NATURE AND ITS ROLE IN THE TRANSITION TO A GREEN ECONOMY

The Economics of Ecosystems & Biodiversity

Final Report

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KEY MESSAGES

1. **Working with nature should be at the heart of the transition to a green economy.** Nature is essential to the health and growth of economies, societies and individuals through the provision of a multitude of ecosystem services. In spite of this, the values of nature to economies and society have often been overlooked and not reflected in the decisions of policy makers, businesses, communities or citizens, contributing to the loss of biodiversity and subsequent impacts on people and the economy.

2. **Human and societal well-being depends on nature.** The rural poor in particular are fundamentally dependent on ecosystem services. Where natural capital is degraded and lost, there is a risk that the livelihoods of entire communities are undermined and humans suffer. Efforts to conserve, restore, and sustainably use natural capital can improve human well-being, alleviate poverty, support livelihoods and increase intergenerational equity.

3. **All sectors of the economy benefit directly or indirectly from nature and their engagement is required for the transition to the green economy** in the context of sustainable development and poverty eradication. This is both in their self-interest (given their reliance on inputs from nature) and reflects their responsibilities (in terms of impacts, risks and liabilities). Greening the "brown" economy is as important as developing green sectors or green niches.

4. **There must be a clear understanding of the value of nature and how to take this value into account in public and private decisions in light of the multiple benefits it provides**. **This is one of many ways of assessing the role and importance of nature**. It is important to understand that identifying the value of nature does not suggest that it should have a cost or a price or be traded in the market and hence commoditized. Furthermore, an economic valuation does not necessarily imply a policy response using market-based instruments; there are many instruments that can be used to reflect the value of nature.

5. **Investments in nature today – whether restoration or protected area management – can save money and promote economic growth in the long term** and must therefore be seen as an integral part of the transition to and the foundation of a green economy. Investments in nature can be significantly more cost-effective than investments in other forms of capital or engineered solutions for delivering certain services or pursuing specific policy objectives, especially if the wider range of co-benefits delivered are factored into the equation. This has been shown to be the case, inter alia, for water purification and supply, flood control, and carbon storage.

6. **There are a range of building blocks for the transition to a green economy** which can be categorised as follows: (a) ***Minimising losses and avoiding inappropriate trade-offs*** (b) ***Investing in environmental infrastructure***; (c) ***Active management of environmental risks*** (d) ***Proactive investment in natural capital***; (e) ***Further eco-efficiency for relative decoupling*** and (f) ***Absolute decoupling of the economy from resource use and its negative impacts***. The relative emphasis of these different blocks depends on the national context.

7. **Good governance is critical to the transition to the green economy and an integral part of the above six approaches.** Components of good governance *inter alia* include: institutions and their roles; processes and participation; transparency and disclosure; and monitoring and enforcement.

8. **Managing the transition** to a green economy will need to take into account not only the opportunity of win-wins, but also the risks of losses for certain groups and trade-offs across sectors and over time. This applies both to specific local decisions and communities and wider structural changes to the economy.

9. Finally, **there is a need to step-up the pace of change** and **move from discrete cases of green economy transition to a fundamental systemic transition warranted by scientific findings**. It will take active engagement by government, business, communities and citizens for the transition to a green economy to realise its potential for improving human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

EXECUTIVE SUMMARY

There is growing recognition among policy-makers and private sector decision-makers that the current model of economic growth is socially, environmentally, and economically unsustainable. This has sparked a renewed focus on the need for the international community to make a committed transition towards a "green" economy in order to ensure a sustainable and desirable future that promotes social equity, poverty eradication, and human well-being (UNEP 2011). This focus has been complemented by the increasing appreciation of biodiversity and ecosystem services (MA 2005) and the economic value of nature, including its intrinsic value (TEEB 2008, 2010a and b, 2011, 2012a and b). These two threads are closely interrelated as healthy and resilient ecosystems are necessary for long-term socio-economic development and efforts to build a green economy should be based on a sound appreciation of the value and role of nature in this transition. This paper contributed to the discussions at the Rio+20 Conference and will contribute to its follow-up by highlighting the role of nature in the transition towards a green economy in the context of sustainable development and poverty eradication.

I. NATURE IN A GREEN ECONOMY

Nature underpins economic growth, human development, and well-being. It is instrumental in building today's economic system and represents the core foundation in the transition to a green economy. In turn, the transition to a green economy will strengthen the foundations of nature by reducing the pressures of economic activities on biodiversity and ecosystems.

Nature and natural capital

Nature is essential to the health and growth of economies, societies, and individuals through the provision of ecosystem services which include the provision of food, raw materials, medicine, and water; regulating the climate; contributing to air and water quantity and quality; and mitigating natural hazards. Nature also offers a wide range of cultural services related to human health, recreation, tourism, scientific knowledge, and spiritual and cultural identity. In providing these services to people, nature can be understood as delivering natural assets and hence be seen as "natural capital", existing alongside manufactured, financial, social and human capital (Pearce et al. 1989). While nature is understood to be more than merely "natural capital", it is nonetheless a useful metaphor to communicate the value or benefits of nature to people and the wider economy (MA 2005).

The green economy

UNEP defines a green economy as "*one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive*" (UNEP 2011). Critically, the green economy concept is more than merely "greening" economic sectors; it is a means of achieving the sustainable development imperatives of:

- Improving human well-being: securing better healthcare, education and job security;
- Increasing social equity: ending persistent poverty and ensuring social, economic and financial inclusion;
- Reducing environmental risks: addressing climate change, ocean acidification, the release of hazardous chemicals and pollutants, and excessive or mismanaged waste; and
- Reducing ecological scarcities: securing access to freshwater, natural resources and improving soil fertility.

In most countries, the transition to a green economy requires changes to existing governance approaches, institutions, and markets. This transition will take different paths in different countries depending, *inter alia*, on a country's domestic context, natural capital, and socio-economic priorities.

Nature in the transition to a green economy

Natural capital, together with the other forms of capital, is a key input for a wide range of economic sectors. It is unique in that it provides what are often free, non-polluting, and low carbon inputs to production; such as clean water from ecosystems or pollination services from bees to support agricultural production. It also provides inspiration for innovation, scientific knowledge and ensures the safeguarding of assets (e.g. through flood control).

All sectors are important for the transition to a green economy and the conservation, restoration and sustainable use of natural capital is a key driver in this

transition. Actors in economic sectors such as agriculture, fisheries, forestry, and water have a fundamental interest in safeguarding their sector's natural asset base. In addition, the engagement of all economic sectors in the transition to a green economy is of key importance if the productive and regenerative capacity of nature is to be preserved or augmented (UNEP 2011). Understanding the dependence of economic sectors on nature and the opportunities to minimise their impacts on the environment is therefore crucial for a successful transition to a green economy (UNEP 2011, TEEB 2012a).

II. NATURE, WELL-BEING AND DEVELOPMENT

Nature's benefits to people and communities

Human and societal well-being depends on nature. Where natural capital is degraded and lost, there is a risk that communities are undermined and humans suffer. In contrast, efforts to conserve, restore, and sustainably use natural capital can improve human well-being, support livelihoods, and increase socio-economic and intergenerational equity (TEEB 2011a, TEEB 2012b). In South Africa, interventions by the government to restore and improve wetlands have not only provided much needed employment opportunities but have also increased the capacity of the wetlands to provide essential services to the poor, including crop and reed production, water for domestic purposes, and grazing for livestock (TEEB 2011a, see also Pollard 2008, Turpie et al 2008).

Efforts to conserve, restore, and sustainably use natural capital can also increase ecological resilience. Ecological resilience can be understood as the adaptive capacity of an ecosystem to withstand shocks, rebuild, or persist on a given developmental trajectory. A resilient ecosystem can continue to provide ecosystem services to local communities under changing environmental conditions, such as climate change, and thus support community viability and livelihoods in the long-term. As such, healthy, functional, resilient ecosystems can be seen as a life insurance policy for many communities.

Nature's contributions to development and prosperity

Healthy and resilient ecosystems may contribute to delivering development goals, especially on poverty eradication. In turn, the degradation and loss of natural capital can undermine development and long-term economic growth and prosperity. Global commitments to improve well-being and eradicate poverty are more difficult to achieve without recognising and taking into account the value of natural capital and its associated benefits.

The role of nature in development has all too often been overlooked and has led to a narrow focus on short-term gains at the expense of long-term prosperity and viability. Private wealth and financial or manufactured capital are systemically prioritised over public welfare and natural capital, which exacerbates the degradation and loss of natural capital (UNEP 2011). However, this is slowly changing. From the local to the global level, efforts to create healthy and resilient ecosystems are helping to deliver development goals.

In the Indian village of Hiware Bazaar, for example, acute water shortages due to vegetation loss were undermining agricultural productivity. The subsequent regeneration of degraded forests and building of earth embankments around hills have helped to conserve rainwater and recharge groundwater. This has increased agricultural production potential by several orders of magnitude and contributed to reducing poverty by 73 per cent in less than a decade (TEEBcase by S. Singh 2010 and TEEB 2012b, building on Tiwari et al., 2007).

Likewise, in the Shinyanga Region in central Tanzania, efforts have been made to restore the Nihili woodland using traditional knowledge. The result has been an increase in the provision of ecosystem services from the woodland (e.g. fuel, fruit, building timber, honey, medicines and fodder) and a reduction in the time needed to collect fuel wood and non-timber forest products by several hours. In addition, the sale of tree products has helped pay for children's schooling and allowed more time for education and productive work, thus creating enabling conditions for development (Barrow, E. and A. Shah 2011 and TEEB 2012b).

Investments in the restoration of ecosystems and the designation of protected areas and associated conservation measures have demonstrated benefits from the local to the global level. Marine protected areas have been shown to lead to an increase in the size and biomass of fish populations inside reserves, generating positive spillover effects to nearby fishing grounds (Halpern, 2003). In Cambodia, the Ream National Park provides fish breeding grounds and other subsistence goods from mangroves in addition

to storm protection and erosion control (Emerton et al. 2002). Safeguarding the provision of ecosystem services is important for many local fishing communities, both for livelihoods and food security. It is also of global importance as over three billion people worldwide rely on fish as a significant source of protein (FAO 2009).

At the city, regional and national levels, safeguarding and investing in our natural resources can address environmental objectives, ecosystem degradation and loss, foster growth and development and create employment opportunities. Nature in and around cities is often considered as a core element of effective urban planning, investment and management. For example, managing and restoring an upstream watershed can be a cost effective method for helping with water purification and ensuring its adequate supply, as increasingly demonstrated across all continents (TEEB 2011a, TEEB 2012b).

Looking at the benefits of nature from a national perspective can also be important for long-term strategic planning and choosing development pathways. For example, the UK National Ecosystem Assessment explored future implications of different policy scenarios on the provision of various ecosystem services from 2000 to 2060. Those scenarios which involved working with nature resulted in significant gains in ecosystem services and led to the most important long-term economic gains to society (UK NEA 2011).

To fully realise nature's contributions to development and prosperity, the focus needs to be not only on effectively responding to the symptoms (e.g. degradation, loss of ecosystem functions and services) but also to the underlying causes and drivers of the problems (e.g. production methods and consumption levels). Addressing these simultaneously will be essential to achieving lasting results.

III. THE MULTIPLE BENEFITS OF VALUING NATURE

Working with nature forms a critical part of the transition to a green economy and can deliver multiple benefits that support economic growth and sustainability. In order to take full advantage of these opportunities, there must be a clear understanding of the value of nature and how to reflect this value in public and private decisions in light of the multiple benefits it provides.

Valuing nature and the tools to do so

Historically, the lack of understanding of the importance of nature and the value of its contributions to society and the economy has contributed to the degradation of nature, undermined the services it provides and led to missed opportunities for addressing poverty, supporting wellbeing and development. However, there is a growing appreciation of the importance of biodiversity and ecosystem services (see e.g. MA 2005) and the economic value of nature (see e.g. TEEB 2008, 2010a and b, 2011, 2012a and b). There is a strong case to be made for valuing nature in both physical and economic terms more systematically than is presently done. The identification, assessment, and demonstration of the value of ecosystem services can improve decision-making by helping to identify win-win opportunities and trade-offs; where policy and business objectives can be met most cost effectively and where there are multiple co-benefits. This information is also increasingly translated into policy responses. For instance, demonstrating the value of water purification services has led to improved forest management policies, the value of carbon sequestration to peatland restoration, and the value of climate change adaptation to floodplain conservation.

A wide array of approaches and instruments is needed to make sure decision-makers take nature's values fully into consideration. These include spatial planning; regulation; protective measures; wise use and management; investments in restoration; certification and labelling; subsidy reform and use of market based instruments (MBIs) such as payments for ecosystem services (PES) (TEEB 2011a). Which instrument is best depends on the specific issue being addressed and the local or national context.

There is currently a real opportunity for a renaissance in decision-making; one that better takes into account nature, its intrinsic values, the wide range of public goods and services it provides, as well as private and collective benefits and values which are both market- and non-market based. There are a number of approaches to highlighting the values derived from nature, ranging from ecosystem service indicators, maps demonstrating the flows of ecosystem benefits, communities, and to the application of monetary valuation techniques. Each approach has strengths and limitations; decision-makers may typically rely on a mix of qualitative, quantitative, and monetary assessments.

Value for money and meeting multiple objectives

Investments in nature today can save money and promote economic growth in the long term and must therefore be seen as an integral part of the transition to and the foundation of a green economy. In the current context of austerity, it is worth taking a careful look at the role of nature and the benefits it provides as these can offer economic savings and opportunities for investments with real social and economic returns. Furthermore, sustainably using and managing natural capital can also support well-being, improve livelihoods, and create added value for both the public and private sectors.

Investments in nature can be significantly more cost-effective than investments in other forms of capital or engineered solutions for delivering certain services or pursuing specific policy objectives – especially if the wider range of co-benefits delivered are factored into the equation. For instance, investments in protected areas have led to benefits in a number of countries, including increased visitor spending in protected areas in Finland, low cost water supply to the city of Dunedin, New Zealand, and avoided soil erosion and improved water supply for farmers in Venezuela (TEEB 2011a, building on Metsähallitus 2009, BPF 2006, and Gutman 2002). Restoration has also been found to be a cost effective solution. The restoration of mangroves helped with flood and storm defences in Vietnam, the restoration of peatlands in Ireland with carbon storage, and the management and restoration of watershed ecosystems increased clean water provision to New York and avoided potentially significant price rises (TEEB 2011a, building on IFRC (2002), Federal Environment Agency 2007, MLUV MV 2009, Schaefer 2009, and Dudley et al 2003).

Ensuring the maintenance of healthy and resilient ecosystems can contribute to meeting multiple policy objectives simultaneously. A payment for ecosystem services scheme launched in Mexico is an example of a tool that addresses multiple objectives – poverty, water security, deforestation and climate change. Water charges are earmarked to support community engagement in forest management, which has resulted in conservation and hydrological service benefits, including aquifer recharge, reduced deforestation rates and avoided greenhouse gas emissions (TEEB 2011a, Muñoz et al. 2010).

IV. GREEN ECONOMY TRANSITIONS

Challenges and commitments

The world population is expected to increase to 9 billion by 2050 and life expectancy will continue to increase as will the share of the world's population living in urban areas. The global economy is also expected to grow significantly, possibly tripling by 2050. While this provides benefits to an expanding middle class and may contribute to poverty alleviation, there are a number of significant risks associated with these trends. The rising level of consumption and production will put increasing stress on the planet's resources and ecosystems, accelerating the historic trends of pollution and the depletion of natural capital. As many ecosystems and landscapes continue to be used unsustainably and our natural capital stocks and flows are further reduced, societal challenges associated with the loss of benefits from nature will rise, likely surpassing critical ecological thresholds or "tipping points".

Growing recognition of the urgent need for action to halt the degradation and loss of natural capital, avoid societal losses and safeguard future possibilities for sustainable growth and well-being has led to the adoption of a range of international commitments including the three Rio Conventions – the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), and the United Nations Convention to Combat Desertification (UNCCD). A number of commitments have also been adopted recently that highlight the growing recognition of the links between nature and the green economy, including commitments to reform environmentally harmful subsidies under the Strategic Plan for Biodiversity 2011-2020 and in the G20 (CBD 2010, Lehmann et al. 2011, UNEP 2011, ten Brink et al 2012); the integration of the value of ecosystem services into natural capital and integrated environmental and economy accounts (SEEA); and the engagement of the business community through improvements to accounting systems, commitments to carbon neutrality and no-net loss of biodiversity, codes of conduct, commitments to reporting, and research activities (TEEB 2012a).

The on-going global financial crisis should not slow down the transition to a green economy. On the contrary, the crisis should act as a catalyst to implement agreed commitments in order to achieve significant cost savings over time, exploit untapped opportunities to create jobs and growth, and finally help society make the transition towards ecologically

sustainable growth and, more broadly, a sustainable and desirable future.

Building blocks for a green economy

While different countries may opt for transition paths towards a green economy tailored to their national circumstances, adopting a wide range of coherent and coordinated measures will be an integral part of successful transitions. The mix and emphasis of these measures will differ from one country to another. In most cases, a balanced approach will include both supply and demand measures, thereby greening the economy with production and consumption-focused measures. As set out above, this approach should build on a sound appreciation of the value and role of nature which will provide a core foundation for the development of a future green economy.

Over the years, a wealth of experience has been accumulated across countries on policies, approaches and measures to reduce or avoid environmental damage, to restore degraded ecosystems and conserve those that are intact and healthy. These measures have been a mix of traditional, business-as-usual approaches to:

- **Minimise losses and avoid inappropriate trade-offs,** through understanding the whole picture of winners and losers of a given decision, and environmental, economic and social impacts over time and location, including international impacts (e.g. associated with traded goods). It is also helped by integrating this knowledge via the use of tools such as impact assessments, product life cycle assessments, project selection and evaluation criteria. Finally, implementing policies to respond to the improved evidence base is critically important, for example, by reforming environmentally harmful subsidies (e.g. fisheries and agricultural subsidy reform in New Zealand or water pricing reform in the Czech Republic) (TEEB 2011a); and

- **Invest in environmental infrastructure to comply with legislation and regulation**, such as water supply and waste water infrastructure to meet water quality standards; waste infrastructure and air pollution control measures to meet emission and air quality standards. This has been the approach over many decades by the private sector (e.g. utilities), public sector (e.g. municipalities) and international organisations (e.g. World Bank).

They have also included, albeit less often, more active ecosystem management approaches, such as:

- **Proactive approaches to risk management** that build on a wider appreciation of risks, such as risk mapping for flood control and taxonomy research for invasive species (e.g. the moth threat to Mexico's key economic and cultural icon the "Nopal" cactus). It also builds on understanding resource use and associated resource scarcity and ecosystem risks by developing ecosystem capital accounts and integrated environmental economic accounts that present the interactions of the economy and the environment.

- **Investment in natural capital** via restoration, conservation, and improved management practices. This includes the development of networks of protected areas (e.g. the EU's Natura 2000 network), the restoration of peatlands for carbon storage, and other co-benefits (e.g. Mecklenburg-Vorpommern in Germany), the restoration of flood plains (e.g. Belgium's Scheldt estuary) or afforestation for flood control (e.g. China's Sloping Land Conversion Programme) (TEEB 2011a, TEEB 2012b).

Finally, certain measures have focused on pursuing environmental sustainability via:

- **Measures for eco-efficiency and wider resource efficiency** through water or other resource pricing and wider environmental fiscal reform to incentivise efficient resource use, via products, process and ambient standards, labelling and consumer information and positive incentives (e.g. payments for ecosystem services, public payments for public goods); and

- **Decoupling the economy** from resource use and its negative impacts through more radical innovation and changes in demand. This can include new clean products and processes building on genetic resources (e.g. pharmaceutical sector and plant based cancer treatment) and biomimicry (e.g. floor tiles and waste, architecture and natural cooling) as well as consumption choice changes through information provision, civil society engagement and the availability of near-zero impact alternatives (TEEB 2011a). Decoupling also builds on the many of the five approaches discussed above.

These six approaches, presented in the figure below, together with good governance are key means to a transition to a green economy. Components of **good governance** *inter alia* include: institutions and their roles; processes and participation; transparency and disclosure; and monitoring and enforcement. The mix and emphasis of measures will differ from one country to another depending on national circumstances and windows of opportunity for progress.

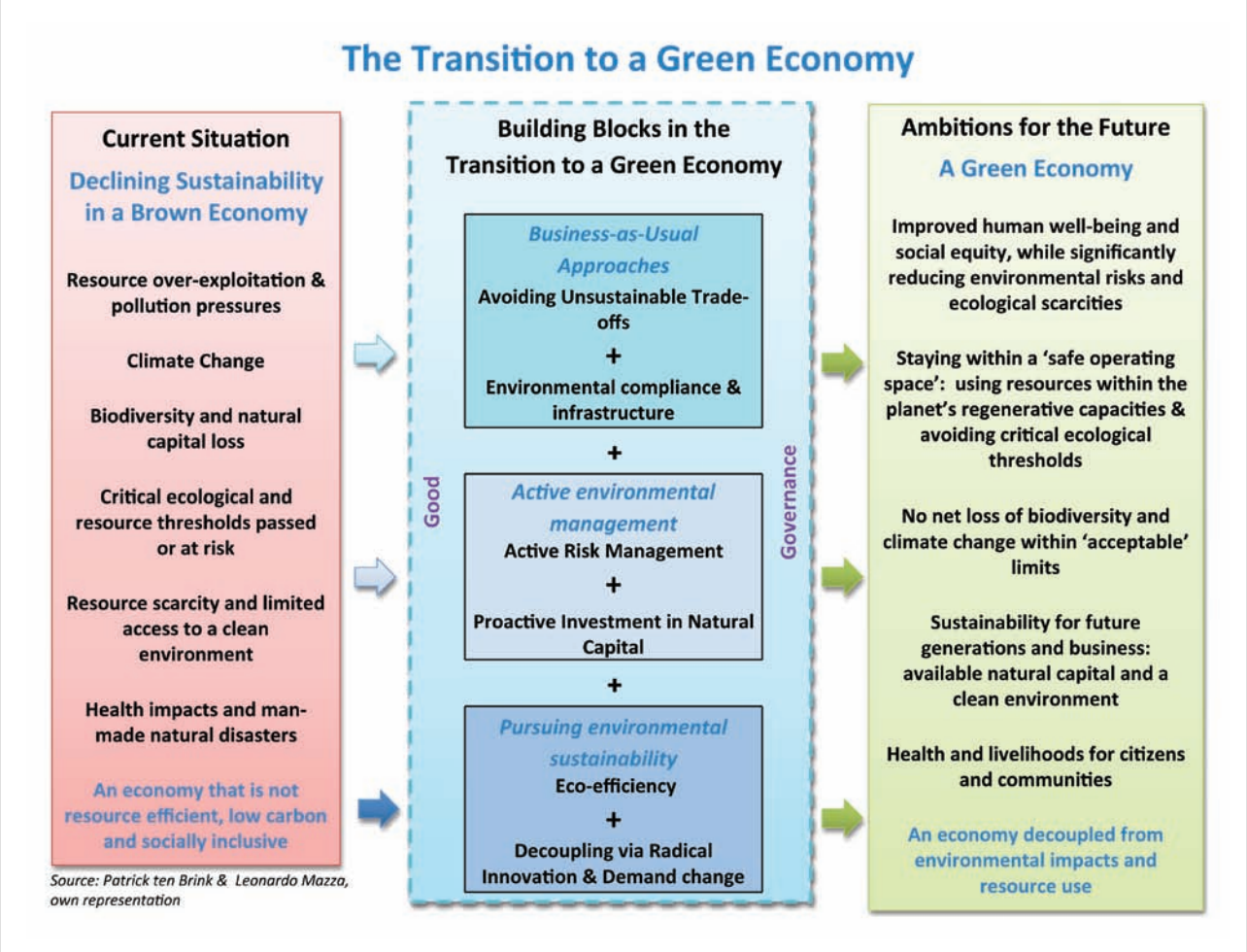


Figure 1: Key approaches and instruments to enable the transition to a green economy

Source: own representation Patrick ten Brink, (see figure 2.2)

Financing the transition to a green economy

The transition to a green economy will require considerable financing. Potential tools to address certain environmental issues and raise funds at the same time include: subsidy reform (which will liberate funds, help overcome technological lock-in and encourage innovation); getting the prices right through the use of market-based instruments (to encourage cost recovery and implement the polluter pays and user pays principles); allocating budgets (e.g. by climate and biodiversity proofing funds), and other innovative financing tools (e.g. REDD+ and beyond).

