Assessment of global megatrends — an update

Global megatrend 8: Growing pressures on ecosystems

European Environment Agency

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Assessment of global megatrends — an update

Global megatrend 8: Growing pressures on ecosystems (*)

(*) In the EEA's first analysis of global megatrends as part of SOER 2010, GMT 8 was entitled, 'Decreasing stocks of natural resources'. The title has been altered slightly in this update to clarify the chapter's focus on the use of renewable ecosystem-based resources and to distinguish it from GMT 7, which addresses non-renewable resources (such as minerals and fossil fuels).

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Assessment of global megatrends — an update

Europe is bound to the rest of the world through an enormous number of systems — environmental, economic, social, political and others. Such networks enable complex flows of materials and ideas across the globe, producing uncertain feedbacks and knock-on effects over time. Greenhouse gas emissions in Europe today can affect the climate in distant locations and far into the future. Land management choices on the other side of the world can influence food and energy prices in Europe. Global communication and trade networks fuel innovation — sometimes boosting efficiency, sometimes creating new environmental pressures.

Most of these interactions are intimately linked and set to unfold over decades. All are likely to have important implications for living standards and well-being.

The European environment's status, trends and prospects have always depended in part on events outside its borders. Yet the growing importance of global networks and flows has augmented this interdependence, creating complex challenges for traditional governance systems framed within national or regional territories. To design effective ways to manage the environmental changes ahead, societies and governments need to understand the global drivers at work and their potential implications.

With this challenge in mind, the European Environment Agency in 2010 produced its first assessment of emerging global trends as part of its five-yearly flagship report on the European environment's state and outlook (SOER 2010). The exploratory analysis summarised 11 global megatrends grouped into five clusters — social, technological, economic, environmental and governance. Introducing the issues succinctly, it sought to trigger a discussion about how Europe should monitor and assess future changes in order to better inform environmental policymaking.

In preparation for its next report on the European environment's state and outlook (SOER 2015), the EEA has initiated an update of the assessment of global megatrends, analysing each of these drivers in a little more detail than previously in terms of their impacts on the European environment and well-being. During the second half of 2013 and early-2014, the EEA is reassessing the 11 megatrends and publishing the updates separately on its website. In 2014 the chapters will be consolidated into a single EEA technical report and will provide the basis for the analysis of megatrends included in SOER 2015. The present chapter addresses megatrend 8: 'Growing pressures on ecosystems'.

Again, it needs to be emphasised that the complexity of highly interconnected human and natural systems introduces considerable uncertainty into projections and forecasts. As much as anything, the assessment of megatrends aims to encourage readers to acknowledge this interdependence and uncertainty. In so doing, it may help point the way towards systems of planning and governance better adapted to meeting the challenges ahead.

Global megatrend 8
Growing demands on ecosystems (*)

Driven by global population growth and associated demands for food and energy, as well as evolving consumption patterns, the pressure on the Earth's ecosystems is continuously increasing. Despite some positive developments, such as a recent reduction in the rates of tropical deforestation, global biodiversity loss and ecosystem degradation are projected to increase.

Climate change is expected to exacerbate this trend by altering the environmental conditions to which species are adapted. In addition, the need to shift to alternative energy sources may create challenges for global land and freshwater resources, most notably related to increased bioenergy production.

Poor people in developing countries are expected to be those most strongly affected by the projected degradation of ecosystems and their life-supporting services. Sustainable management of ecosystems and socio-economic development are thus intertwined challenges. Continuing depletion of natural capital globally would not only increase pressure on European ecosystems but also produce significant indirect effects, such as environment-induced migration.

8.1 Key drivers of increasing demands on ecosystems

Population, earnings and consumption

During the last century, global population growth, increased earnings and shifting consumption patterns (see GMTs 1, 2 and 5) have resulted in steadily increasing human interventions into the natural environment. Humans harvest biomass to provide for many aspects of their existence, including essentials such as food, fuels, fibres and construction materials. The associated conversion of land has wide-ranging impacts on ecosystems and the services that they provide, including their ability to maintain a healthy, stable environment.

One way to quantify humanity's diverse demands on ecosystems is in terms of 'human appropriation of net primary production' (HANPP). Krausmann et al. (2013) estimate that humans today appropriate 25 % of the Earth's primary production of biomass annually, via harvesting or burning, or as a result of land conversion. This is almost twice the rate of appropriation recorded a century ago. Humanity has, however, become more efficient in its exploitation of biomass during this period. Since 1910, the human population has quadrupled and global economic output increased by a factor of 17. Per capita HANPP thus declined from 3.9 tonnes of carbon annually in 1910 to 2.3 tonnes in 2005, due in part to a shift away from wood fuel to fossil fuels (Krausmann et al., 2013).

As illustrated in Map 8.1, human-induced land use changes, such as the conversion of forest to cropland or infrastructure, account for a major part of the annual appropriation of biomass in Africa and the Middle East, and eastern Europe, central Asia and Russia. In contrast, consumption (e.g. of crops or timber) accounts for most of the appropriation in western industrial countries and Asia.

