billion people are already living in these informal urban settlements without adequate access to vital infrastructures.

Urbanisation has a formative effect on society and people's quality of life as well as on the global production and consumption patterns of resources and energy. At the same time, cities are facing the consequences of climate change. It is in cities where most people and assets are at risk of suffering extreme weather events. International agreements such as the Sustainable Development Goals and the New Urban Agenda confront these challenges.



Population change 2015 – 2050
(Business as usual)



Source: UN; WBGU; PBL

...with strong growth in Sub-Saharan Africa

Benefits and **impacts** of Dutch international trade

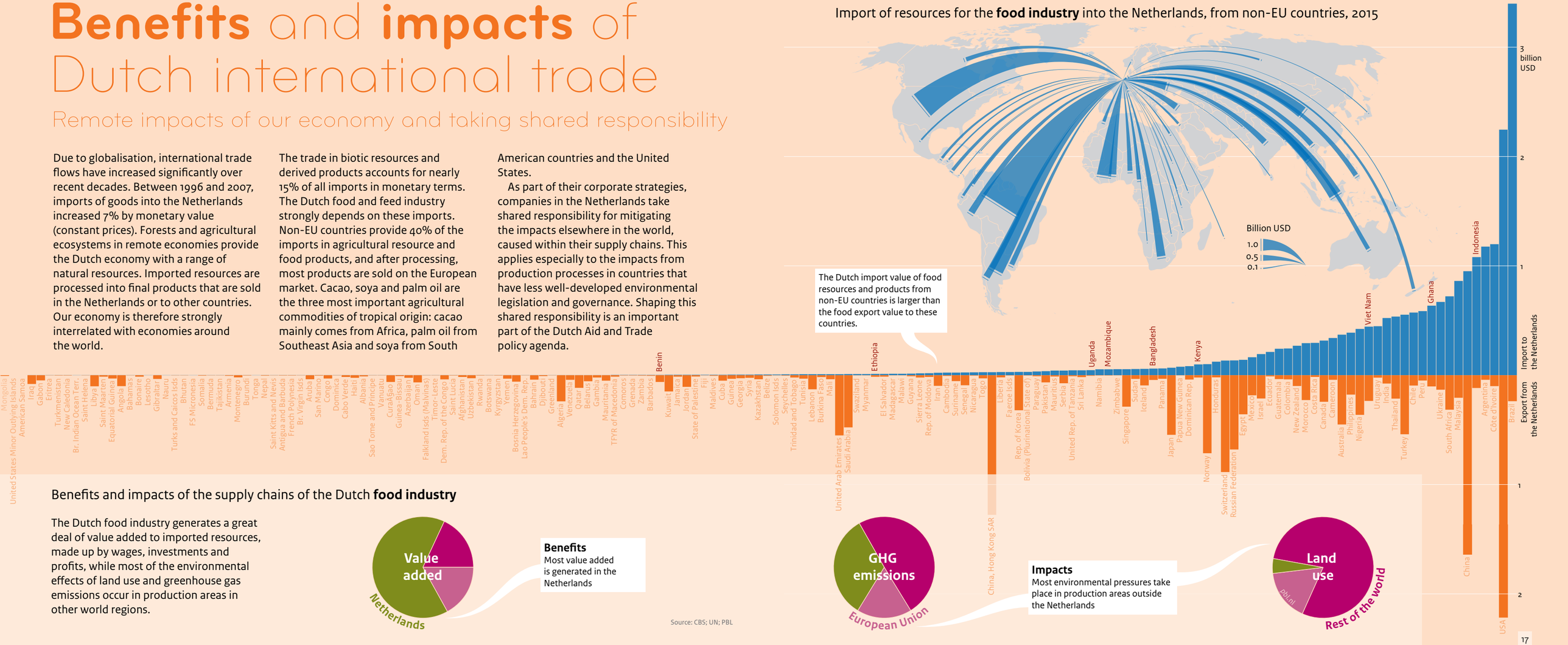
Remote impacts of our economy and taking shared responsibility

Due to globalisation, international trade flows have increased significantly over recent decades. Between 1996 and 2007, imports of goods into the Netherlands increased 7% by monetary value (constant prices). Forests and agricultural ecosystems in remote economies provide the Dutch economy with a range of natural resources. Imported resources are processed into final products that are sold in the Netherlands or to other countries. Our economy is therefore strongly interrelated with economies around the world.

The trade in biotic resources and derived products accounts for nearly 15% of all imports in monetary terms. The Dutch food and feed industry strongly depends on these imports. Non-EU countries provide 40% of the imports in agricultural resource and food products, and after processing, most products are sold on the European market. Cacao, soya and palm oil are the three most important agricultural commodities of tropical origin: cacao mainly comes from Africa, palm oil from Southeast Asia and soya from South American countries and the United States.

As part of their corporate strategies, companies in the Netherlands take shared responsibility for mitigating the impacts elsewhere in the world, caused within their supply chains. This applies especially to the impacts from production processes in countries that have less well-developed environmental legislation and governance. Shaping this shared responsibility is an important part of the Dutch Aid and Trade policy agenda.

Import of resources for the **food industry** into the Netherlands, from non-EU countries, 2015



Source: CBS; UN; PBL

Benefits and impacts of the supply chains of the Dutch **food industry**

The Dutch food industry generates a great deal of value added to imported resources, made up by wages, investments and profits, while most of the environmental effects of land use and greenhouse gas emissions occur in production areas in other world regions.

Benefits
Most value added is generated in the Netherlands

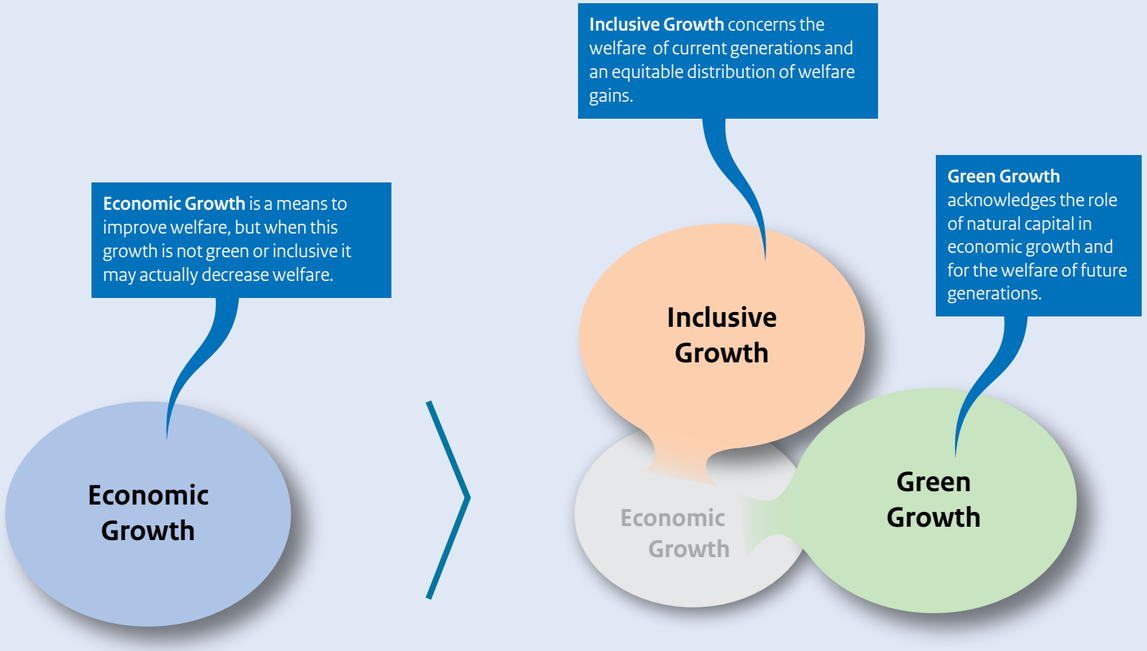
Impacts
Most environmental pressures take place in production areas outside the Netherlands

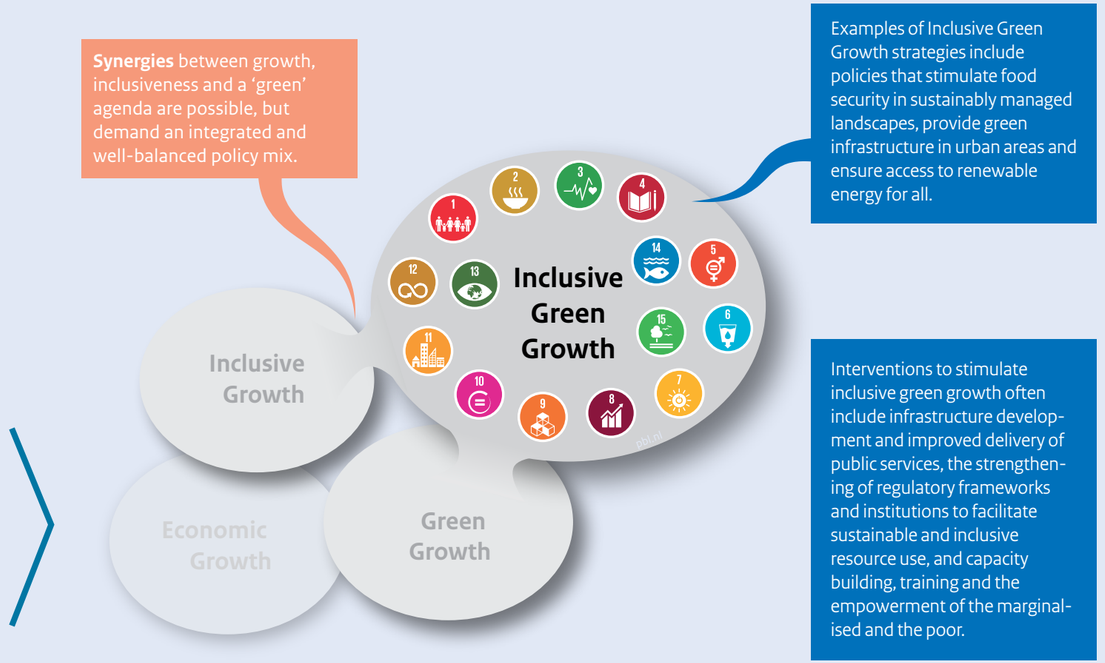
Challenges for the nexus between **food**, **water**, **energy** and **land**

Food, water, energy and land are the main areas of concern where human development and the environment meet and where inclusive and green growth development strategies are most urgently required to ensure the achievement of the Sustainable Development Goals. In this section, we look at challenges in these areas, and concrete solutions to address them.

The 2030 Agenda emphasises that solutions to issues in relation to food, water, energy and land should not be considered in isolation, but by capturing synergies between the various demands for natural resources while managing trade-offs. The interrelated nature of these areas of concern is referred to as the environmental nexus. Several infographics in this section focus on Sub-Saharan Africa, as, in this strongly urbanising region, ending hunger and ensuring modern energy for all is most urgent, while also many other future challenges converge here.

Synergies between economic growth, inclusive development and a 'green' agenda are possible, but trade-offs between areas are likely to occur; for instance, reconciling the expansion of areas for food production with the resulting biodiversity loss and carbon emissions following habitat conversion. This means that a balancing of objectives is needed as well as the use of an integrated policy mix. The search for trade-offs, synergies and solutions is illustrated here with the results from modelling studies based on explorative and normative scenarios (see Annex for scenario details).





Achieving **Sustainable Development Goals...**

Sustainable development implies that growth is both inclusive and green. Economic growth is essential for the alleviation of poverty. Climate change, ecosystem degradation, resource depletion and biodiversity loss illustrate that current economic growth is not green. Nor is it always inclusive; persistent poverty and inequality in countries with fast growing economies are the very example that economic growth alone is not enough. The poor tend to benefit the least from economic growth, due to unequal access to assets, opportunities and decision-making processes. Distributing the benefits of economic growth thus often requires institutional change.

Stimulating Inclusive Green Growth requires that the market and governance failures underlying current non-inclusive and non-green growth pathways are adequately addressed. This implies attention for the factors causing the poorest to be excluded from economic development, and those causing the degradation and depletion of natural capital, including unregulated use of the commons, underappreciation of the value of ecosystems and ignorance of the future benefits of natural capital use.

There is a growing body of evidence of interventions that work. Often, such interventions focus either on better representation and inclusiveness, or on improved efficiency of resource use and conservation. Attention for both, including the possible trade-offs that may arise between growth, green growth and inclusive growth objectives, is required for attaining the Sustainable Development Goals.

...through **Inclusive Green Growth**

Source: PBL

Despite increases in food supply, **hunger persists**

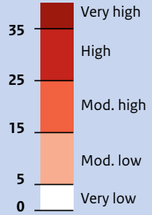
Opportunities for country-specific approaches to free people from hunger

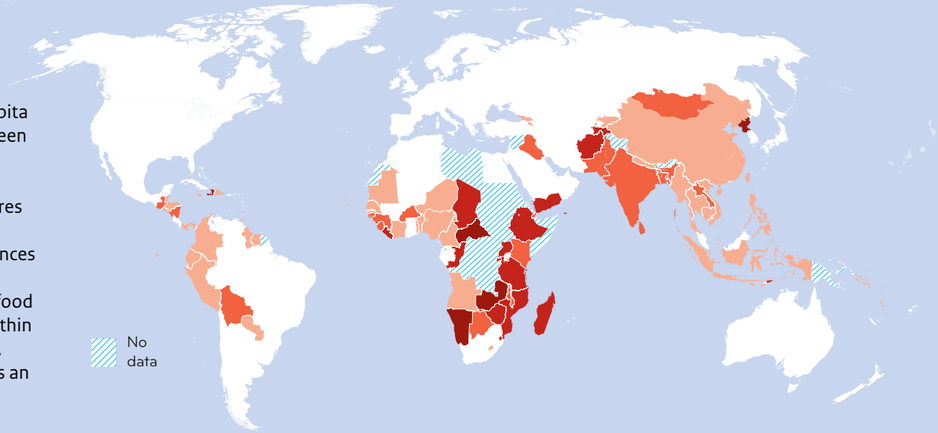
The question of how to sustainably feed the growing global population features high on international policy agendas. Hunger and malnutrition are persistent problems despite the fact that global food production levels are sufficient to feed the world population. Undernourishment means that a person is not able to acquire enough food to meet the daily minimum dietary energy requirements over a period of one year, and hunger is defined by the FAO as being chronically undernourished. Although the Millennium Development Goal to halve the number of people suffering from hunger was reached for the developing world, 795 million people were still undernourished in 2015, of which 28% live in Sub-Saharan Africa.

However, there are glimmers of hope. The average food supply per capita in Sub-Saharan Africa increased between 1990 and 2010, even though the same period saw a high population growth. Importantly, Africa-wide average figures do not express the wide diversity of country-specific accounts. The differences between countries are large, ranging from an 8% drop to a 60% growth in food supply. Moreover, differences exist within countries. Even in wealthier countries, undernourishment is still prevalent, as an increase in average food supply does not necessarily mean a decrease in hunger.

Additional measures beyond agronomic improvements are paramount when facing the challenge of improving food supply and food accessibility for all people. Local and international policies should take a country's context into account. The quality of policies and the efficiency of interventions can be improved by understanding the institutional and local context and enhancing the diagnostic capacity of governments to create inclusive policies for national priorities.