There will also be a need for increased investment from business and increased effectiveness of development cooperation financing. Ethical investment funds, insurance companies, banks, or indeed rating agencies, have not played a major role in financing nature's role in the transition to the green economy to date. There is, however, a potential for scaling up the contributions from this sector. This will be in part driven by an increased appreciation of nature's contribution to reducing risks relating to increased resource scarcity and from natural hazards exacerbated by climate change (TEEB 2012a) and could be further leveraged through the effective use of financial instruments.

Governance for a green economy

Actions at all governance levels, involving the participation of all relevant stakeholders, are needed for a successful transition to a green economy. A culture of appreciation for the multiple values of nature can support good governance at many levels and take advantage of a range of economic and non-economic valuation approaches. These approaches should cover the range of benefits to society and economy (the ecosystem services) and intrinsic values, and make use of a plurality of tools to demonstrate the importance of nature (TEEB 2010a). Similarly, a culture of evidence-based assessment, aiming to understand the full set of impacts from

decisions – who are the winners and losers, what the spatial impacts are, the time profile of benefits and costs and trade-offs and synergies – is a critical aspect of good governance. The transition to a green economy will need to recognise the roles and responsibilities of all sectors and engage a wide array of stakeholders. It will need to take account not just of countries' domestic improvement, but also the impacts associated with importing goods from third countries (e.g. embedded carbon, water and biodiversity in products). There is a need for, inter alia, public support for research and education, support for networks of excellence, public funding for investments in natural capital, a regulatory framework and its enforcement, access to information and wider public participation, as well as public private partnerships. Progress with the above will require due engagement by business, stimulated and facilitated by appropriate policies, processes and institutions. Consideration is needed on institutional credibility, global/national/local systems of targets, quantitative indicators as well as on mechanisms to achieve those targets. Due participation, consultation and engagement of civil society, communities – including indigenous populations and citizens – will also be of fundamental importance.

Managing the transition

While the transition to a green economy will lead to many win-wins, it may also mean losses for certain groups and trade-offs across sectors and over time. These impacts need to be accounted for in transition plans. Managing the transition will thus be critical, as will transparency and communication during the process. Careful transition management can include targeted education and skills training, the provision of early information, the phased introduction of measures taking into account affordability (e.g. as regards moving towards cost recovery in pricing), spatial planning (e.g. zoning fisheries areas), investment in substitute products or services, and, in some cases, compensation for losses.

Accelerating efforts

It is clear from the current state of the environment, and the magnitude of challenges faced that the transition to a green economy will not happen with a marginal increase in efforts. More ambitious and accelerated efforts are urgently needed if there is to be a real transition to a green economy that offers improved well-being and social equity, while significantly reducing environmental risks and ecological scarcities. This will require active engagement and collaboration between governments, businesses, communities and citizens. It also requires new ways of thinking about the current state of affairs and our ambitions for the future.

There is a need for systemic solutions to address the systemic problems facing our economies and a need to step up the pace of change. This implies a move from discrete cases of green economy transition to a fundamental systemic transition warranted by scientific findings (UNEP 2012, EEA SOER 2010). Different countries and stakeholders can embrace change and lead action in different areas across the building blocks for the transition to a green economy. At the recent UN Conference on Sustainable Development (UNCSD/Rio+20), green economy was recognised as an important tool for achieving sustainable development and eradicating poverty. Similarly, moving towards a green economy was acknowledged to be fundamental for the healthy functioning of the Earth's ecosystems. The follow-up to the Rio+20 Conference offers an important opportunity to commit to working with nature and driving the transition to a truly sustainable future that promotes social equity, poverty eradication and human well-being.

1. INTRODUCTION

The Challenges

The world population is expected to increase to 9 billion by 2050 and life expectancy will continue to increase as will the share of the world's population living in urban areas. The global economy is also expected to grow significantly, possibly tripling by 2050 (OECD, 2012). While this provides benefits to an expanding middle class and may contribute to poverty alleviation, there are a number of significant risks associated with these trends. The rising level of consumption and production will put increasing stress on the planet's resources and ecosystems, accelerating the historic trends of pollution and the depletion of natural capital. As many ecosystems and landscapes continue to be used unsustainably and natural capital stocks and flows are further reduced, societal challenges associated with the loss of benefits from nature will rise – likely surpassing critical ecological thresholds or "tipping points". It is clear that humanity is consuming more than the regenerative capacity of the planet and that there needs for a fundamental change in the level of response if major collapses are to be avoided (Club of Rome 2012).

Recognition of the need for change

There is growing recognition among policy-makers and private sector decision-makers that the current model of economic growth is socially, environmentally and economically unsustainable. This has sparked a renewed focus on the need for the international community to make a committed transition towards a "green" economy that promotes social equity, poverty eradication and human well-being in order to ensure a sustainable and desirable future (UNEP, 2011). This focus has been complemented by the increasing appreciation of biodiversity and ecosystem services (MA, 2005) and the economic value of nature, alongside its intrinsic value (TEEB, 2008; 2010a and b; 2011; 2012a and b). These two threads are closely interrelated as healthy and resilient ecosystems are necessary for long-term socio-economic development. At the same time, efforts to build a green economy should be based on a sound appreciation of the value and role of nature in this transition, in terms of the intrinsic values of biodiversity and the anthropocentric values from nature to society and the economy.

Commitments to respond to the challenges

Growing recognition of the urgent need for action to halt the loss of natural capital so as to avoid societal losses and safeguard future possibilities for sustainable growth and well-being has recently led to the adoption of a range of commitments. These include the recent Strategic Plan for Biodiversity 2011-2020 which inter alia calls for sustainable use and restoration of nature and its benefits and the mainstreaming of nature across wider objectives and strategies for sustainable development; support for the REDD+ initiative and ecosystem based adaptation to climate change within the UNFCCC; and a commitment to prevent global desertification under the UNCCD. Other important commitments include the reform of environmentally harmful subsidies, which has also been identified as a priority for addressing both the loss of biodiversity and climate change, and commitments to integrate the value of nature into national accounting systems. These commitments offer important opportunities to drive the transition towards a green economy.

Objectives of this report

This report aims to clarify and help mainstream nature's role in the transition to a green economy in the context of sustainable development and poverty eradication. It contributed to discussions at the Rio+20 Conference and will continue to support the development of green economy strategies and plans as well as their implementation in the follow-up of Rio+20. While this report is primarily targeted at policy and decision makers, it is also accessible to the wider public. This report has benefitted from a wide review process and includes insights from the many discussions on the green economy in the context of sustainable development and poverty eradication at Rio+20 conference.

This report examines the green economy concept, the role of nature in this process, and the contribution of nature to social objectives, development, and business practice. It goes on to identify tools and principles of valuing nature and examples of where working with nature meets objectives cost effectively and offer multiple additional benefits. It concludes with a discussion on the building blocks and tools needed for a transition to a green economy that will help respond to global and local challenges and realise commitments to change. It also identifies additional needs to catalyse and implement the transition to a green economy.

2. NATURE IN A GREEN ECONOMY

A. What is a green economy?

Recent years have seen the emergence of a range of closely related concepts in the field of sustainable development, notably those of the "Green New Deal", "Green Growth" and "Green Economy". They are all related though used in different ways and arguably have different roles and meanings. To offer a simplified picture – "Green New Deal" can be seen as a catalyst and "Green Growth" an approach contributing to a "Green Economy", which in turn is an essential means of achieving the objective of sustainable development. This section offers a brief review of these concepts.

Green Economy

A green economy may be defined as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive[2]" (UNEP, 2011a). Critically, the green economy concept is more than merely "greening" economic sectors, it is a means of achieving the sustainable development imperatives of:

- Improving human well-being by securing better healthcare, education and job security;
- Increasing social equity by ending persistent poverty and ensuring social, economic and financial inclusion;
- Reducing environmental risks by addressing climate change, ocean acidification, the release of hazardous chemicals and pollutants, and excessive or mismanaged waste; and
- Reducing ecological scarcities by securing access to freshwater, natural resources and improving soil fertility.

Nature and its intrinsic value should also be respected and taken into account in decisions in a green economy.

Transitioning towards a green economy takes us away from the traditional "brown" economy approach that depends heavily on fossil fuels, unsustainable resource extraction and environmental degradation. According to UNEP "..[i]n a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. These investments need to be catalysed and supported by targeted public expenditure, policy reforms and regulation change" (UNEP, 2011a).

In February 2012, stakeholders gathered at the UNEP Governing Council to draft **key principles of a green economy**[3]. These became the focus of a wide international consultation and have resulted in a set of principles which an increasing number of organisations are signing up to. The nine principles are considered necessary to help develop a collective understanding and vision of what a green economy needs to deliver and are also a reminder of the wider objectives that a transition to a green economy needs to embrace. The principles are: 1. The Sustainable Principle (a green, fair and inclusive economy delivers sustainable development); 2. The Justice Principle (it delivers equity); 3. The Dignity Principle (it creates genuine prosperity and well-being for all); 4. The Healthy Planet Principle (it invests in natural systems and rehabilitates those that are degraded); 5. The Inclusion Principle (it is inclusive and participatory in decision-making); 6. The Good Governance and Accountability Principle (it is accountable); 7. The Resilience Principle (it builds economic, social and environmental resilience); 8. The Efficiency and Sufficiency Principle (it delivers sustainable consumption and production); and 9. The Generations Principle (it invests for the present and future).

While there are a lot of issues that could be highlighted in discussions on the green economy, one that has recently received particular attention following the broader focus of the green economy is the need to move beyond traditional indicators, i.e. GDP, towards more holistic approaches and metrics to assessing sustainable economic progress that consider environmental assets and liabilities. In a recent report, the UN Secretary General's High-Level Panel on Global Sustainability recognises this and identifies the establishment of a common framework for measuring progress as a key area for achieving a sustainable economy (United Nations Secretary-General's High-Level Panel on Global Sustainability, 2012).

Green New Deal

The idea of a "**Green New Deal**" gained prominence following the 2007-2008 economic and financial crises. To ensure that national economic recovery packages result in more sustainable post-recovery economies that are less prone to the very risks and weaknesses that led to the crisis, in 2008 UNEP launched an inquiry on how to seed the transition

towards a "green economy". Recommendations summarised in UNEP's March 2009 Policy Brief and the "Global Green New Deal" (Barbier, 2010), correspond to an economic policy strategy for ensuring a more economically and environmentally sustainable world economic recovery that could act as a catalyst in a transition to a green economy. Reviving growth and creating jobs remain essential objectives, but policies should also aim to reduce carbon emissions and dependency; protect ecosystems, biodiversity, and water resources; and alleviate poverty.

Green Growth

According to the OECD, "**Green Growth** *means "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies*" (OECD, 2011). With the aim of helping governments devise country-specific strategies to successfully mainstream green strategies in national policies, the OECD's Green Growth Strategy lists, inter alia, policy options to address barriers to green growth such as regulatory uncertainty or low research and development returns. It recommends the use of indicators to monitor the planning or implementation of the strategy in four main categories: environmental and resource productivity; economic and environmental assets; environmental quality of life; and economic opportunities and policy responses. Hence, the perspective taken by the OECD's Green Growth initiative provides a useful toolbox for delivering the measures and monitoring the progress towards achieving a green economy.

Sustainable development

The transition towards a green economy can be seen as a key vehicle to meeting the goals of sustainable development. As economic development becomes more resource efficient and hence less dependent on depleting natural resources and generating less pollution, countries can achieve more sustainable economic development. Sustainable development with its economic, social and environmental pillars remains, however, a wider concept than the green economy. For example sustainable development specifically include a direct objective on healthcare, whereas the green economy, while being instrumental in supporting human health and wellbeing, does not have healthcare as a central pillar.

These are nuanced points of definition and the critical issue is how the concepts are actually implemented in practice.

The Brundtland Report, 'Our Common Future' (WCED, 1987) presented sustainable development as "meeting present needs without compromising the ability of future generations to meet their own needs", linking two main concepts, namely "needs" and "limits" and thus integrating discussions about the environment and poverty reduction. The report balanced developed and developing countries' interests. It stressed that while economic growth is necessary, the quality of this growth needs to change to account for the planet's ecological limits by giving primacy to the need for long-term preservation of living conditions following principles on intra- and inter-generational fairness (Fedrigo-Fazio and ten Brink, 2012). The issue of ecological limits was again highlighted by the seminal Millennium Ecosystem Assessment (MA, 2005), which helped highlight the poor state of ecosystems and refocused attention on the environmental limits of our planet.

Paths to a Green Economy

As emphasized in the UNEP Green Economy Report, the "transition to a green economy will vary considerably between nations, as it depends on the specifics of each country's natural and human capital and on its relative level of development" (UNEP, 2011a). For countries having attained high levels of economic development, the challenge will generally focus on reducing their per capita ecological footprint while at the same time pro-actively improving quality of life (e.g. improving green spaces in cities, low-carbon public transport). In countries that still have relatively low per capita ecological footprints, the challenge will consist in delivering improved levels of living standards and overall well-being to their citizens without drastically increasing their ecological footprint (UNEP, 2011a). It is clear that the paths to the green economy will have to be paved by drawing on a wide range of policy and financial instruments addressing both production and consumption in our economies and with different tools and approaches for greening different sectors of the economy (see Annex 1 for a brief overview of action in different economic sectors).

B. Nature and natural capital

Nature, biodiversity and ecosystem services

Nature consists of ecosystems, landscapes, habitats, species, and genetic materials. Interactions between these different components (including living and non-living elements), as well as those between nature and our societies and economies, such as through the flow of ecosystem services, are fundamental for the existence of life. Some elements

of nature are particularly unique and/or endangered (e.g. endemic species or rare habitats). One possibility to conserve these elements is through the establishment of protected areas (PA). However, a large part of nature, including more 'ordinary' elements (such as agricultural landscapes and forests), remains open to wider use and has different levels of biodiversity. Both represent elements of 'green infrastructure' that underpin our socio-economic systems (see Box 2.1).

Nature, in all its diversity, provides a range of benefits to society via the flow of so called ecosystem services (see Box 2.1 and Box 2.2). For example, nature provides food, fibre, fuel and water for human consumption. It also maintains ecosystem processes that regulate climate, pollinate crops, recycle nutrients, mitigate natural hazards and maintain water, soil and air quality. Furthermore, nature plays an integral role in human enjoyment (e.g. recreation and aesthetic values), knowledge, spiritual well-being and cultural identity. These benefits depend, amongst other things, on the quantity, quality and diversity of species, genes and ecosystems. Furthermore, maintaining the diversity of species, habitats and ecological processes helps ecosystem resilience, i.e. their ability to continue to provide services under changing environmental conditions such as climate change. Ecosystem resilience provides a kind of 'natural insurance' against potential shocks and losses of ecosystem services (TEEB, 2010b).

It should be noted that the term 'ecosystem services' is anthropocentric - i.e. it is used to highlight the values or benefits that nature provides to people, society or the economy. Nature also has an intrinsic value beyond its utility to mankind. Both types of values are important to recognise and keep in mind when embarking on the path to the green economy. The wider values of nature were recognised in the recent Rio+20 outcome document which reaffirms "the intrinsic value of biological diversity, as well as the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its critical role in maintaining ecosystems that provide essential services, which are critical foundations for sustainable development and human well-being" (para 197 UNCSD 2012).

Box 2.1: Key definitions: biodiversity, ecosystems and ecosystem services

Biological diversity means 'the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (UN, 1993). The term covers every form of life on earth (plants, animals, fungi and micro-organisms), the diversity of communities that they form and the habitats in which they live. It encompasses three levels: ecosystem diversity (i.e. variety of ecosystems); species diversity (i.e. variety of different species); and genetic diversity (i.e. variety of genes within species).

Ecosystem means 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (UN, 1993). Every ecosystem is characterized by complex relationships between living (biotic) and non-living (abiotic) components (resources), sunlight, air, water, minerals and nutrients. The quantity (e.g. biomass, productivity), quality and diversity of species (e.g. richness, rarity) all play an important role. The functioning of an ecosystem often hinges on certain species or groups of species that perform key functions e.g. pollination, grazing, predation, or nitrogen-fixing.

Ecosystem services refer to the flow of benefits that people obtain from ecosystems (MA, 2005). These include:

- provisioning services (e.g. food, fibre, fuel, water);
- regulating services (benefits arising from ecosystem processes that regulate climate, pollination, natural hazards such as flooding, spread and outbreak of diseases, waste, air and water quality);
- cultural services (e.g. recreation, tourism, and aesthetic, spiritual and ethical values);
- supporting services (e.g. soil formation, photosynthesis, nutrient cycling; MA, 2005) necessary for sustaining almost all other ecosystem services.

Further to the classification above, 'habitat services' can also be recognised as a separate category of ecosystem services to highlight the importance of ecosystems to provide habitats for migratory species (e.g. as nurseries) and as gene pool 'protectors' (maintain gene pool diversity and vitality) (TEEB, 2010a).

In more economic terms, it can be said that ecosystem services flow from 'natural capital stocks' (also sometimes termed 'natural assets'), like interest or dividends from the financial stocks.

Green infrastructure has been described as "the network of natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas, which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ecosystem services" (Naumann et al., 2011). Though arguably a very broad definition, the concept's emphasis on the multiple benefits which networks of natural and semi-natural landscape features can provide makes it useful for policy development and as a communication tool.

Resilience has been defined as 'the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change' (IPCC Fourth Assessment Report).

In essence, resilience of an ecosystem lies in its ability to withstand external pressures, while at the same time sustaining the same functionality and in the end the services it provides. Due to the fact that ecosystems are often known to behave non-linearly (i.e. exhibiting abrupt changes, thresholds), resilience plays a crucial role in decreasing the vulnerability of ecosystems to perturbations (e.g. climate change) and therefore sustaining the provision of associated benefits to human. From an economic point of view, resilience is type of 'natural insurance', which ensures continuing provision of a range of ecosystems services to individuals and societies (TEEB, 2010a).

The figure below presents a simplified illustration of the interconnections between the conditions or states of ecosystems. It shows functions and service flows; the drivers affecting the state, functions and flows; the benefits that people, society and the economy gain from nature and tools to value these benefits. The use of valuation tools (whether monetary or non-monetary) can help demonstrate values of nature and if these values are taken into account, or "captured", in decisions (whether policy, purchase or investment decisions) it can help "realise" the values, by better informed decisions that lead to an improved state of biodiversity, functioning of the ecosystems and flow of services they provide.

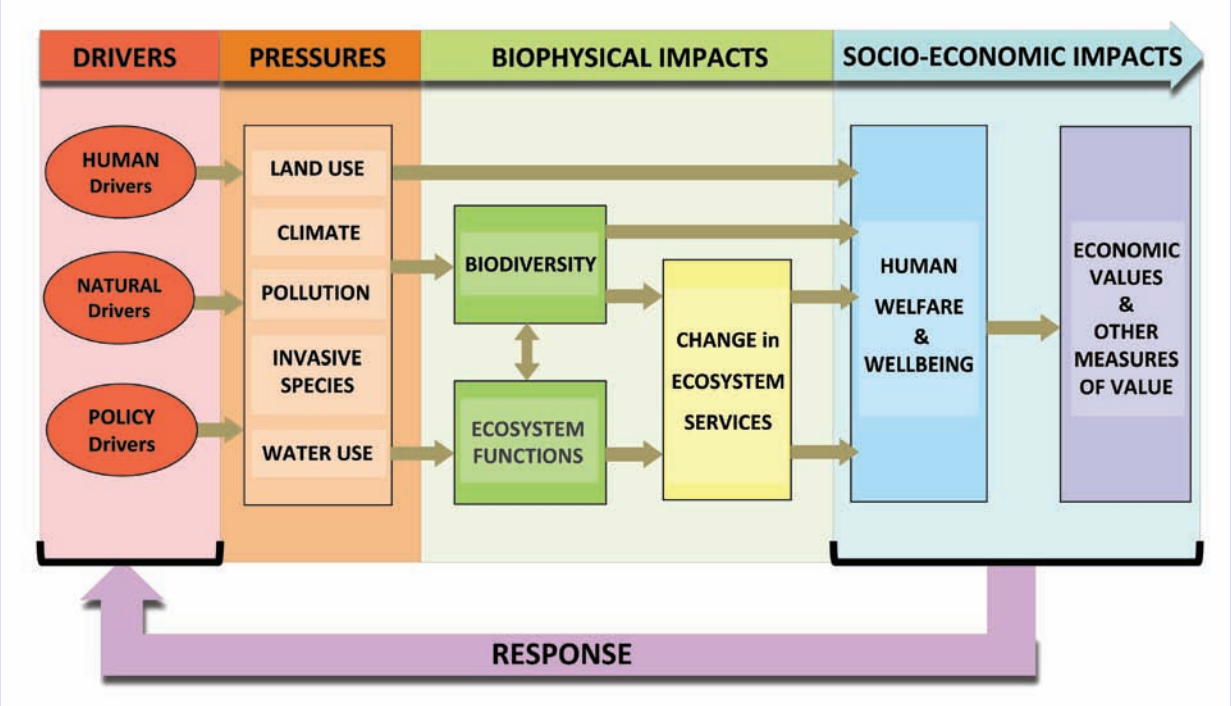


Figure 2.1: The Pathway from Drivers to Impacts

Source: adapted by authors from TEEB, 2011a and Braat et al., 2008.[4]

Natural capital

'Natural capital' is an 'economic metaphor for the limited stocks of physical and biological resources found on earth' (MA, 2005).

Nature, in providing a series of services that benefit society and the economy, can be understood as providing natural assets, which are increasingly referred to as "natural capital". Natural capital stocks provide flows of ecosystem services. The analogy with other forms of capital (See Box 2.2), such as manufactured and financial capital, has helped to highlight the role of nature in the economy. It has also been useful for underlining the loss of natural capital and in exploring the underlying causes of its unsustainable use and management. These causes rely mostly on the characteristic of such goods that could be considered as "public goods" whose use and access are often difficult to regulate. Difficulties in the regulation of public goods, have led to overexploitation and conversion of natural habitats (Barbier, 2011).

Nature is however more than "natural capital" as it has not just value and importance for people, society and the economy, but also has intrinsic value, with roles and functions for other species. Natural capital is nonetheless a useful concept to communicate the value or benefits of nature to mankind (See Box 2.3).

Box 2.2: The different types of capital

Manufactured or "man-made" capital: This includes produced assets that are used to produce other goods and services, such as machines, tools, buildings and infrastructure – i.e. fixed assets. This category can also include money and other financial assets that are sometimes termed **financial capital**. "Financial capital" is sometimes seen as a distinct category of capital (Aronson et al. 2007 and Van Andel & Aronson, 2012).

Human capital: This generally refers to the health, well-being and productive potential of individual people and includes mental and physical health, education, motivation, and work skills. These elements not only contribute to a happy and healthy society, but also improve the opportunities for economic development through a productive workforce.

Social capital: Like human capital, this is related to human well-being but on a societal rather than individual level. It consists of the social networks that support an efficient, cohesive society and facilitate social and intellectual interactions among its members. Social capital refers to those stocks of social trust, norms and networks that people can draw upon to solve common problems and create social cohesion, e.g. neighbourhood associations, civic organizations and cooperatives. The political and legal structures that promote political stability, democracy, government efficiency and social justice are also part of social capital. Thus the elements of social capital are central factors of productivity as well as being desirable in themselves.

Natural capital: In addition to natural resources (like timber, water, and energy) and mineral reserves, natural capital includes natural assets that are not easy to value monetarily (e.g. species diversity, endangered species, ecosystems that perform ecological services like air and water filtration) and can be considered as the components of nature linked directly or indirectly to human welfare. Forests, agricultural land and soil, grasslands, wetlands, rivers and coral reefs are examples of natural capital.