Over the last 50 years, global per capita annual consumption of meat has almost doubled, increasing from around 23 kg per person to some 42 kg (see black line in Figure 8.1). Among the ten most populous world regions or countries, the United States has by far the highest per capita meat consumption, although consumption has declined slightly in recent years. China and Brazil recorded strong increases in meat consumption in the last 20–30 years, with Brazil recently reaching the European per capita level. In contrast, other populous Asian countries such as India,

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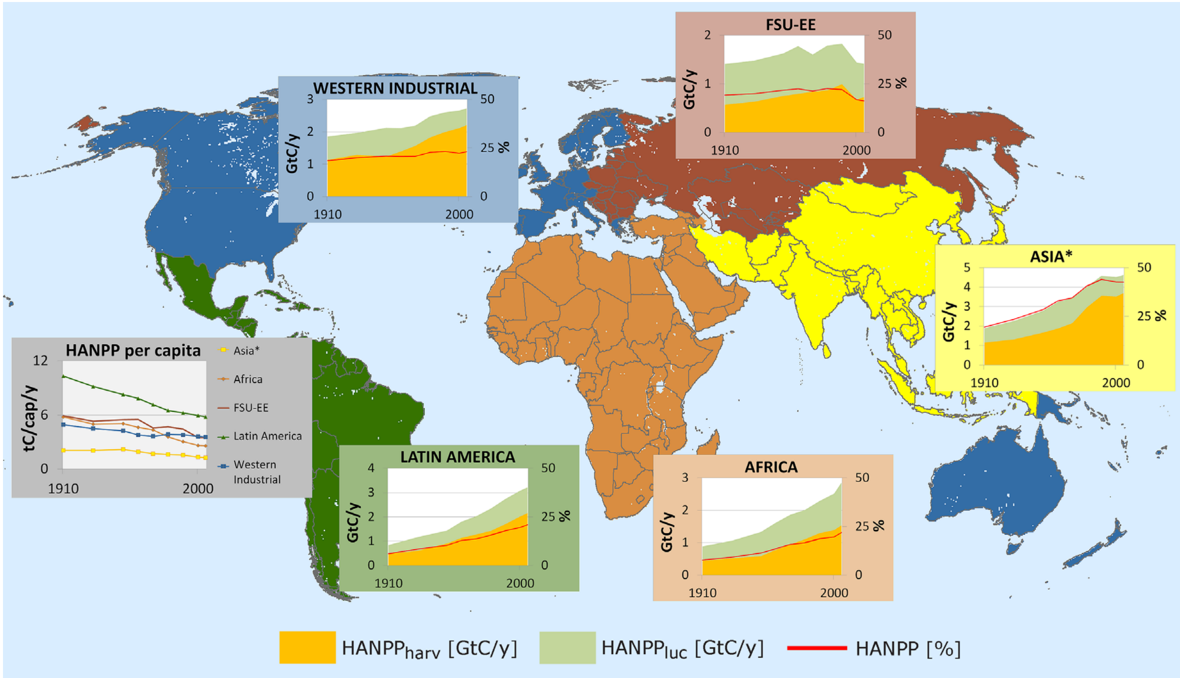
Map 8.1 Human appropriation of net primary production, 1910–2005



Note: HANPP is 'human appropriation of net primary production'. Net primary production is quantified in terms of the total carbon produced annually by plant growth. $HANPP_{harv}$ refers to gigatonnes of carbon in biomass harvested or consumed per year, including e.g. crops/food, timber, forest slash, forages consumed by livestock. $HANPP_{luc}$ refers to losses of carbon stock in biomass (gigatonnes per year) due to human-induced land use change, such as the conversion of forest to cropland or infrastructure.

Source: Krausmann et al., 2013.

Bangladesh, Pakistan and Indonesia, as well as the most populous African country, Nigeria, still remain at relatively low meat consumption rates.

Looking ahead, human pressures on ecosystems are likely to increase. Projections suggest that the global population will expand by 40 % in the next 40 years, from around 7 billion today to around 9.6 billion (UNDESA, 2013; GMT 1). Pressures on natural resources are likely to intensify, particularly in regions where high population growth rates coincide with a high and direct dependence on natural capital for economic development (OECD, 2012), such as in sub-Saharan Africa or parts of south-east Asia.

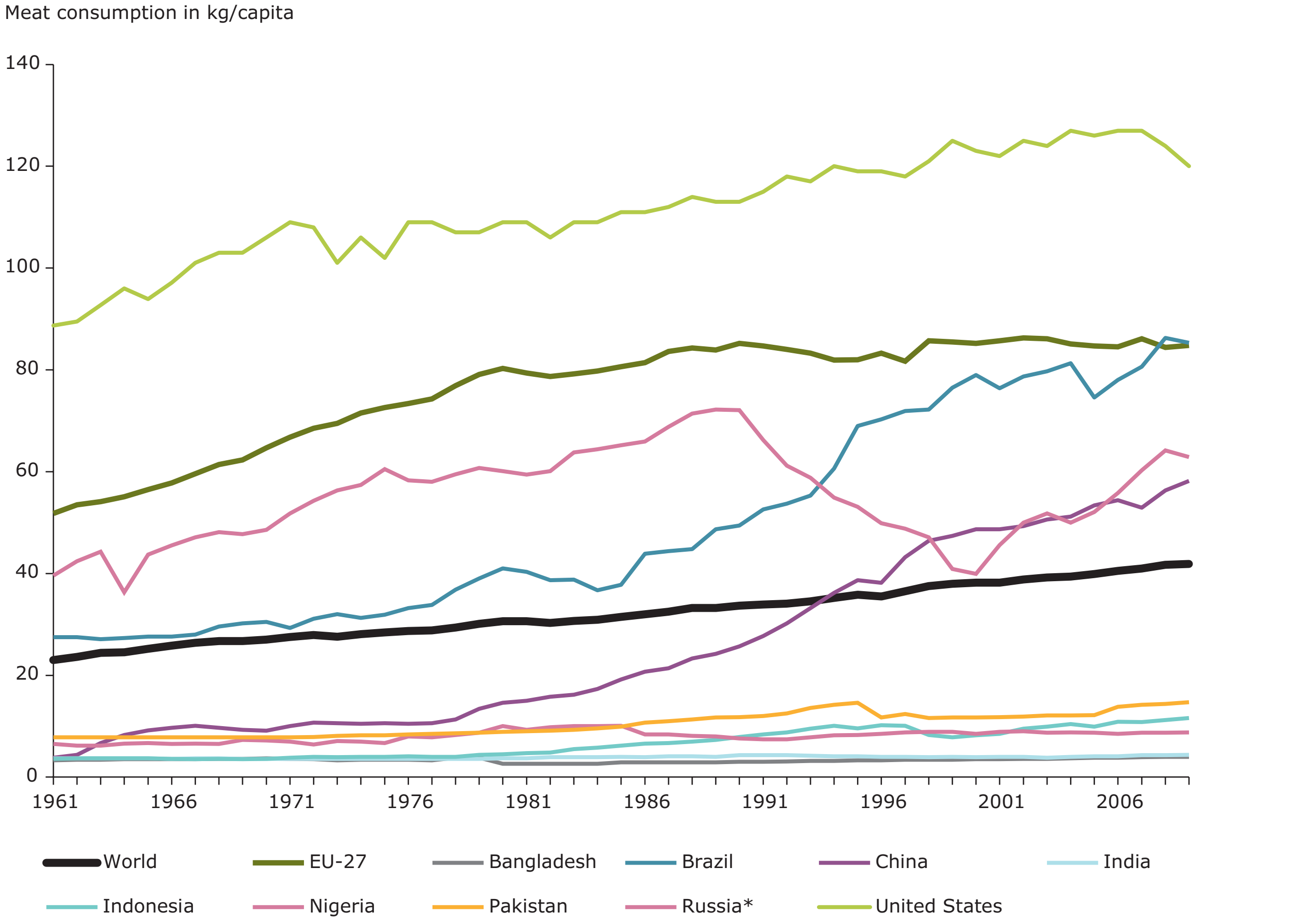
Economic growth is likely to augment demand for natural resources. Per capita economic output is projected to triple by 2050 (OECD, 2013; GMT 5), bringing changes in consumption patterns including a shift to increased meat consumption, which is comparatively resource intensive (UNEP, 2012). The impacts of such a shift on ecosystems could be considerable. For example, increased global demand for meat has been identified as the main driver of deforestation in the Amazon since the early 1990s (Zaks et al., 2009).