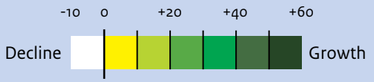
Prevalence of undernourishment
% of population
(2014 – 2016)





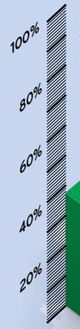
Undernourishment and food supply increases in Sub-Saharan Africa

Change in food supply
% per capita 1990 – 2010



Population size

Prevalence of undernourishment
% of population
(2009 – 2011)



Decrease in food supply and high level of undernourishment in **Zambia**

Large increases in food supply and low level of undernourishment in **Ghana**

Source: FAO; PBL

Healthy **soils**, healthy **lives**

Nutrient deficiencies affect approximately 2 billion people worldwide

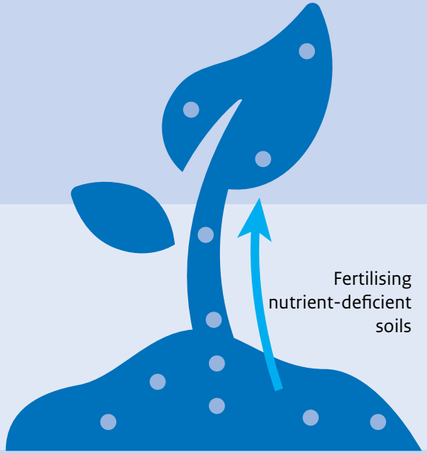
Whereas hunger affects 800,000 people worldwide, malnutrition, or nutrient deficiencies, affects a much larger population. Nutrient deficient soils are one of the major causes of low crop productivity and may affect low nutritional quality of produce. Micronutrient deficiencies are widespread in Africa and have profound societal effects.

One of the causes of dietary nutrient deficiency is a lack of nutrients in the soil. Healthy soils are important for plant growth and for stimulating agricultural intensification. An important factor among the many that influence soil health is the concentration of the macronutrients and micronutrients that are essential for plant growth. In most African soils, these concentrations are low, prompting a renewed focus on the limitations imposed by the lack of micronutrients, such as zinc and boron.

Several options are available to remedy the situation, the most interesting of which are the application of fertilisers, breeding new plant varieties and providing food supplements. The most effective policy response – addressing both low crop yield and malnutrition – is likely to be a mix of these three, though the weight of each may differ substantially from one country to another depending on the severity of the local problems.

Plant productivity

Nutrient deficient soils is one of the major causes of low crop productivity and, possibly, of low nutritional quality of produce. Healthier soils lead to production increases and larger amounts of nutrients fixed in crops, which are then available for human consumption. Healthy soils may eventually bring down malnutrition.

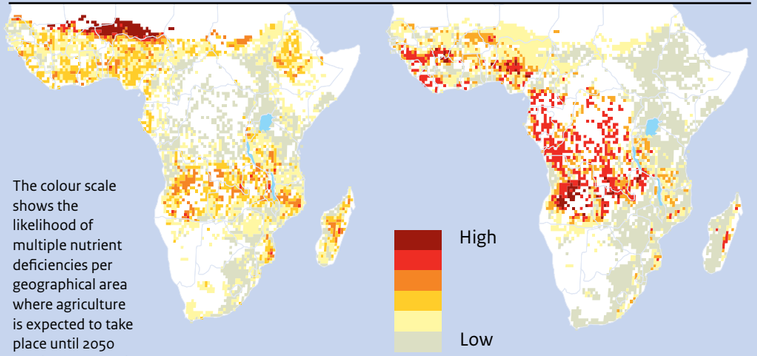


Micronutrient deficiency

(B, Cu, Fe, Mn and Zn) in the bottom 25% range of each nutrient distribution in Sub-Saharan Africa.

Macronutrient deficiency

(Ca, K, Mg, and N) in the bottom 25% range of each nutrient distribution in Sub-Saharan Africa.

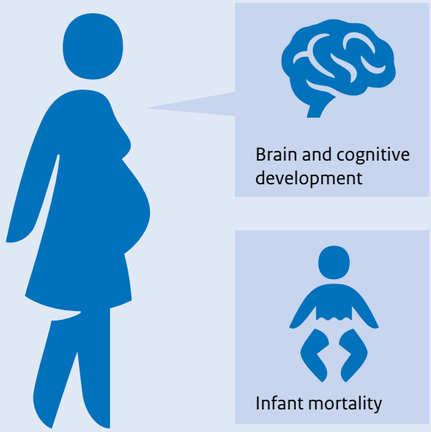


The colour scale shows the likelihood of multiple nutrient deficiencies per geographical area where agriculture is expected to take place until 2050 (Business as usual)

MEASURES

Fertiliser application

The use of fertilisers increases overall soil nutrient concentrations. Unlike widely available macronutrient fertilisers, those providing micronutrients are rarely available on local African markets. To ensure effectiveness of micronutrient fertilisers under varying local soil conditions, they need to be custom-made. But dwindling global reserves may cause problems. Zinc is in scarce supply, and over 90% is used in industrial products, such as cars and electric appliances. The fact that fertilising zinc-deficient soils in Africa may consume up to 3% of the annual zinc supply, highlights the vulnerability of Africa's agricultural sector to supply distortions.



Human nutrition and health

Zinc-intake deficiencies are a prime cause of infant mortality. The element also plays a critical role in the growing brain and cognitive development. Deficiencies of iodine and iron, together with stunting, can contribute to children not reaching full developmental potential.

Plant breeding

When geared towards increasing the relative content of essential nutrients in crops, breeding programs can enhance the bioavailability of essential nutrients in local produce. Although promising, breeding programs take long to produce results and improved varieties have been developed for a few crops only. In addition, plant breeding does not address the issue of low nutrient concentrations in soils.

Food supplements

Deficiencies in human consumption can be offset outside the field of soils and agriculture, through the distribution of food supplements, fortification of commonly purchased foods and awareness campaigns on the benefits of dietary diversity. These initiatives can effectively reduce malnutrition and improve health, but obviously, none targets low levels of soil nutrients and poor crop yields.

Source: Yale; ISRIC; PBL

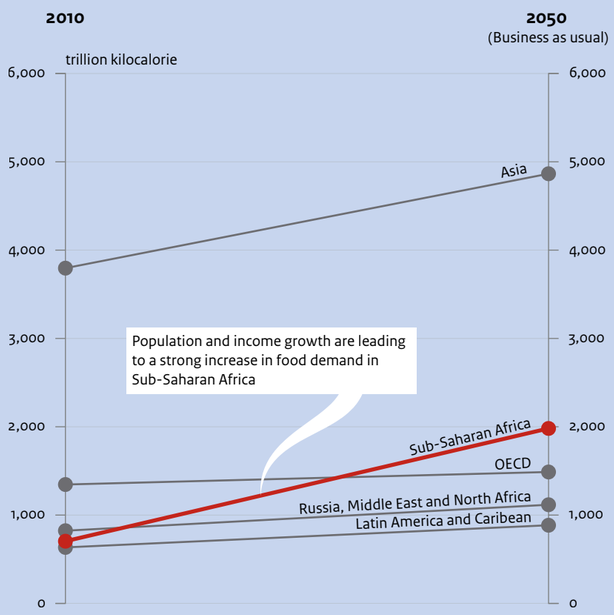
Matching **food demand**...

Limiting cropland expansion by producing food more efficiently

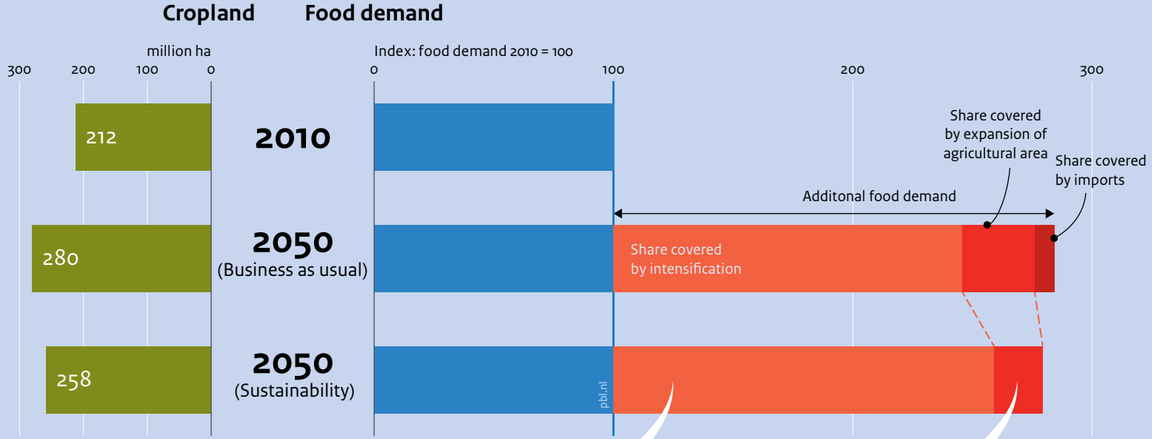
Sustainable Development Goal 2 aims to *end* world hunger. In the light of the staggering population growth expected for many African countries, the foreseeable increase in productivity will not be enough to meet the resulting food demand in 2050. Unlike the situation in most other regions, expansion of agricultural areas is urgently needed in Sub-Saharan Africa. At the same time, SDG 15 aims to halt biodiversity loss, and the desire to meet both SDGs has triggered a heated debate on the trade-offs between them. One way to make these SDGs compatible is to limit further expansion and produce food in a more sustainable manner.

Between 1990 and 2010, the intensification of production practices and the rise in yields in particular were the main drivers of growth in domestic food production in Africa. Agricultural expansion played a minor role in the increases. To continue these positive developments into the future an integrated pathway that serves several SDGs by combining economic growth, reduction of inequality and conservation of natural areas. To end world hunger and simultaneously preserve natural areas, agricultural productivity needs to increase by using resources, such as fertilisers and land, more efficiently and reduce food losses along production and supply chains.

Growing food demand



...and **cropland** availability in Sub-Saharan Africa



Closing yield gaps

Closing yield gaps is the most straightforward avenue to increase the availability of calories. It refers to the production increase that is attainable when there are no pests or diseases and no limitations on fertiliser use.

Expanding agricultural areas

Cropland expansion occurs mainly at the expense of natural areas. The depiction of Africa as a continent with an immense potential for agricultural expansion needs nuancing. The distribution of potentially available underutilised cropland is highly uneven across the continent. Most of it is located in large, sparsely populated countries (e.g. the Democratic Republic of the Congo), often characterised by weak governance and limited opportunities for economic development.

Source: FAO; PIK; PBL

Towards **sustainable water** supply

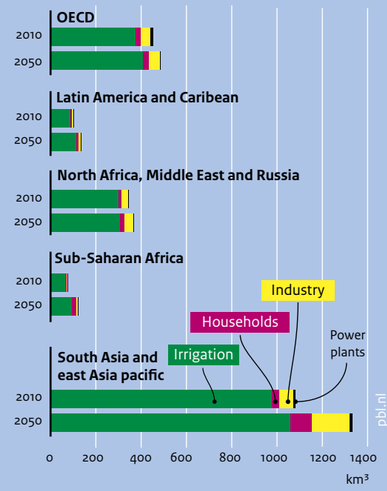
Water is essential for agricultural production, industry, human settlements and natural vegetation. Climate change, which brings higher average temperatures and changing precipitation patterns, combined with increasing competition for water resources, may result in substantial increases in the number of people living under severe water stress. In emerging economies and rapidly urbanising countries, sharp rises in water consumption are expected, mainly due to demands for irrigation and industry. Competition for water between sectors and between countries sharing a river basin may increase.

Expansion of irrigated crop areas and the expected increases in crop yields may not be feasible because of water scarcity. Water is first extracted from rivers and lakes or stored in reservoirs. When this supply is insufficient, water is extracted from aquifers. In many cases, groundwater depletion is the main driver of land subsidence which causes extensive damage to urban infrastructures and buildings. Land subsidence also increases vulnerability to coastal flooding. In the short term, land subsidence poses a larger threat on coastal and delta cities than rising sea levels.

The consequences of water shortages for daily life are unpredictable, and depend greatly on improvements in water management, such as rainwater collection, irrigation efficiency and water storage capacity, and also on changes in crop types and allocation of land and water to agricultural producers.

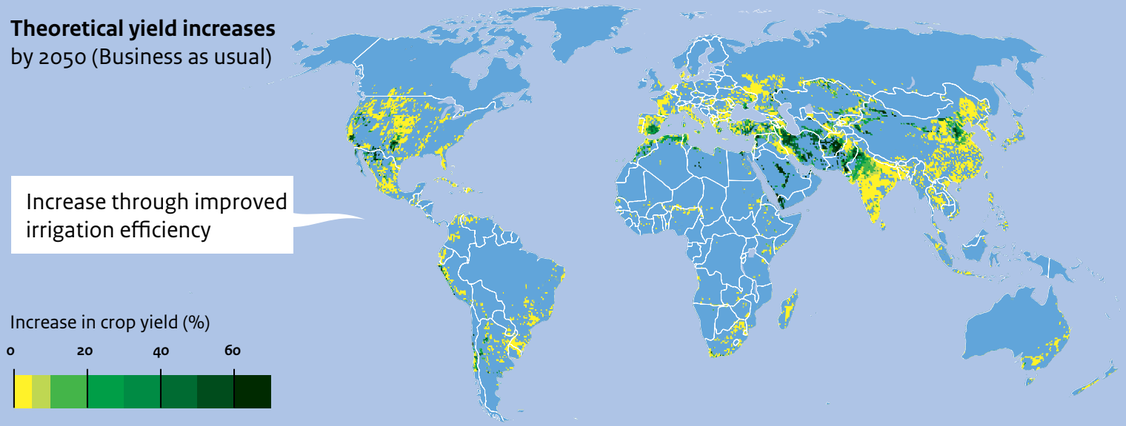
Water consumption

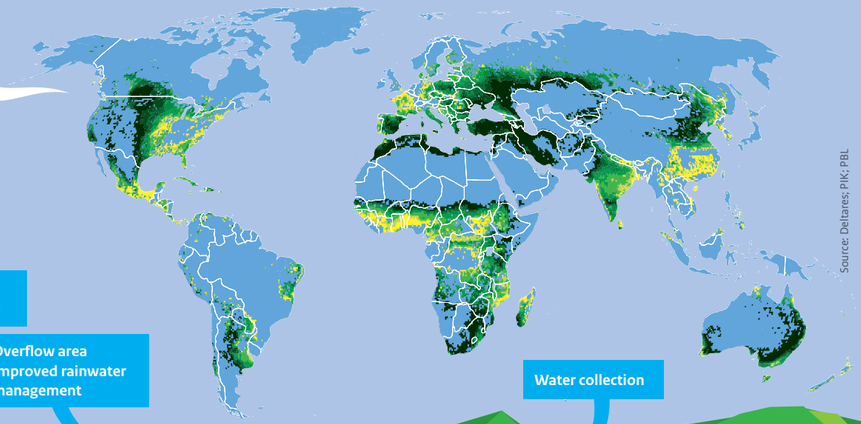
(Business as usual)



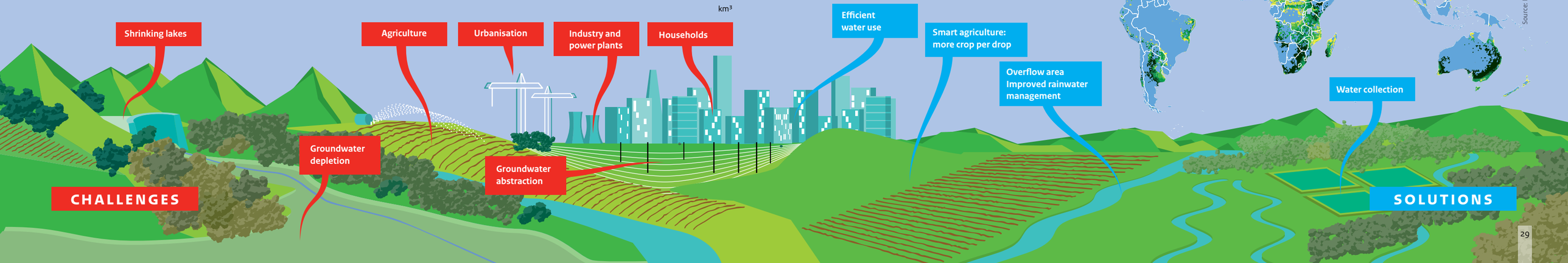
Theoretical yield increases

by 2050 (Business as usual)