Source: TEEB (2011a), GHK et al (2005) building on Pearce et al. (1989) and Ekins (1992)

Most sectors have benefited from declining resource prices over the past century, allowing them to primarily focus their management on increasing financial capital and labour productivity (McKinsey, 2011). Rising scarcity and increasing resource prices mean that it is no longer possible to consider the economic process of producing goods and services and generating human welfare to be primarily dependent on the accumulation of physical and human capital. In the future, much more attention will be given to natural capital as crucial to the functioning of the economic system of production, consumption and overall welfare (Barbier, 2002; TEEB 2011a; TEEB 2012a and b).

Box 2.3: Natural capitals and their values – some examples from around the world

Forests
Global forests are estimated to store 289 Gigatonnes (Gt) of **carbon** in their biomass alone (FAO, 2010). It has been estimated that halving deforestation rates by 2030 would reduce global greenhouse gas emissions by 1.5 to 2.7 Gt CO2 per year, thereby avoiding damages from climate change estimated at more than US$3.7 trillion in Net Present Value terms (Eliasch, 2009).

A third of the world's hundred largest cities draw a substantial proportion of their **drinking water** from forest-protected areas (Dudley and Stolton, 2003). For instance, the four European cities of Berlin, Vienna, Oslo, and Munich, each benefit significantly from both water purification and provision services (ten Brink et al, 2011). At a local level, the Central Otago conservation area (Te Papanui Catchment) in New Zealand was estimated to have saved the city of Dunedin approximately US$65 million in water supply costs (BPL, 2006).

In the Alpine region of Switzerland, the use of forests is recognised as a major component of **disaster prevention**. Today 17 per cent of Swiss forests are managed mainly for their protective function, estimated to bring value of around US$ 2-3.5 billion per annum in avalanche, rock fall and landslide protection (ISDR, 2004).

Coral reefs & coastal ecosystems
Some 30 million people in coastal and island communities are totally reliant on reef-based resources as their primary means of **food production, income and livelihood** (Gomez et al, 1994; Wilkinson, 2004). More broadly speaking, estimates of the number of people dependent on coral reefs for their food resources range from 500 million (Wilkinson, 2004) to over one billion (Whittingham et al., 2003). At state level, the total annual benefits of the coral reefs in Hawaii were estimated at around US$360 million per year (Cesar et al., 2002). Similarly, coral reef- and mangrove-associated tourism were estimated to contribute US$150-196 million to Belize's economy in 2007 (equivalent to 12 to 15 per cent of GDP), while annual economic benefits from reef- and mangrove-dependent fisheries were estimated at between US$14-16 million (Cooper et al, 2008).

Wetlands
A global economic assessment of 63 million hectares of wetlands estimated their value at US$3.4 billion per year. Wetlands play a significant role in delivering **ecosystem services globally**. The highest benefits are found in Asia with an economic value of US$1.8 billion per year (Schuyt and Brander, 2004). Wetlands and peatlands can play a significant role in **climate change mitigation**. For example, the drainage of 930,000 ha of peatlands in Germany for agriculture has been estimated to cause emissions of 20 million tonne of CO2-eq. per year. Total damage of these emissions amounts to EUR 1.4 billion (approx. US$ 1.85 billion) (Förster, 2010; MLUV MV, 2009; Schäfer, 2009). The increased appreciation of the value of wetlands has led to greater interest in and benefits from restoration (see Mecklenburg-Vorpommern case in Box 3.3).

A study aiming to analyse the role of wetlands in **reducing flooding** related to hurricanes in the United States has estimated an average value of US$8,240 per hectare per year, with coastal wetlands in the US estimated to provide US$23.2 billion a year in storm protection services (Dudley et al, 2010).

Fisheries
Nearly 80 million tonnes of fish were captured in 2008, with an estimated value of more than US$80 billion. This translates into around 35 million jobs directly linked to the industry, the livelihoods of more than 300 million people, and food security for millions of coastal communities (TEEB, 2012c).The value of the marine capture seafood production at the point of harvest is

some 20 per cent of the $400 billion global food fish market (World Bank and FAO, 2009).

Biodiversity & the benefits of pollination

Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee (Klein et al, 2007). On a global scale, it has been estimated that the services that insect pollinators provide are worth around EUR153 billion, which is 9.5 per cent of the total value of the world's agricultural food production in 2005 (Gallai et al, 2009). Insect pollination is also estimated to increase the yields of 75 per cent of globally important crops and is responsible for an estimated 35 per cent of world crop production (Klein et al, 2007). At a national level, the United Kingdom's National Ecosystem Assessment estimated the economic value of biotic pollination as a contribution to crop market value in 2007 at EUR 629 million (approx. US$ 875 million) in 2011 (UK NAE, 2011).

Source: Building on TEEB (2009), TEEB 2010b, TEEB 2011a

C. Links – nature, natural capital and green economy

Nature – a largely invisible and neglected form of capital

Natural capital, alongside the other capitals, is a key input for a wide range of economic sectors and underpins much of our consumption, see Figure 2.2.

Different sectors in the economy have varying level of dependence on nature and the exposure on its degradation. Actors in economic sectors directly reliant on natural resources i.e. agriculture, fisheries, forestry and water; also called 'natural capital sectors' in UNEP, 2011a) have a fundamental interest in safeguarding their sector's natural asset base. Managing the natural capital in a more sustainable way is likely to enhance the sectors' productivity. For instance, greening the agricultural sector by diversifying crop rotation, using natural and organic soil nutrients, reducing soil erosion or improving efficiency of water usage can offer a way to feed the growing populations while sustaining the sector's

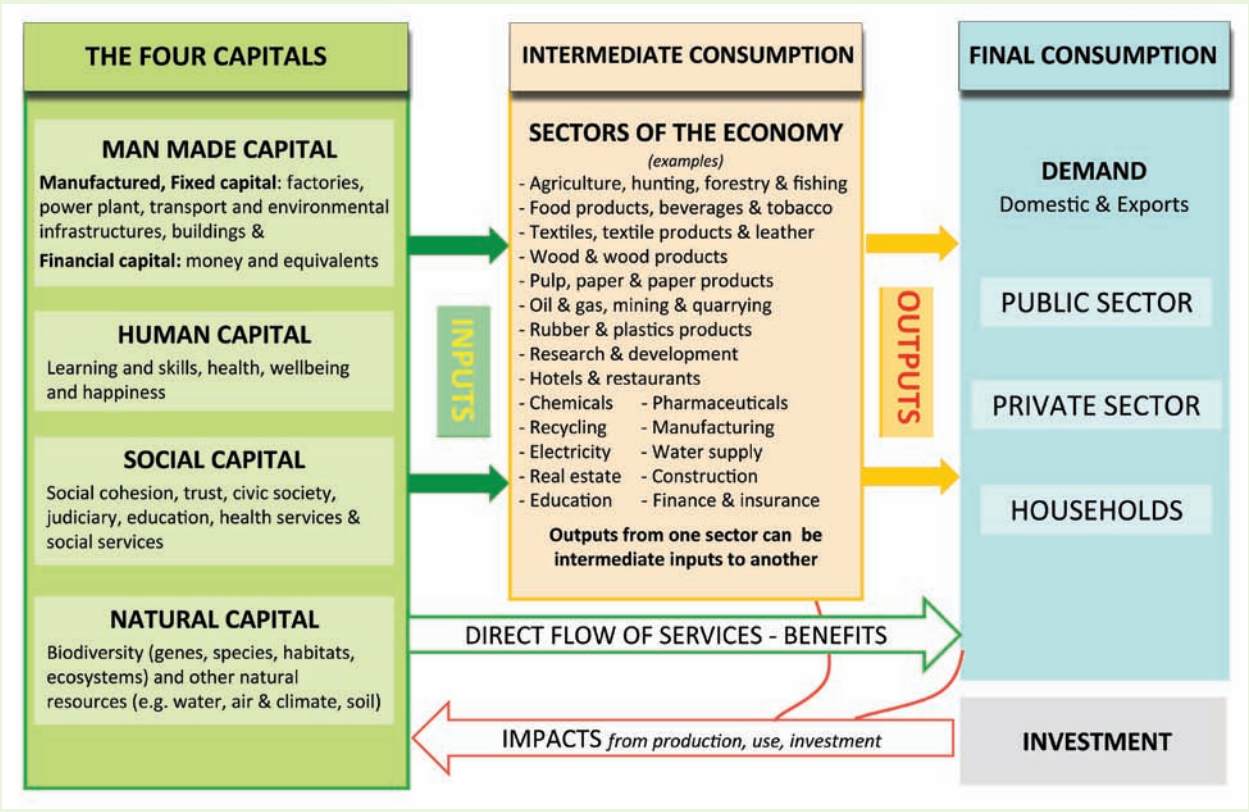


Figure 2.2: Natural capital and its contribution to the economy and livelihoods: selected examples of sectoral links

Source: own representation, Patrick ten Brink

natural base (UNEP, 2011a). Similarly, greening the fisheries sector by inter alia reorienting public subsidies (which have created excessive capacity and consequently decreased fish stocks), towards a focus on strengthening fisheries management and reducing excessive capacity can lead to an increased level of fisheries catch in the long term (Ibid). Dependence of these sectors on nature, in turn, increases their exposure to impacts of natural capital degradation and other risks, including the impact of climate change.

All economic sectors have impacts on the environment (albeit at different degrees) and are exposed to varying degrees to the depletion of natural capital. Thus the engagement of all economic sectors is critical if the productive and regenerative capacity of nature is to be preserved or augmented (UNEP, 2011a). Understanding the dependence of economic sectors on nature and the opportunities to minimise their impacts on the environment is therefore crucial for a successful transition to a green economy (UNEP 2011a, TEEB 2012a).

The distinct values of nature have historically not been taken into consideration in national accounts (see Section 5) and decision-making processes, being largely "invisible". The "under-pricing" and "undervaluing" of natural capital also makes it difficult to design appropriate policies for ensuring that income or profits from the use of natural capital are reinvested in other productive assets (Barbier, 2002). The World Bank's Changing Wealth of Nations Report highlights how the portfolio of capitals can change in countries over time and the importance of re-investing income or profits to replace non-renewable with sustainable sources of income (World Bank, 2011). The TEEB initiative brought to light many estimates of the value derived from ecosystems which highlighted the added value of re-investing income or profits from selling non-renewable natural resources into sustainable sources of income, such as ecosystems (see Box 2.2 above). The findings and recommendations of TEEB and UNEP's Green Economy Report (UNEP, 2011a) are consistent and can both contribute to fostering a transition to a green economy in the context of sustainable development and poverty eradication.

Natural capital in emerging markets and the business sector

Investment in the restoration of natural capital can make economic sense for the public and private sectors, once the full range of benefits and time horizons over which these benefits materialise are taken into consideration (Aronson et al, 2007). Beyond improving locational quality (through creating new poles of attraction) and helping meet a wider range of policy goals (e.g. urban renewal, water purification and wastewater treatment, regional development, transport and tourism, protection from natural hazards and policies for public health), restoration activities can be also a profitable market for businesses. For example, mandatory biodiversity offsets (e.g. US mitigation banking) create an emerging market estimated at US$3 billion/year in 2010 and expected to potentially grow to US$ 5-8 billion/year by 2020 (TEEB , 2012a).

The private sector has a core role to play in the transition to a green economy by creating markets for sustainable products and services and by changing the societal habits – as business significantly influences consumer behaviour. Businesses are increasingly active in green markets and help to green the brown economy (TEEB 2012a). A growing range of businesses are going beyond simply acknowledging and taking into account the value of nature. These businesses build on the opportunities offered by the enhancement and conservation of nature to create value, highlighting that the stewardship of natural capital can be a driver in the transition to a green economy. Moreover, some areas, such as biomimicry or pharmaceuticals, are building on the insights and material gained from the natural world (see further below). These industries are not as directly dependent on nature and natural capital as, for instance, agriculture, forestry or fisheries. Nonetheless they demonstrate the inter-dependence of our economies with nature and the viable business and innovation opportunities available in the transition to a green economy. For example, companies can satisfy the growing demand for 'sustainable' goods and services in **ecotourism, organic agriculture and sustainable forestry**, supported, for instance, by certification schemes. This trend reflects increasing public and business awareness that conventional production and consumption practices threaten the long-term viability of ecosystems. Far from only being opportunities in developed countries, many green business opportunities can and are already being realised in developing countries, as illustrated in Box 2.4.

Box 2.4: The growth of green product markets
Greening products: from niche to mainstream

Formerly niche markets are becoming increasingly mainstream. Global sales of organic food and drink have recently been increasing by over US$5 billion a year, reaching US$46 billion in 2007 (Organic Monitor, 2009); the global market for eco-labelled fish products grew by over 50% between 2008 and 2009 (MSC, 2009); and it is estimated that global spending on ecotourism is increasing at a higher rate than the industry-wide average growth (UNEP, 2011c).

Source: TEEB (2011a); TEEB (2010b)

Organic agriculture and case example of Uganda

Organic Agriculture (OA) is defined by the Codex Alimentarius Commission as a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It prohibits the use of synthetic inputs, such as drugs, fertilizers and pesticides. According to IFOAM, the global market for organic foods and drinks is estimated to be around US$50 billion, and increased by 10-20 per cent annually between 2000 and 2007. This sub-sector provides a unique export opportunity for many developing countries, owing to the fact that 97 per cent of the revenues are generated in the OECD countries, while 80 per cent of the producers are found in developing countries of Africa, Asia and Latin America.

Uganda has taken important steps in transforming conventional agricultural production into an organic farming system, with significant benefits for its economy, society and the environment. By 2003, Uganda had the world's 13th-largest land area under organic agriculture production and the most in Africa. By 2004, Uganda had around 185,000 ha of land under organic farming covering more than 2 per cent of agricultural land, with 45,000 certified farmers. By 2007, 296,203 hectares of land were under organic agricultural production with 206,803 certified farmers. This constitutes an increase of 359 per cent in terms of number of farmers and 60 per cent in terms of acreage, respectively, from 2002 to 2007.

Source: UNEP (2011b)

Cosmetics, body care products, and medicines based on natural ingredients form part of the **expanding trade in biodiversity products**, yet few formal certification schemes are currently in place in these areas. In the search for increased resource efficiency, these sectors, as well as the pharmaceutical and biocontrol sectors that rely heavily on **genetic resources** (see Box 2.5 below), and the food and drink industry which is making increasing use of genetic resources, can be expected to experience further growth as the principles related to access and benefits sharing are implemented, reducing bio-piracy, encouraging investment and benefitting local communities.

Box 2.5: Genetic resources – a key resource across multiple sectors

The Nagoya Protocol on Access and Benefits Sharing (ABS) has led to discussions on suitable measures to support access to genetic resources, the sharing of benefits deriving from these, and respecting traditional knowledge. This has helped highlight the fundamental importance of genetic resources for economies. While genetic resources play very different roles across sectors, the following are each affected: botanic gardens, culture collections, academic research, biocontrol; industrial biotechnology, plant breeding or seed industry, horticulture, cosmetics, pharmaceuticals, farm animal breeding and food and beverages.

According to Laird and Wynberg (2012), interest in genetic resources overall has increased, though demand for access to "wild" genetic resources has declined in most sectors. The importance of ABS for sectors varies as some sectors rely more on wild genetic resources than others. The pharmaceutical industry relies partially on wild genetic resources: 26% of all new approved drugs over the last 30 years are either natural products or have been derived from a natural product (Newman and Cragg, 2012). In the plant breeding or seed sector conventional breeders rely on modern varieties, though old varieties, landraces and crop wild relatives are still used to introduce specific features such as insect and disease resistance into breeding populations

(Schloen et al, 2011). The food and beverage industry, on the other hand, relies significantly on wild genetic resources for product development and marketing. In recent years interest in wild novel species and associated traditional knowledge has even increased. Demand for access to wild resources from these sectors is likely to be maintained as these help companies to market their products in competitive markets (Laird and Wynberg, 2012).

The biocontrol sector relies most heavily on wild genetic resources; plants, viruses, bacteria, fungi, insects, nematodes and invertebrates are very often collected in situ as living organisms. Within the EU, for example, in situ collections are as important as non-EU in situ collections (FAO, 2009a).

To communicate the scale of these sectors where nature can play a critically important role: the global food and beverage industry was valued at US$5.7 trillion in 2008, the global pharmaceutical market at US$808 billion in 2009 (IMAP, 2011), the cosmetics market at US$136 billion in 2006 (Global Insight, 2007), global biotechnology industry revenues at $84.6 billion in 2010 (Ernst & Young, 2011) and the commercial seed market at US$42 billion in 2009-2010 (SCBD, 2008). The global market for augmentative biocontrol was estimated at around US$100-135 million in 2008 (FAO, 2009a). Finally, there are also over 3,000 botanical gardens worldwide (IEEP et al., 2012).

Biomimicry (learning from nature) is likely to be a key source for inspiration, innovation and growing markets which can offer industry alternatives to the typically "brown" economy or "heat, beat and treat" approach that requires enormous amounts of energy, raw material, toxic chemicals and heavy machinery to manufacture every day products while polluting the soil, water and air (Lovins, 2008) (See Box 2.6).

Box 2.6: Biomimicry

Biomimicry is expanding in areas as diverse as architecture, engineering and product development (Biomimicry Institute, 2010a, b; van Nierop et al., 2008; Business Green, 2010). It brings together science, design, policy, and manufacturing to tackle problems faster, smarter and with less impact on the biosphere. The Harvard Business Review (2009) identified biomimicry as one of the year's key breakthrough ideas. An examination of the worldwide Patent Database for 1985 to 2005 shows that the appearance of terms like 'biomimicry','bioinspired' and 'biomimetics' has jumped by 93 per cent compared with a 2.7 per cent increase in patents overall (Janine Benyus, cited in Freedman, 2010). Estimated revenue from the top 100 biomimetic products in 2005 to 2008 totalling US$1.5 billion.

Many opportunities are being studied and may bring benefits in the medium term – e.g. studying fish shoals may lead to the generation of ten times more energy from the same amount of space in wind farms (Whittlesey et al, 2010), the Namib Desert beetle with its moisture collecting system is inspiring materials research at MIT on water collecting materials and antibacterial coating (MIT news, 2006). What is being studied currently is still only scratching the surface of the wealth of solutions found in nature, our 'living library of life' with billions of years of experimentation.

These new and growing economic sectors underline firstly that business has a critical role to play in the transition to a green economy (see also TEEB, 2012a) and that the growth in the nature-based economy is likely to lead to the creation of a significant amount of new jobs over the years to come, as illustrated by a few selected examples in Box 2.7. Over time brown jobs will become greener and those lost, as the economies undergo structural change in the transition to a green economy, will be replaced by green jobs. UNEP analysis showed that employment actually contributes to reducing carbon emissions and offers businesses and workers a real stake in a green economy and suggested that the pursuit of green jobs will likely be a key driver as the world sets out to build a low-carbon economy (UNEP, 2008 and ILO, 2012). The arguably inevitable shifts in the job market and the training and skills needed for newly created ones calls for transition planning, capacity support, and education to avoid skills shortages and facilitate a smooth transition.

Box 2.7: Jobs derived from the transition to the green economy

Jobs linked to biodiversity and ecosystem services
Nature-based recreation (e.g. hunting, fishing and observing wildlife) accounted for nearly 1 per cent of GDP in the US in 2006 or US$122 billion (US Fish and Wildlife Service, 2007). Maintaining natural areas in good condition is fundamental to the sector's continued growth. Reinvesting some tourism revenues in ecosystem protection can support community-based conservation and provide an alternative to more damaging development, while at the same time creating numerous job opportunities. In Bolivia, for instance, tourism related to protected areas and wider nature-based tourism is estimated to generate around 20,000 jobs, indirectly supporting close to 100,000 people (Pabon-Zamora et al, 2009).

A report on the social dimension of biodiversity policy quantified employment in different sectors dependent to different degrees on ecosystem services. It found that, in Europe, 15 million jobs (7% of the EU total in 2008) are in natural resource based activities closely linked to biodiversity and highly dependent on the delivery of ecosystem services (Nunes et al, 2011).

Source: TEEB (2011a)

Jobs and the green economy in South Africa
The R7.7-billion (approx. $US 1bn) budgeted for environmental programmes in South Africa between 2012/13 and 2014/15 is estimated to provide 205,877 work opportunities and 102,603 full-time equivalent jobs (Engineering news, 2012). This is in line with a recent 'Green Jobs' report produced jointly by the Industrial Development Corporation and the Development Bank of Southern Africa. The report estimated that there was an opportunity to create 98,000 new direct jobs in the short term, almost 255,000 in the medium term and around 462,000 employment opportunities in the formal economy by 2025 by pursuing efforts to green the South African economy (Maia et al, 2011). The bulk of these prospects were said to reside in the area of natural resource management, where some 232,926 jobs, or 50.4% of the total, could be created through employing people to conserve and restore ecosystems, such as grasslands and wetlands, or to improve soil and land management.

Funding for environmental programmes had also been bolstered by additional allocation of R1.1-billion (approx. $US 140 million) over the three-year period for the Working for Water and Working on Fire programmes. Both of these programmes are thought to have provided significant benefits; Working for Water programme were estimated to have yielded water savings worth R400-billion as a result of the removal of water-sapping alien plants and the Working on Fire initiative had played a role in restricting the damage associated with forests fires (Engineering news, 2012). In addition, the South African National Treasury made R800-million (approx. $US 100 million) available for a 'Green Fund' to support projects designed to help South Africa transition to a low-carbon, resource efficient and job-creating economy. The objective of the fund was to provide catalytic finance for green economy projects and mainstreaming activities, which would not have been implemented without fiscal support (iol news, 2012).

Source: Engineering news (2012); iol news (2012) and Maia et al (2011)

3. NATURE, WELL-BEING AND DEVELOPMENT

A. Nature provides benefits for people and communities

Nature's contribution to people's well-being and health

Ecosystems and their biodiversity underpin not just the economy but also the well-being of people, communities, and society. Seventy per cent of the world's poor live in rural areas and depend directly on biological diversity for their livelihoods (SCBD, 2010). More than 3 billion people depend on marine and coastal biodiversity for their livelihoods, while over 1.6 billion people (including 1 billion living in poverty) rely on forests and non-timber forest products. The World Bank estimated that in 43 countries classified as 'low income', natural capital makes up 36 per cent of their total wealth as calculated by the World Bank (WAVES, 2012), even without factoring in the wider range of services ecosystems provide. Over a billion people in developing countries rely on fish as a primary source of protein (World Bank and FAO, 2009), around 1.1 billion people are dependent on forests for their livelihoods, and over half of all commercial medicines are derived from natural substances - mostly sourced in rainforests (TEEB 2011a and sources therein). Beyond goods and services, biodiversity often plays an important role in religious beliefs, traditional knowledge and social institutions. Many communities are enmeshed within the ecosystems in which they live and this connection forms the basis of their identity and culture.