Food and bioenergy

The United Nation's Food and Agriculture Organization (FAO) estimates that by 2050 agricultural production (including all crop and livestock products) will grow by about 60 % (FAO, 2012b). Increasing wealth is projected to boost annual demand for meat products by 76 % to 455 million tonnes, although a decline in annual growth rates is anticipated over time as more countries attain high per capita levels of meat consumption (FAO, 2012b).

The FAO (2012b) likewise projects that global cereal production will increase by 46 % in 2050, relative to output in 2005. Despite expected increases in productivity and efficiency, increased food demand

Figure 8.1 Meat consumption in the world's most populous regions and countries, 1961–2009



Note: * Data prior to 1992 refer to the Union of Soviet Socialist Republics (USSR).

The figure represents the ten most populous world regions/countries, which account for more than 65 % of the total world population (in 2012).

Source: FAO, 2013.

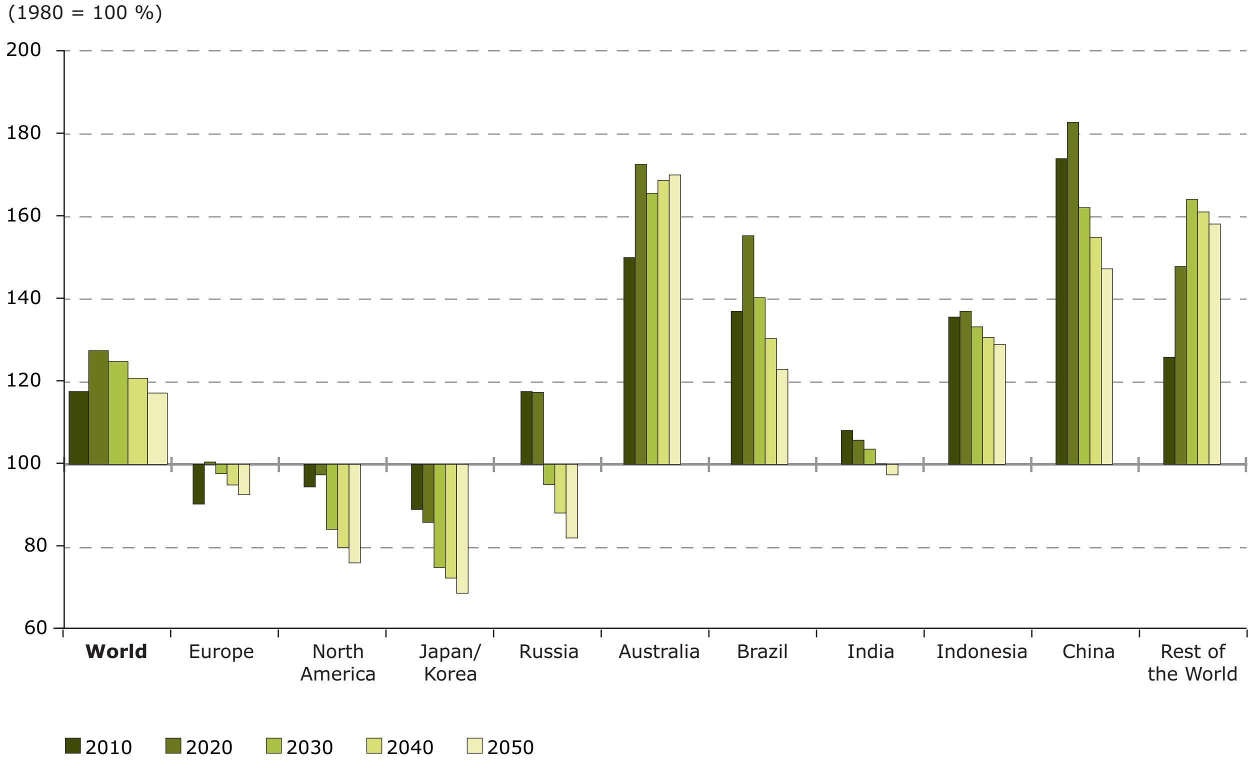
may necessitate a short-term increase in the global food crop area of about 1 million km^2 (OECD, 2012). As illustrated in Figure 8.2, however, the global figure may peak before 2030.