Source: Deltares; PIK; PBL



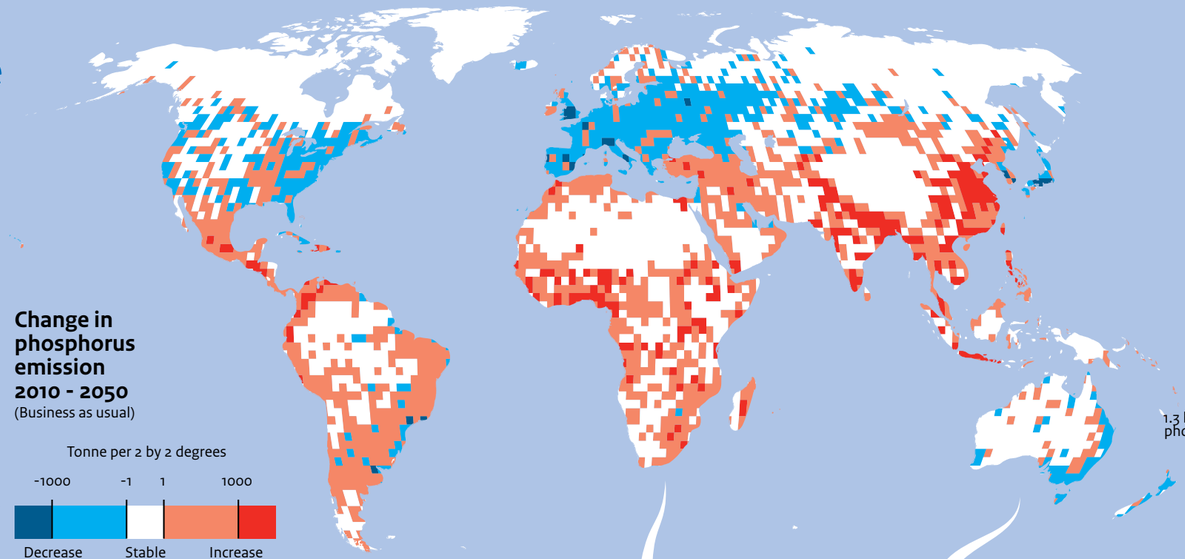
Too dirty water

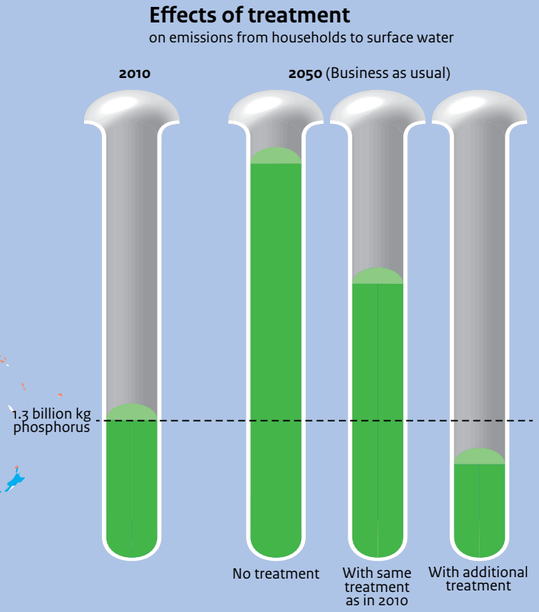
Towards **improved** waste water treatment

A century ago, the dominant flow for nutrients was their reuse in agriculture. Today, nutrients mostly end up in surface water. This results in eutrophication caused by phosphorus emissions and the subsequent pollution of rivers, lakes and coastal waters.

In developed countries, continued investments in wastewater treatment are expected to stabilise and restore surface water quality. However, in developing countries, further deterioration is expected to occur between 2010 and 2050. It is increasingly recognised that the urban water system is best designed, planned and managed in an integrated manner. Wastewater treatment should be part of a larger system, aimed at delivering services to urban dwellers without compromising on sustainability.

An option for improving wastewater quality is to combine wastewater collection with wastewater treatment to avoid the discharge of untreated wastewater and contribute to the reuse of nutrients in agriculture. Wastewater treatment plants can be upgraded to include tertiary treatment systems with new technologies that enable the removal of 95% or more of the nutrients contained in the effluent. For rural areas, promising options may be on-site sanitation and better management of faecal sludge. International agreements are important incentives for countries to invest in wastewater treatment to improve water quality downstream.



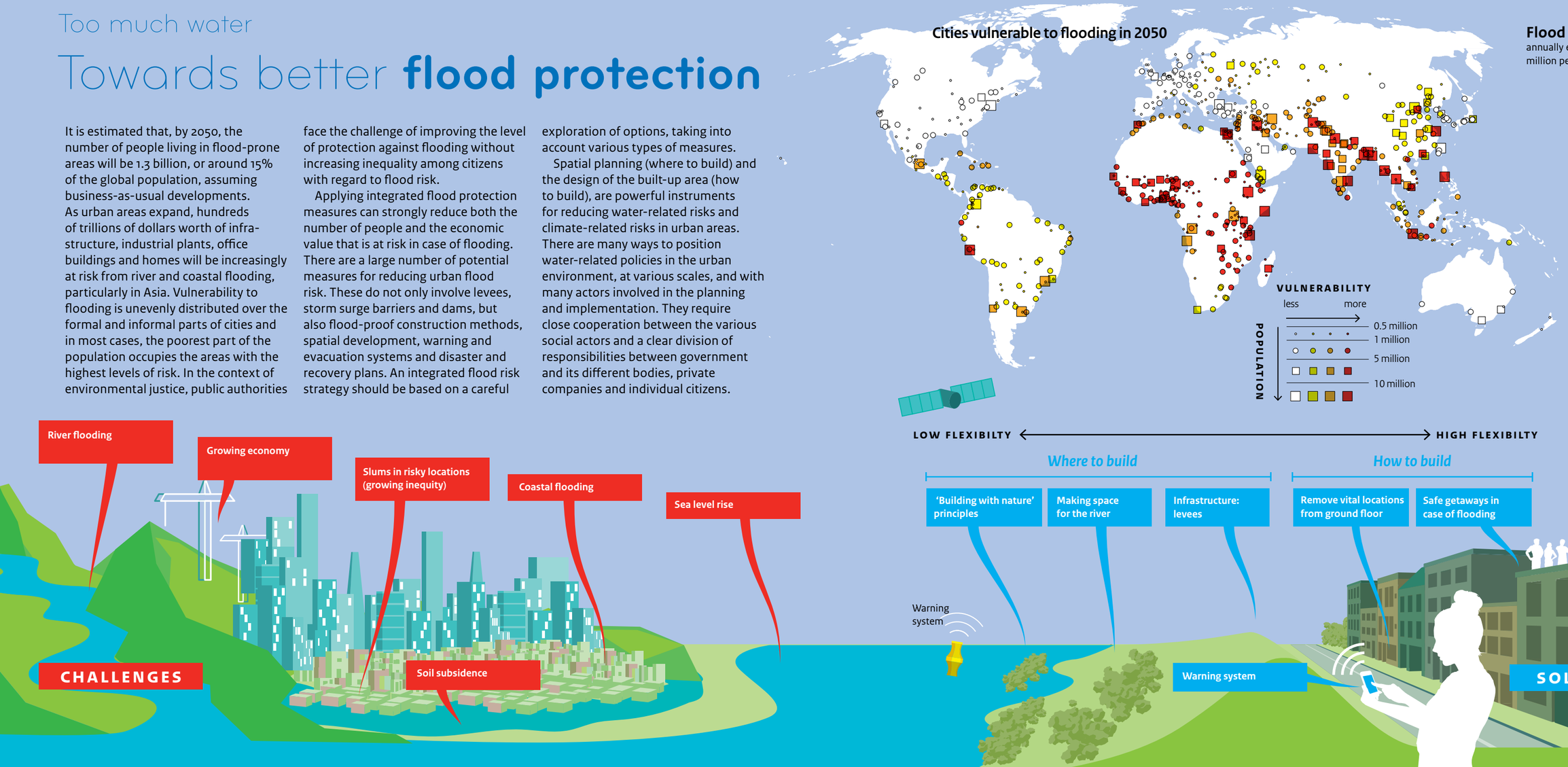


Towards better **flood protection**

It is estimated that, by 2050, the number of people living in flood-prone areas will be 1.3 billion, or around 15% of the global population, assuming business-as-usual developments. As urban areas expand, hundreds of trillions of dollars worth of infrastructure, industrial plants, office buildings and homes will be increasingly at risk from river and coastal flooding, particularly in Asia. Vulnerability to flooding is unevenly distributed over the formal and informal parts of cities and in most cases, the poorest part of the population occupies the areas with the highest levels of risk. In the context of environmental justice, public authorities face the challenge of improving the level of protection against flooding without increasing inequality among citizens with regard to flood risk.

Applying integrated flood protection measures can strongly reduce both the number of people and the economic value that is at risk in case of flooding. There are a large number of potential measures for reducing urban flood risk. These do not only involve levees, storm surge barriers and dams, but also flood-proof construction methods, spatial development, warning and evacuation systems and disaster and recovery plans. An integrated flood risk strategy should be based on a careful exploration of options, taking into account various types of measures.

Spatial planning (where to build) and the design of the built-up area (how to build), are powerful instruments for reducing water-related risks and climate-related risks in urban areas. There are many ways to position water-related policies in the urban environment, at various scales, and with many actors involved in the planning and implementation. They require close cooperation between the various social actors and a clear division of responsibilities between government and its different bodies, private companies and individual citizens.

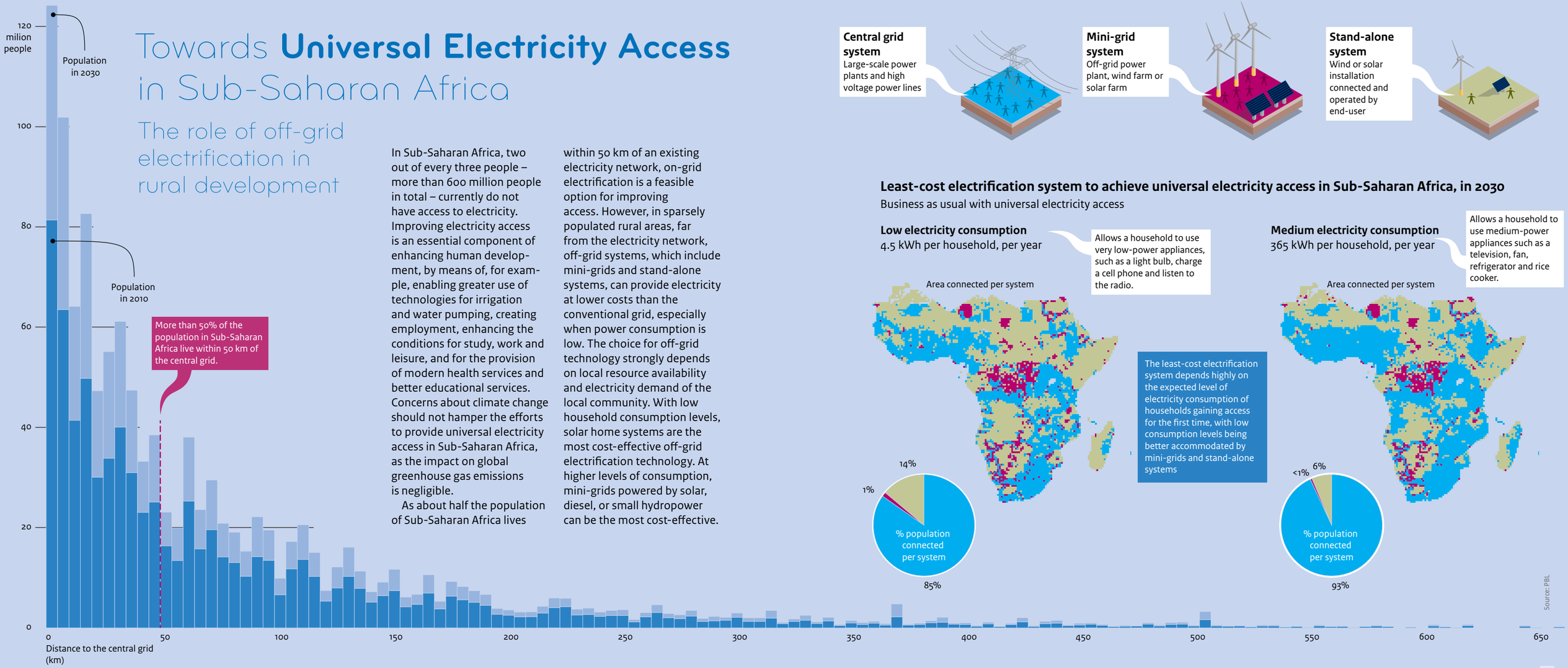


Towards **Universal Electricity Access** in Sub-Saharan Africa

The role of off-grid electrification in rural development

In Sub-Saharan Africa, two out of every three people – more than 600 million people in total – currently do not have access to electricity. Improving electricity access is an essential component of enhancing human development, by means of, for example, enabling greater use of technologies for irrigation and water pumping, creating employment, enhancing the conditions for study, work and leisure, and for the provision of modern health services and better educational services. Concerns about climate change should not hamper the efforts to provide universal electricity access in Sub-Saharan Africa, as the impact on global greenhouse gas emissions is negligible.

As about half the population of Sub-Saharan Africa lives within 50 km of an existing electricity network, on-grid electrification is a feasible option for improving access. However, in sparsely populated rural areas, far from the electricity network, off-grid systems, which include mini-grids and stand-alone systems, can provide electricity at lower costs than the conventional grid, especially when power consumption is low. The choice for off-grid technology strongly depends on local resource availability and electricity demand of the local community. With low household consumption levels, solar home systems are the most cost-effective off-grid electrification technology. At higher levels of consumption, mini-grids powered by solar, diesel, or small hydropower can be the most cost-effective.



Least-cost electrification system to achieve universal electricity access in Sub-Saharan Africa, in 2030

Business as usual with universal electricity access

Low electricity consumption
4.5 kWh per household, per year

Allows a household to use very low-power appliances, such as a light bulb, charge a cell phone and listen to the radio.

The least-cost electrification system depends highly on the expected level of electricity consumption of households gaining access for the first time, with low consumption levels being better accommodated by mini-grids and stand-alone systems

Medium electricity consumption
365 kWh per household, per year

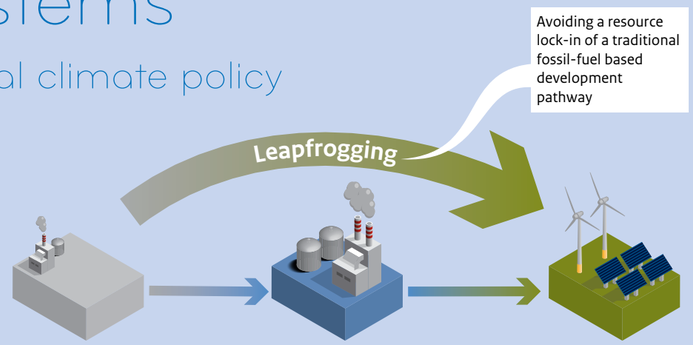
Allows a household to use medium-power appliances such as a television, fan, refrigerator and rice cooker.