Thus it is not just wealth (man-made capital) that is in danger from an erosion of natural capital, but also individual well-being, productivity, skills and health (human capital), social well-being, solidarity, and political stability (social capital). Nature and healthy ecosystems are critical at many different levels (TEEB, 2011a). Habitat degradation and the loss of biodiversity are threatening the livelihoods of more than 1 billion people living in dry and sub-humid lands. The impact of environmental degradation is most severe among people living in poverty, since they have few livelihood options. Therefore, the availability and sustainable use of biodiversity by the poor are of direct relevance to poverty eradication.[5]

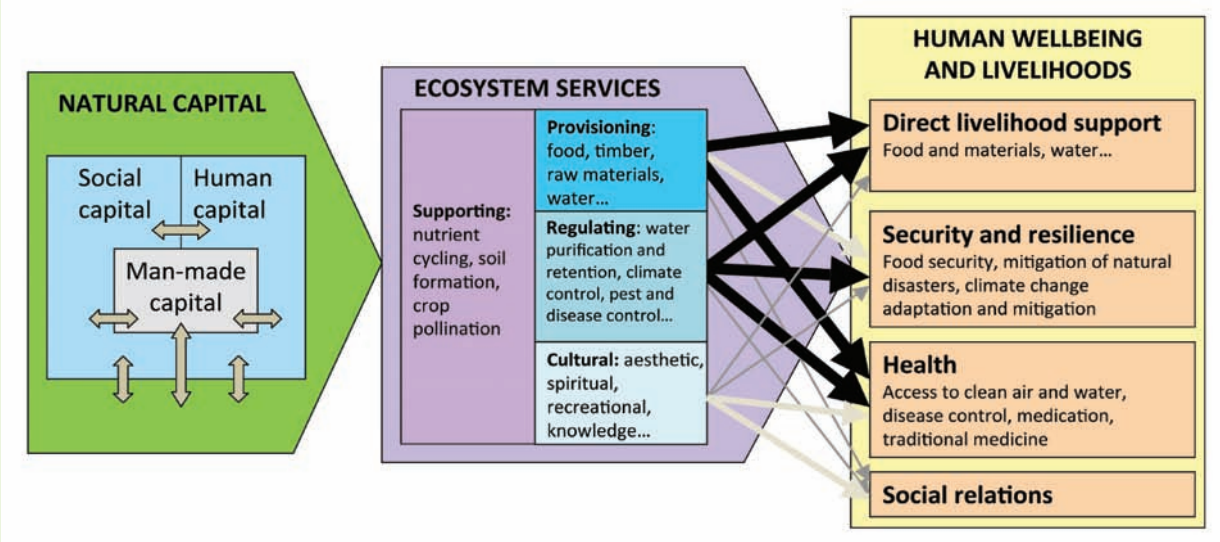


Figure 3.1: Contribution of natural capital to human well-being and livelihoods

Source: Own Representation Laure Ledoux, building on MA (2005) and TEEB (2011a)

Building on the representation of the relationship between ecosystem services and human wellbeing developed in the context of the Millennium Ecosystem Assessment (MA, 2005), the figure below depicts the role of natural capital in this process. The flow of ecosystem services – provisioning, regulating and cultural services – can provide direct and indirect support for livelihoods (food, materials, water, jobs), security (food, climate, and natural disasters), health (via clean water, disease control, medicines) and harmonious social relations and community well-being (MA, 2005; see Figure above). Natural capital plays an essential role in the provision of these services as it underpins both the functioning of ecosystems, as well as other forms of capital.

The flow of ecosystem services can provide direct and indirect support for livelihoods (food, materials, water, jobs), security (food, climate, and natural disasters), health (via clean water, disease control, and medicines) and harmonious social relations and community well-being (MA, 2005; see Figure 3.1).

Fundamentally, the provision of these services contributes a key portion of the income of the rural poor; however, this is currently not fully reflected in standard economic measurement tools such as Gross Domestic Product (GDP) (see Box 3.1).

Box 3.1: The dependency of poor rural communities on ecosystem services

A better reflection of the value of ecosystems and their services for the poor than GDP can change one's perspectives quite considerably. For example, in Brazil, Indonesia and India, the standard GDP contribution of agriculture, forestry and fisheries combined was 6.1%, 11.4%, and 16.5% respectively in 2005. This reflects only the traded goods in the markets. If adjusted for (non-marketed) ecosystem services (e.g. unrecorded timber and fuelwood use by communities, non timber forest products, ecological services such as water recharge and carbon storage, and ecotourism), these figures have been estimated to rise to 17.4%, 14.5% and 19.6% respectively (Gundimeda and Sukhdev in TEEB 2011a). This could be seen to present an average / aggregate picture for the country. For the rural poor, the share of ESS and non-market goods of total income would be much higher – 89.9%, 74.6%, and 46.6% respectively (ibid).

The issue of the rural poor's dependency on income from non-market products and services is critical to factor into policy-making in order to address the goal of poverty eradication effectively. Their dependency and increasing loss of livelihood from the erosion of natural capital underlines the need for a strategy for investing in the natural capital stocks that support the livelihood of the poor.

Restoration that increases well-being – an example from Tanzania

In 1986, a government initiative named Hifadhi Ardhi Shinyanga (or HASHI), meaning "soil conservation" in Swahili, was launched. Over the subsequent 25 years, approximately 500,000ha of woodlands were restored across over 825 villages in Shinyanga region. Ngitili (traditional enclosures or fodder reserves), and traditional knowledge was an integral part of forest restoration. Trees and catchment conservation improved water quality, restored woodlands provide fodder for oxen in dry season, the livelihoods of agropastoralists whose activities had been at risk from degradation has improved. The time to collect various natural resources has also reduced considerably – by 2 to 6 hours for fuelwood, 1 to 2 hours for water, and 3 to 6 hours for fodder (Monela et. al, 2005; Otsyina et al., 2008; in Barrow and Shah, 2011).

Resilience (the inherent capacity of a system to deal with any external shock) of ecosystems can support community resilience and vice versa. A resilient ecosystem continues to provide ecosystem services to local communities longer under changing environmental conditions, such as climate change, than degraded ecosystems and hence supports community viability and livelihoods. In addition, healthy ecosystems supplying rural communities with food and renewable energy can provide community resilience towards economic turmoil and associated volatile food and energy prices. Engagement in the management and conservation of nature by a communities building on the innate strength of their members and institutions can in turn support ecosystem resilience (See Box 3.2). Conservation goals formulated and embraced by local groups to achieve multiple benefits can have a greater chance of being sustained and supported over the long run.

Box 3.2: Supporting management and conservation through community engagement

Support Group for Conservation and Sustainable Development Initiatives, (CACID) Cameroon: The rehabilitation of the Waza Logone floodplain in northern Cameroon brought together international researchers, NGOs, and the local organization *Cellule d'Appui à la Conservation et aux Initiatives de Developpement Durable* (CACID). Local practitioners led a critical element of the project: namely, resolving conflicts between farmers, fishermen, pastoralists, and protected area authorities over access to the floodplain's natural resources. This was achieved through a highly participatory process. Based on interviews and surveys, the project concluded that methods used to settle conflicts favoured settled communities and the owners of fishing canals at the expense of the pastoralists. To redress this imbalance, the project intervened on behalf of pastoralists at their request on separate occasions, working through customary institutions to mediate resolutions accepted by all parties. Often this involved establishing new transit corridors for pastoralist through settled lands, agreed through exhaustive discussions with all stakeholders. The long-term impact of these interventions remains the project's principal achievement in improving social and economic well-being in the floodplain, and has proved fundamental in supporting the sustainable management of the Waza Logone region.

Ethiopia's Productive Safety Net Programme (PSNP) reaches over eight million beneficiaries in 300 food-insecure districts, providing cash and food in return for work done by communities on environmental conservation, water source protection, and terracing. Through the programme, the calorie intake of recipient households has increased by nineteen per cent, with many faring better during the 2008 drought and high food price conditions than did households not in the programme. Significant community assets have been created as well, which have had a positive impact beyond the household level. Public works projects take place under the programme each year, with the bulk of investments focusing on soil and water conservation, rural feeder roads, and selected projects in natural resource management and social services. The legitimacy of local government authorities has been strengthened by their involvement in setting the priorities for these initiatives

Source: *UNDP Equator Prize website*[6]

B. Loss of natural capital and implications for people and communities

Nature, poverty and equity

The deleterious impacts of environmental degradation and the associated loss of ecosystem services are borne disproportionately by the poor, contributing to growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social and political conflicts (MA, 2005). The ones most immediately and directly affected by any loss of biodiversity are arguably the rural poor in developing countries, where the majority of populations depend directly on natural resources. The livelihoods of many of the world's rural poor are intricately linked with exploiting fragile environments and vulnerable ecosystems (Barbier, 2005). Natural resources are a basic source of their income generation (recall Box 2.2 above). Moreover, healthcare needs for the world's poor are mostly met by traditional medicines and treatments extracted from natural sources. Loss of this biodiversity is particularly profound in these cases as the cost of substitute treatment - modern medicines - is often prohibitive. A loss of ecosystem services also risks undermining progress towards achieving many of the Millennium Development Goals (MDGs) (UN, 2000; TEEB, 2008).

Impacts of losses at the community/individual level

Over 600 million of the rural poor currently live on lands prone to degradation and water stress, and in upland areas, forest systems, and drylands that are vulnerable to climatic and ecological disruptions (Comprehensive Assessment of Water Management in Agriculture, 2007). The tendency of rural populations to be clustered on marginal lands and in fragile environments is likely to continue in the foreseeable future. Forty-two per cent of the world's poor depend on degraded lands for nutrition and income (Nkonya et al, 2011). This means that poorer households, particularly in rural areas, are likely to face disproportionate losses from the depletion of natural capital due to their relatively high dependence on certain ecosystem services for income and insurance against hard times (see Box 3.3).

Box 3.3: The consequences of desertification on small agricultural holdings

More than two billion people depend on the world's arid and semi-arid lands. Preventing land degradation and supporting sustainable development in drylands has major implications for food security, climate change and human settlement.
Ban Ki-moon
United Nations Secretary-General, 2011

Drylands cover approximately 40% of the world's land area, and support two billion people 90% of whom live in developing countries (Reynolds et al, 2007 and UNEP, 2007). All five of the 'BRICS' countries (Brazil, Russia, India, China and South Africa) contain drylands. Unsustainable land and water use and the impacts of climate change are driving the degradation of drylands. Approximately 6 million km^2 of drylands (about 10%) bear a legacy of land degradation. Such degradation, where drylands lose their productive capacity leading to food insecurity and poverty (sometimes referred to as 'desertification') – can take the form of soil erosion, nutrient depletion, water scarcity, altered salinity, or the disruption of biological cycles. Degradation reduces biological productivity and can impact the ability of ecosystems to absorb and use rainwater. Dryland degradation costs developing countries an estimated 4-8% of their national GDP each year (UN, 2011).[7]

The risk of land degradation and desertification compromises the livelihoods of the pastoralists and small-scale farmers that are currently sustained by the land. Climate change is already causing significant decreases in crop yields in some rain-fed African agricultural systems. This is likely to worsen by 2020 and further on. It is also likely that climate change will cause grassland productivity to decline by between 49-90% in semi-arid and arid regions. The livelihoods of over 1.2 billion people inhabiting dryland areas in 110 countries are currently threatened by drought and desertification (IFAD, 2006).

Country level costs of degradation. A recent study approximated that the loss of agricultural productivity in the arid regions of Cameroon costs US$1–2 billion per year, and that the cost of degrading watersheds is US$50–150 million per year (Fomente, 2009 in UN, 2011).

In many countries, poor households rely on natural capital for a disproportionately large fraction of their income (e.g. in agriculture, forestry, fisheries; see also Box 3.2 above). They are therefore particularly vulnerable to climate-driven risks posed by rising sea levels, coastal erosion, glacier melting and more frequent storms since they have few means to cope with losses of critical ecosystem services (drinking water purification or protection from natural hazards). Around 14 per cent of the population and 21 per cent of urban dwellers in developing countries live in low elevation coastal zones that are exposed to these risks (McGranahan et al, 2007). The livelihoods of billions – from poor farmers to urban slum dwellers – are threatened by a wide range of climate-induced risks that affect food security, water availability, ecosystem, and human health (UNDP, 2008; OECD, 2008).

A transition to a green economy involves greening a range of key sectors that are particularly important for the poor (i.e. agriculture, forestry, fishery and water management) and can contribute to eradicating poverty (see Table A1 in Annex 2). Investing in greening these sectors, including through scaling up microfinance, is likely to benefit the poor in terms of jobs and secure livelihoods that are predominantly based on ecosystem services. Similarly, "greening the brown sectors of the economy" will also be important since industrial, infrastructure, and energy sector activities can lead to substantial degradation of ecosystems that in turn lead to a loss of ecosystem services that would otherwise benefit the poor.

Biodiversity conservation and sustainable management of ecosystems is thus a key element in strategies to eliminate poverty, and make a significant contribution to meeting internationally-agreed objectives, such as the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) that are to be prepared by 2014 in the context of the Rio+20 commitment, as well as targets for poverty reduction at national and local levels (TEEB, 2010b).

Costs of mismanagement of key natural assets
Public goods or common natural resources that are in a situation of open access are generally more difficult to govern and can lead to significant inefficiencies and losses (often termed "tragedy of the commons"). Governance of the "commons" is a critical challenge for local to global governance in

the transition to a green economy in the context of sustainable development and poverty eradication. The most striking example of this is world fisheries, which includes competition on the global commons of the open seas and suboptimal management of stocks within many national waters. Fisheries yields are significantly lower than the maximum potential due to excess fishing pressure in the past. The inefficiency has been estimated at around $50 billion/year in an industry with an annual landed catch value of $86 billion (World Bank and FAO, 2009). Overcapacity and mismanagement in the fisheries sector, coupled with poor regulation and weak enforcement of existing rules, has led to this over-exploitation (World Bank and FAO, 2009) (see Box 3.4). A green economy response to the challenge is about identifying rules and regulations that can better take external costs (through the loss of nature and over-exploitation of resources) into account in decision making.

Box 3.4: Loss of biodiversity, marine ecosystem services and livelihoods

There are several well-documented cases where changes to biodiversity have led to the degradation or collapse of ecosystem services with consequent impacts on livelihoods. These could arguably have been avoided with greater understanding of the risks and an earlier policy response. Some examples are given below for the marine environment:

In the late 1980s, the invasion of the Black Sea by a comb jellyfish (an invasive alien species accidentally released into the Black Sea together with ballast water from a cargo ship) led to the subsequent collapse of the fishing industry. The comb jellyfish are predators and contributed to the fall in anchovy landings from hundreds of thousands of tons to tens of thousands of tons per year by the end of the 1980s. The collapse of the fishing industry led to the loss of 150,000 jobs. Environmental degradation also led to a reported loss of US$300 million in tourist industry revenue (Lubchenco, 1997 and Harbison and Volovik, 1994).

The Canadian cod fishery in Newfoundland, Canada provided 80 to 100 per cent of income in some communities, employing 20 per cent of the population. Its collapse led to more than 40,000 people losing their jobs, including 10,000 fishermen (Vilhjálmsson et al, 2010).

1300 fishermen lost their jobs due to the degradation of the former Lake Karla in Greece, the consequent impact on commercial fisheries and the lack of livelihood alternatives (Zalidis and Gerakis, 1999).

Following the 1998 coral reef bleaching event in the Indian Ocean, predicted total economic damages over the next 20 years could reach US$8 billion, including US$1.4 billion in lost food production and from fisheries, US$3.5 billion in lost tourism revenue and US$2.2 billion in lost coastal protection. Economic losses from coral bleaching in the Philippines are estimated at between US$6 million and US$27 million, depending on the coral reef's recovery (Pratchett et al, 2008).

Source: TEEB (2011a)

Many public goods, such as forests, fisheries or open pasture, face similar management challenges with risks of overexploitation, degradation and loss. The story is not all bleak as successful approaches to managing common natural resources are being implemented at national level (e.g. New Zealand fisheries and use of tradable fisheries quotas, see Lehmann et al 2011) and at community levels (see work of Elinor Ostrom – e.g. Ostrom, 1990, 1999; Oakerson, 1992; Agrawal, 2001).

Limits to substitutability and costs of substitution

When a natural resource is degraded or depleted, we look for ways to acquire a substitute, e.g. another fishing ground, another forest for fuel or another aquifer for water. This substitution of ecosystem services can sometimes happen by natural means: the services lost from the original ecosystem may be (partly) substituted by exploiting another, similar ecosystem in some other location. In other cases, substitution can be by artificial means, through use of technical or man-made analogue solutions e.g. substituting loss of clean water from a local ecosystem by means of shipping in water (e.g. by truck, pipeline or purchasing bottled water), of investing in water desalination and/or water purification plants.

However, there are limits and other constraints to substitution and this has very important implications for economies, individuals and societies. For some services and groups of society, there are:

- no equivalent alternatives for the population concerned (e.g. for local fisheries collapse);
- only degraded alternatives or alternatives perceived as of lesser quality – e.g. culturally less preferable fish or agricultural protein substitute;
- the alternatives are much more costly or even unaffordable – e.g. imported fish.

The limits of substitution are more pronounced at a local level than globally and again the poor will be more adversely affected than the relatively well-off who have wider access to and are able to afford non-local goods. The middle classes and the wealthy can also be affected by the loss of natural capital over time.

There are limits to substitution even at the global level for some goods and this is expected to increase in the future. There is also a wider debate about "strong" versus "weak" sustainability – i.e. to what extent natural capital and the benefits it provides can be substituted with other forms of capital (e.g. manufactured, financial capital) as a direct provider of utility (Neumayer, 2003). Proponents of weak sustainability regard natural capital as being substitutable in the production of consumption goods and as a direct provider of utility (i.e. natural capital can be safely run down as long as enough man-made capital is built up in exchange). Supporters of strong sustainability consider that substitutability is limited at best and call for the preservation of the physical stock of those forms of natural capital that are regarded as non-substitutable ('critical natural capital'). Their perspective translates into management rules for preserving critical natural capital (e.g. fisheries, forests) that would involve the use of renewable resources such that their stock does not deteriorate and limiting pollution to the natural absorptive and regenerative capacity of the environment. As ecosystem services are lost as a result of biodiversity loss and ecosystem degradation it become increasingly clear that there are limits to substitutability and that strong sustainability better captures the limited substitutability of some forms of natural capital, in particular ecosystems.

C. Nature's contribution to development and prosperity

The role of nature in development has all too often been overlooked and has led to a narrow focus on short-term gains at the expense of long-term prosperity and viability. Private wealth and financial or manufactured capital are systemically prioritised over public welfare and natural capital, which exacerbates the degradation and loss of natural capital (UNEP, 2011a). However, this is slowly changing. From the local to the global level, efforts to create healthy and resilient ecosystems are helping to deliver wider development objectives. Some examples are discussed below.

Local level

Particularly in rural areas, nature plays a key role in supporting people's livelihoods and essential provisioning services on which they rely (e.g. food, timber, clean water or natural medicines). A disturbed functioning of ecosystems might undermine communities' viability and resilience and increase poverty. In turn, restoration of previously degraded ecosystems have, in many cases, proved to support jobs and also increase the level of ecosystem services and associated benefits (see Box 3.5).

Box 3.5: Restoration for poverty alleviation

In the Indian village of Hiware Bazaar, acute water shortages due to vegetation loss were undermining agricultural productivity. The subsequent regeneration of degraded forests and building of earth embankments around hills have helped to conserve rainwater and recharge groundwater. This has increased agricultural production potential by several orders of magnitude and contributed to reducing poverty by 73 per cent in less than a decade (TEEBcase by S. Singh 2010 and TEEB 2012b, building on Tiwari et al., 2007). Likewise, as shown in Box 3.2, in the Shinyanga Region in central Tanzania, efforts have been made to restore the Nihili woodland by utilizing traditional knowledge, resulting in an increase in the provision of ecosystem services from the woodland (e.g. fuel, fruit, building timber, honey, medicines and fodder) and a reduction in the time needed to collect fuel wood and non-timber forest products by several hours. In addition, the sale of tree products has helped pay for children's schooling and allowed more time for education and productive work, thus creating enabling conditions for development (TEEB 2012b, building on Barrow, E. and A. Shah 2011).

Urban planning, renewal and green infrastructure
More than half the world's population lives in urban areas and this pattern is expected to increase if current migration patterns continue. There is growing recognition that nature plays a key role for cities and urban areas by offering water purification and supply, a range of recreation and health benefits, air pollution control, local climate effects (e.g. city cooling, mitigating the "heat island effect[8]"), as well as supporting tourism and the value of the housing stock. The level of benefits will depend on each city's green infrastructure and its management, and the interactions between the city, its citizens and the surrounding ecosystems. Box 3.6 provides some figures for nature's different services in Cape Town, South Africa.

Box 3.6: Cape Town's ecosystem services

Tourism:
Total tourism value: US$137-418 million per annum; based on the amount of revenue generated by visitors who were travelling to, or in, the city in 2007; as a result of the attraction of natural features.

Recreation:
Local recreational values: US$58-70 million per annum based on benefits transfer for recreation.

Globally important biodiversity:
Donor funding of US$32 million for conservation has flowed to the region giving a proxy of value - it can easily be argued that Cape Town is one of the most important cities in the world for biodiversity conservation.

Aesthetic and "sense of place" related values:
Evidence shows that natural spaces play an important role in improving health and well-being in cities. Natural assets help to attract skilled entrepreneurs and others that drive economic development. Cape Town's branding is now strongly linked to its natural assets.

Natural assets are a key driver of the film and advertising industry and are valued between US$18.8-56.4 million per annum, based on industry expenditure linked to natural asset locations.

Natural hazard regulation:
Savings of US$650,000 to US$8.6 million per annum for natural hazard regulation (wildfires, floods and storm surge) based on estimates of the cost of damages avoided from buffering of fires, flooding and storm surge by natural assets.

Water purification and waste treatment, assimilation:
The need to dredge Zeekoevlei Wetland for US$8.5-9.9 million represents the minimum clean-up costs needed for the wetland to function normally and avoid ecosystem collapse.

Source: TEEB (2011b) building on De Wit and van Zyl (2011); De Wit et al (2009)

Cities benefit from ecosystem services within and beyond their borders, and also have an ecological footprint through the importation of goods and services. Understanding the benefits of green city infrastructure, the benefits from links to nature, and the environmental costs of globally traded goods (embedded biodiversity, embedded carbon and footprints) is valuable to informed policy response, investment, and procurement decisions. For example, Rio de Janeiro (Brazil) is dependent for its water supply on a protected area within it city boundaries. New York (USA) and Quito (Ecuador) are reliant on ecosystems outside their borders.

Regional level
The same issues apply at a regional level which is, in many instances, the most appropriate level for developing initiatives to conserve and restore ecosystems. The question as to what level of governance level is right will depend on the regional and national contexts, notably institutions and competencies, as well as landscape issues. River basin catchments would suggest a focus on the "functional geographic unit". In other cases, programmes can be set up nationally but with regional or local initiatives within the wider framework – as is the case within South Africa's Working for Water programme (See Box 3.7).

Box 3.7: Benefits of restoration: An example from South Africa

The government-funded Working for Water (WfW) programme clears mountain catchments and riparian zones of invasive alien plants in order to restore natural fire regimes, the productive potential of land, biodiversity, and hydrological functioning. It is a large scale public works programme, with more than 300 projects in all nine South African provinces. It has employed around 20,000 people per year, 52 per cent of them women, and also provided skills training, health and HIV/AIDS education to participants. WfW is best understood as a Payment for Ecosystem Services (PES)-like programme as it does not pay landowners to provide continued services but consists of the municipal government contracting workers to manage public land sustainably (Wunder, 2008). WfW uses a special kind of PES scheme, where previously unemployed individuals tender for contracts to restore public or private lands. By using this approach, costs to rehabilitate catchments range from 200-700 EUR per hectare (Turpie et al, 2008) while benefits may reach a 40-year Net Present Value of 47,000 EUR/ha.

A local example within a national programme: Manalana wetland restoration within Working for Wetlands

The Manalana wetland (near Bushbuckridge, Mpumalanga) was severely degraded by erosion that threatened to consume the entire system if left unchecked. The wetland supports around 100 small-scale farmers, 98 of whom are women. Approximately 70 per cent of local people make use of the wetland in some way, with about 25 per cent depending on it as their sole source of food and income. The wetland was thus considered to offer an important safety net, particularly for the poor, contributing about 40 per cent of locally grown food.

An assessment of the ecosystem potential underlined that the value of benefits from degraded wetland was just 34 per cent of what could be achieved from the ecosystem after investment in ecosystem rehabilitation. The Working for Wetlands public works programme intervened in 2006 and the rehabilitated wetland now contributes provisioning services (crop and reed production, water for domestic purposes and for livestock, and grazing) worth around 297 EUR per household per year on average. The benefits were twice the restoration costs. In addition, the Manalana wetland acts as a safety net that buffered households from slipping further into poverty during times of shock or stress.

Source: www.dwaf.gov.za/wfw, www.un.org/esa/sustdev/publications/africa_casestudies/bushbuck.pdf, Pollard et al., 2008

National level

Healthy and resilient ecosystems providing steady flows of multiple benefits underpin a country's long term development and wealth; as long as economies reinvest the proceeds generated from sustainably used natural capital into productive assets (see Box 3.8 below).