Triggered by stagnating or shrinking populations and stabilising diets, the crop area may decrease steadily in Europe, North America, Japan, South Korea and Russia, while similar trends might commence in other parts of the world from 2030 onwards. In contrast, food crop area is expected to increase markedly in sub-Saharan Africa (included in 'Rest of the world' in Figure 8.2) (OECD, 2012). In that region yields may be particularly affected by climate change (see Box 8.1).

Pressures on terrestrial ecosystems may be aggravated by a rapid expansion in land allocated to cultivating bioenergy crops, as a means of reducing dependence on fossil fuels (see GMT 7). In addition to potentially increasing food prices, biofuels generated from food crops such as grains, sugar cane and vegetable oils can also have significant ecological impacts. For example, they have been linked to deforestation (Box 8.2) and other land conversions at the expense of natural areas.

Bioenergy crops can also contribute to freshwater scarcity. One study estimates that the global water footprint associated with cultivation of bioenergy crops (i.e. direct and indirect water use across the entire supply chain) will increase ten-fold in the period 2005–2030 (Gerbens-Leenes et al., 2012). Mitigating associated pressures on ecosystems will depend in part on the technological and commercial emergence of bioenergy produced from

Figure 8.2 Projected change in global food crop area, 2010–2050



Note: 'Europe' in this figure refers to the EU-27 plus Iceland, Liechtenstein, Norway and Switzerland.

The land use model is calibrated based on FAO statistics for the period 1970–2000, and simulates food crop area for the period 2001–2050. Therefore, the results for the year 2010 are modelled data, not observed values.

Source: OECD, 2012.

Box 8.1 Food security in sub-Saharan Africa and potential climate change impacts

In coming decades, rapid population growth is expected to boost demand for food in many of the world's poorest regions, necessitating the allocation of more land to food production. At the same time, agricultural output in some of these regions, notably sub-Saharan Africa, may be severely impacted by increased temperatures and changing precipitation patterns. Assuming an increase in the global average temperature of 4 °C or more by the end of the 21st century, results from 14 different global climate models suggest substantial decreases in yields for some of the most important crops in sub-Saharan Africa. Average maize yields could decline by 24 % from the 2000s to the 2090s, bean yields by 71 % and forage grass yields by 7 % (Thornton et al., 2011). Climate change thus may pose a serious challenge to food security.

Box 8.2 Oilcrops and deforestation

Rapid expansion of oil palm plantations is considered to be a key driver of rain forest destruction in south-east Asia. In that region, the area under oilcrop cultivation increased by almost 70 % between 2000 and 2009, rising from 4.2 to 7.1 million hectares.

Globally, demand for oilcrops may rise by 89 % in the period to 2050 (FAO, 2012b), with Indonesian production potentially meeting a large share of this increase. The Indonesian government expects to expand the area devoted to palm oil plantations from around 6 million hectares in 2008 to 20 million hectares in 2030, mostly at the expense of forest (UNEP, 2009). The development is triggered by increasing demands for consumer goods in China and India, and growing demand for biofuels in Europe and elsewhere (UNEP, 2012).

residues of agriculture and forestry that do not require additional land (UNEP, 2012).

Competition for land

Growing global competition for scarce land resources and related concerns about food and energy security are apparent in the number of large-scale transnational acquisitions of land during recent years, mostly in developing countries. This phenomenon, sometimes referred to as 'land grabbing', has increased rapidly. Between 2005 and 2009, global acquisitions totalled some 470 000 km^2 (Rulli et al., 2013) which approximately equals the size of Sweden. As a consequence, large-scale commercial farming is expanding at the expense of smallholder farmers' access to land and water.

Africa and Asia account for 47 % and 33 % of the land area 'grabbed' globally. In some African countries, such as Liberia and Gabon, close to 100 % of the cultivated land has been acquired through such transactions. Many of the corporations and governments responsible for 'grabbing' the land are from Europe and the Middle East, as well as North America and south-east Asia (Map 8.2).

A key motive for land grabbing, particularly for countries in arid regions, is the goal of securing access to the freshwater resources available there (Rulli et al., 2013). Like land grabbing, this process (sometimes termed 'water grabbing') reflects growing concerns about access to essential resources. In coming decades, the combined effects of population growth, associated food demand and climate change are expected to create significant threats to the availability of freshwater (Murray et al., 2012). A review of 405 of the world's major river basins found that 201 (containing 2.7 billion people) currently face water scarcity in at least one month per year (Hoekstra et al., 2012). Moreover, the arid regions in north Africa and the Middle East that were not part of that analysis.