Source: PBL

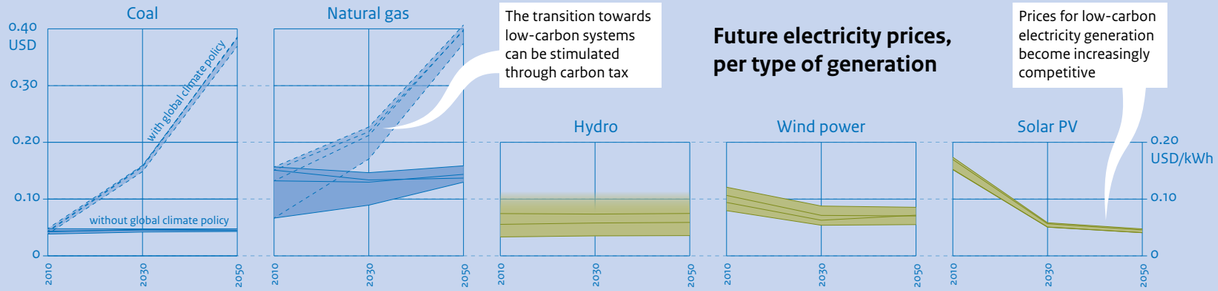
Leapfrogging towards **low-carbon** electricity systems

Consequences of global climate policy

The Sub-Saharan African electricity system is still in its infancy. The current production capacity can only meet around 35% of the projected electricity demand for 2030 and less than 15% of the projected demand for 2050. Nevertheless, Sub-Saharan Africa is richly endowed with both fossil and renewable energy sources, which can easily accommodate the projected electricity demand. Coal is abundant in southern Africa, and several countries in Sub-Saharan Africa have large natural gas reserves. The potential for renewable energy production is huge, with options for solar photovoltaic energy in Sub-Saharan Africa, large and small-scale hydropower in eastern and central Africa, and wind power particularly in eastern Africa.

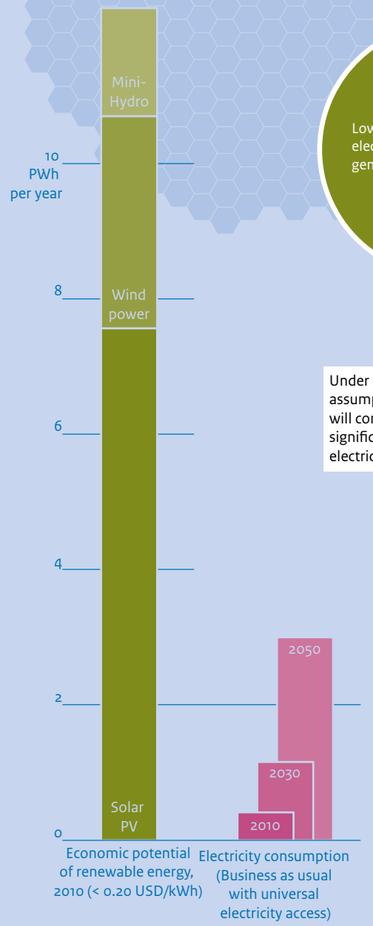


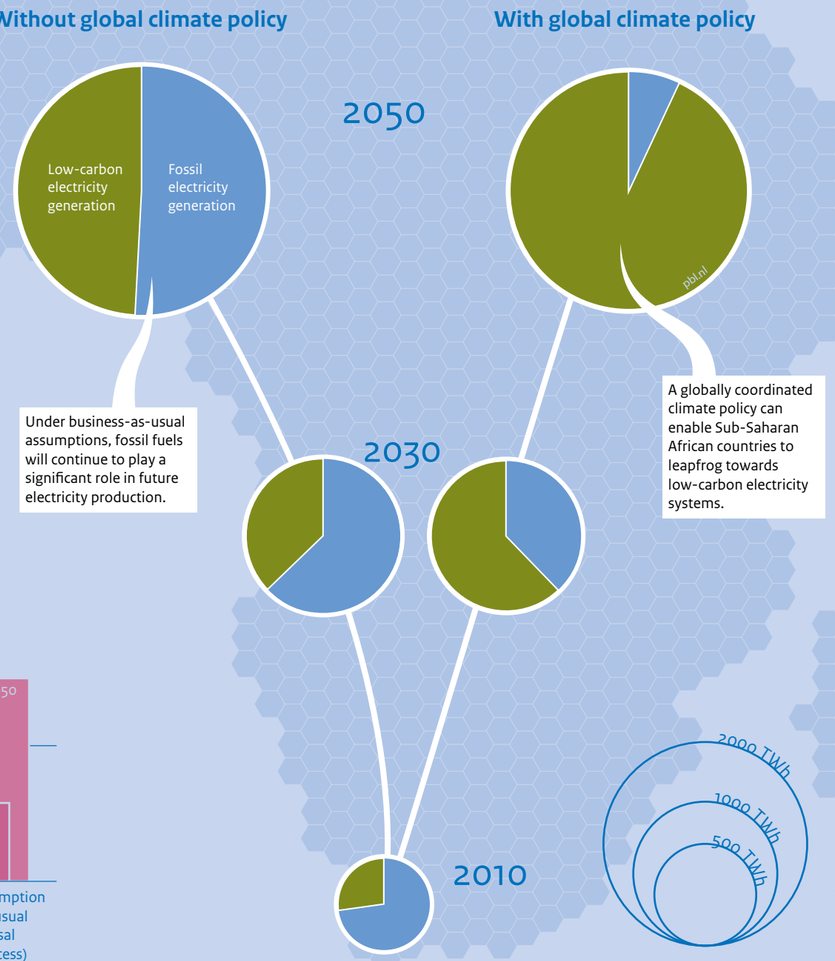
Being a laggard not only comes with challenges, but also opens up opportunities; as a large part of the generation capacity still needs to be built, Sub-Saharan Africa can benefit from the global renewable energy revolution to leapfrog to electricity systems dominated by renewable energy. Over the last few decades, the costs of the related technologies have decreased significantly, largely driven by innovation and renewable energy policies in emerging economies and OECD countries. This trend is expected to continue in the future. Pricing carbon emissions makes renewable energy technologies even more competitive, due to the resulting rise in fossil fuel prices. This policy option makes it possible to combine increased electricity access in this developing region with mitigating climate change.



Future electricity prices, per type of generation

Electricity generation





Source: PBL

Combining **human development** with **biodiversity** conservation

Engaging production sectors to bring multiple SDGs within reach

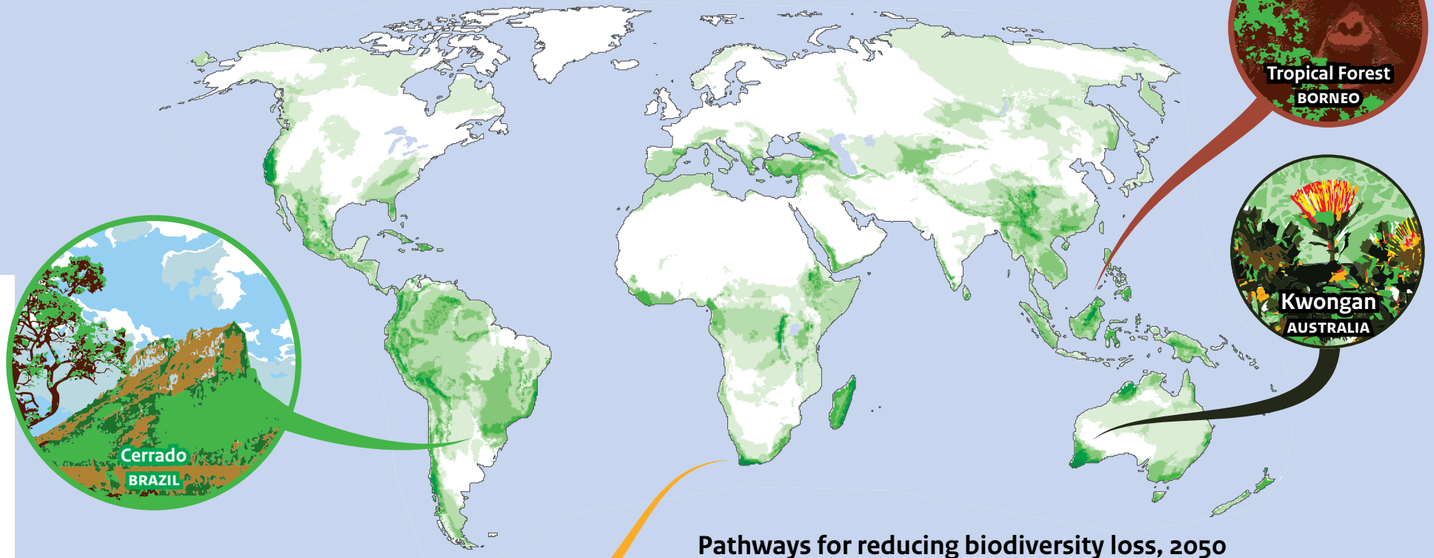
If current trends in population and wealth growth continue, the increasing demand for food, wood, water and energy will have negative consequences for biodiversity worldwide. Most pressures causing this loss can be attributed to production sectors. To address and mitigate these pressures, businesses need to become aware of their impact on biodiversity, and of the economic risks of losing natural capital and its benefits. Mainstreaming biodiversity concerns in production sectors is therefore an important strategy for attaining the targets of the Convention on Biological Diversity (CBD).

Integrated development pathways with the potential to bring several SDGs within reach are wanted. They need to serve the CBD targets: halt global biodiversity loss, halve the rate of natural habitat loss (CBD-Aichi target 11), and expand the protected areas network (CBD-Aichi target 5). The pathways should also serve SDGs in other domains, such as eradicating poverty and hunger, providing access to safe drinking water and modern types of energy generation, and limiting the mean global temperature increase to 2 °C by 2100.

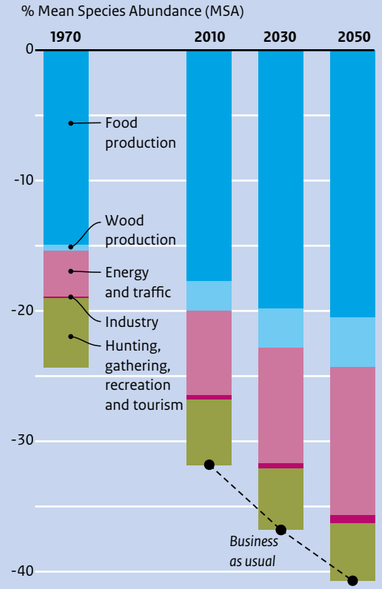
Options for production and consumption of food, feed, fibres and fuel, along with energy generation and measures for climate mitigation form the central part of solution packages that are built around pathways for alternative future development. In all pathways, hotspot areas of highly valued biodiversity should be prioritised and given the status of protected areas.

Hotspots of biodiversity

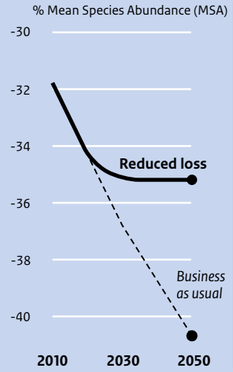
The aim of Aichi target 11 is to protect 17% of all ecosystem types to cover a representative share of Earth's diversity in life forms. Priority maps for biodiversity indicate where the major hotspots for biodiversity worldwide are found, and where land-use planning should be guided primarily by biodiversity concerns.



Causes of terrestial biodiversity loss attributed to production sectors



Pathways for reducing biodiversity loss, 2050



SPARING

Global Technology
Pathway achieves the 2050 targets with a focus on optimal large-scale global technological solutions, such as **intensive agriculture** and a high level of **international coordination**.

SHARING

Decentralised Solutions
Pathway with a focus on **regional priorities** and local ecology-friendly technologies. Agriculture is interwoven with **natural corridors**.

CARING

Consumption Change
Pathway with a focus on changes in human consumption patterns, most notably by limiting meat, reduce waste, and a less energy-intensive and material-intensive lifestyle.

Source: WCMC, PBL

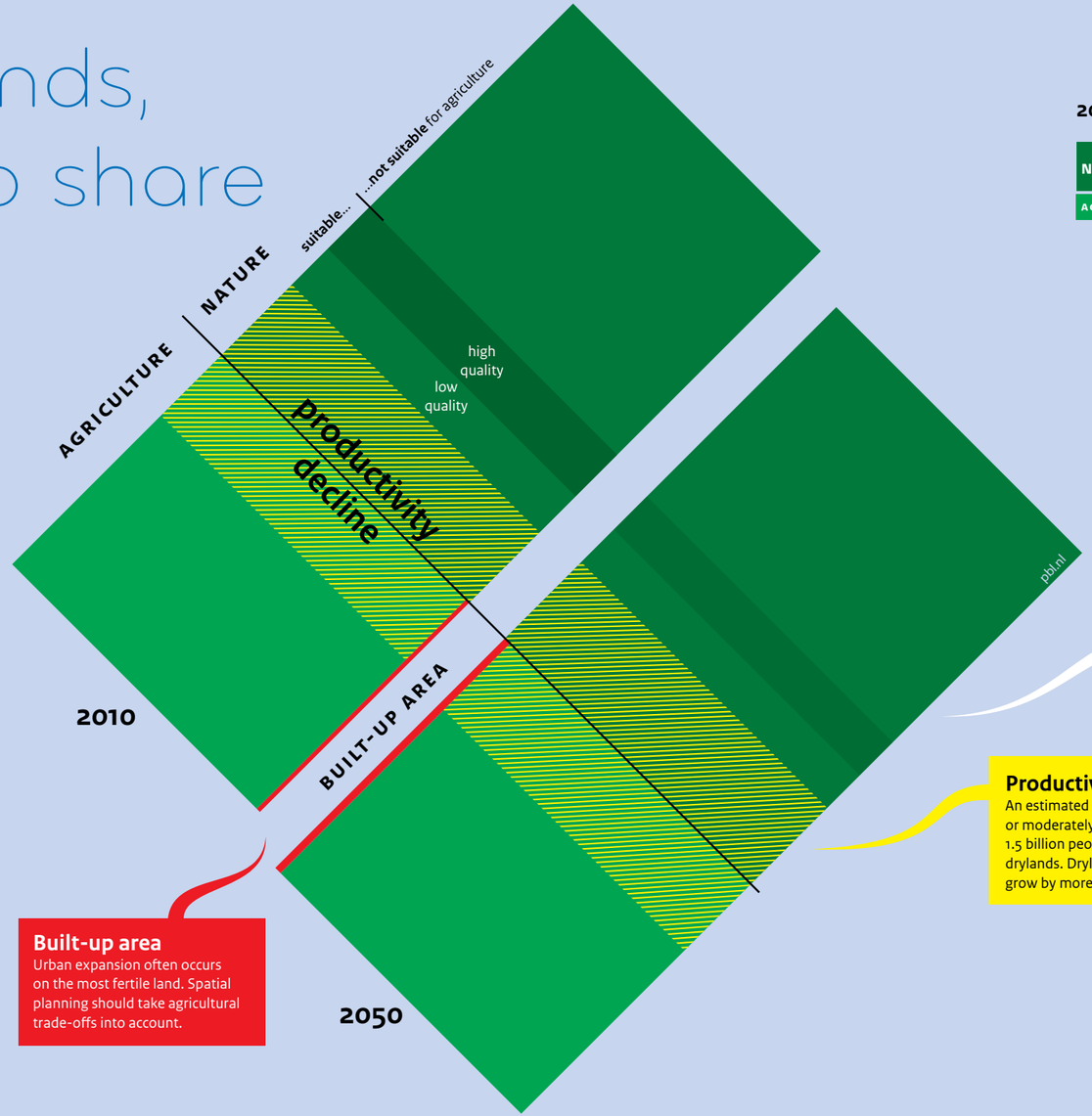
High demands, **little land** to share

Competing claims on a common resource

Land, in terms of surface area and the quality of soils and vegetation, is essential for the provision of food, fibre, energy and water, for conserving biodiversity and for regulating climate. Fertile land, suitable for agriculture, is abundant in some countries and scarce in others.