In cases where natural capital and its benefits are not managed sustainably, the result is often a "boom and bust" pattern of economic development (Barbier, 2002). The challenge here is the development of mechanisms for recovering the resource income and making sure it is invested for long-term economic growth; from non-renewable capital into other assets (World Bank, 2011). This also involves using the income and profits from resource exploitation – an issue of national interest for countries with significant natural endowments.

Historically, countries with a direct dependence on ecosystem services or with a large extractive industry have considered natural capital only as an income or profit source. In practice they treated natural capital as if it were an unlimited resource with unlimited capacity to generate goods and services, only committing low levels of investments to maintain and/or recovery their functionality. The natural capital, which was a driver of economic development, has often been depleted without sufficient consideration for the future.

Box 3.8: Insights on "genuine savings" from Botswana

Botswana, in southern Africa, stands as a model for the careful management of its natural resource base. Botswana is rich in natural resources. A combination of minerals, energy, protected areas, crop and pastureland, and non-timber forest products make the country's natural capital worth a third of its total wealth (WAVES, 2012).

Over the last two decades, the country's economy has grown by an average of about 7.8 per cent – the highest across the region – and between 1995 and 2005 it managed to increase its per capita wealth by 35 per cent. This has been possible through the careful management of its natural resource base with strong governance and accountability structures. The government reports mineral revenues annually in publicly available documents and there is open discussion of how to make best use of these revenues. In the 1990s the Ministry of Finance and Development Planning introduced the Sustainable Budget Index to monitor the extent to which mineral revenues were used for investment in the government budget. The Department of Environmental Affairs piloted wealth accounting to be used to monitor recovery of resource rent and investment of rents, the second and third areas of policy necessary for transforming mineral wealth into other forms of capital. The wealth accounts show that the government of Botswana has consistently recovered a large share of the rents generated by mining.

Besides being recognized by Transparency International for consistently having the best ranking in Africa on its Corruption Perception Index, Botswana has had a long-time commitment to ensuring that income from its mining sector is re-invested in the country's development – especially in education and health. An environmental accounting programme provides the proof that mining income is indeed benefiting Botswana's long-term development. As a result, the people of Botswana have seen a steady improvement in their household incomes and access to essential social services is high. It has managed to achieve this while many neighbouring, resource-rich countries saw declines in their growth and per capita wealth over the same period. For the future, Botswana's key to economic diversification may lie in nature-based tourism supported by its rich ecosystems.

Source: World Bank (2011), WAVES (2012)

The recognition of the long-term contribution of natural systems and resources can make to economic growth and human well-being has resulted in recent initiatives related to wealth accounting which would foster a better understanding of the contributions of ecosystems in human well-being and wealth creation a reality. The approach would, for example, see a country factoring more than just the potential income from a new property development into its decision-making about clearing a mangrove forest. The long-term losses to the ecosystem from damaged fish populations and compromised coastal protection are likely to outweigh the benefits from the short-term income and lead to the conservation of such a natural asset providing important flows of a variety of benefits over the long run (World Bank, 2011).

4. THE MULTIPLE VALUES OF NATURE

A. Appreciating nature's values

Strategic Plan for Biodiversity 2011-2020: Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

Is it possible or sensible to estimate the value of nature? Many would say that it cannot be done in monetary terms, as there is an intrinsic value of nature which will forever be beyond the reach of economic tools. Others would argue that nature is too complex to value whether monetary or non-monetary tools are used, and that any valuation would only reflect a partial understanding of what nature is and that the resulting value estimates can hardly capture the complexity of nature's contribution to human well-being and economic development. However, in our day-to-day decisions we are already implicitly, but effectively, attributing a judgement as to the value to nature. Even without being conscious of it, we are pricing nature.

Decisions, whether made by policy-makers, business, communities or citizens need to take account of the values of nature. In some cases, physical data on the state of nature, its functions and services is enough, such as availability of clean water, fish stock levels, and health benefits. Having clear and recognisable community or citizen preferences can also be sufficient to safeguard or invest in biodiversity. However, for many decision-makers having a monetary estimate of the values of nature will offer an important additional evidence base for decision-making – whether for policy development and implementation, instrument design, planning, land use and land use conversion decisions and investment choices.

In the last decades, the question of measurement and valuation of ecosystems as "capital assets" has been growing in importance. While there has been major progress since the Millennium Ecosystem Assessment (MA, 2005) the challenge remains of making quantified linkages between biodiversity and ecosystem functioning, ecosystem services and their benefits to people, society and the economy in different ecological, and social and economics contexts (TEEB, 2010a; Barbier, 2011). The conceptualisation of nature as natural capital which delivers multiple benefits highlights the actual value of natural capital which is often still ignored in public and private decision-making. This has led to resource and ecosystem degradation. The TEEB approach suggested that both monetary and non-monetary valuation could be used to highlight the benefits derived from ecosystems (TEEB, 2010a; TEEB, 2011a; TEEB, 2012a and b).

Reasons for valuing nature

Many benefits arising from nature stem from the habitat functions and various services (regulatory, provisioning, and cultural) that ecosystems perform. However, these are, most often, non-marketable and hence require methods to measure their socio-economic value (i.e. the value they bring to society and the economy). Failure to measure and account for these values means that ecosystems are "under-priced" in policy and development decisions. This will have implications in terms of conversion of ecosystems to other more "economically visible" uses than conservation (Barbier, 2011). Although markets recognise certain values or benefits delivered by ecosystems (e.g. food, timber, fuel), many others are not taken fully into account through economic signals in day-to-day decisions by business and citizens or are accurately reflected in society's accounts. In addition, there is uncertainty over the future values of ecosystem services; as it might well be that in future their benefits could be larger than at present. This is an aspect that needs to be addressed immediately, given that in many cases the conversion and loss of an ecosystem is irreversible (Barbier, 2011).

Valuing non-market ecosystem services is essential for making decisions to conserve or convert ecosystems. By failing to take account of the value of these services, ecological landscapes will be undervalued as natural assets, and the result will be excessive conversion and degradation (Barbier, 2011). Under-valuing biodiversity and ecosystem services has already contributed to the steady loss of forests, soils, genetic diversity, wetlands and coral reefs as well as wild species, local variants of crops and productive assets like fisheries. Ignoring values beyond the immediate, private and visible in markets has resulted in the depletion of the planet's natural capital stock without a proper understanding of actual value lost to society and people.

Recent years have seen a growing appreciation of the importance of ecosystem services (see e.g. MA, 2005) and the value of nature (see e.g. TEEB 2008, TEEB 2010a, TEEB 2011a). There is now a real opportunity for a renaissance in decision-making to take into account nature and its wide range of public goods and private benefits. This would in particular allow correcting the bias typical of much decision making today, which tends to favour private wealth

and physical capital above public wealth and natural capital (TEEB, 2010b).

Approaches and tools

A wide variety of valuation tools including economic and non-economic approaches can be used to reflect the diversity of values or benefits people derive from nature.

- As regards the non-economic approaches, these include measuring the flow of services from ecosystems to the benefitting population and activities – which can involve mapping, modelling and use of biophysical indicators (see for example Staub et al. 2011). Others involve asking stakeholder preferences (e.g. citizens' juries) or using direct negotiation (as in some payment for ecosystem service schemes) (ten Brink et al., 2011 and White et al., 2011 in TEEB, 2011a).
- On the economic side, some tools use available market prices to calculate values, others try to reveal value, and yet others require values to be stated by those (actually or potentially) benefitting. For certain uses, it can be helpful to compare costs – e.g. using (avoided) costs of substitutes - and replacement or restoration costs in the case of ecosystem loss or degradation (TEEB, 2010a, White et al 2011 in TEEB, 2011a).
- Production function approaches – which calculate outputs from an understanding of how a combination of inputs (including ecosystem services) lead to production of other ecosystem services or commodities (e.g. for agricultural outputs from land, fisheries outputs from marine ecosystems and carbon sequestration by forests) can be both physical and monetary tools (TEEB, 2010a).

When applying a particular tool, one needs to keep in mind that **each tool has its strengths and limitations and needs to take into account the specificity of the context in which it can be used** (TEEB, 2010a). Furthermore, how valuation is done strongly depends on the problem/policy question that is to be answered. The use of economic values is strongly context specific.

The choice between qualitative, quantitative, and monetary valuation approaches largely depends on the significance of the decision, the time and resources available and the type of ecosystem function or ecosystem service in question, the nature of the decision for which the evidence of value is needed and the needs of the audience (TEEB, 2011a). In practice they are not fully separate analyses as the monetary value would need to build on the quantitative assessment, which in turn would benefit from qualitative assessments. The qualitative assessment is often the least resource intensive type of assessment (though extensive consultation and participation can be important); the quantitative assessment can be resource intensive (e.g. if ecosystem modelling and associated mapping is required), and the monetary assessment is as resource intensive as the ambitions for scope, depth and precision required. Similarly, fewer ecosystem goods and services are amenable to monetary analysis than to quantitative or qualitative analyses. As such, an appropriate choice of tools needs to be considered for appropriate context – for instance, sometimes qualitative or quantitative assessments on their own can sufficiently support decisions, while in other situations only a monetary assessment can raise political support for policy action.

In addition, other tools, such as participatory approaches, can be used and wider ethical considerations (such as distributional impacts on different income groups, communities, as well as intrinsic values) need to be taken into account when evaluating the trade-offs associated with ecosystems management.

Whatever tool or combination of tools is chosen to assess and demonstrate the values of nature, it is important to recognise and communicate that different tools of ecosystem valuation will provide different results with different meanings and implications for the economy and society (see Box 4.1).

Finally, it is important to be aware of the inherent complexity and uncertainties of many valuation exercises. In fact, all environmental analyses are inevitably affected by statistical and methodological uncertainty to varying degrees. It is also often intrinsically impossible to encompass the full breadth of environmental consequences entailed by the alternative scenarios being analysed, since some of them are not yet fully understood in all their ramifications and potential mutual interactions. Therefore, the results of any valuation exercise should always be treated with caution, and complemented by different tools and perspectives.

Box 4.1: Values, Prices and Costs

A lot of confusion can arise from the use of the related but different terms of 'value', 'price' and 'cost'. They mean different things, though are sometimes taken to be equivalent when communicating key messages. Also, what is sometimes overlooked is that different models and methodologies lead to results presented in different terms (values, prices, or costs), and these may not be comparable. It is important to underline that:

- Something of value does not need to have a cost or a price in the market; estimating an economic value does not mean putting a price tag on the environment.
- Demonstrating that something has value, however, does not necessarily mean that it can be bought or sold.
- Exploring the economic value is one of many ways of assessing the role and importance of nature. To develop as full picture as possible a mix of tools and measures should be used.

As noted above, there are a range of methods to ascertain value, and the values themselves can be of different types – from real market values that can feature in companies' "bottom lines", national accounts and GDP, to values representing well-being, which are meaningful at a social level, but invisible to the economy. To be more precise:

- **Some values are reflected in "real money" transactions:** "cash-in-hand", i.e. that can be seen in bank accounts and national accounts – e.g. spending on products provided by ecosystems, measured using market prices (taking subsidies into account) and tourism spending in sites or related to visits.
- **"Real value" – avoided real costs:** e.g. the value of water purification is real money in the sense of avoided real costs (e.g. to water company or drinks company) and can influence companies' profitability and hence national GDP, but is not (currently) directly visible in accounts nor is the focus of market transactions – apart from where the water purification service benefits is captured via a payment for ecosystem service scheme.
- Others are **welfare benefits**: e.g. health benefits, recreation benefits, identity and spiritual and cultural values. These are genuine benefits to people, but are not real in cash terms.

Historically, mainly the first of the above has been taken into account in decisions. Looking at all types of values can help redress this imbalance.

Source: ten Brink et al (2011)

Valuation of nature: lessons and needs

Economic valuation does not necessarily imply economic solutions such as market based- or fiscal instruments. Regulation and spatial planning are also fundamental ways of responding to the unsustainable use and management of ecosystems and biodiversity and to the values they provide. It is also useful to note is that one can have market based instruments without monetary valuation – an appreciation of the importance of nature, combined with designating incentives in light of political feasibility or negotiated solutions can be an equally plausible route.

The key issue affecting the choice of tool and coverage of the assessment relates to the problem that the analysis is designed to provide evidence for. In particular, critical factors to take into account in value assessments include the spatial dimension (interactions of ecosystem with social and economic systems – see Figure 4.1 and who are the beneficiaries at local, national and global level – see Figure 4.2). The time scale - the profile of benefits or costs over time – and how it is addressed (length of time coverage in the analysis and use of discount rate) is also critically important to ensure a complete evidence base and avoid short term biases. System complexity and ecological thresholds also affect the choice of tools – as they can limit the application of monetary valuation tools and essentially argue for risk assessment approaches. Finally, identifying who the stakeholders are that need to be covered by the assessment will be important for the analysis scope. This will be essential to identify the winners and losers of the decision. In some cases a focus on the local level will be sufficient, but more often a wider geographic scope will be needed. In some contexts, the assessment scope could usefully include third country stakeholders related to production of imported goods, and indeed sometimes a wide set of actors throughout the product value chain. Such considerations might support both better value assessments, but also subsequent engagement in solutions.

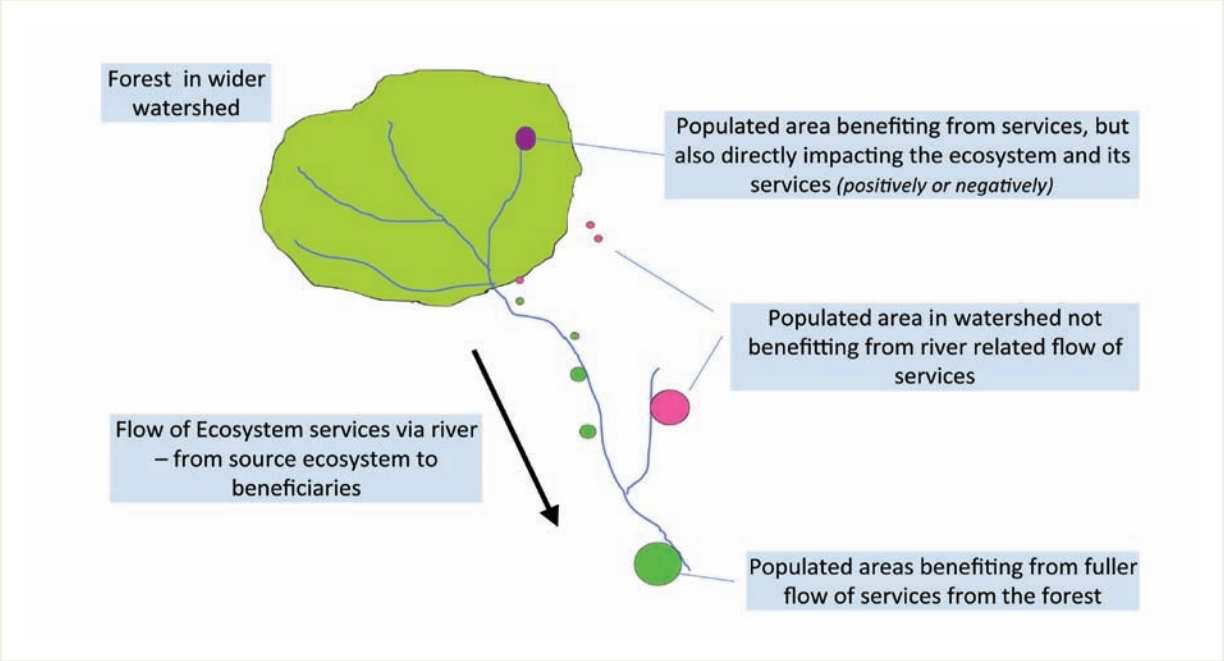


Figure 4.1: The Spatial Dimension – interaction of ecosystems with social systems
Sources: Adapted from Balmford et al (2008)

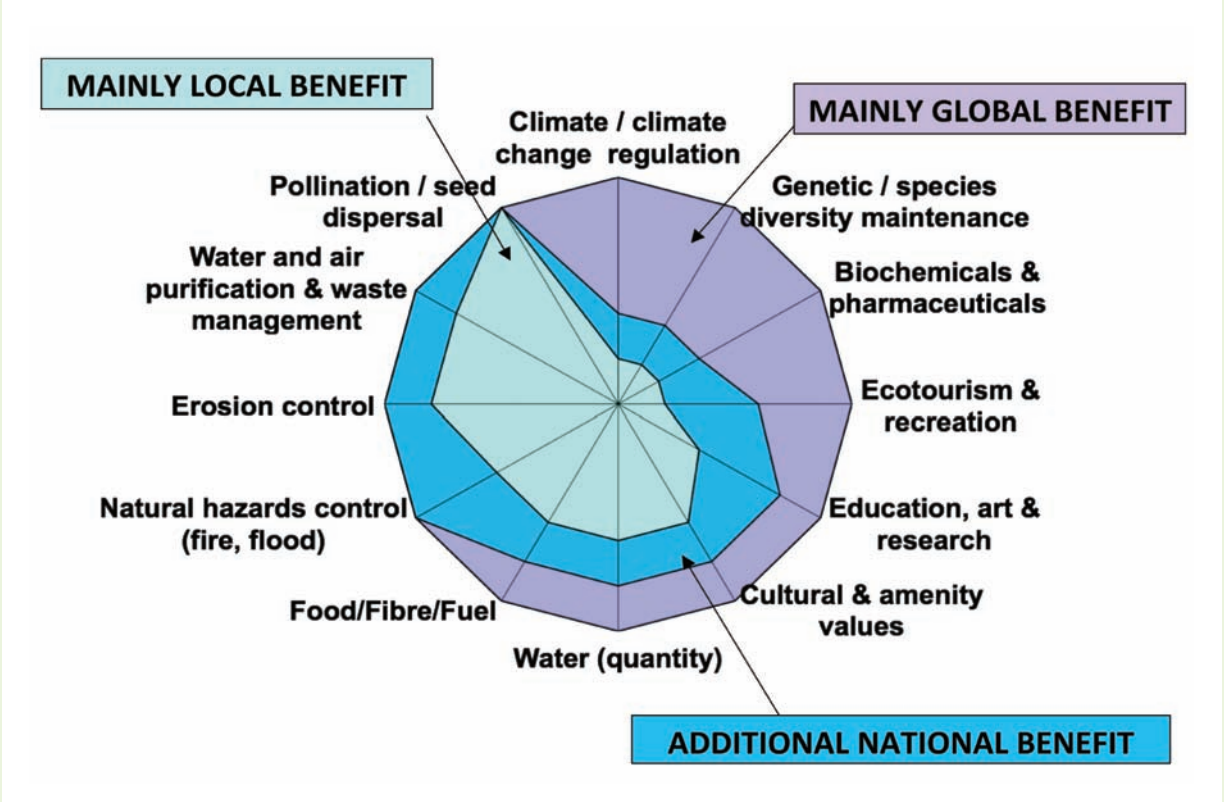


Figure 4.2: The spatial dimension – Illustration of the distribution of benefits
Note: in practice for a given site the level of ecosystem services will vary[9]; hence a more "starlike pattern" would emerge.
Sources: Own representation, Patrick ten Brink

Valuation, whether monetary, quantitative, or qualitative, is a tool to guide decisions, not a precondition for acting to conserve biodiversity. Decision-makers across all levels and sectors need to commit to systematic and timely analysis of proposed projects, programmes and policies through strategic environmental impact assessments. The aim should be to have a more complete evidence base available at the right time to make the right decision (TEEB, 2011a).The precautionary principle should be applied in decision-making affecting biodiversity and ecosystem services when impacts cannot be predicted with confidence and/or when there is uncertainty about the effectiveness of mitigation measures. Each country needs to develop and institutionalize a culture of analysis, consistent with recognized best practices. This can be done by developing capacity and having an accepted, functional and supported policy assessment system in place (TEEB, 2011a).

Proportionality and fit for purpose

Another key issue is that the level of precision in the appreciation or demonstration of value is context dependent – i.e. what is fit for purpose depends on what use will be made of a derived value. In certain circumstance the benefits of conservation and restoration will be an order of magnitude larger than the costs including value of loss of services from ecosystem conversion. In these cases there is no need for particular precision. If the conclusion is clear that conservation or restoration makes senses, then there is arguably little point (unless the objective is scientific understanding) of paying for a more expensive study to obtain a more precise answer.

Similarly, for most 'big policy questions' it generally matters less whether the benefits are four or five times the cost, the key question is whether the benefits are larger than the costs. However, for some decisions the answer may of course not be clear cut, and if that is the case, further analysis and data may be needed – both biophysical and monetary, to complement the initial analysis. The level of effort should be proportional to the need.

When it comes to non-compliance cases, there are merits in being more precise, but even in these cases, some valuation and some negotiation (i.e. legal and political bargaining) will be needed to obtain a settlement deemed fair and appropriate. Finally, when the aim is to investigate whether an instrument – e.g. payment for ecosystem services, such as the REDD+ scheme – offers true additionality (CO_2 savings) and at what level the payments would need to be to achieve the policy-objective, a greater level of precision is needed.

In sum, in any assessment of value it is useful to be clear as to what level of precision is needed for the question the assessment is aiming to illuminate. A robust order of magnitude may be sufficient, or fit for purpose in some cases; however in marginal cases more precision will be needed.

B. Investing in natural capital can save money

Saving money: spending less and/or avoiding costs

Many activities can be more efficiently provided by maintaining or restoring 'ecological infrastructure' than by artificial structures or processes (TEEB, 2011a). Water and beverage companies, communities and citizens benefit from clean water provision by ecosystems. A range of companies have found it useful to assess the costs that they would face were they need to invest in water filtration installations to ensure appropriate water quality. This allows them to assess whether it is cheaper to engage with local stakeholder in the watershed (farmers, foresters) and pay them for conservation or restoration (beyond legal compliance) to improve water quality and hence avoid the need and cost of treatment. Water authorities and utilities in New York, Ecuador, Bolivia, Costa Rica and Mexico have concluded that the cost savings from conservation or restoration merit action and stakeholder engagement and have instituted Payment for Ecosystem Service (PES) schemes to safeguard the provision of stable clean water, as have beverage companies in France, Belgium and Germany (see Box 4.2 below).

Investing in natural solutions can also offer cheaper and more effective ways to mitigate the impacts of natural disasters than technical or man-made analogue solutions. Ecosystems (especially forests and wetlands) can help reduce the likelihood and scale of extreme events – e.g. avalanches, storms, fire and floods – many times at a lower cost than that of man-made risk reduction measures (e.g. avalanches in Switzerland, Dudley et al, 2010; flooding in Belgium, TEEB 2011a). These benefits are site specific and depend on the interrelationships between extreme events, ecosystems, social systems (e.g. population density) and economic systems affected (economic assets such as buildings and infrastructures). Using ecosystem-based solutions has often proved to be significantly cost-efficient. For instance, natural flood protection

measures are increasingly being incorporated into land-planning strategies. However, it has to be noted that the exact functioning of the effect of ecosystems on natural hazards mitigation is still insufficiently understood and needs to be improved (e.g. TEEB, 2011a; MA, 2005).

Box 4.2: Value for money from natural capital

Natural solutions for water regulation, filtration and treatment
Forests and wetlands filter and clean much more cheaply than water treatment plants:

- New Zealand: The Central Otago conservation area (Te Papanui Catchment) saved the city of Dunedin NZ$93 million (approximately US$65 million) in water supply costs (BPL, 2006).
- Venezuela: The national protected area system prevents erosion, flooding and water supply fluctuation that would reduce farm earnings by around US$4 million/year (based on data provided in Gutman, 2002, updated by the authors to account for inflation and increase in land under irrigated agriculture).
- Catskill Mountains, US: US$2 billion natural capital solution (restoration and maintenance of watershed) versus a US$7 billion technological solution (pre-treatment plant).

Forest investments to reduce flooding
In China, following severe Yangtze River flooding in 1999, the government committed to invest over US$40 billion in the Sloping Land Conversion Programme by offering farmers along the river cash incentives to cede their land for forest conversion to decrease erosion and mitigate flood impacts (Bennett and Xu, 2007; Tallis et al, 2008).