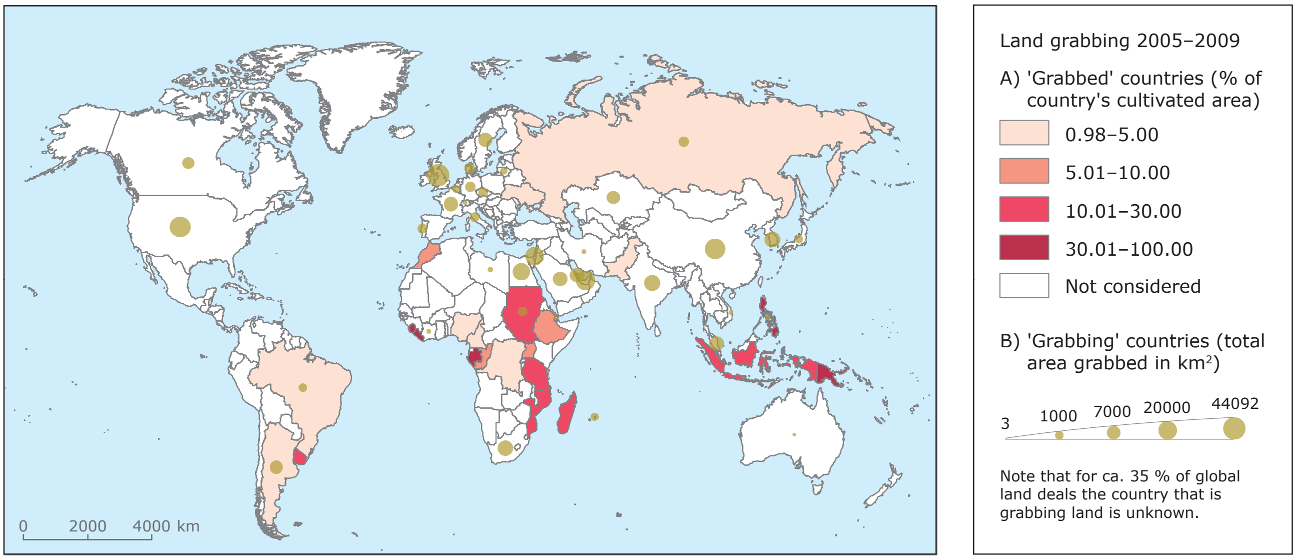
Scenarios on how to meet the world's food demand in 2050 suggest that even if water use is made much more efficient, the absolute agricultural intensification needed could lead to severe water stress in many world regions (Pfister et al., 2011). This implies a threat to both human water security and to the functioning of ecosystems, including their capacity to provide essential services. Already today, habitats associated with more than half of the global runoff to the oceans are moderately to highly threatened by water shortages (Vörösmarty et al., 2010).

8.2 Future trends in the status of ecosystems

Terrestrial biodiversity

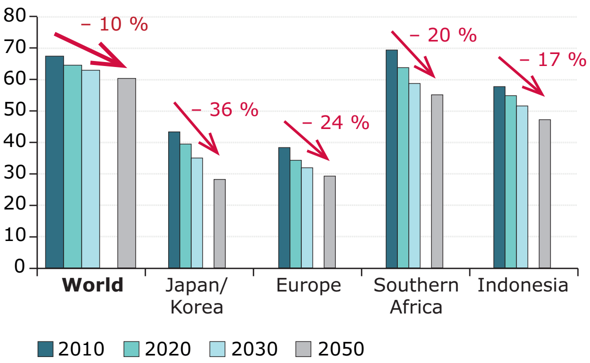
According to OECD projections (2012), human interventions into the natural environment

Map 8.2 Transnational land deals, 2005–2009



Source: Adapted from Rulli et al., 2013.

Figure 8.3 Terrestrial mean species abundance, globally and for selected world regions, 2010–2050



Note: 'Mean species abundance' is a measure of how close an ecosystem is to its natural state. It is defined as the mean abundance of original species in an area relative to the abundance in an undisturbed situation. A rating of 100 % implies that the biodiversity matches that in the natural situation. An MSA of 0 % means that there are no original species remaining in the ecosystem.

In this figure, 'Europe' refers to the EU-27 plus Iceland, Liechtenstein, Norway, and Switzerland.

Source: OECD, 2012 (output from IMAGE model).

will continue depleting biodiversity in coming decades (Figure 8.3) due to a range of pressures including climate change, forestry, development of infrastructure and agriculture (Figure 8.4). Towards the mid-21st century, climate change, forestry and bioenergy are expected to become more important drivers of biodiversity loss.

In a business-as-usual scenario, global terrestrial biodiversity measured as mean species abundance (MSA) is projected to decline further to around 60 % of the level that potential natural vegetation could support by 2050 (Figure 8.3). Particularly significant losses may occur in Japan and Korea (with a decrease of 36 % relative to the 2010 level), Europe (24 %), southern Africa (20 %), and Indonesia (17 %).

These estimates may be conservative, as they exclude two important concerns: risks associated with transgressing possible ecosystem thresholds (see Box 8.4) and the increasing spread of invasive alien species. Whether dispersed intentionally or unintentionally by global travel and trade, invasive alien species pose a serious threat to native biodiversity and can seriously distort ecosystems that they newly inhabit (Butchart et al., 2010).

Forests

The multiple competing demands for land have led to alarming rates of (tropical) deforestation during recent decades. While aggregate tropical deforestation remains high, some regions or countries, such as Brazil, have slowed their rates of forest loss. Mainly due to reforestation and afforestation in developed countries in temperate areas or in emerging economies, some models project global net forest loss to halt after 2020 and begin to recover thereafter (Figure 8.5).

The projected recovery largely reflects increases in the area of plantation forest. While plantations can provide ecosystem services such as provisioning timber, carbon sequestration and soil stabilisation, they fall short of primary forests in delivering other essential services such as supporting global biodiversity and genetic resources, and plant pollination. In contrast to plantations, primary forests are projected to decrease steadily up to 2050. The regions of most concern are Africa, Latin America and the Caribbean (which makes up part of the 'rest of the world' in Figure 8.5).

In addition to human encroachments, climate change may also be altering the remaining tropical forests. For example, Scholz and Vergara (2010) calculate that, even without direct human clearance of forest areas, climate change could reduce the extent of the Amazon biome by one third.