Current trends suggest there will be increasing demands on land. More people and growing wealth require more land for the production of food, fibre and bio-energy, for urban settlement and for afforestation for the mitigation of climate change, while an increasing demand for nature conservation areas reduces the amount of land available for other purposes. The difficulty of balancing these competing claims on land are further exacerbated by climate change and land degradation that reduce productivity of the land.

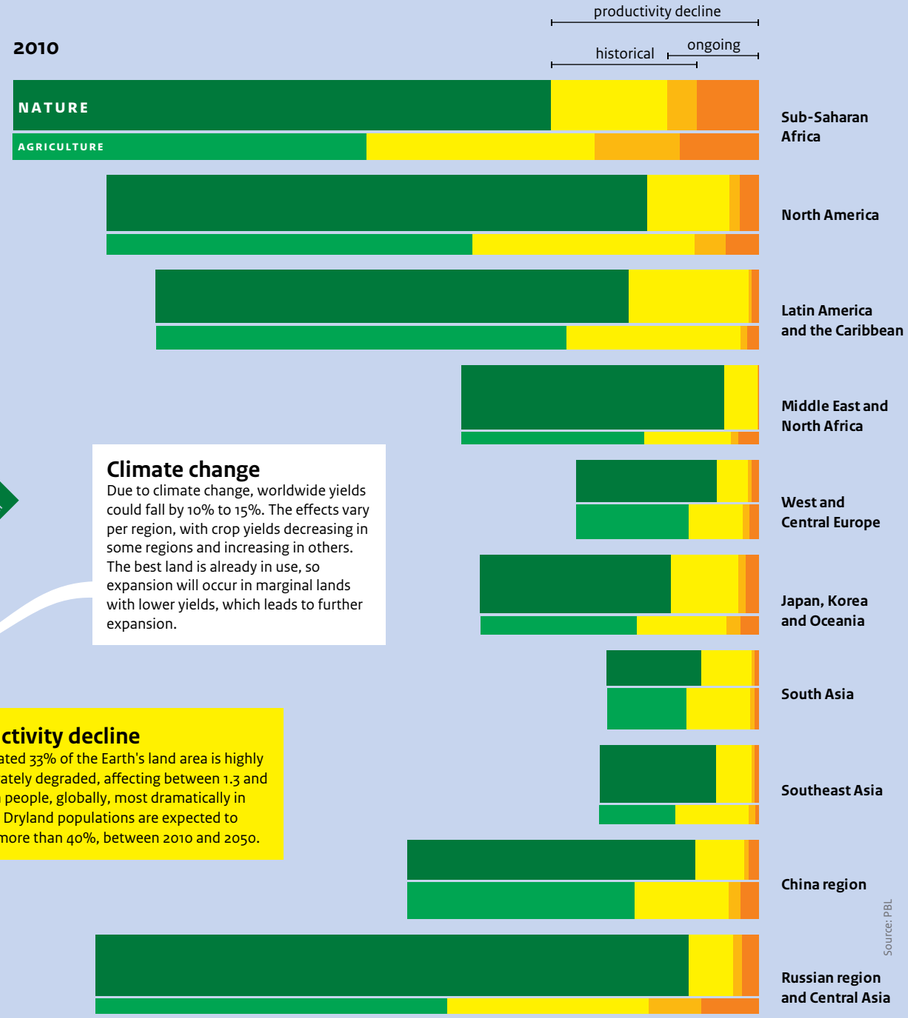
The sustainability of future land use depends primarily on effective land management, including land-use allocation and access to land. The scope of land management is mostly local or national, whereas land itself has increasingly acquired a global dimension, through trade, foreign investment and global concerns about climate change, food security and nature conservation. Despite these emerging challenges, there is reason for hope. Improving the sustainability and efficiency of land-use management could connect many of the SDGs.



Built-up area
Urban expansion often occurs on the most fertile land. Spatial planning should take agricultural trade-offs into account.

Climate change
Due to climate change, worldwide yields could fall by 10% to 15%. The effects vary per region, with crop yields decreasing in some regions and increasing in others. The best land is already in use, so expansion will occur in marginal lands with lower yields, which leads to further expansion.

Productivity decline
An estimated 33% of the Earth's land area is highly or moderately degraded, affecting between 1.3 and 1.5 billion people, globally, most dramatically in drylands. Dryland populations are expected to grow by more than 40%, between 2010 and 2050.



Exploring new **partnerships** and **coalitions**

The sustainability challenge is too large to be managed alone. If we want to ensure a good quality of life, including sufficient and affordable food, water, energy and natural resources for the future, then we need to mobilise all the creativity available. The 2030 Agenda and the SDGs call for cooperation and multi-actor partnerships worldwide, on and between all levels in order to realise more inclusive and greener development pathways. This idea is addressed specifically in SDG 17 which aims to 'strengthen the means of implementation and revitalise the global partnership for sustainable development'.

The concept of the energetic society is useful here – the idea that there are lots of innovative businesses and citizen initiatives which aim to transform society and make sure it progresses towards a more sustainable future. We see manifestations of this emerging trend in international sustainable development in the form of efforts made by engaged citizens, responsible businesses initiatives, knowledge networks and civil society organisations, amongst many others. These actors and initiatives show an unprecedented learning ability, creativity and capacity for rapid response. Governments can tap into this potential, supporting and exploiting it to attain shared objectives.

This section illustrates some of the arenas of global sustainable development where new concepts for coalitions and partnership building are emerging. These arenas include food systems, international supply chains, landscapes and finance systems, each with their own multi-actor and multi-level governance structures. Whether these new coalitions and partnerships will be able to effectively and successfully respond to the development challenges is an urgent question. Creating a stimulating enabling environment is a specific challenge for governments to safeguard the long-term public interests in this new governance landscape for sustainable development.

Addressing the Sustainable Development Goals through **partnerships**

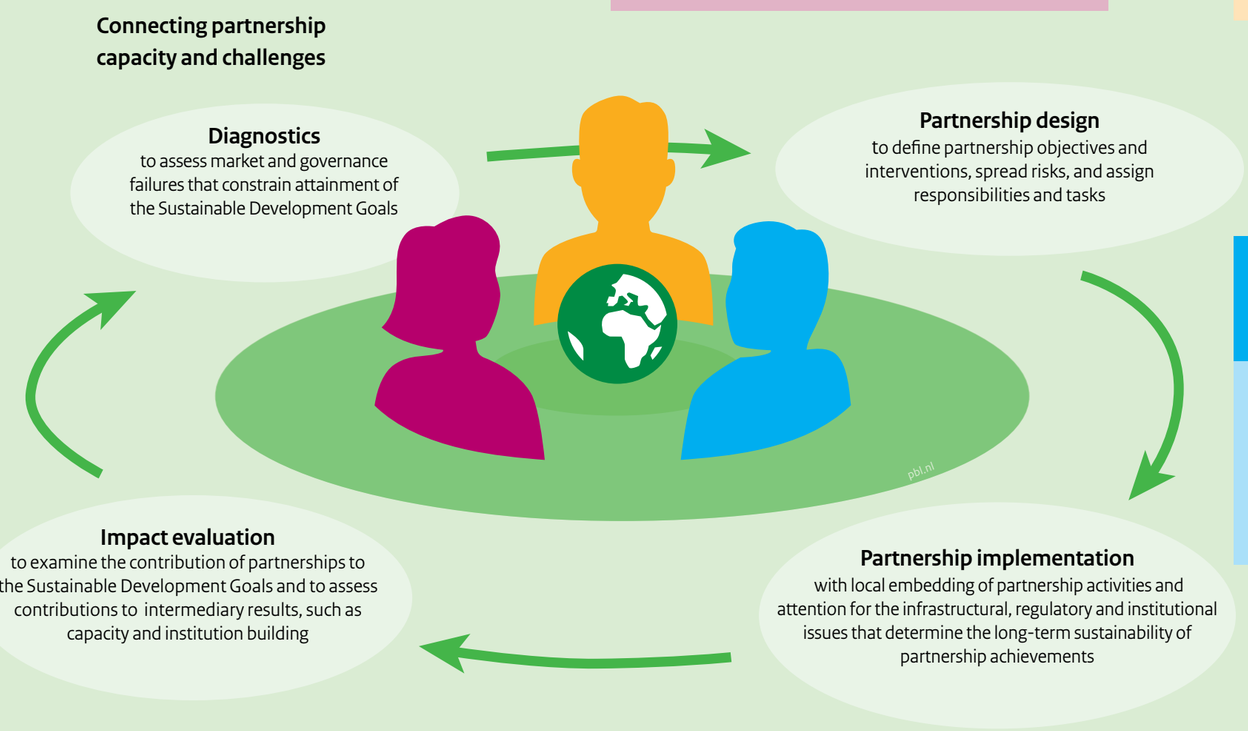
Opportunities and conditions for successful partnerships

The use of partnerships in international cooperation is increasing. In a globalised world, national governments lack the influence, capacity and mechanisms to coordinate actions across different levels and therefore cannot effectively stimulate sustainable development. Partnerships have the potential to combine the efficiency of the market, the regulatory capacity of the public sector and the social representation of civil society organisations. In fact, revitalising global partnerships is itself one of the sustainable development goals.

Stronger civic and private-sector engagement should not be understood as the public sector withdrawing from these policy areas. Neither the private sector nor civil society has the capacity, or incentives, to tackle the market and governance failures that constrain the attainment of the sustainable development goals. For example, without infrastructure development, initiatives to enhance agricultural productivity are not sustainable. Similarly, if water use is unregulated, initiatives to promote sustainable use of water resources fall short. And if marginalised stakeholders are not represented through local institutions, efforts to stimulate inclusive growth are doomed to be short-lived.

Partnerships are generally expected to deliver on development challenges, but there is mixed evidence about whether they will succeed. For global partnerships to effectively contribute to the Sustainable Development Goals, issues on a local level must be linked to the global level, and public and private interests must be aligned. Thus, effective partnerships start with a clear diagnosis of the market and governance failures that need to be tackled, and follow a design that clearly assigns risks, responsibilities and tasks. Further requirements are that partnership activities are strongly embedded in the local situation, which ensures that context-specific knowledge is available and that outcomes are evaluated, including the contribution of the partnership to the sustainable development goals.

Connecting partnership capacity and challenges



Civic

Civil society, including NGOs
Civil society is often represented in partnerships by global NGOs which do not necessarily represent local interests. When there are no institutions representing stakeholder interests, partnerships may need to invest in local institution and capacity building to ensure inclusive outcomes for the long term.

Public

Public partners or governments
The role of public partners is often limited to funding, whereas for guaranteeing public outcomes it is important that public partners are more actively involved. Since, for global donors, it is difficult to guarantee local outcomes, it is crucial that the public objectives of the partnership are defined clearly, the partnership is accountable and local government is somehow involved.

Private

Private partners or businesses
A private partner may be a local business organisation or a multinational, both with very different interests in joining a partnership. It is important to acknowledge such differences. In fact, the main objective of many partnerships is to link businesses to each other in global supply chains.

Source: PBL

Towards resource-smart **food systems**

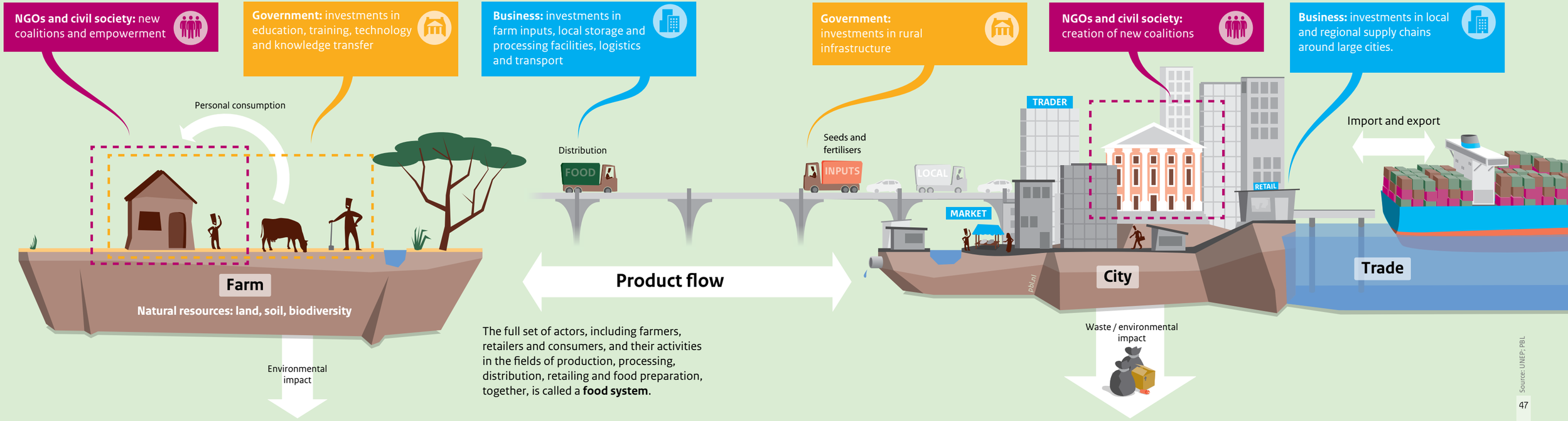
Using partnerships to link production areas to urbanising regions

In urbanised regions, food systems have grown more complex, due to the growing distance between primary producers and consumers. Crucial natural resources, such as soils and ecosystems are often not managed sustainably or efficiently enough to be able to produce sufficient amounts of food. Furthermore, a significant part of the production is lost, due to inadequacies in storage, processing and transport to cities. Farmers, who manage most of the food production and distribution systems are often aware of the challenges, but not in a position to introduce improvements. Typically, the main causes for this are a lack of access to good quality inputs (such as seeds, fertilisers and water), a lack of access to urban markets, and low and unstable food prices.

Therefore, a shift towards resource-smart food systems is necessary. These are food systems which do not compromise the environmental basis and deliver food security, support livelihoods and ensure human health for future generations. In resource-smart food systems, natural resources are managed sustainably and efficiently. The produced food is used efficiently with low levels of food losses and food waste. These food systems also make a positive contribution to human health, for instance, by discouraging the consumption of ultra-processed foods.

To promote resource-smart food systems, coalitions and partnerships can be created to bring the required capacities together. Businesses such as retailers and food companies should invest in local and regional supply chains around large cities. This involves supplying inputs to farmers, setting fair prices, and creating adequate storage and processing facilities. Governments should create a proper enabling environment for farmers with attention for good rural infrastructure, knowledge transfer and education, and the creation of a fair and accessible legal system which enforces land tenure rights. NGOs should stimulate beneficial developments by having a positive-critical role towards both governments and private actors, defining local standards for sustainable production and creating new coalitions, for instance through the establishment of multi-stakeholder platforms.

Food systems: activities and actors



The full set of actors, including farmers, retailers and consumers, and their activities in the fields of production, processing, distribution, retailing and food preparation, together, is called a **food system**.

Source: UNEP; PBL

Voluntary market standards drive sustainable production and consumption

Cooperation between supply-chain actors is required for scale-ups

Enhancing the sustainability of international supply chains is an important target of Dutch foreign policy. The main objective of the Dutch Aid and Trade agenda is, 'together promoting industry in developing countries, corporate social responsibility and international investment'.

There are a multitude of voluntary initiatives that try to achieve sustainable trade in timber and in agricultural resources, such as coffee, cacao, fish, soya and palm oil. Businesses and NGOs together have established platforms for defining market standards for sustainable production and trade, and logos have been introduced to inform consumers, such as Fair Trade and UTZ Certified for coffee and cacao, RTRS (Round Table on Responsible Soy) for soya, and FSC (Forest Stewardship Council) for timber. By using these standards to certify their supply chains, companies may contribute to several SDGs, such as eradicating extreme poverty, encouraging sustainable economic development and protecting biodiversity.