Fish stock regeneration through protection of fish nurseries in mangroves
In Cambodia, the Ream National Park provides fish breeding grounds and other subsistence goods from mangroves worth an estimated US$600,000 per year and an additional US$300,000 in services such as storm protection and erosion control (Emerton et al, 2002).

Carbon capture and storage
Finding cost-effective means to mitigate climate change is essential, given the scale of the challenge. Proposed man-made solutions include allocating substantial funds to artificial carbon capture and storage (CCS) e.g. by pumping CO_2 into the ground. Natural ecosystems (forests, agricultural land, wetlands) already store vast quantities of carbon above ground and in water or soil and absorb additional amounts every year: deforestation or degradation can lead to very significant emissions (FAO, 2010). See also Mecklenburg-Vorpommern case in Box 4.3.

Source: TEEB (2011a)

Working with nature can also often offer cost-effective solutions to address different policy goals and challenges. As many ecosystems such as forests and peatlands play a crucial role in the earth's carbon cycle via the sequestration and storage of carbon, informed and well implemented management solutions can represent an efficient way to mitigate climate change via natural solutions. This includes restoration of degraded ecosystems to support their carbon uptake and avoiding degradation of carbon-rich ecosystems, both of which help reduce global CO_2 emissions at relatively low costs. In addition, ecosystems can help to buffer against the natural disasters which are projected to increase due to climate change (see Box 4.3).

Box 4.3: Ecosystem-based climate mitigation and adaptation: a lower cost solution?

Climate change is being accelerated by biodiversity loss and ecosystem degradation. Healthy ecosystems – for example, forests and bogs – contain substantial carbon reservoirs and are vital to regulating the global climate. While climate change poses an immense challenge today, the continued degradation of these ecosystems threatens to greatly increase greenhouse gas emissions and intensify the negative effects of climate change in the future. The sustained supply of certain ecosystem services – such as stream flow regulation in drought prone areas – will be critical in buffering human populations from the adverse impacts of climate change, which include coastal flooding, droughts and other hazards. Healthy and diverse natural ecosystems are expected to be more

resilient in the face of climate change than ones that have been degraded.

Restoration and sustainable management of carbon pools in natural ecosystems can make important contributions. Recognition of this role has, for example, led to GEF-funded projects in South East Asia and Europe that have been working to reduce carbon emissions from peatlands: peatland degradation has the potential to emit greenhouse gases, which – according to different estimates – could have a global warming potential that is equivalent to 13-30 percent of the global emissions from fossil fuel combustion (UNDP, 2010).

It is important to acknowledge that not all climate protection measures generate co-benefits to the same extent and that indeed some do actually result in harm to ecosystems and biodiversity, such as biofuel crop production, afforestation of biodiversity rich habitats or the establishing of forest plantations or monocultures. It is therefore preferable to make use of measures which have potential to deliver co-benefits, which is often the case of ecosystem-based adaptation and mitigation measures, which can at the same time contribute to biodiversity conservation and ecosystem service maintenance (Plesník, 2009). Existing cost effective solutions for climate mitigation and adaptation include:

- **Natural hazards management and ecosystem-based adaptation to climate change**: During typhoon Wukong in Vietnam in 2000, areas planted with mangroves were relatively unharmed while neighbouring provinces without mangroves suffered significant losses of life and property (Brown et al, 2006). Also, mangrove restoration by volunteers cost US$1.1 million, but saved US$7.3 million annual expenditure on dyke maintenance and benefited the livelihoods of an estimated 7500 families in terms of planting and protection (TEEB 2011a building on IFRC, 2002).

- **Climate change mitigation**: In Mecklenburg-Vorpommern, Germany, 30,000 hectares of peatland were restored over the period 2000 to 2008, leading to emission savings of up to 300,000 t CO2-equivalent at an avoidance cost of CO2 ~ 8 to 12 €/t CO2. If alternative land use options are realized (extensive grazing, reed production or alder forest growth) costs can decrease to 0 to 4 € / t CO2 (Forster, 2010). In the state of Sao Paulo (Brazil) natural forest will be restored on approximately 5,576 ha of land around four reservoirs created by hydroelectric plants. This is expected to sequester 0.67 Mt CO2e by 2012 and 1.66 Mt CO2e by 2017 along with increasing critical habitats and creating vital wildlife corridors, connecting the newly forested lands with existing conservation areas (World Bank, 2009).

Source: UNDP (2012), TEEB (2011a) building on Federal Environmental Agency (2007); MLUV MV (2009); Schäfer (2009), World Bank (2009)

Furthermore, investment in agricultural knowledge, science and technology (AKST) can also help the land provide multiple benefits – and particular the synergy of food provision and carbon storage (see Box 4.4).

Box 4.4: Services co-benefits – investment in science and innovation for agricultural production and carbon storage

The Quantitative Assessment (QA)[10], carried out for TEEB by a team led by the Scottish Agricultural College (and comprising IVM and Wageningen University) explored different policy options to combat the loss of biodiversity and ecosystem services, applied at a global scale. Against this backdrop of biodiversity loss, PBL (2010) carried out projections of the effects of global policy interventions. Nine global option scenarios were considered. Two of the ones that have the highest impact in terms of mitigating biodiversity loss are 'Increased agricultural productivity' and 'reduced deforestation'.

The 'increased agricultural productivity' option assumes that there are significant investments in agricultural knowledge, science and technology (AKST) in the developing world, which in turn means that less forestry land is encroached upon.

These bio-physical change projections translate into value changes (enhanced global ecosystem service provisioning). Even with a high 5% discount rate, the values from land use change (excluding carbon sequestration benefits) amount to around 960 billion USD (2007 baseline)

between 2000 and 2050. The biggest beneficiaries are in Central and South America, and in China.

The benefits of enhanced carbon sequestration and storage over the same period (2000 to 2050) using the 5% discount rate and the well-established POLES model for carbon amount to 3166 billion USD.

The QA also estimated the cost of such a policy intervention using published data, based on IFBRI studies. Using these estimates, the benefit-cost ratio is around 15.6 with the POLES carbon estimate, and is positive (3.6) without any carbon value being added.

What this result is telling us is that such investment in AKST is unequivocally beneficial. Apart from the obvious ethical reasons to support a reduction in hunger and food insecurity, there are sound economic benefits – evidence of higher learning outcomes in schools and thus productivity in later (adult) life for instance.

Payment for Ecosystem Services (PES) schemes may in some cases be a cost-effective option with win-win outcomes. PES is an environmental policy instrument that promotes the conservation of an ecosystem by remunerating the land owner of managers that provide ecosystem services (e.g. carbon sequestration in forests and wetlands). PES schemes can be developed at the global, national, regional, or local levels and can be funded by the ecosystem service users or by a public body or a NGO/foundation when the ecosystem service user is the society as a whole or a very broad category of stakeholders (see Box 4.5).

PES can cover, for example, payments for sustainable management of water resources and/or agricultural land, biodiversity conservation and the restoration of degraded ecosystems, and storage and/or sequestration of carbon in biomass (see TEEB, 2011a Chapter 5 for examples of PES practice).

Establishing a PES scheme can deliver environmental benefits which would otherwise be lost, secure livelihoods and in many cases support business and/or public interests. For instance, in France, water company Vittel pays farmers in the water catchment to adopt agricultural practices that contribute to better water quality. This arrangement creates both environmental and business benefits while at the same time ensures the livelihoods of the farmers involved. One of the water providers for the city of Paris has also followed suit, working with farmers in its reservoir areas to reduce pesticide use and converting to organic farming (Zakeossian, 2011).

Box 4.5: REDD+: A cost-effective approach to climate change mitigation

Global deforestation is a major source of carbon emissions, estimated to account for around 17 per cent of global GHG emissions (IPCC, 2007). Given that the major part of deforestation happens in developing countries, causing a significant loss of tropical forests where the majority of the world's species are found, it also represents a substantial contribution to the global loss of biodiversity. The proposals for the Reduced Emissions from Deforestation and Forest Degradation (REDD+) programme represent a potential cost-effective solution to the challenges of climate change and biodiversity loss. However, to deliver all the potential co-benefits, REDD+ needs to be well-designed, co-ordinated and implemented, with a strong governance framework in place.

REDD+ is essentially a PES scheme on a global scale which aims to establish a global payments scheme for carbon storage and sequestration in the forests of developing countries funded by the developed world. A well-designed REDD+ has major potential to deliver substantial biodiversity co-benefits, if the activities are targeted towards forest areas that have high carbon potential as well as high biodiversity benefits (TEEB, 2011a). Tools for such targeting are currently being developed and implemented – for instance, the Carbon and Biodiversity Demonstration Atlas (UNEP-WCMC, 2008) presents regional and national maps for six tropical countries that show where areas with high carbon coincide spatially with areas of biodiversity importance. Using and improving these tools can lead to effective and well-targeted funding for conservation which delivers many ecosystem co-benefits.

It has been estimated that REDD could lead to a halving of deforestation rates by 2030, cutting emissions by 1.5-2.7Gt CO_2/year, that it would require between US$17.2-33 billion/year and have an estimated long-term net benefit of US$3.7 trillion in present value terms (this accounts only for the benefits of reduced climate change) (Eliasch, 2008). Delaying action on REDD would reduce its benefits dramatically: waiting ten more years could reduce the net benefit of halving deforestation by US$500 billion (Hope and Castilla-Rubio, 2008).

Sources and related publications: Eliasch (2009); Hope and Castilla-Rubio (2008); Hussain and Markandya (2012); IPCC (2007); Kindermann et al (2008); Nepstad et al (2007); Olsen, N. and Bishop, J. (2009); Stern (2007); TEEB (2011a); UNDP (2012); UNEP-WCMC, 2008; and Wertz-Kanounnikoff (2008)

C. Investing in natural capital can enhance biodiversity and provide wider benefits

Investing in nature and ecosystems-based solutions (e.g. to climate adaptation and mitigation), can recover lost benefits and enhance existing ones, many of which go beyond the specific original objectives of the policy intervention. For example, minimising flood risk via ecosystems-based solutions can lead to a range of additional services to local populations such as recreation, non-timber forest products, as well as conserving biodiversity.

Multiple benefits from conservation and restoration

Protected areas cover 12.9 per cent of land surface and 6.3 per cent of territorial seas (IUCN and UNEP-WCMC, 2010). Evidence shows that they can play an integral role in sustainable, green economic development (see Box 4.6). It has been estimated that the global benefits of protection far outweigh the costs (Kettunen et al, 2011). However, benefits from protection are often broadly dispersed, long-term and non-marketable, while the costs of protection and the earning potential from non-protection choices are often short-term and concentrated. Therefore, policy actions are needed to address this unequal distribution of benefits and costs. This is vital to make protected areas a socially and economically attractive choice and to maximize their contribution to human well-being at all scales.

Box 4.6: The benefits of protected areas

Benefits to fisheries and agricultural sectors: A review of 112 studies in 80 marine protected areas (MPAs) found that fish populations, size and biomass all dramatically increased inside reserves, allowing spillover to nearby fishing grounds (Halpern, 2003). Various studies have reported fish catch increases in the vicinity of MPAs a few years after their establishment (Russ et al, 2003; Gell and Callum, 2003; McClanahan and Mangi, 2000). MPAs can also rebuild resilience in marine ecosystems and provide insurance against fish stock management failures (Pauly et al, 2002). In terms of agriculture, Venezuela's national PA system prevents sedimentation that would reduce farm earnings (based on Gutman, 2002).

Benefits to tourism sector: Over 40 percent of European travellers surveyed in 2000 included a visit to a national park (Eagles and Hillel, 2008). This creates an important source of local earnings and employment. In Scotland, the Cairngorms National Park receives around 1.4 million visitors a year, each spending on average GB£69 (US$100) per day on accommodation, food, transport and entertainment (Cairngorms National Park Authority, 2005). In Bolivia, tourism related to PAs and wider nature-based tourism is estimated to generate around 20,000 jobs, indirectly supporting close to 100,000 people (Pabon-Zamora et al, 2009).

Benefits to regional economic development: In Finland the total annual revenue linked to visitor spending in national parks and key recreation areas (total of 45 areas) has been estimated as 87 million EUR/year, generating 10 EUR return for every 1 EUR of public investment (Huhtala et al. 2010). In New Zealand, economic activity from conservation areas on the west coast of South Island created an extra 1814 jobs in 2004 (15 per cent of total jobs) and extra spending in the region of US$221 million/year (10 percent of total spend), mainly from tourism (Butcher Partners, 2005). In the coastal/marine Ostional Wildlife Refuge, Costa Rica the revenue from legally collected and sold turtle eggs from the reserve benefiting local villagers and broader businesses alike, was

estimated at US$1 million (Troëng and Drews, 2004).

An estimation of the economic value of the European network of protected areas, Natura 2000, suggested this to be in a range of 200-300bn EUR annually, based on and scaling up from existing site-based studies. Although the pool of studies was limited both in numbers and geographical distribution, the number illustrates the significant scale of the benefits provided by protected areas network in the EU (ten Brink et al, 2011).

Source: Kettunen et al. (2011) in TEEB (2011a) and sources therein.

While some PESs focus on single objectives (as noted above), others have been designed to meet multiple objectives simultaneously. The Costa Rican PSA programme pays landholders for providing carbon sequestration and hydrological services and conserving biodiversity and landscapes. The above mentioned Working for Water programme and also the Working for Wetlands programme in South Africa help with provisioning and regulating services while providing employment opportunities (see Box 4.7). In Ecuador the Programme Socio Bosque helps with deforestation, carbon storage and poverty alleviation (see TEEB 2011a). The Mexican PSAH similarly succeeds in delivering multiple benefits (see Box 4.7)

Box 4.7: Payment for hydrological services of forests in Mexico (PSAH)

Mexico's federal government created a voluntary PES scheme in 2003 with the aim of linking those benefiting from the forests' water-related environmental services with their providers in the watersheds and aquifers recharge areas of the country. This was a national scheme, benefitting from good hydrological, forest cover and social data on poverty distribution in the country. The scheme started in 2003 covering 127 thousand hectares and this has grown to 2.3 million hectares by 2010. Indigenous communities (*ejidos*) responsible for forestland as common property accounts for the majority of the area under the scheme and over 3,300 individuals and communities engaged by 2009 with a total payment committed of $US303million.

Results – By comparing statistically equivalent forests between 2000 and 2007, the PSAH reduced the rate of deforestation from 1.6 per cent to 0.6 per cent. This was achieved even under conditions in which signed forests had a lower than average risk of deforestation and where PSAH had contracts with an average of two years under operation. This translates into 18,300 hectares of avoided deforestation with three more years of contract to go. Expressed in avoided greenhouse gas (GHG) emissions this equates to 3.2 million tonnes CO_2eq. An improved targeting mechanism could increase the effect on reduced deforestation, reduced emissions and greater protection of watersheds and aquifers of the programme, giving fee-payers more environmental value for their money (Muñoz et al, 2010). As regards poverty alleviation, most of the payments (78% in first three years of operation) went to forests owned by people living in areas with high or very high marginalization and within this around a third (in 2004) under the extreme poverty line.

Key insights include:
- There were three times as many applications as funds;
- The choice of objectives and prioritization significantly affects the focus and allocation of funds: this is directly reflected in the final outcomes;
- GIS, hydrological and census data were valuable elements in setting up the programme as they helped identify areas of deforestation, aquifer over-exploitation and poverty.

Source: Muñoz-Piña et al (2008); Muñoz et al (2010)

Green infrastructure and economic co-benefits
Investing in nature provides cost-effective solutions beyond protected areas. For example, natural water retention measures within wider green infrastructure have not only proved more cost-effective than engineered solutions in the long run, they also offer a range of co-benefits – e.g. carbon storage in soils, landscape value, recreation, and biodiversity (see Box 4.8 below). Examples include:

- A range of international projects and investments in mangrove restoration to strengthen natural coastal barriers to increase security against waves were launched after the 2004 tsunami in South-east Asia. These include the EU-Asia Pro-Eco II B Post Tsunami Project or Mangrove Action Project (EC, 2009). Where restoration is effective, it leads not only to addressing specific objectives of security, but also supports marine nurseries, fisheries take and biodiversity.
- The restoration of the Skjern River in Denmark-creating outflows from the river to the fjord in order to form a delta of ca. 220 hectares, creating a lake of ca. 160 hectares, and permitting periodic floods on land within the project area, requiring the conversion of 1550 hectares of arable land to extensive grazing – led to cost savings (land allocation, pumping costs, floods, as well as improved outdoor recreation, improved hunting, improved fishing, non-use value of biodiversity protection etc.). Nutrient and metal reduction and reed harvesting. The 'bottom line' results suggested NPVs of 228 million DKK ($36 million) at 3 per cent discounting, falling to 67 million ($8 million) at 5 per cent and break even at 7 per cent. This sensitivity to the discount rate is typical for projects with front-loaded costs and long-term benefits (Dubgaard, 2004 in TEEB, 2011a).

Box 4.8: Natural water retention measures – example of flood control in Belgium

Major infrastructural works were planned in the Scheldt estuary, flowing from Belgium into The Netherlands, including the deepening of the fairway to the harbour of Antwerp and complementary measures to protect the land from storm floods coming from the North Sea.

A cost–benefit analysis was carried out, looking at different ways of achieving the same flood risk control taking into account ecosystem services, including the recreational value of new floodplains. It shows that an intelligent combination of dikes and floodplains can offer more benefits at lower cost than more drastic measures such as a storm surge barrier near Antwerp. The hydrodynamic modelling also shows that floodplains are the best way to reduce future flooding risks.

The initial results showed that the benefits of floodplains were highest and that floodplains with reduced tidal areas (RTA) were more attractive than floodplains with controlled inundation area (CIA). Based on these results, the Dutch and Flemish governments approved an integrated management plan consisting of the restoration of approximately 2500ha of intertidal and 3000ha of non-tidal areas, the reinforcements of dikes and dredging to improve the fairway to Antwerp.

The payback with the storm surge barrier was 41 years, 14-17 years (two options) for 1800ha of flood plains, and 14 years for a variant consisting of 1325ha flood plains and 24km of dykes.

Source: De Nocker et al (2004), Meire et al (2005), Broekx et al (2010) in TEEB (2011a)

There is a strong case for quantifying and valuing the benefits provided by ecosystems and biodiversity in both physical and monetary terms more systematically than we do now. Even where this happens, there will still be questions about the impact on different groups and the distribution of benefits. This reminds us that policy assessment serves to inform decision makers and help them weigh up the pros and cons of different options, but not to make the decision (TEEB, 2011a).

5. GREEN ECONOMY TRANSITIONS

A. Challenges associated with natural capital loss and responses

Throughout most of history there has been a growing demand for natural resources driven by continuous population growth and increasing individual consumption which has resulted in large-scale land conversion (e.g. deforestation, cultivation and urbanisation) and a major loss of world's biodiversity (MA, 2005). This loss is estimated to be at a rate 100 to 1000 times greater than in pre-human times and continues to accelerate (May et al, 1995; MA, 2005). In turn, the loss of biodiversity has an adverse effect on ecosystems and the services they provide to people. As of 2005, 60 per cent of the world's major ecosystem goods and services that underpin livelihoods were degraded or used unsustainably (MA, 2005).

For instance, a recent study has shown that 40 per cent of the world's oceans are severely affected by human activities (WWF, 2008). Moreover, unsustainable fishing practices severely affects the ability of oceans to provide a source of food for human and are thought to be a cause of major inefficiencies – global fisheries are estimated to underperform by $50 billion annually (World Bank and FAO, 2009). Humans have converted about a quarter of the Earth's potential net primary production[11], either through direct cropping (53%), land-use-induced productivity changes (40 %) or human-induced fires (7 %) (EEA, 2010).

As already noted in the introduction to this paper, the global economy is expected to grow significantly, possibly tripling by 2050 (OECD, 2012), driven by factors including the increase of the world population to 9 billion by 2050 and a further increase in life expectancy. While economic growth undoubtedly will lead to benefits to middle classes and the poor there are also significant risks associated with these trends. Moreover with newly emerging economies expected to adopt the unsustainable consumption patterns of the developed world, this is projected to lead to an explosion in the consumption of energy from non-renewable carbon intensive energy sources (OECD, 2012), further fuelling climate change.

The overall rising level of consumption and production will put increasing stress on the planet's resources and ecosystems, accelerating the historic trends of pollution and the depletion of natural capital. As many ecosystems and landscapes continue to be used unsustainably and our natural capital stocks and flows are further reduced, societal challenges associated with the loss of benefits from nature will increase, particularly in relation to food and water (see Annex 2). It is evident that humanity is consuming more than the regenerative capacity of the planet can supply, and that there is a need for fundamental change in the level of response if major collapses are to be avoided (Club of Rome, 2012).

Natural systems also have 'tipping points' beyond which rapid and damaging changes can become irreversible (OECD, 2012). The 2°C global temperature warming limit is such a threshold, which has been integrated successfully into political discussions, though not yet fully into practical commitments. Future growth may be compromised if critical thresholds of degradation are reached, undermining economically important or vital ecosystem services (UNEP, 2011a). However, these thresholds are not fully understood, nor are the environmental, social and economic consequences of crossing them. While more data is being collected to inform decision-making, a precautionary principle approach should be adopted to avoid irreversible changes and major losses. In the meantime, we need data and indicators to measure these 'tipping points' or 'critical thresholds' and associated critical trends (ten Brink et al 2008).

Commitments to respond to the challenges

Global frameworks for action like the new Strategic Plan for Biodiversity 2011-2020 may contribute to addressing the current challenges and help to avoid future crises. Many of these frameworks already recognize the key economic role of biodiversity and ecosystem services and urgently need effective implementation at national level.

Multilateral and bilateral agencies, foundations and non-governmental organizations all have a role to play in this process, such as through capacity building in developing countries. The UNCCD's ten year strategic plan (10YSP) and framework to enhance the implementation of the Convention (2008 to 2018), which, inter alia, aims at *Enabling dryland communities to sustain their ecosystem services and make a contribution to global public goods*, offers common ground for achieving these objectives. The UNFCCC provides critically important mechanisms for biodiversity conservation and ecosystem restoration in forest areas through the REDD+ instrument and investments in ecosystem-based mitigation and adaptation (TEEB, 2011a).

Closer cooperation is required between international and regional environmental treaties, organizations and processes to maximize biodiversity synergies – including opportunities under the UN 'sister' conventions UNCBD, UNCCD and UNFCCC and of course due to operational links with other conventions (e.g. Ramsar) and protocols. Investment in natural capital contributes to all three Rio conventions as well as to the Rio+20 objectives and commitments and can be a key vehicle for achieving useful synergies.

The new Strategic Plan for Biodiversity 2011-2020 adopted at the tenth meeting of the parties in October 2010 (Nagoya, Japan), is a globally agreed upon framework for national implementation. The plan sets out five strategic goals and 20 headline targets for 2020 to guide national strategies (e.g. national biodiversity strategies and action plans, NBSAPs) and other efforts to preserve biodiversity and restore degraded ecosystems have a potential to significantly assist in the transition to a green economy.

The key outcome of the UN Conference on Sustainable Development (UNCSD / Rio+20) was the adoption of a global political agreement by the Heads of State and Government and high level representatives to renew their commitments to sustainable development and poverty eradication, and to ensure the promotion of economically, socially and environmentally sustainable future for both current and future generations (UNCSD 2012). Countries agreed to consider green economy as one of the important tools available for achieving sustainable development and eradicating poverty. Furthermore, as regards nature and the green economy, ensuring the healthy functioning of the Earth's ecosystems (e.g. removing unsustainable patterns of production and consumption that undermine biodiversity conservation) is mentioned as one of the purposes for green economy.

B. Fundamental building blocks in the transition to a green economy

It is not enough to know, one should also use; it is not enough to want, one should also act
Johann Wolfgang von Goethe, 1749-1832

We are living in a world of declining sustainability, with most economies being largely "brown". The aim of the transition to a green economy is to achieve a resource efficient, low-carbon, equitable, economy that stays within a 'safe operating space' – of working within the planet's regenerative capacities and avoiding critical ecological thresholds. This approach must include the aim of no net loss of biodiversity (indeed net gain should be strived for), while at the same time ensuring that climate change stays within 'acceptable' limits. Furthermore, actions today need to ensure that future generations have sufficient access to resources and to a clean and healthy environment, which is underpinned by productive and resilient ecosystems.