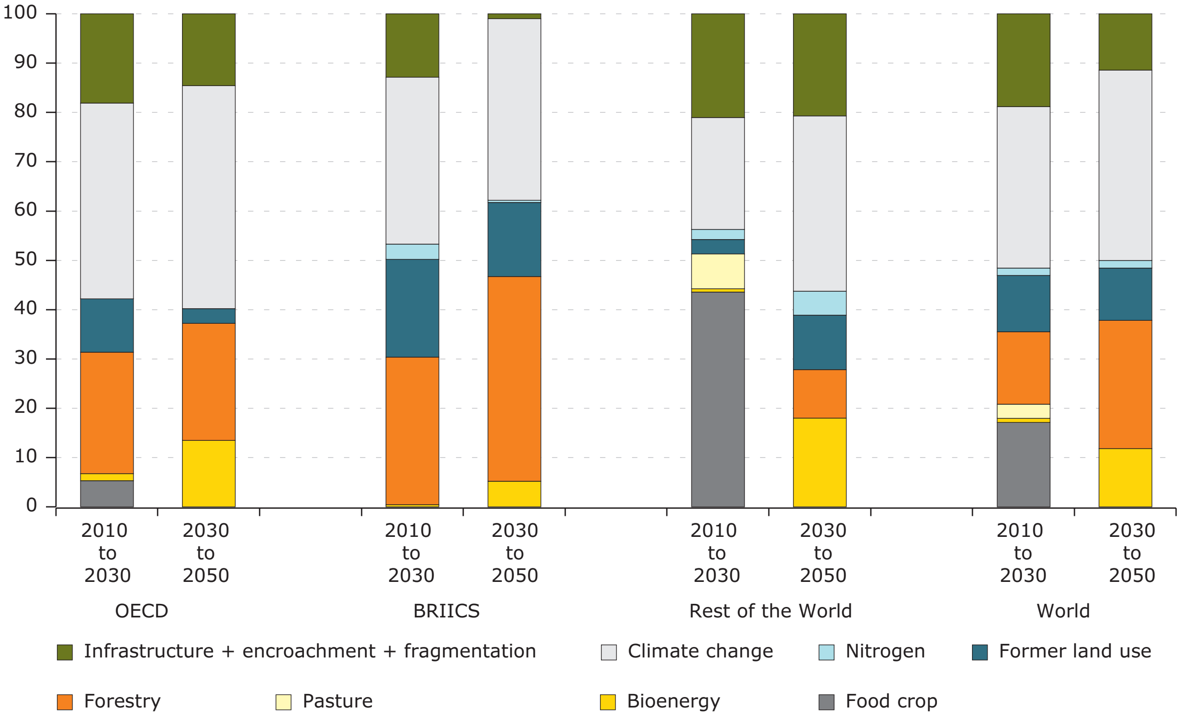
Drylands and wetlands

In addition to forests, two types of ecosystems have been identified as particularly threatened by depletion and loss of biodiversity: drylands and wetlands. Drylands cover about 40 % of the Earth's surface and host about 2 billion people, mostly in developing countries. Their destruction is continuing at an alarming rate, driven by the transformation of rangeland into cultivated cropland, resulting in problems such as water stress and soil degradation. The irreversible conversion of peatland and coastal wetlands (e.g. mangroves) for agriculture, aquaculture and human infrastructure is also likely to continue at very high rates (UNEP, 2012).

Marine ecosystems

In recent decades global marine ecosystems have become increasingly threatened, which is a major concern in view of their importance to societies

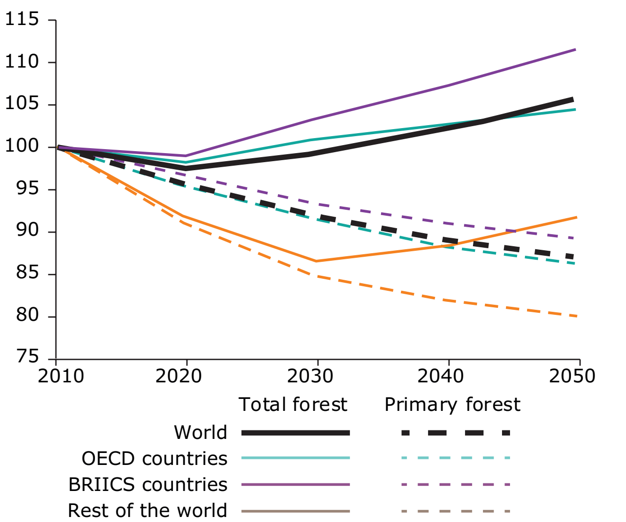
Figure 8.4 Share of different pressures on future global terrestrial biodiversity loss



Note: The numbers represent relative contributions to further (additional) biodiversity loss projected for the two time periods (2010–2030 and 2030–2050). As such, they do not explain losses incurred prior to 2010.
The contribution of 'food crop' (agricultural land) depends on the assumptions regarding future land conversions. The values presented here are based on an assumption of no further increase in agricultural land after 2030. Some other studies (e.g. PBL, 2012) assume that agricultural expansion will continue after 2030. As a result, they project 'food crop' continuing to make a significant contribution to biodiversity loss in the period 2030–2050. 'BRIICS' denotes Brazil, Russia, India, Indonesia, China and South Africa.

Source: OECD, 2012 (output from IMAGE model).