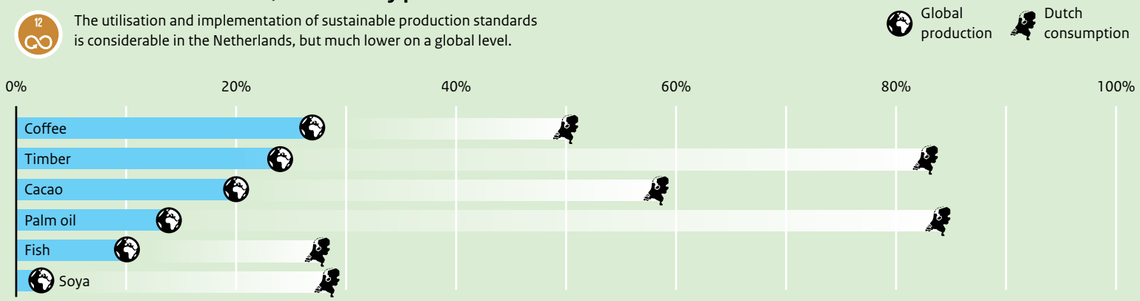
From the year 2000 onwards, the market share of sustainably produced commodities has increased considerably in the Netherlands, thanks to the joint efforts and cooperation between companies, sector organisations, and civil society, with the Dutch Government playing a supporting role. Market shares of sustainably produced resources are also significant in other countries, but in production regions the adherence to standards for making production more sustainable is much lower.

There are several barriers to scaling up sustainable consumption and production and realising inclusive impacts, such as high costs for producers, a lack of local finance and knowledge, insufficient global demand, and the absence of a level playing field in consuming countries. These barriers call for businesses, NGOs and governments to jointly develop solutions that can support local and global governance levels, and be applied across sectors. Governance arrangements are required at farm, company and landscape levels, in and across production sectors, in trade and distribution, and finally at the global level where both national governments and intergovernmental institutions operate.

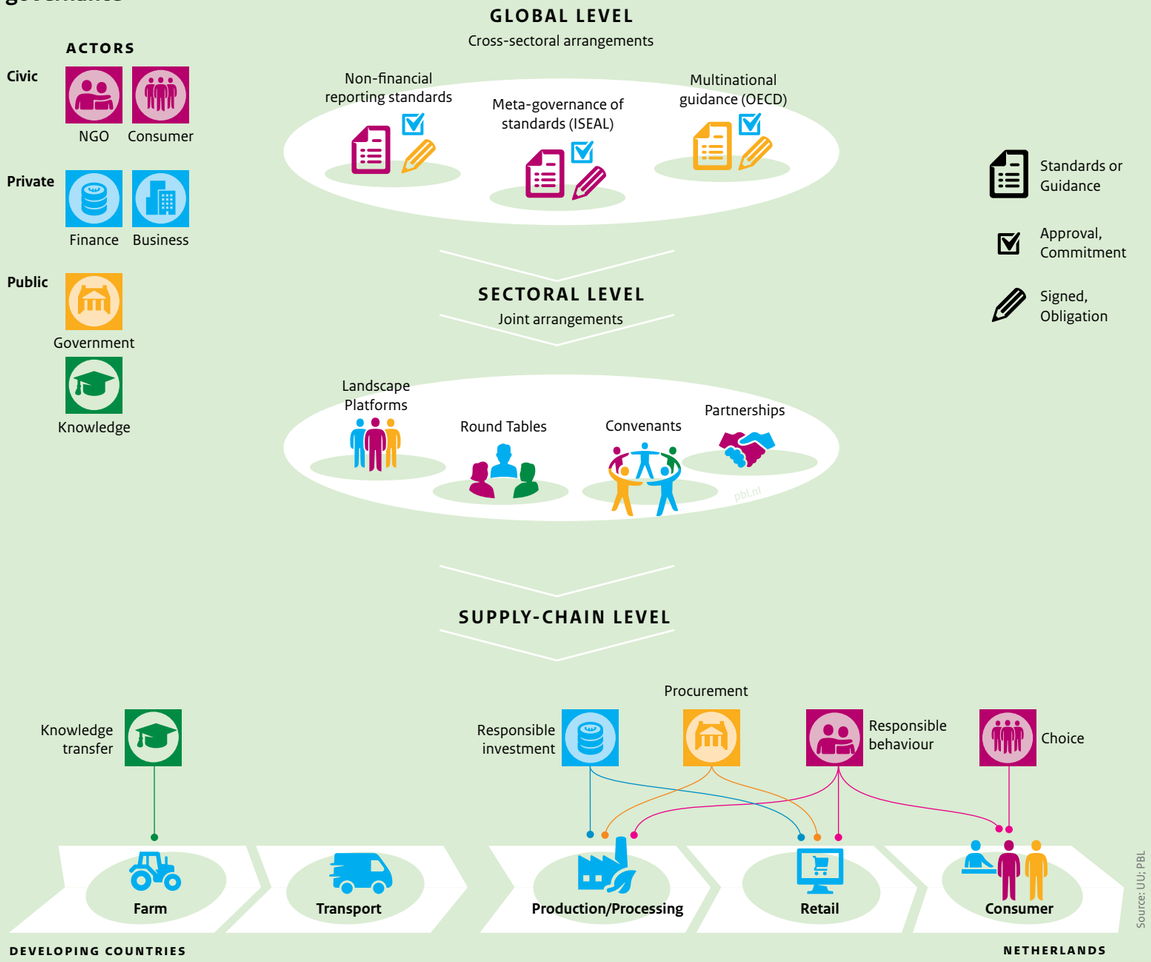
Market shares of certified, sustainably produced natural resources

12

The utilisation and implementation of sustainable production standards is considerable in the Netherlands, but much lower on a global level.



Levels of supply chain governance



Finding shared solutions at **landscape level**

The landscape approach provides a platform for all stakeholders

The landscape is the level on which our current and future global challenges converge. In pre-industrial, primitive or traditional landscapes, the use and conservation of available natural resources appears to have been balanced, most likely due to lower population densities, a deeper sense of community within human settlements and a locally based food production system.

Increasing globalisation and technological development have accelerated the integration of producers into global supply chains, bringing economic development to many rural landscapes, for example, the emergence of palm oil production landscapes in Indonesia. However, agricultural expansion and growth do not necessarily lead to inclusive and green development.

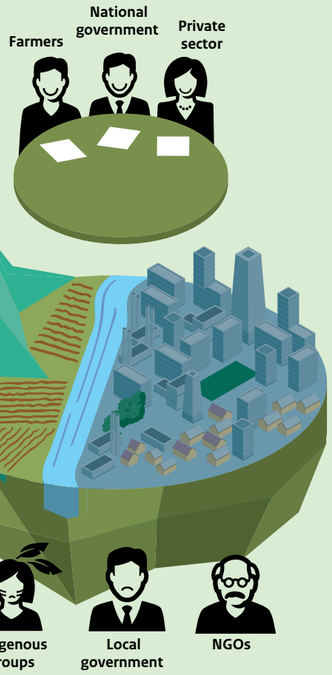
Pre-industrial landscape

Growth-without-limits landscape

Increasing incomes could improve food security and heatlh care.

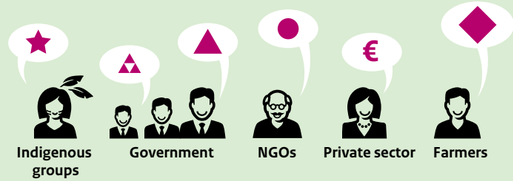
But land is used intensively for production, risking biodiversity loss and soil degradation.

Short-term gains prevail. Benefits and losses are unequally distributed.

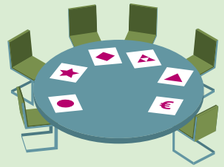


Inclusive and green growth

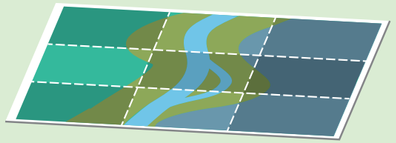
The stakeholders...



... negotiate, explore and plan...



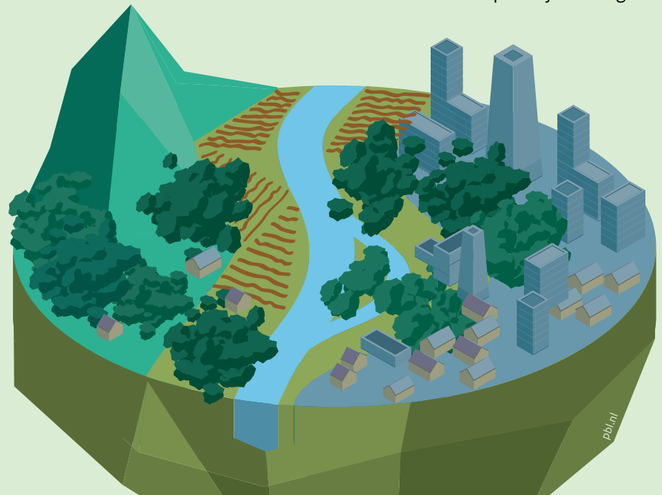
... to implement a shared design...



...that is aimed at

inclusive and green growth

Finding the right landscape configuration can help to achieve many SDGs, simultaneously.



In many cases, large-scale agricultural development has gone hand in hand with land-related conflicts, the violation of indigenous population rights and the degradation of biodiversity and ecosystem services.

Today, landscapes are seen as the spatial scale on which many different stakeholders, from global to local, need to cooperate. The spatial boundary of a landscape approach is often determined by an issue, benefit or risk that is commonly acknowledged by different stakeholders in a certain area. Local balancing of competing interests, sharing benefits and mitigating perceived collective risks are prerequisites to achieving multiple SDGs simultaneously.

The landscape approach aims to find a shared solution. It involves local, regional and sometimes even international negotiations between many diverse stakeholders, including farmers, NGOs, indigenous communities and governments. Creating an enabling environment and a platform that provides a level playing field for all stakeholders is considered a priority for the government.

Source: LPFN; PBL

Bridging the **finance gap**

Coordinating finance for on-the-ground implementation

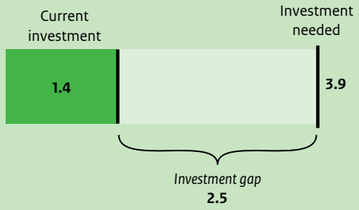
The annual investment gap for reaching the SDGs in developing countries stands at an estimated USD 2.5 trillion. In response, world leaders have agreed to cooperate under the 2015 Addis Ababa Action Agenda on financing for development. Confronting the decrease in governmental funding for collaborative development projects, this agenda emphasises the importance of domestic revenue mobilisation and private sector co-financing.

However, encouraging private sector investment in green growth areas, such as ecosystem restoration and renewable energy, is proving to be difficult. Long term returns and uncertain risks play a large role and the institutional setting is often not favourable. Due to a lack of intermediary regulatory institutions, supply and demand for financing is not coordinated, leading to increased transaction costs. Altogether, this results in a gap between available finance and required project investment on the ground.

Bridging the finance gap requires investment partnerships to pool and manage financing and to create a knowledge sharing environment to reduce uncertainties and perceived investment risks. Many initiatives, such as the Dutch Good Growth Fund, are designing innovative ways to finance sustainable development, though public sector commitment remains key. After all, important benefits from reaching the SDGs are non-monetary and long-term, and only public funding can safeguard long-term public benefits, for both current and future generations.

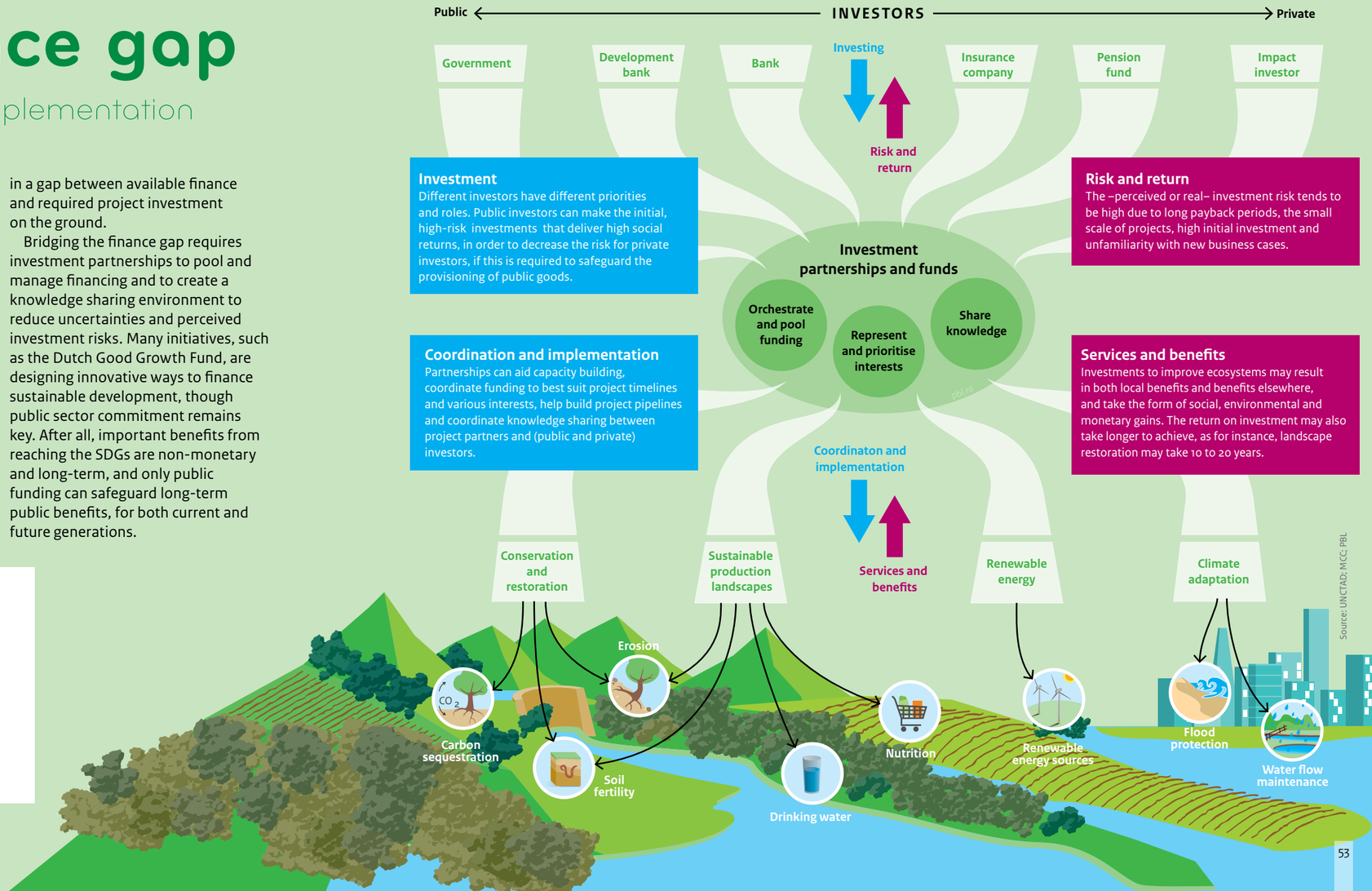
Estimated annual investment needs for the SDGs in developing countries

(trillions of US dollars)



Domestic revenue mobilisation

A sound tax base is key for economic development and growth. Domestic revenue mobilisation is the idea that countries generate their own public funding to finance sustainable development. This requires institutional capacity to collect taxes and manage public resources effectively, but it also demands international cooperation to combat tax evasion and illicit financial flows. For example, by introducing a land tax, the tax base could be increased, thus, increasing government revenue. At the same time, if designed properly, such land tax could help improve land-use efficiency and income distribution, though this requires that land rights are well-defined and that certain land uses are exempt from taxation.