Many efforts have been made for decades to avoid environmental damage and restore degraded ecosystems. A wealth of experience has been gained across countries on policies, approaches and measures. Measures taken are a mix of traditional, "business as usual" approaches of minimising losses and investing in environmental infrastructure, plus more active ecosystem management that includes restoration and builds on appreciation of risks and on benefits of working with natural capital, as well as those focused on resource efficiency and decoupling the economy from impacts on environment.

The six approaches, identified in the Figure 5.1 below are fundamental building blocks of a transition to a green economy. These can be categorised as follows: (a) *Minimising losses and avoiding inappropriate trade-offs* (b) *Investing in environmental infrastructure*; (c) *Active management of environmental risks* (d) *Proactive investment in natural capital*; (e) *Eco-efficiency for relative decoupling* and (f) *Absolute decoupling of the economy from resource use and its negative impacts.* Good governance is critical to the transition to the green economy and an integral part of these six approaches. Components of good governance *inter alia* include: institutions and their roles; processes and participation; transparency and disclosure; and monitoring and enforcement.

While different countries may opt for different transition paths it is likely that adopting a wide range of measures will be an integral part of successful transitions. The mix and emphasis of measures may differ from one country to another, given national circumstances and windows of opportunities for progress. There will inevitably be some tools that help implement a range of different approaches in practice, and hence there will be some overlap between building blocks. There are of course other ways of categorising areas for progress. The approaches and building blocks discussed below should therefore be seen in this context.

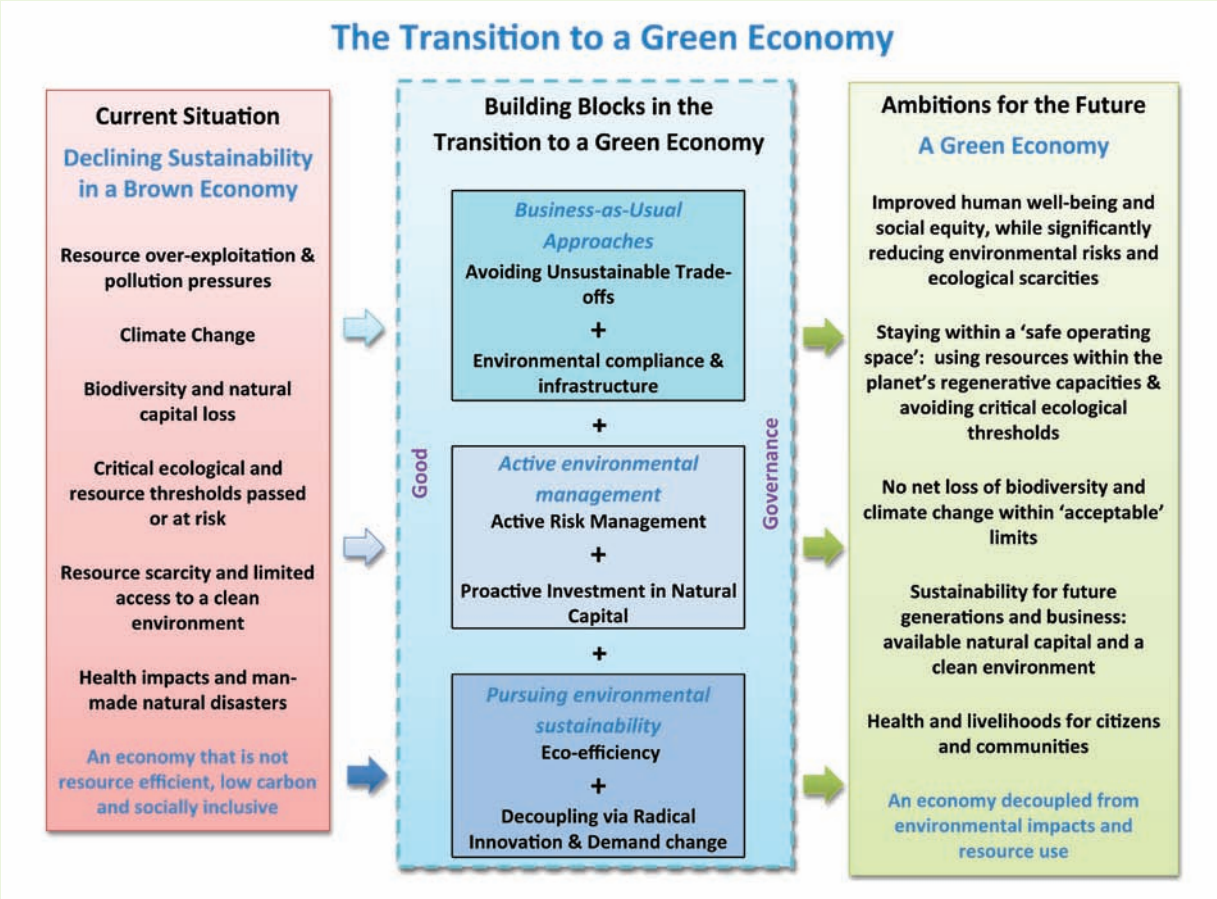


Figure 5.1: Key approaches and instruments to enable the transition to a Green Economy
Sources: ten Brink & Mazza, own representation

Avoiding unsustainable trade-offs

Unsustainable trade-offs have been created through the misallocation of capital (e.g. investment decisions), economic development and growth strategies and policies encouraging the accumulation of physical, financial and human capital, while at the same time also driving the degradation and depletion of natural capital. Trade-offs ensue where one gains and another loses – across capitals, across peoples, and across time. In practice, policies and use of funds lead to a range of trade-offs sometimes intentionally (i.e. choosing priorities), and sometimes because of lack of awareness of the existence, scale and implications of decisions on economic, environmental or social aspects. Avoiding inappropriate trade-offs is a key building block of any strategy to a green economy. Policies and measures to help avoid unsustainable trade-offs or minimise the level of the trade-offs have arguably been a "traditional" approach to addressing the environmental challenges, even if not always fully or successfully.

There is a need to redefine objectives and better identify the benefits and negative impacts of different policy/investment decisions. Instruments and measures include the more effective use of tools like Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), and Impact Assessment (IA). Greening built ("grey") infrastructure, ideally upfront rather that after the infrastructures are in place, is also a key part of the solution. The approach of using whole life costing (WLC) can also be a helpful "modern" way of integrating the long-term implications into present decisions and avoiding trade-offs.

Similarly, assessing the wider values of ecosystems and the benefits and losses from decisions across different stakeholders, income groups, location, time and pillars of sustainable development is key to ensuring to understanding and avoiding inappropriate trade-offs. Ecosystem damage carries costs for business and society. Current decision-making is biased towards short-term economic

benefits because the long-term value of ecosystem services is poorly understood and rarely accounted for. It is also biased towards local or national decisions or private benefits. Recognizing the value (or loss) of ecosystem services more widely, of public goods and losses of public goods, and impacts on other countries (e.g. through the product supply chain and trade) can create a fuller and transparent evidence base of trade-offs in decisions. This can lead to better, more cost-efficient decisions and avoid inappropriate trade-offs. It is also an important step towards refocusing economic and financial incentives to achieve sustainability goals.

One key tool for progress is the reform of environmentally harmful subsidies (EHS) as EHS are fundamentally about trade-offs and reforming environmental harmful subsidies is about aiming to avoid unsustainable trade-offs. The last decade has seen increased efforts to phase out or reform inefficient and environmentally harmful subsidies (EHS) in some countries and the calls for further action have multiplied since the 2008 global financial crisis, particularly due to need for decreased public expenditure in a range of developed countries. Subsidies can have negative environmental, social and economic effects nationally and internationally. For instance, subsidised water can lead to a fall in ground water levels which can reduce water access to other social groups such as small scale farmers, increasing their cost of water provision or affecting their output. Fisheries and agricultural subsidies can affect trade and production in third countries with associated land and resource use impacts (Lehman et al 2011). Given the importance of subsidy reform for the transition to the green economy, details on commitments to reform and a tool to facilitate reform are presented in the box below.

Box 5.1: Reforming Environmentally Harmful Subsidies

Commitments to reform

Global commitments to reform environmental harmful subsidies include the 2010 commitment to reform incentives harmful to biodiversity (**CBD Strategic Plan 2011-2020 Target 3**). Decision X/44 on Incentive Measures for Biodiversity of the Convention on Biological Diversity (CBD, 2010) acknowledges that, inter alia, *'(...) perverse incentives harmful for biodiversity are frequently not cost-efficient and/or not effective in meeting social objectives while in some cases use scarce public funds'. It therefore stresses the importance of identifying, eliminating, phasing out, or reforming existing harmful incentives for sectors that can potentially affect biodiversity, with a view to minimizing or avoiding their negative impacts*.

At a **G20** meeting in September 2009, leaders committed to *"rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption"* and called on all countries to "*adopt policies that will phase out such subsidies worldwide*" (Pittsburgh summit declaration, 2009).

At the **Rio+20** Conference, this pledge was reiterated and there were calls inviting other countries to join the commitment: *"225. Countries reaffirm the commitments they have made to phase out harmful and inefficient fossil fuel subsidies that encourage wasteful consumption and undermine sustainable development. We invite others to consider rationalizing inefficient fossil fuel subsidies by removing market distortions, including restructuring taxation and phasing out harmful subsidies, where they exist, to reflect their environmental impacts, with such policies taking fully into account the specific needs and conditions of developing countries, with the aim of minimizing the possible adverse impacts on their development and in a manner that protects the poor and the affected communities"* (The Future We Want, Rio+20).

The Rio+20 Conference also reiterated commitments on fisheries subsidies. "173. *We reaffirm our Johannesburg Plan of Implementation commitment to eliminate subsidies that contribute to illegal, unreported, and unregulated fishing and overcapacity taking into account the importance of this sector to developing countries…"* (The Future We Want, Rio+20).

The range of countries making progress on subsidy reform is constantly increasing. This is supported by recent efforts by governments to understand the impacts of subsidies, the potential to save money and identifying measures that better meet domestic and internal objectives. One example of progress at a national level can be seen in **France** where the Loi Grenelle I *(art. 48 et 26*) explicitly provides that *"the State, on the basis of on an audit, will review tax measures that are harmful to biodiversity and will propose new tools to allow a gradual transition to a tax regime that will better suit to new environmental challenges."*

A tool to identify subsidies

The fundamental link between nature and the green economy and the potential for multiple benefits from reform of environmentally harmful subsidies indicate the importance of subsidy reform. There are multiple benefits of reform including environmental, economic (budgetary consolidations, as well as and innovation via addressing technological lock-in), and social (improving targeting) benefits. Figure 5.1 presents a checklist of questions to develop an inventory and clear next steps for eliminating/redefining incentives currently harmful for biodiversity. A key issue for most countries is one of political priority – as getting ministers' attention for subsidy reform has to compete with many other priorities, so the question of windows of opportunity may in reality be the first question for many countries.

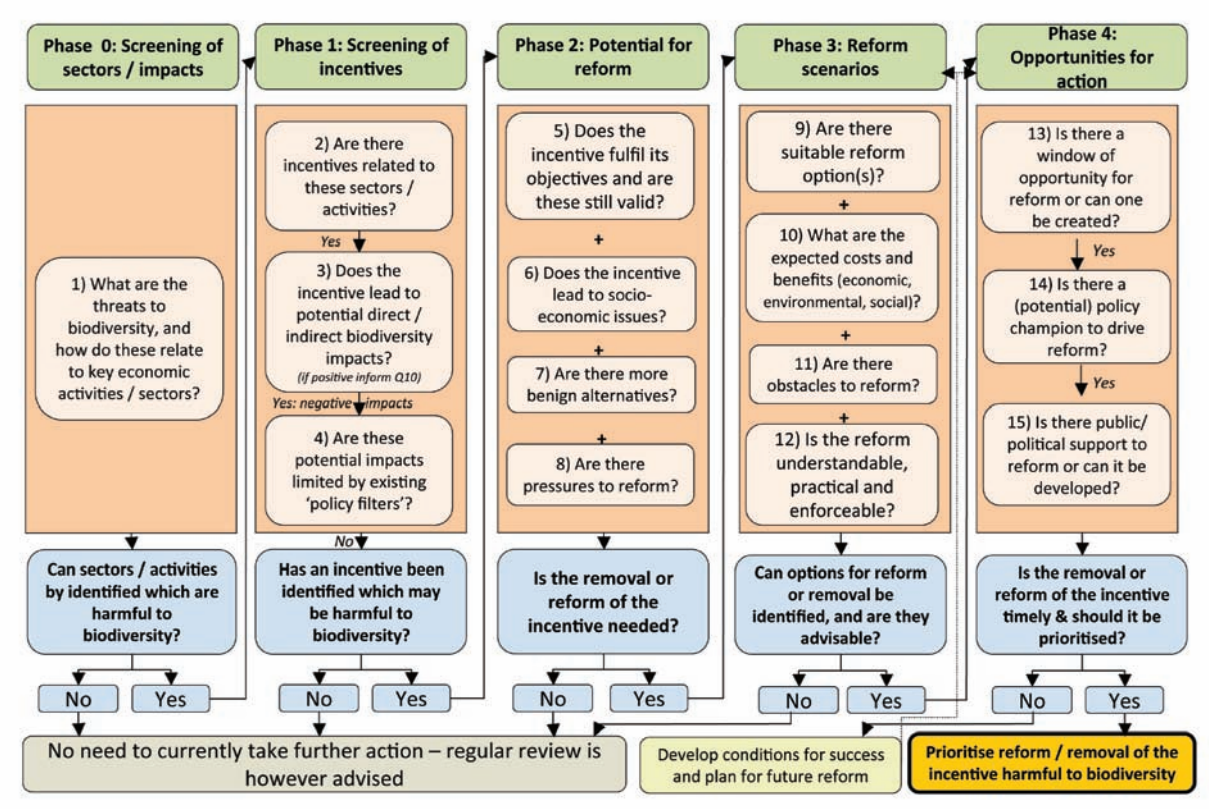


Figure 5.1: Flowchart – the subsidy reform tool

Source: ten Brink et al. (2012), building on Valsecchi et al. (2009) and Lehmann et al. (2011)

Environmental compliance and environmental infrastructures

A second "traditional" approach to addressing environmental issues and also critical for the transition to a green economy is that of investment in environmental infrastructures to comply with environmental legislation. The implementation of public infrastructure-related legislation (e.g. on water quality, wastewater treatment, waste) requiring significant economic investment; setting of environmental "thresholds" such as through emissions, and environmental quality standards are all measures that are an integral part of this building block. Particular instruments and measures in this area that help encourage the transformation to a green economy include greening investment (both public and private); conditionality in financing; the optimal use of fiscal tools (such as levies/charges) to achieve full cost recovery and to implement the polluter pays principle; and the promotion of better governance and as a minimum ensuring respect for the rule of law, in particular through inspection and enforcement activities.

The focus on investment in man-made environmental infrastructures (water supply, waste water treatment, waste management) has been, and will continue to be, critical for most countries for reducing pressures on nature, for health benefits and quality of life. At the same time this is a major

provider of jobs and local economic development, and is a core part of green economy strategies in many countries.

Box 5.2 below illustrates the wide number of benefits that make the development of environmental infrastructures worthwhile.

Box 5.2: Overview of key benefits of improved sewage and waste water treatment infrastructure

The investment in sewage collection and waste water treatment infrastructures leads to a range of important environmental, health and social and economic benefits:

Health and social benefits: The existence of sewage collection network and waste water treatment plants can significantly reduce the risks of health problems such as diarrheal diseases, dysentery etc. There are also social benefits through reduced odour, improved water quality for swimming and other leisure as well as use in domestic activities.

Environmental benefits: The increased and improved treatment of wastewater is meant to lead to a reduction in nutrient discharges and, therefore, a reduction in eutrophication in aquatic ecosystems, with due improvements to the ecosystems and associated recovery of fish and other aquatic life.

Economic benefits: Many drinking water sources are derived from rivers, which receive wastewater discharges. Therefore a reduction in contaminants in the abstracted waters can bring direct financial benefits in terms of reduced costs of treatment for potable water. With improved water treatment, surface water should be more suitable for economic uses such as cooling water and industrial water, and for fisheries and agriculture. This will bring significant direct cost reductions to water intensive industries in particular.

These benefits can indeed be achieved very quickly once such infrastructure is in operation. The City of Turku (Finland) for example put in use its new waste water treatment plant in 2009 and managed to reduce its phosphorus emission by over 60 per cent in only two years, considerably improving water quality in the surrounding areas and reducing the eutrophication risk along a stretch of the coastline.

Setting, implementing and enforcing environmental standards for waste water treatment and surface water quality can be a fundamental driver the transition to a green economy.

Source: ten Brink et al., 2011a; www.solutions 2011.fi/index.php/keke:praxis_12

These "**traditional, business-as-usual approaches**" are increasingly being complemented by two areas of **active environmental management**: ***active risk management*** to address environmental risks, and ***proactive investment in natural capital***. These are elaborated further below.

Active risk management

There has recently been a new focus in many countries on risk management that is based on a more comprehensive assessment, understanding of, and response to risk. Expectations of increased risks of climate impacts (flooding, drought, storms, landslides, sea-level rise) make the need for risk approaches ever more urgent. Similarly, increased levels of travel and trade can increase risks of invasive alien species resulting in potential impacts on key sectors of the economy, environment and human health, again requiring more risk-based approaches. Mapping, risk assessments, coordination, communication, information and cooperation between nations is critical.

To minimise risk, a precautionary approach is best applied in anticipation of an increasingly resource-constrained situation. Preventive measures that help us to better understand and to manage risks are needed. Spatial planning and risk mapping exercises, for example in relation to sea level rise and climate change, can help to avoid future damage, or exacerbation of climate change impacts, as well as help in mitigation measures. Further development and better application of the precautionary principle and polluter pays principle also support preventive measures.

Instruments and measures include the development of indicators, for example on resource limits and ecological thresholds (Rockström et al., 2009; Bio IS et al., 2012); restoration potential (WRI Forest Restoration Map) and climate change/risk maps (for example relating to potential floods, sea level rise, and water stress/desertification); the use of natural capital and environmental economic accounts at a national level and appropriate business accounting

practices relating to risks to inputs (resources, ecosystem services) and risks via eventual liabilities (carbon pricing, damage settlements); and linking risk and environmental management systems (such as the international standard ISO14001). Some of these are short term active risk management approaches that can be implemented locally and quickly (e.g. risk maps), while others require more long term coordinated effort. For example, the economy needs to deliver the progressive reduction of environmental risks to acceptable levels at the avoidance of reaching ecological scarcities and thresholds as well as resource scarcities and associated risks of price volatility. Many countries have already recognised this need and have committed to strengthening indicators and accounting systems for natural capital hence their inclusion in the Aichi Biodiversity Target 2 (see Box 5.3).

Box 5.3: Natural Capital accounts, SEEA and WAVES

More detailed accounts are needed to better manage our economies. Development is a process of building wealth and managing a portfolio of capital(s). The use of conventional economic indicators, such as GDP and other macroeconomic aggregates, can lead to a distorted picture of economic performance, particularly since such measures do not reflect the extent to which production and consumption activities may be drawing down natural capital. By either depleting natural resources, or degrading the ability of ecosystems to deliver economic benefits, in terms of provisioning, regulating or cultural services, economic activity may be based on the depreciation of natural capital (UNEP, 2011a).

Changes in stocks can be evaluated in both physical and monetary terms and incorporated into the national accounts, as being pursued in the on-going development of the System of Environmental and Economic Accounting (SEEA) by the UN Statistical Division, and the adjusted net national savings methods of the World Bank.

In March 2012, the UN Statistics Division adopted a revised version of the SEEA Central Framework (also referred to as Vol. 1), which covers natural resources. Vol.2 on experimental ecosystem accounts provides a second perspective on environmental assets and considers both the material and non-material benefits obtained from ecosystems. Vol.2 is expected to be completed before February 2013. This work is led by the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA), and has been informed by the London Group on Environmental Accounting[12], the contributions at the regularly held international Experts Meetings on Environmental Accounts[13], and also the work on Ecosystem Capital Accounts (ECA) by the European Environment Agency (EEA 2011).

The World Bank's *Global Partnership for Ecosystem Valuation and Wealth Accounting* (WAVES)[14] calls for countries to implement the SEEA where there are already agreed methodologies and join in developing methodologies for including natural capital which currently cannot be included – ecosystem services, which are also part of the SEEA. This then lays the basis for producing indicators for monitoring performance at the national level and for sector specific analysis leading to a more optimised use of natural assets. The wider use of such complementary measures, including net domestic product and genuine savings (one of the macro-economic indicators that can be produced using information under the SEEA), would provide a more accurate and realistic indication of the level of economic output and total inclusive wealth, including stocks of physical, human and natural capital (UNEP, 2011a). Countries engaged in the partnership include: Australia, Canada, Japan, Norway, France, the UK, Botswana, Colombia, Costa Rica, Madagascar, Philippines.

The partnership and commitments to accounts has received a positive boost from the Rio+20 commitments. The recent Gaborone Declaration by 10 African Nations (Gaborone Declaration 2012) also called for support for green accounting and created momentum for the accounts related commitments at Rio+20.

At the Rio+20 Conference in June 2012, fifty-seven countries and the European Commission supported a communiqué that called on governments, the UN system, international financial institutions and other international organizations to strengthen the implementation of natural capital accounting around the world and factor the value of natural assets like clean air, clean water, forests and other ecosystems into countries systems of national

accounting. 86 private companies also joined forces behind the move and committed to collaborate globally to integrate natural capital considerations into their decision-making processes. In addition, governments have recognized the need for broader measures of progress to complement GDP in order to better inform policy decisions, and have requested the UN Statistical Commission to launch a programme of work in this area (UNCSD, 2012).

Governments, private companies and international organizations including the World Bank Group have identified the need for coordinated action to:

- develop institutional arrangements to strengthen the implementation of natural capital accounting;
- develop science-based methodologies for natural capital accounting as a complement to GDP and corporate performance measurements; and
- pilot and demonstrate the economic, social and environmental aspects of scaled up and integrated approaches to natural capital accounting.

In the European Union, a Regulation on National Environmental Economic Accounts has been adopted which requires the 27 member countries to regularly report on environmental taxes, various resources, and emissions to air, land and water. Such harmonised reporting methods will ensure a clearer picture of the interlinkages between the economy and the environment, giving a clearer indication of the flow of resources through the Member States' economies and the share of environmental taxes in overall taxation. With the regulation, there is a window of opportunity every three years to expand the scope of the areas covered by national accounts, which could build on, inter alia, progress with the SEEA, WAVES, ECA and national efforts on a range of other accounting initiatives.

Proactive investment in natural capital

Investment in natural capital is growing in importance, as underlined in Chapter 4. Conservation and restoration actions are critical to ensure resilient ecosystems maintain biodiversity, maintain or improve ecosystem functions and increase service flows (see Box 5.4 below for the CBD commitments). This is in a category of its own given the recent growth in interest and the importance of seeing natural solutions as at least equivalents to man-made solutions (e.g. MA 2005, TEEB 2010, 2011a, 2012a,b).

Such investments include the protection/ management and restoration of wetlands for carbon storage; forests for aquifer recharge and water provision for cities; flood plains for flood control, etc. For such investments to be successful, decision-makers will need instruments and measures such as the clarification of the values of natural capital (which can be in quantitative terms, such as flow of ecosystem services, and in monetary terms); investment in natural capital (including protected areas and wider green infrastructure); and incentives, for example through payments for ecosystem services or recognition of benefits through spatial planning and regulation. The level of value tends to be very location specific both due to the scale, quality, and diversity of the biodiversity on the site, its functions and links to people and the economy.