Figure 8.5 Projected change in global forest area, 2010–2050



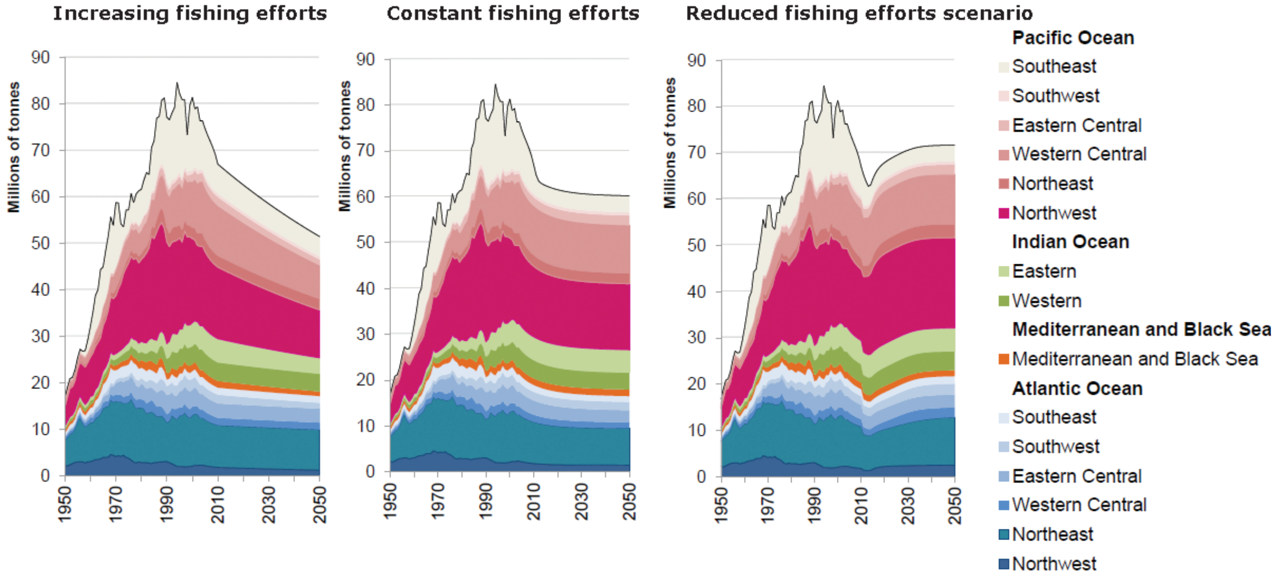
Note: 'BRIICS' denotes Brazil, Russia, India, Indonesia, China and South Africa.

Source: OECD, 2012 (output from IMAGE model).

across the world. The estimated value of the global catch in wild fisheries in 2008 was more than USD 80 billion. The industry directly employs some 35 million people worldwide, supports the livelihoods of more than 300 million people, and provides food security for millions of coastal communities (ten Brink et al., 2012).

In 2009, some 30 % of marine fish stocks were over-exploited or depleted, producing yields below their biological and ecological potential. In the same year, 57 % were fully exploited and only about 13 % were not fully exploited and thus held potential for increased harvests (FAO, 2012a). Modelling of alternative marine fisheries strategies until 2050 indicates that marine catches and stocks will decline in the world's main fishing regions unless fishing efforts are reduced (Figure 8.6). Unsustainable fishing strategies are likely to result in reduced wild catches, increasing demands for farmed fish. Such aquacultures are likely to put pressure on terrestrial ecosystems given the associated need for crop-based feed (Kram et al., 2012).

Figure 8.6 Observed and projected fish catch, 1950–2050 (three different scenarios)



Source: Kram et al., 2012.

8.3 Implications of ecosystem degradation

Models and scenarios in both global and regional environmental assessments indicate that biodiversity loss and ecosystem degradation will continue or accelerate under all the policy scenarios considered (Leadley et al., 2010; IEEP et al., 2009). Drivers such as population growth and increasing per capita resource use have a dominant role in shaping biodiversity outcomes, greatly outweighing the impacts of measures to protect biodiversity (IEEP et al., 2009).

Loss of ecosystem services

Ecosystem degradation not only diminishes the diversity of living organisms on Earth, but also erodes nature's ability to support human societies (TEEB, 2010). The diversity of living organisms and ecosystems provide people with a wide range of valuable ecosystem services, including:

- **provisioning** food, raw materials, medicines and genetic resources;
- **regulating** the environment, for example via carbon storage and sequestration, mitigating hazards from flooding and other disasters, pollinating crops and preventing erosion;
- **cultural services** such as providing opportunities for recreation and ecotourism, and delivering spiritual and educational values (MEA, 2005; TEEB, 2010).

The benefits of protecting ecosystems and their associated services often far outweigh the costs (Balmford et al., 2002; TEEB, 2010; Box 8.3). However, market systems seldom convey the full social and economic values of ecosystem services. As a result, market prices often incentivise unsustainable and socially undesirable decision-making about resource use and ecosystem management.

Costs of climate change mitigation and adaptation

The issue of climate change provides a clear example of the potential costs of ecosystem service loss. Substantial reductions in greenhouse gas emissions are needed in the decades ahead to mitigate climate change (see GMT 9). Here, the vast amounts of carbon stored in natural ecosystems are of global importance. Currently global deforestation and forest degradation account for about 12 % of global CO_2 emissions annually (van der Werf et al., 2009). Protecting natural habitats can ensure continued carbon storage if the ecosystems are managed effectively to prevent degradation. Consequently elements of an international financial mechanism to reduce greenhouse gas emissions from deforestation

Box 8.3 Benefits of the Natura 2000 Network

The EU's Natura 2000 network of nature protection areas currently contains more than 26 000 terrestrial and marine sites of high biodiversity value. Estimates show that the benefits that flow from Natura 2000 are in the order of EUR 200–300 billion per year, while the annual costs associated with managing and protecting the network are approximately EUR 5.8 billion. In addition, the 1.2–2.2 billion visitor days to Natura 2000 sites each year generate recreational benefits worth EUR 5–9 billion per annum (ten Brink et al., 2011).

and forest degradation (REDD+) has been adopted by parties to the United Nations Framework Convention on Climate Change (UNFCCC, 2010).