The emerging **governance landscape** for sustainable development

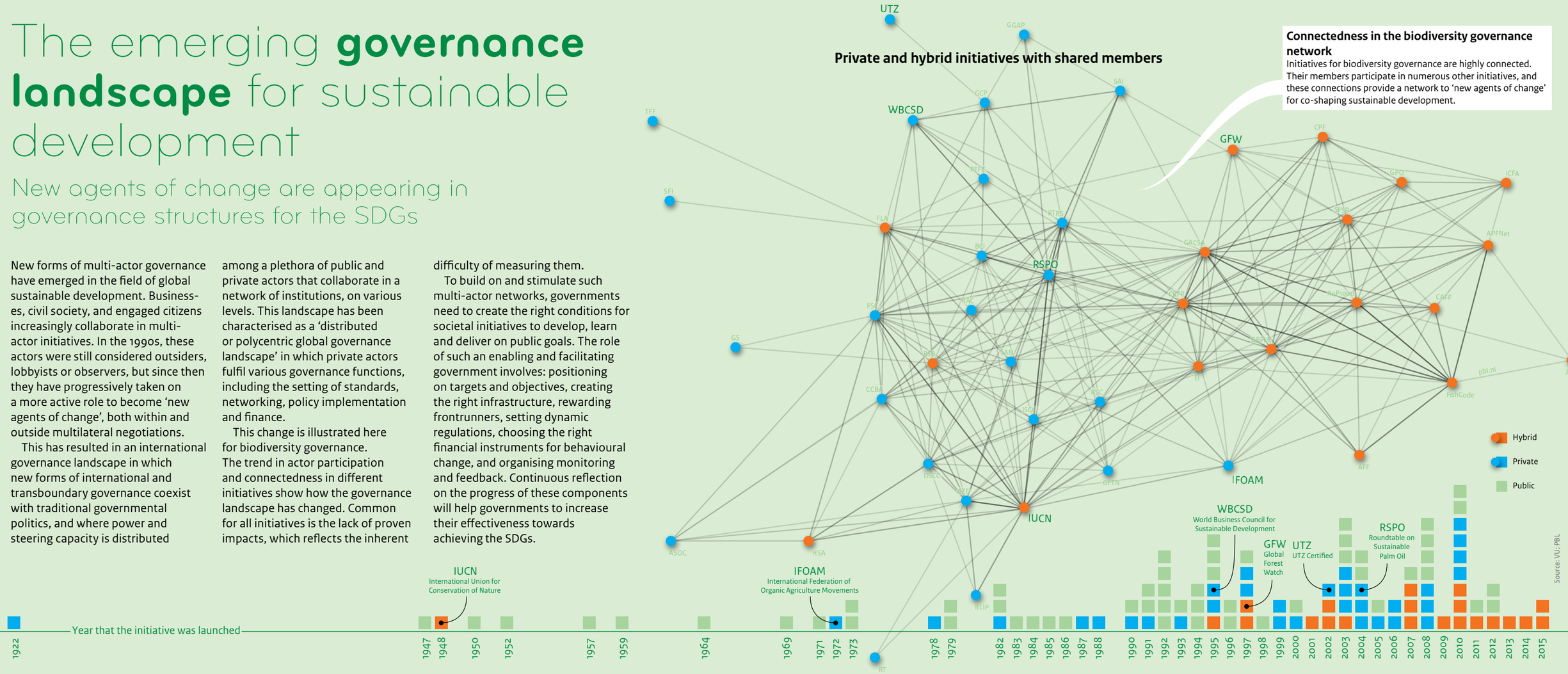
New agents of change are appearing in governance structures for the SDGs

New forms of multi-actor governance have emerged in the field of global sustainable development. Businesses, civil society, and engaged citizens increasingly collaborate in multi-actor initiatives. In the 1990s, these actors were still considered outsiders, lobbyists or observers, but since then they have progressively taken on a more active role to become 'new agents of change', both within and outside multilateral negotiations.

This has resulted in an international governance landscape in which new forms of international and transboundary governance coexist with traditional governmental politics, and where power and steering capacity is distributed among a plethora of public and private actors that collaborate in a network of institutions, on various levels. This landscape has been characterised as a 'distributed or polycentric global governance landscape' in which private actors fulfil various governance functions, including the setting of standards, networking, policy implementation and finance.

This change is illustrated here for biodiversity governance. The trend in actor participation and connectedness in different initiatives show how the governance landscape has changed. Common for all initiatives is the lack of proven impacts, which reflects the inherent difficulty of measuring them.

To build on and stimulate such multi-actor networks, governments need to create the right conditions for societal initiatives to develop, learn and deliver on public goals. The role of such an enabling and facilitating government involves: positioning on targets and objectives, creating the right infrastructure, rewarding frontrunners, setting dynamic regulations, choosing the right financial instruments for behavioural change, and organising monitoring and feedback. Continuous reflection on the progress of these components will help governments to increase their effectiveness towards achieving the SDGs.



Annex

Using scenarios to explore development pathways

This book uses results from scenario studies carried out by PBL and its partners. Scenario analyses can help in exploring future development pathways by incorporating assumptions about key future uncertainties. The scenarios used are plausible descriptions of future developments, based on a coherent and internally consistent set of assumptions about key relationships and driving forces (e.g. population growth, economic development, rate of technology change). These scenarios are used in the integrated assessment model IMAGE, to make future projections with respect to food, water, energy and climate (Stehfest et al., 2014).

Various sets of scenarios were used. The first set consists of the Shared Socio-economic Pathways or SSPs (Van Vuuren et al., 2017; Doelman et al. forthcoming). The SSPs characterise overall development, based on detailed projections of key determinants of global environmental change and social development, including population growth, economic growth, technological change, level of environmental protection, and level of cooperation between countries and regions. They describe future pathways spanning uncertainties in two dimension: societal challenges to adaptation to climate change and societal challenges to mitigation of climate change. While they are designed for climate change research, they are broad enough to serve as a general framework to assess a range of possible futures for other environmental and developmental challenges. Two SSPs were used for this book.

The SSP2, or 'Middle of the Road' scenario, defines the continuation of trends typical of recent decades, with some progress being made towards achieving development goals, a slowing down of the historical rates of resource and energy consumption, and slowly decreasing fossil fuel dependence. This scenario is used as a business-as-usual scenario for the infographics on urbanisation (pp. 14–15), nutrition, agricultural land use and expansion (pp. 24-25, 26-27), water use, waste water and flooding (pp. 28–29, 30–31, 32-33), electricity access and generation (pp. 34–35, 36–37), and land degradation (pp. 40–41). For some of these infographics, specific interventions were included, in addition to the SSP2 development, to explore the effect of policy measures; for instance, to assess the effects of climate policy on electricity generation in Sub-Saharan Africa (pp. 36-37), and of new measures in water treatment and sanitation on phosphorous emissions from households to surface water (pp. 30-31).

The SSP1, or 'Sustainability' scenario, defines trends consistent with a greener growth paradigm, i.e. a more inclusive development respecting environmental boundaries. This scenario makes 'reasonably ambitious' assumptions about achieving improvements in resource efficiency and human development, and about citizens' preferences regarding consumption and production patterns within the energy and land-use systems. This is the scenario used for the infographic on agricultural land use and expansion (pp. 26–27).

For the infographic on biodiversity loss and conservation (pp. 38–39), another set of scenarios was used (see Kok et al., 2014; PBL 2012). This set includes a business-as-usual scenario and three so-called pathways, specifically designed to simultaneously address biodiversity concerns as well as a range of long-term human development and environmental concerns. As in the SSPs, the business-as-usual scenario assumes that basic socio-economic mechanisms continue to operate in the same fashion and no specific new policies are introduced to meet sustainability goals. It assumes a continuation of current trends, including the gradual introduction of new technologies and the involvement of businesses and civil society in decision-making, while economic inequalities remain.

In addition to the business-as-usual scenario, the set includes the following alternative pathways:

Global Technology (also called Sparing) achieves the 2050 targets with a focus on optimal large-scale technological solutions, such as intensive agriculture and a high level of international coordination.

Decentralised Solutions (also called Sharing) achieves the 2050 targets with a focus on regional priorities and ecology-friendly technologies. Energy, food and wood are produced locally or regionally and agriculture is interwoven with natural corridors.

Consumption Change (also called Caring) achieves the 2050 targets with a focus on changes in human consumption patterns, most notably by limiting meat intake per capita, by ambitious efforts to reduce waste in the agricultural production chain and by adopting a less energy-intensive and material-intensive lifestyle.

Data and references per spread

p. 6 Welcome to the Anthropocene

Trend data compiled by PBL and Steffen et al. (2014). The following information sources were used, plus data from a set of online databases: FAOSTAT database, International Road Federation (IRF) database (2011), World Bank World Development Indicators:

Alcamo J, Döll P, Henrichs T, Kaspar F, Lehner B, Rösch T and Siebert S. (2003). Development and testing of the WaterGAP 2 global model of water use and availability. Hydrological Sciences Journal 48:317–337.

Bouwman L, Goldewijk KK, Van der Hoek KW, Beusen AH, Van Vuuren DP, Willems J, Rufino MC and Stehfest E. (2013). Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period. Proceedings of the National Academy of Sciences 110:20882–20887.

Etheridge DM, Steele L, Langenfelds R, Francey R, Barnola JM and Morgan V. (1996). Natural and anthropogenic changes in atmospheric CO2 over the last 1000 years from air in Antarctic ice and firn. Journal of Geophysical Research: Atmospheres 101:4115–4128.

Flörke M, Kynast E, Bärlund I, Eisner S, Wimmer F and Alcamo J. (2013). Domestic and industrial water uses of the past 60 years as a mirror of socio-economic development: A global simulation study. Global Environmental Change 23:144–156.

Flörke M, Lapola D, Schaldach R, Voß F and Teichert E. (2010). Modelling historical and current irrigation water demand on the continental scale: Europe. Advances in Geosciences 27:79–85.

Grubler A, Johansson TB, Mundaca L, Nakicenovic N, Pachauri S, Riahi K, Rogner H-H and Strupeit L. (2012). Chapter 1 – Energy Primer. In: Global Energy Assessment – Toward a Sustainable Future. Cambridge University Press and the International Institute for Applied Systems Analysis, Cambridge (UK) and Laxenburg, pp. 99–150.

Klein Goldewijk K, Beusen A and Janssen P. (2010). Long-term dynamic modeling of global population and built-up area in a spatially explicit way: HYDE 3.1. The Holocene 20:565–573.

Kummu M, Ward PJ, De Moel H and Varis O. (2010). Is physical water scarcity a new phenomenon? Global assessment of water shortage over the last two millennia. Environmental Research Letters 5:034006.

Langenfelds R, Steele L, Van der Schoot M, Cooper L, Spencer D and Krummel P. (2004). Atmospheric methane, carbon dioxide, hydrogen, carbon monoxide and nitrous oxide from Cape Grim flask air samples analysed by gas chromotography. Baseline 8:46.

MacFarling Meure C. (2004). The natural and anthropogenic variations of carbon dioxide, methane and nitrous oxide during the Holocene from ice core analysis. PhD thesis. University of Melbourne.

MacFarling Meure C, Etheridge D, Trudinger C, Steele P, Langenfelds R, Van Ommen T, Smith A and Elkins J. (2006). Law Dome CO2, CH4 and N2O ice core records extended to 2000 years BP. Geophysical Research Letters 33.

Mackenzie FT, Ver LM and Lerman A. (2002). Century-scale nitrogen and phosphorus controls of the carbon cycle. Chemical Geology 190:13–32.

Maddison A. (1995). Monitoring the World Economy 1820–1992. OECD, Paris.

Morice CP, Kennedy JJ, Rayner NA and Jones PD. (2012). Quantifying uncertainties in global and regional temperature change using an ensemble of observational estimates: The HadCRUT4 data set. Journal of Geophysical Research: Atmospheres 117.

Pongratz J, Reick C, Raddatz T and Claussen M. (2008). A reconstruction of global agricultural areas and land cover for the last millennium. Global Biogeochemical Cycles 22.

Steffen W, Broadgate W, Deutsch L, Gaffney O and Ludwig C. (2015) The Trajectory of the Anthropocene: the Great Acceleration. The Anthropocene Review 2 (1): 81–98.

PBL (2010). Rethinking global biodiversity strategies: exploring structural changes in production and consumption to reduce biodiversity loss. PBL Netherlands Environmental Assessment Agency, The Hague.

UNWTO (2006). International Tourist Arrivals.

p. 8 Earth matters

Haines-Young R and Potschin M. (2011). Common International Classification of Ecosystem Services (CICES): 2011 Update. European Environment Agency, Copenhagen.

World Bank (2011). The changing wealth of nations : measuring sustainable development in the new millennium. The international bank for reconstruction and development Washington.

WAVES (2016) Wealth Accounting and WAVES https://www.wavespartnership.org/en/wealth-accounting-and-WAVES.

p. 10 The future is now

UNFCCC (2015). Adoption of the Paris Agreement. Report No. FCCC/CP/2015/10/Add.1

UNISDR (2015). Sendai Framework for Disaster Risk Reduction 2015–2030. United Nations Office for Disaster Risk Reduction, Sendai, Japan.

United Nations (2015). Addis Ababa Action Agenda of the Third International Conference on Financing for Development.

United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development.