In addition to supporting climate change mitigation by serving as stores for carbon, natural ecosystems play an important role in climate change adaptation. Ecosystem-based adaptation approaches rely on the capacity of ecosystems to buffer human communities against the adverse impacts of climate change through 'adaptation services' (Jones et al., 2012; World Bank, 2010). Mangrove forests and coastal marshes, for example, can reduce disaster risk as they are natural buffers that protect against erosion and wave damage along exposed coastlines. As the climate is changing and temperatures increase (see GMT 9), society's need for adaptation measures, including ecosystem-based approaches, will increase.

Unequal distribution of impacts across society

The projected degradation of ecosystems and their services will create many challenges for poor people across the world. Lower income groups in developing countries rely disproportionately on the sustainability of local ecosystem services to provide for their basic needs and afford health and security.
It is estimated, for example, that non-market ecosystem goods and services account for 89 % of the total income of the rural poor in Brazil, 75 % in Indonesia and 47 % in India (Figure 8.7). Sustainable management of ecosystems and socio-economic development are thus intertwined challenges (Sachs et al., 2009; TEEB, 2010; UNDP, 2011).

Box 8.4 Environmental thresholds and tipping points

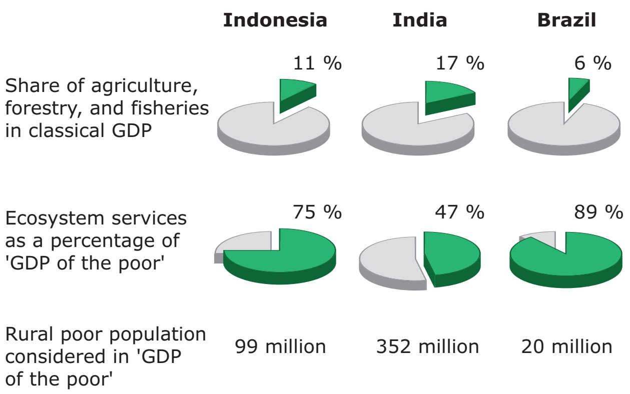
There is evidence that ecosystems may need to maintain a minimum quality (e.g. in terms of the abundance and diversity of species) in order to functioning effectively and deliver many important ecosystem services. Below critical thresholds, ecosystems may reach a tipping point and may suddenly switch in character, no longer providing the same kind, or level, of ecosystem service (Barnosky et al., 2012).

Thresholds, amplifying feedbacks and time-lag effects leading to 'tipping points' are considered widespread and make the impacts of global change on biodiversity hard to predict and difficult to control once they begin. Some studies even suggest that a planetary-scale tipping point (i.e. radical changes in the global ecosystem as a whole) might be approaching (Barnosky et al., 2012).

Amazonian forest dieback
Research shows that complex interactions between deforestation, fire and climate change in the Amazon basin could push ecosystems to tipping points. This could result in widespread Amazonian forest dieback over coming decades, through a self-perpetuating cycle of more frequent fires and intense droughts leading to a shift to savannah-like vegetation (Leadley et al., 2010). The probability associated with such scenarios varies from moderate to high depending on whether the projected temperature increase is less or greater than 3 °C.

The potential implications of widespread dieback would be enormous. Regional effects would include significant reductions in rainfall over large areas of Latin America and beyond. Mass extinctions and reductions in species abundance would have large cultural impacts and greatly reduce many ecosystem services. Global scale impacts would include a reduced carbon sink, increased carbon emissions, and the massive loss of biodiversity due to the exceptionally high species diversity in the Amazon (Leadley et al., 2010).

Figure 8.7 The rural poor's reliance on ecosystem services



Source: Adapted from TEEB, 2010.

8.4 Why are the increasing demands on global ecosystems important for Europe?

The continuing degradation of ecosystems across the world affects Europe directly and indirectly. Diminishing global natural capital stocks may limit Europe's ability to draw on natural resources elsewhere, thereby increasing pressures on European ecosystems.

As the world's poor are most directly reliant on functioning ecosystem services, widespread ecosystem degradation can negatively influence poverty and inequality, which may fuel conflict and instability in regions with fragile governance structures. Besides the indirect impacts this may also directly lead to increased human migration flows to Europe.

Failing to take advantage of cost-effective ecosystem-based solutions for climate change mitigation in other parts of the world may impose increased costs on Europe. Moreover, if ecological systems reach critical tipping points (for example Amazon forest dieback) it could result in unprecedented global environmental, social and economic implications.

With these concerns in mind, the EU's biodiversity strategy includes a global focus. Specifically, Target 6 provides that: 'By 2020, the EU has stepped up its contribution to averting global biodiversity loss.'

Box 8.5 Key uncertainties regarding the future state of the global ecosystem

While there is no doubt that land, soil, freshwater, forest and marine resources are under growing pressure, the magnitude and nature of change is subject to significant uncertainty. The global ecosystem is complex and composed of components that interact in non-linear ways. A growing body of literature highlights that critical thresholds are approaching, beyond which abrupt and irreversible failures in life-support functions of the planets' natural resources may occur (see Box 8.4).

A key uncertainty is the degree of socio-economic change over the coming decades. This relates for instance to the extent of global population growth, economic development across world regions, changes in consumption patterns, or technological advances.

While the response of species and ecosystems to human-induced alterations as well as climate change impacts is still not fully understood, it is clear that current policies and strategies are not adequate to facilitate the sustainable management of the Earths' natural capital. Recent assessments suggest that current stocks might be still be sufficient to meet future demands for food, water, energy, and materials, if complex transitions towards changed value patterns and associated changes in consumption are accomplished, along with successful policy innovations.

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