United Nations (2016). New Urban Agenda: Quito Declaration on Sustainable Cities and Human Settlements for All.

p. 12 Human development in a safe and just operating space

Global Footprint Network (2017). National Footprint Accounts, 2017 Edition. Please contact Global Footprint Network at data@footprintnetwork.org for more information. For explanantion see http://www.footprintnetwork.org/resources/glossary/

Lucas P, Ludwig K, Kok M and Kruitwagen S. (2016). Sustainable Development Goals in the Netherlands – Building Blocks for Environmental Policy for

2030. PBL Netherlands Environmental Assessment Agency, The Hague.
Raworth K. (2012). A Safe and Just Space for Humanity: Can we live within the doughnut? Oxfam, Oxford (UK).
Rockström J, Steffen W, Noone K, Persson Å, Chapin FS, Lambin EF, Lenton TM, Scheffer M, Folke C and Schellnhuber HJ. (2009). A safe operating space for humanity. Nature 461:472–475.
Waage J, Yap C, Bell S, Levy C, Mace G, Pegram T, Unterhalter E, Dasandi N, Hudson D, Kock R, Mayhew S, Marx C and Poole N. (2015). Governing Sustainable Development Goals: interactions, infrastructures, and institutions. In: Waage J and Yap C (eds.). Thinking Beyond Sectors for Sustainable Development. Ubiquity Press, London, pp. 79–88.

p. 14 An urbanising world

Hajer M and Dassen T. (2014). Smart about cities: visualizing the challenge for 21st century urbanism. PBL Netherlands Environmental Assessment Agency, The Hague.
Kraas F, Leggewie C, Lemke P, Matthies E, Messner D, Nakicenovic N, Schellnhuber H, Schlacke S, Schneidewind U and Brandi C. (2016). Humanity on the move: Unlocking the transformative power of cities. WBGU-German Advisory Council.
Ligtvoet W, Hilderink H, Bouwman A, Puijenbroek P, Lucas P and Witmer M. (2014). Towards a world of cities in 2050. An outlook on water-related challenges. Background report to the UN-Habitat Global Report. PBL Netherlands Environmental Assessment Agency, The Hague.
UN DESA (2015). World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP.241. United Nations Department of Economic and Social Affairs, New York.

p. 16 Benefits and impacts of Dutch international trade

Trade data for agricultural resources and derived food products in 2015 are compiled by PBL from the UN Comtrade Database, selecting categories 1 to 24 (with the exception of category 6). Goods that are exported in the same state as previously imported (so-called re-exports) are also included. The following information sources were used:

CBS, CPB, PBL and SCP (2011). Monitor Duurzaam Nederland 2011 [Monitor sustainable Netherlands 2011 (in Dutch)]. Statistics Netherlands, The Hague.
UN (2017). UN Comtrade Database, https://comtrade.un.org/, accessed 24 January 2017.
Wilting HC and Van Oorschot MM. (2017). Quantifying biodiversity footprints of Dutch economic sectors: A global supply-chain analysis. Journal of Cleaner Production 156:194–202.

p. 20 Achieving Sustainable Development Goals through inclusive green growth

Berkhout E, Bouma J, Terzidis N and Voors M. (forthcoming), Supporting Local Institutions for Inclusive Green Growth: Developing an Evidence Gap Map, forthcoming in special issue of NJAS - Wageningen Journal of Life Sciences.
Bouma J and Berkhout E. (2015a). Inclusive Green Growth. PBL Netherlands Environmental Assessment Agency, The Hague.
Lucas P, Ludwig K, Kok M and Kruitwagen S. (2016). Sustainable Development Goals in the Netherlands – Building Blocks for Environmental Policy for 2030. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 22 Despite increases in food supply, hunger persists

FAO (2017a). FAOSTAT Food Balance Sheets 2016, Production Database, Land Database. http://faostat.fao.org/, accessed 28 February 2017.
FAO (2017b). The State of Food Insecurity in the World 2015. http://www.fao.org/hunger/en/, accessed 28 February 2017.
Huisman L, Vink M and Van Eerdt M. (2016). African Food Supply in Perspective. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 24 Healthy soils, healthy lives

Black RE, Victoria CG, Walker SP, Bhutta ZA, Christian P, De Onis M, Ezzati M, Grantham-McGregor S, Katz J, Martorell R and Uauy R. (2013). Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries. *The Lancet* 382: 427–51
Hengl T, Leenaars JGB, Shepherd KD, Walsh MG, Heuvelink GBM, Mamo T, Tilahun H, Berkhout E, Cooper M, Fegraus E, Wheeler I and Kwabena NA. (submitted). Soil nutrient maps of Sub-Saharan Africa: assessment of soil nutrient content at 250 m spatial resolution using machine learning. Nutrient Cycling in Agroecosystems.
PBL (2015). Scoping study DGIS-Resource Efficiency project. PBL Netherlands Environmental Assessment Agency, The Hague.
USGS (2014). Minerals yearbook: Zinc. United States Geological Survey. Available from: https://minerals.usgs.gov/minerals/pubs/commodity/zinc/myb1-2014-zinc.pdf.

p. 26 Matching food demand and the availability of cropland in Sub-Saharan Africa

Doelman JC, Stehfest E, Tabeau A, Van Meijl H, Lassaletta L, Gernaat DEHJ, Neumann-Hermans K, Harmsen M, Daioglou V, Biemans H and Van Vuuren DP. (forthcoming). Exploring SSP land-use dynamics using the IMAGE model: regional and gridded scenarios of land-use change and landbased climate change mitigation. Global Environmental Change.
FAO (2017). FAOSTAT Food and Agriculture Data. http://faostat.fao.org/, accessed 28 February 2017.
Popp A, Calvin K, Fujimori S, Havlik P, Humpenöder F, Stehfest E, Bodirsky BL, Dietrich JP, Doelmann JC and Gusti M. (2017). Land-use futures in the shared socio-economic pathways. Global Environmental Change 42:331–345.

p. 28 Too little water

Biemans H. (2012). Water constraints on future food production. PhD thesis. Wageningen University.
Bijl DL, Bogaart PW, Kram T, De Vries BJ and Van Vuuren DP. (2016). Long-term water demand for electricity, industry and households. Environmental Science & Policy 55:75–86.
Erkens G and Sutanudjaja E. (2015). Towards a global land subsidence map. Proceedings of the International Association of Hydrological Sciences 372:83.
Jägermeyr J, Gerten D, Schaphoff S, Heinke J, Lucht W and Rockström J. (2016). Integrated crop water management might sustainably halve the global food gap. Environmental Research Letters 11:025002.

p. 30 Too dirty water

Hilderink H, Lucas P, Ten Hove A, Kok M, De Vos M, Janssen P, Meijer J, Faber A, Ignaciuk A and Petersen A. (2008). Towards a global Integrated sustainability model: GISMO1.0 status report. PBL Netherlands Environmental Assessment Agency, The Hague.
Ligtvoet W, Hilderink H, Bouwman A, Puijenbroek P, Lucas P and Witmer M. (2014). Towards a world of cities in 2050. An outlook on water-related challenges. Background report to the UN-Habitat Global Report. PBL Netherlands Environmental Assessment Agency, The Hague.
Van Drecht G, Bouwman A, Harrison J and Knoop J. (2009). Global nitrogen and phosphate in urban wastewater for the period 1970 to 2050. Global Biogeochemical Cycles 23.
Van Puijenbroek P, Bouwman A, Beusen A and Lucas P. (2015). Global implementation of two shared socioeconomic pathways for future sanitation and wastewater flows. Water Science and Technology 71:227–233.

p. 32 Too much water

Ligtvoet W, Hilderink H, Bouwman A, Puijenbroek P, Lucas P and Witmer M. (2014). Towards a world of cities in 2050. An outlook on water-related challenges. Background report to the UN-Habitat Global Report. PBL Netherlands Environmental Assessment Agency, The Hague.
Ward PJ, Jongman B, Weiland FS, Bouwman A, Van Beek R, Bierkens MF, Ligtvoet W and Winsemius HC. (2013). Assessing flood risk at the global scale: model setup, results, and sensitivity. Environmental Research Letters 8:044019.
Winsemius HC, Aerts JC, Van Beek LP, Bierkens MF, Bouwman A, Jongman B,

Kwadijk JC, Ligtvoet W, Lucas PL and Van Vuuren DP. (2016). Global drivers of future river flood risk. Nature Climate Change 6:381–385.

p. 34 Towards universal electricity access in Sub-Saharan Africa

Lucas PL, Dagnachew AG and Hof AF. (2017). Towards universal electricity access in Sub-Saharan Africa: A quantitative analysis of technology and investment requirements. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 36 Leapfrogging towards low-carbon electricity systems

Lucas PL, Dagnachew AG and Hof AF. (2017). Towards universal electricity access in Sub-Saharan Africa: A quantitative analysis of technology and investment requirements. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 38 Combining human development with biodiversity conservation

Kapos V, Ravilious C, Campbell A, Dickson B, Gibbs HK, Hansen MC, Lysenko I, Miles L, Price J, Scharlemann JPW and Trumper KC. (2008). Carbon and biodiversity: a demonstration atlas. UNEP-WCMC, Cambridge (UK).

Kok M, Alkemade A, Bakkenes M, Boelee E, Christensen V, Van Eerdt M, Van der Esch S, Janse J, Karlsson-Vinkhuyzen S, Kram T, Lazarova T, Linderhof V, Lucas P, Mandryk M, Meijer J, Van Oorschot M, Teh L, Van Hoof L, Westhoek H and Zagt R. (2014). How sectors can contribute to sustainable use and conservation of biodiversity. PBL Netherlands Environmental Assessment Agency, The Hague.

OECD (2012). OECD Environmental Outlook to 2050. OECD – Organisation for Economic Co-Operation and Development, Paris.

p. 40 High demand, little land to share

Nkonya E, Mirzabaev A and Von Braun J. (2016). Economics of Land Degradation and Improvement: A Global Assessment for Sustainable Development. Springer.

PBL (forthcoming). Exploring the impact of changes in land use and land condition on food, water, climate change mitigation and biodiversity; Scenarios for the UNCCD Global Land Outlook. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 44 Addressing the Sustainable Development Goals through partnerships

Bouma J and Berkhout E. (2015). Public–private partnerships in development cooperation. Potential and pitfalls for Inclusive Green Growth. PBL Netherlands Environmental Assessment Agency, The Hague.

Berkhout E, Bouma J, Terzidis N and Voors M. (forthcoming), Supporting Local Institutions for Inclusive Green Growth: Developing an Evidence Gap Map, forthcoming in special issue of NJAS - Wageningen Journal of Life Sciences.

Hospes O, Dewulf A and Faling M. (2016) Inclusiveness in Public-Private Partnerships: NGO Views and Strategies, Wageningen University.

p. 46 Towards resource-smart food systems

UNEP (2016). Food Systems and Natural Resources. A Report of the Working Group on Food Systems of the International Resource Panel. Westhoek H, Ingram J, Van Berkum S, Özay L and Hajer M. UNEP, Nairobi.

p. 48 Voluntary market standards drive sustainable consumption and production

Market shares data are compiled by PBL. Most Dutch market shares are for 2015, with the exception of fish (2014) and soya (2013). Most global shares are for 2013, with the exception of wood (2014) and fish (2015). The following information sources were used:

CBS (2015). Monitor duurzame agro-grondstoffen 2015 [Monitor sustainable agricultural resources 2015 (in Dutch)]. Statistics Netherlands, The Hague.

https://www.cbs.nl/nl-nl/economie/landbouw/monitor-duurzame-agro-grondstoffen-2015.

KNVKT (2015). Meerdere wegen naar duurzame koffie. Rapportage verduurzaming 2015 [Various pathways towards sustainable coffee. Sustainability report (in Dutch)], The Hague, Royal Dutch Coffee and Tea Association (KNVKT).

Lernoud J, Potts J, Sampson G, Voora V, Willer H and Wozniak J. (2015). The State of Sustainable Markets – Statistics and Emerging Trends 2015. ITC International Trade Centre, Geneva.

Logatcheva K. (2015). Monitor Duurzaam Voedsel 2014: consumentenbestedingen [Monitor sustainable Food 2014 (in Dutch)]. LEI Wageningen UR, The Hague, Wageningen.

MSC (2016). Global impacts report 2016. MSC Marine Stewardship Council, London.

Oldenburger J, Fons Voncken F, Penninkhof J and Van Benthem M. (2016). Duurzaam geproduceerd hout op de Nederlandse markt in 2015 [Sustainably produced wood on the Dutch market in 2015 (in Dutch)]. Stichting Probos, Wageningen.

Task Force Duurzame Palmolie (2015). Duurzame plamolie de norm in 2015 [Sustainable palm oil is the norm in 2015 (in Dutch)]. Final report.

Van Gelder JW, Kuepper B and Vrins M. (2012). Soy barometer 2014, a research report for the Dutch Soy Coalition. Profundo research and advice, Amsterdam.

Van Oorschot M, Kok M, Brons J, Van der Esch S, Janse J, Rood T, Vixseboxse E, Wilting H and Vermeulen WJV. (2014). Sustainability of international Dutch supply chains: Progress, effects and perspectives. PBL Netherlands Environmental Assessment Agency, The Hague.

Vermeulen WJV, Uitenboogaart Y, Pesqueira LDL, Metselaar J and Kok MTJ. (2010). Roles of Governments in Multi-Actor Sustainable Supply Chain Governance Sytems and the effectiveness of their interventions. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 50 Finding shared solutions at the landscape level

Thaxton M, Forster T, Hazlewood P, Mercado L, Neely C, Scherr SJ, Wertz L, Wood S and Zandri E. (2015). Landscape partnerships for sustainable development: achieving the SDGs through integrated landscape management LPFN. LPFN Landscapes for People, Food and Nature, Washington.

Van der Horn S and Meijer J. (2015). The Landscape Approach. PBL Netherlands Environmental Assessment Agency, The Hague.

p. 52 Bridging the finance gap

Kalkuhl M, Fernandez Milan B, Schwerhoff G, Jakob M, Hahnen M and Creutzig F. (2017). Fiscal Instruments for Sustainable Development: The Case of Land Taxes. MCC, Mercator Research Institute on Global Commons and Climate Change, Berlin.

Sewell A, Bouma J and Van der Esch S. (2016). Scaling Up Investments in Ecosystem Restoration. The key issues: financing and coordination. PBL Netherlands Environmental Assessment Agency, The Hague.

UNCTAD (2014). World Investment Report UN, Switzerland.

p. 54 The emerging governance landscape for sustainable development

Hajer M, Nilsson M, Raworth K, Bakker P, Berkhout F, De Boer Y, Rockström J, Ludwig K and Kok M. (2015). Beyond cockpit-ism: Four insights to enhance the transformative potential of the sustainable development goals. Sustainability 7:1651–1660.

Hajer MA. (2011). The energetic society: In search of a governance philosophy for a clean economy. PBL Netherlands Environmental Assessment Agency, The Hague.

Kristensen K, Widerberg O and Pattberg P. (forthcoming). The Biodiversity-Governance nexus, an exploratory assessment. IVM, Institute for Environmental Studies, Amsterdam.

p. 56 Annex: Using scenarios to explore development pathways

Doelman JC, Stehfest E, Tabeau A, Van Meijl H, Lassaletta L, Gernaat DEHJ, Neumann-Hermans K, Harmsen M, Daioglou V, Biemans H and Van Vuuren DP. (forthcoming). Exploring SSP land-use dynamics using the IMAGE model: regional and gridded scenarios of land-use change and landbased climate change mitigation. Global Environmental Change.

Kok M, Alkemade A, Bakkenes M, Boelee E, Christensen V, Van Eerdt M, Van der Esch S, Janse J, Karlsson-Vinkhuyzen S, Kram T, Lazarova T, Linderhof V, Lucas P, Mandryk M, Meijer J, Van Oorschot M, Teh L, Van Hoof L, Westhoek H and Zagt R. (2014). How sectors can contribute to sustainable use and conservation of biodiversity. PBL Netherlands Environmental Assessment Agency, The Hague.

PBL (2012). Roads from Rio+20. Pathways to achieve global sustainability goals by 2050. PBL Netherlands Environmental Assessment Agency, The Hague.

Van Vuuren DP, Stehfest E, Gernaat DEHJ, Doelman JC, Van den Berg M, Harmsen M, De Boer HS, Bouwman LF, Daioglou V, Edelenbosch OY, Girod B, Kram T, Lassaletta L, Lucas PL, Van Meijl H, Müller C, Van Ruijven BJ, Van der Sluis S and Tabeau A. (2017). Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm. Global Environmental Change 42:237–250.

Stehfest E, Van Vuuren D, Kram T, Bouwman L, Alkemade R, Bakkenes M, Biemans H, Bouwman A, Den Elzen M, Janse J, Lucas P, Van Minnen J, Müller M and Prins A. (2014). Integrated assessment of global environmental change with IMAGE 3.0: Model description and policy applications. PBL Netherlands Environmental Assessment Agency, The Hague.

Colophon

People and the Earth is the result of a joint effort by many people

project team: Marcel Kok, Annelies Sewell, Filip de Blois, Allard Warrink, Paul Lucas and Mark van Oorschot

with contributions from: Michel Bakkenes, Ezra Berkhout, Jetske Bouma, Arno Bouwman, Anteneh Dagnachew, Ton Dassen, Martha van Eerdt, Stefan van der Esch, Tom Kram, Willem Ligtvoet, Mandy Malan, Johan Meijer, Kersten Nabielek, Machteld Schoolenberg, Henk Westhoek, Harry Wilting and Willem-Jan van Zeist

graphics: Beeldredactie PBL and Frédérik Ruys (Vizualism)

production and English language editing: PBL Publishers

layout: Textcetera, The Hague

printing: Xerox/OBT, The Hague

isbn: 978-94-92685-02-5

publication number: 2510

PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all of our studies. We conduct solicited and unsolicited research that is both independent and scientifically sound.

www.pbl.nl/people-and-the-earth

2017