Box 5.4: Investment in conservation, restoration and green infrastructure

While their prime focus of Protected Areas (PAs) is on the conservation of biodiversity, unique and endangered ecosystems, species, gene pools and habitats, they help avoid loss of value to society and the economy by avoiding degradation. Protected areas can also "capture new values" – e.g. by management and restoration leading to improved carbon storage, resilience to climate change, and water supply As of 2010, protected areas already covered 12.9 per cent of the Earth's land surface, while marine protected areas only covered 6.3 per cent of territorial seas and less than 1% of the high seas (IUCN and UNEP-WCMC, 2010[15]). The CBD target presents the needs for PAs – further designation (especially in marine) and at least as importantly, the management, which will require additional funding from today's levels:

CBD Strategic Plan 2011-20: Target 11: By 2020, at least 17 per cent of terrestrial and inland water and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically

representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

There is also a wider restoration target (Target 15 in the Box 4.15 above) and objective which covers areas beyond protected areas and includes wider green infrastructure:

CBD Strategic Plan 2011-20 Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Costs of restoration vary enormously between sites and area. Some ecosystems can be restored relatively cost-effectively, such as grasslands, rangelands and forests, while others often require substantial investments (e.g. coral reefs). While in many cases the benefits of restoration will outweigh the costs, it is also clear that it is best to avoid the degradation of ecosystems and the need for restoration. This can be done by developing appropriate regulation and fully implementing the polluter pays principle. This is particularly important since restoration, while in most cases worthwhile, often represents a real funding challenge.

Source: TEEB, 2011a

Eco-efficiency

Some countries and regions of the world have identified eco-efficiency as a win-win opportunity for addressing economic and environmental challenges. Many activities have focused particularly on energy efficiency, to contribute towards achievement of Kyoto Protocol targets. Fewer have developed detail on resource-related eco-efficiency, and there is great potential to marry efforts to protect natural capital while developing social and economic capital. There are many tools to support eco-efficiency, including political objectives and targets, market prices, reform of environmentally harmful subsidies, product standards and related certification systems and labelling, green public and private procurement, and innovation. These cannot all be covered here (see TEEB 2011a). Box 5.5 below focuses on aligning incentives and getting the prices right.

Box 5.5: Aligning incentives and market solutions

Market failure occurs when economic signals do not fully reflect the values of nature. Furthermore, subsidies on resources, whether on products such as energy, water, materials or activities such as fishing, forestry, or agriculture, can encourage inefficient use of resources, leading to sub-optimal investment decision or practices inappropriate for the resource and ecosystem base – another market failure. While changing economic signals and incentives can be part of the solution, good governance, regulation and planning will remain the foundation. Needs in this regard therefore include:

- **Adjust incentives in line with environmental impacts** – both positive and negative – rewarding benefits through prices, payments and markets – for example setting up payment for ecosystem service schemes or applying the polluter pays principle to avoid or address losses – e.g. by restoration requirements or liability and compensation practices (see TEEB 2011a).
- **Greening the markets and the supply chain** – developing and regulating markets, setting standards, supporting labelling, applying codes of conduct, and leading by example through green public procurement whether at local, regional, national or indeed business levels (see TEEB 2012a).
- **Reform environmentally harmful subsidies (EHS) –** identifying which subsides are "good" (still relevant, targeted, effective, positive impacts, few negative effects) which are "bad" (no longer relevant, waste of money, important negative effects) and which are "ugly" (badly designed – e.g. inefficient, badly targeted, significant negative effects). There is also a need to develop inventories of EHS and prepare and implement road maps for their reform (see Lehman et al., 2011, ten Brink et al., 2012).

These steps will each help encourage eco-efficiency and are a core part of a green economy approach and vital for fiscal consolidation. Implementing Target 3 of the CBD Strategic Plan 2010-20 will be critically important here.

While economic signals are important, regulation is also key; emissions standards, environmental quality standards (e.g. air, water quality), product standards and building standards (e.g. for efficiency) are all important for encouraging eco-efficiency.

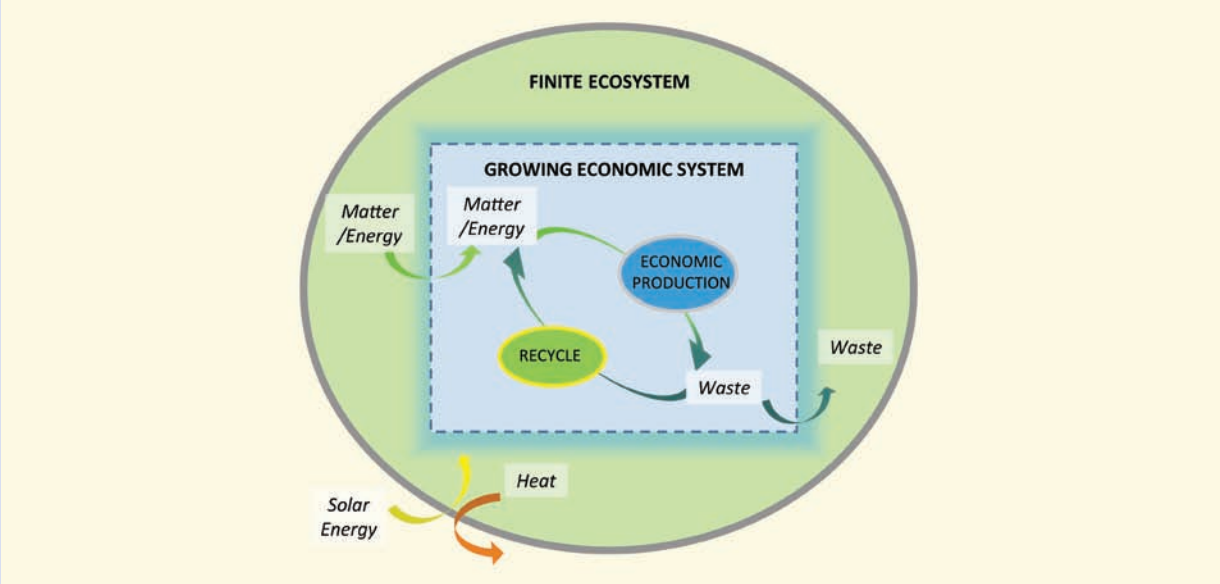
While resource efficiency will lead to relative decoupling and reduce the pressure on resources and the environment, over the long term **absolute decoupling** will be needed to achieve true sustainable development. Relative decoupling will not in itself be enough to meet avoid growing pressures on the environment across all areas (Jackson 2009).

Absolute decoupling

In most countries and for most environmental issues where decoupling of resource use and GDP has occurred, this has resulted in **relative decoupling** (UNEP 2011d). This has been achieved through a combination of regulation, commitments, investment and innovation in certain areas (e.g. CFCs and the ozone hole, O_2 emissions from the power sector, particulates from passenger vehicles). These have however been the exception rather than the norm so far, and there is arguably a need for a paradigm shift in approach. Relative decoupling is not enough – the resource use or environmental impact needs to fall in absolute terms. On an increasingly "crowded" planet, a policy approach explicitly aiming to achieve **absolute decoupling** is needed, as further explained in Box 5.6 below.

Box 5.6: The need for a paradigm shift

There are biophysical boundaries that create a concrete context for development. Our planet's ecosystems, generative and regenerative capacities, resource limits as well as the carbon, water and nitrogen cycles each create contexts and limits that need to be respected, indeed will make themselves respected. The economy can grow within the wider planetary ecosystem, but if critical thresholds (ecological, resources and in turn economic and social thresholds) are to be avoided growth must take into account these limits and dynamics. (e.g. Rees, 2003; see Figure below)



Source: building on REES (2003)

Efficiency gains alone will not solve the problem. Improving energy efficiency, water use efficiency and resource efficiency will lead to important steps forward, but historical developments have shown that relative gains do not lead to absolute gains for many of the challenges we are facing – energy and resources use notably – both due to the rebound effect (i.e. people often use more of what becomes more affordable) and due to the fact that demand growth outstrips efficiency gains. The rate of efficiency gains and relative decoupling is far too slow to lead to absolute reductions in pressures – unless there is a major increase in the pace of efficiency and innovation (e.g. by a factor of 4 as recommended by von Weizsäcker et al., 1997, or indeed further e.g. by factor of 10). Even then, with a growing world economy, population and growth in consumption and production, efficiency gains

will reach their limits (including the laws of physics) (Jackson, 2009).

For absolute decoupling to become a reality, there needs to be a paradigm shift to get radical innovation and also social innovation: increasing resource productivity and efficiency more radically than current trends while at the same time helping consumers develop less resource intensive lifestyles.

Source: Jackson (2009)

Such an approach would build on many if not all of the above approaches, though would require considerably more effort in setting and meeting ambitious resource efficiency objectives and targets. Support mechanisms will also need to be created or refocused to support a transition to a green economy, such as providing further encouragement to renewable energies, energy efficiency, public transport and modal shifts, sustainable buildings (from design and build to refurbishment and demolition/recycling, and spatial development), design for sustainability, waste prevention and recycling/reuse. Instruments and measures to achieve the transformation include investment and incentives, product standards, training and training related activities (skills assessment and reskilling, capacity-building), but also social capital elements (including behavioural change, social norms change, information).

This will require some radical innovations. These can include traditional green economy innovations such as zero carbon energies and zero waste processes. It can also include ecosystem-, species- or gene-based solutions for processes (water purification) products (e.g., pharmaceuticals or new materials), and applications (e.g. biomimicry and architecture). Changes in consumer demand will also be key, for example by moving to more sustainable purchasing and consumption habits (e.g. diet, travel). Furthermore, developing a culture that encourages sufficiency, given resource constraints and ecosystem limits, will arguably be needed. To achieve absolute decoupling, we will need both man-made technological and nature-based solutions, and tailored societal individual choice.

Using the tools and building blocks

The building blocks discussed above are all key steps to transform our approach to natural capital and move towards a development path that integrates economic, social and environmental concerns in a resource-efficient economy that works within the planet's ecological capacities.

To simplify and illustrate the challenge, Figure 5.2 below presents two contrasting pathways for biodiversity. One is based on the continuing loss of biodiversity and associated erosion of natural capital as measures do not halt or reduce the loss of biodiversity that results from rising pressures from consumption and production from an increasingly rich, growing world population. The other leads to a slowing of and gradual halt in biodiversity loss through a wide range of polices and measures, followed by a reversal of such loss with additional efforts of restoration and investment in natural capital thus driving a net positive gain agenda of nature. This supports the green economy transition recognising that natural capital leads to improved stewardship, protection and investment and, in turn, to a net appreciation of the natural capital base.

Target 5 of the CBD Strategic Plan for Biodiversity 2011-2020 is that:

By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

The figure puts the milestone for halting the loss at 2020. It then envisages a gain so that no net loss relative to current levels is achieved by 2030 and a new paradigm of positive trend in natural capital accumulation is entered thereafter. Unfortunately, without a significant increase in effort this appears grossly optimistic, given the current rate of biodiversity loss and increasing (rather than decreasing) pressures from production and consumption. The lack of integration of biodiversity concerns and ecosystem service values into the market and sector policies also adds to pessimism. Biodiversity policy alone will not be enough to halt biodiversity loss, let alone move to the needed new paradigm of investment in natural capital and appreciation of the interconnections and interdependencies of economic and social systems with the world's ecosystems. This is recognised in Article 6b of the CBD which calls on all Parties to:

'integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies'.

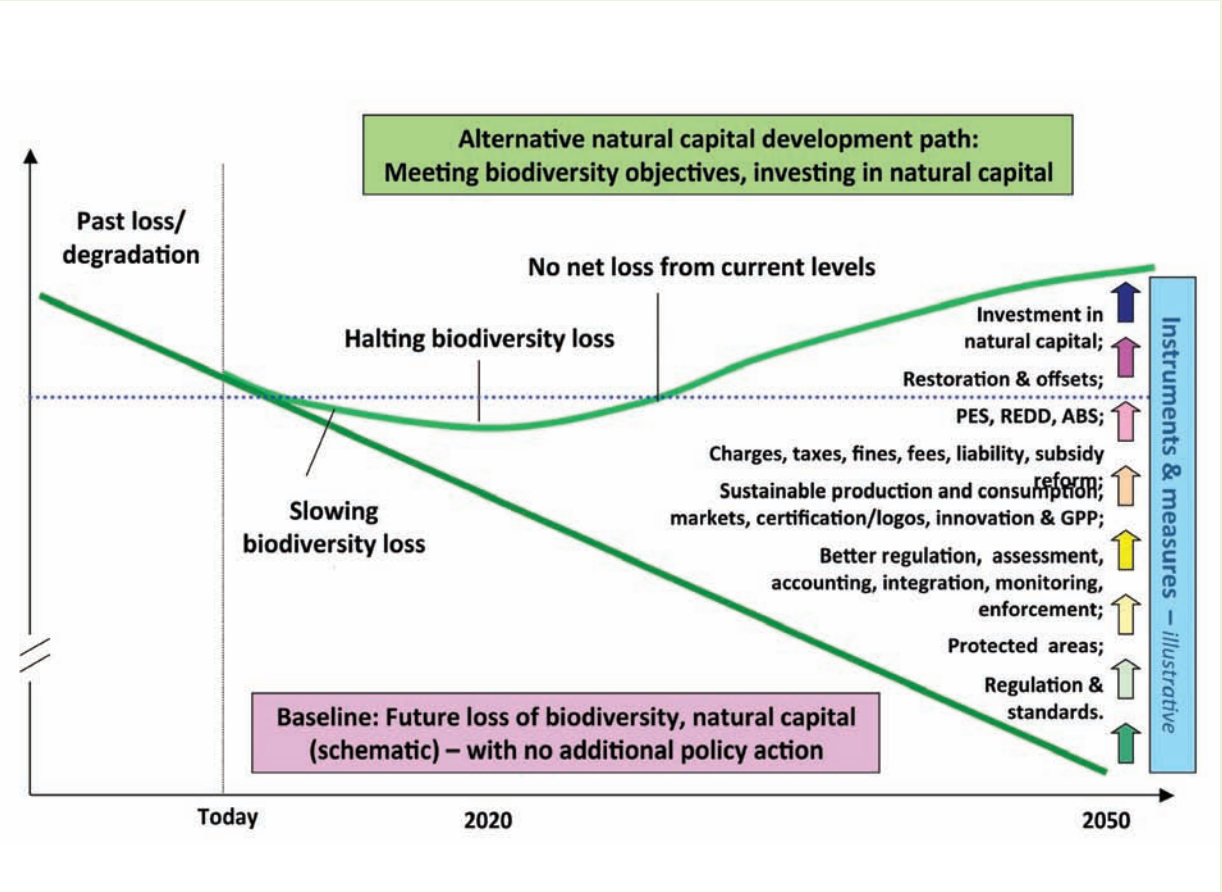


Figure 5.2: Eroding natural capital base and tools for an alternative development path
Source: Patrick ten Brink, own representation

Some progress has been made in many countries and many tools are already proving their merits. Key challenges will be in increasing the effort, which requires 'mutual learning' (being inspired by each other), mainstreaming, good governance and finding the finance to realise it.

C. Enabling conditions for the transition to a green economy

Financing the transition

The UNEP Green Economy Report estimates the annual financing required to green the global economy to be in the range US$1.05-2.59 trillion. The report presents a detailed plan for investments of US$1.3 trillion per year – roughly equivalent to two percent of global GDP – in ten key sectors (see Table A1 in the Annex). It establishes a link between this sum and the one to two percent of global GDP that is currently being spent globally on a range of subsidies that often perpetuate unsustainable resources use in areas such as fossil fuels, agriculture (including pesticide subsidies), water and fisheries (See Box 5.7 below). The report suggests that the transition can be paid for in part by removing or reforming these harmful subsidies, which will liberate funds, help address technological lock-in and encourage innovation (UNEP 2011a).

Box 5.7: The scale of subsidies

Despite reductions in some sectors and countries, the overall level of public subsidies remains remarkably high. Conservative estimates point to hundreds of billions of dollars in annual subsidies, though most sectors face conceptual and data deficiencies in making accurate assessments. Energy subsidies are around US$500 billion/year worldwide, with US$310 billion in the 20 largest non-OECD countries in 2007. In 2010, the fossil-fuel consumption subsidies in 37 emerging and developing economies were estimated to have totalled US$409 billion (IEA, 2011). Agricultural subsidies in OECD countries averaged US$261 billion/year from 2006 to 2008 while global fisheries subsidies have been estimated at US$15 billion to US$35 billion per year (Lehmann et al, 2011). Water use is also widely subsidised, notably for agriculture, as the price of water often does not reflect the cost of providing it, or indeed the total resource costs, which leads to its overuse and resulting scarcity.

The IEA estimates that without major reforms, fossil-fuel consumer subsidies in the economies captured by the IEA survey will grow, reaching USD 660 billion in 2020, or 0.7% percent of global GDP (IEA, 2011).

While subsidy reform has the potential to raise significant funds, on its own it will not be enough and a portfolio of additional instruments will need to be used. Potential tools to address some of the environmental issues and raise funds at the same time include:

- **Getting the prices right**: charges, taxes, resource costs and full cost recovery, and the use of payments for ecosystem services (PES) – ensuring the market incentives increasingly become a driver in the transition. These instruments can both raise income and, by creating incentives for lesser resource use and reduction pollution, can reduce the level of financing required to green the economy.

- **Raising the regulation baseline:** as this reduces risks and avoids costs associated with pollution and accidents. Making polluters pay helps avoid damages and increases industry's involvement and contribution in the transition to a green economy. It would also lessen investment needs to address the impacts of environmental pollution and damages.

- **Implementation and enforcement of regulation**: ensure resources for implementation and address non-compliance. This helps ensure that polluters pay, generally through investments to avoid pollution and on occasion via non-compliance fees and fines or compensation payments;

- **Clarifying property rights** (ownership, use, access, etc.), to give certainty and encourage action driven by a long-term perspective including investment in restoration, sustainable management practices, the setting up of PES schemes, the leveraging of investments.

- **Allocating budgets** in light of appreciation of the benefits, priorities and responsibilities – locally (cities), at state or region level, nationally, internationally, globally.

- **Including ecosystem services and biodiversity consideration into funding and funds** – for example, via not only minimum criteria (i.e. avoiding trade-offs), but also positive criteria reflecting benefits of biodiversity and ecosystem services for poverty alleviation, development, saving resources, money and reducing burdens and hence encouraging due investment flows.

- **Sharing of benefits arising from the utilisation of genetic resources:** to provide funds, capacity building and an economic incentive to states and local communities for the preservation of their natural capital.

To date ethical investment funds, insurance companies and banks, or rating agencies have not generally played a major role in financing nature's role in the transition to the green economy. There is potential for a growth in the influence of these as liability issues become more important, and risks linked to access to resources and ecosystem services, driven by global competition, are on the rise (TEEB, 2012a).

It is critical to appreciate that in practice those who pay and those who benefit are very often not the same people. Similarly, the costs and the benefits can occur at different timescales – degradation from activities today can cause costs for future generations, and investment in restoration can lead to benefits over many generations. Furthermore, action in one area can lead to benefits at different

scales – from local to global (recall figure 4.2). All of these issues are part of the governance challenge for the transition to a green economy. Work on innovative financing instruments and looking at opportunities and challenges is on-going and brings together a wider range of actors including national governments, the CBD, the OECD and the GEF.

Governance of the transition: a multi-level, multi-stakeholder process

A holistic approach to governance – one which fully appreciates the interconnections of ecosystems, social systems and the economy – is urgently needed. Though difficult, further integration of governing structures would significantly facilitate effective policy-making to address the challenges we are facing. As part of this, it is very important to recognise the roles, responsibilities and opportunities of different stakeholders and their motivations, interests and incentives in order to harness their potential. This critical information helps develop a realistic picture of potential positive engagement (and resistance) and understand how to best catalyse change. As noted below there are many potential champions of solutions at different geographic levels and in different groups (see TEEB 2010a, TEEB 2011a, b; TEEB 2012a, b for details).

Global commitments, while often difficult to reach, can be important drivers of progress – especially where synergies are pursued (e.g. ecosystem-based climate adaptation and mitigation to support the UNFCCC and ensuring links between the UNFCCC, UNCBD and UNCCD).

Various tools are already proving their merits at **national level** (TEEB 2011) and there is major potential not just for leading by example, but also for collaboration and mutual learning. Cities and regions also have a growing role to play as the local nature of the ecology-economy-society interactions is increasingly recognised and as the world becomes increasingly urban (see TEEB, 2012b and TEEB, 2011b).

Businesses large and small, where they assess and take account in their management approaches and accounts of the value of flow of ecosystem services from nature into their activities, and take account of the possible risks and liabilities of their potential impacts, will be a critically important driver of progress (TEEB 2012a; see also Box 5.8). Emerging developments include corporate sustainability reporting and accounting, such as the Puma's Environmental Profit and Loss Account, the Natural Capital Declaration of the financial sector and the TEEB for Business Coalition[16] (Puma, 2011; Natural Capital Declaration, 2012).

Box 5.8: Reasons for business to integrate biodiversity

There are also considerable incentives for businesses to take biodiversity into consideration in their decision making. These refer to both risks of inaction and opportunities from proactive engagements which can be categorised as follows:

1. *Operational:* enhancing natural ecosystems can result in reduced cost of accessing resources, guarantee sustainable access to resources over the long term and reduce the risk of disruption to resource base.
2. *Access to new markets:* opportunities exist to develop new products that reduce the impact on natural ecosystems (as demonstrated by the expansion of certified biodiversity friendly products), capturing new revenues from company-owned natural assets or entering new markets such as watershed protection or carbon sequestration.
3. *Reputation management:* companies may limit the risk of damage to corporate reputation and licence to operate by reducing impact on biodiversity or having a net positive impact; this in turn, may present an opportunity to increase brand recognition and improve market position.
4. *Reduced exposure to regulation and legal action:* acting early to avoid negative impacts on biodiversity can reduce vulnerability to the risk of liability for damages, potential lawsuits by stakeholders and new regulatory frameworks, which might constrain business activities and reduce profitability.
5. *Access to finance:* as more banks and investors begin to adopt more rigorous lending and investment policies, reducing biodiversity impacts could result in more favourable financing terms and improved access to capital. Similarly, insurance coverage and cost is expected to become increasingly sensitive to environmental liabilities and hazards.

Source: Building on TEEB 2012b, WBCSD 2010, McConville et al., 2012

Equally, **communities and people**, via engagement, management and investment decisions as well as consumption and lifestyle choices are also critical. Community-based management of natural resources has a long and strong tradition, often in the literature highlighted with regard to fisheries, forests, traditional knowledge and protected areas. As has been underlined, common property can be successfully managed by the groups using it, and in some cases, is actually better managed than if privatized or managed by government (Ostrom, 1990). Citizens, through their actions and purchasing decisions, can lower their consumption impacts out of responsibility or self-interest. Focusing on youth via education and engagement will be critical. Supporting skills, knowledge and understanding in the new generation will be essential for the transition to a green economy.

NGOs can, inter alia, raise funds, purchase land, get PES schemes started, offer volunteers to help with monitoring, science and restoration, and contribute evidence to support policy formation. Furthermore, as recognised by the recent agreement to establish the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) **scientists and academics** can provide critical insights and discoveries to help all of the above groups benefit from nature's extraordinary potential.

One of the many keys to good governance is **transparency**. A lack of transparency is both the cause and a symptom of poor governance; it is a brake to progress, and can reduce/hinder participation. In both cases critical information is likely to be overlooked and not taken into account in decision-making. An acknowledgement of the importance of ensuring transparency to facilitate good governance has led to the adoption of the Aarhus Convention – The UNECE Convention on Access to Information, Public Participation in Decision making and Access to Justice in Environmental Matters (UNECE, 1998) – establishes legally binding rights and obligations with regard to government decision-making processes on matters concerning the local, national and transboundary environment.

Finally, consideration is also needed on institutional credibility, global/national/local systems of targets, quantitative indicators as well as on mechanisms to achieve those targets.

Managing the transition

The transition to the green economy will result in many win-wins, but will also mean losses for some. Transition management will be a key aspect of the way forward, as will efforts to improve understanding and transparency along the way.

The transition to a green economy will not always be a smooth path – there will be winners and losers and even some winners may find that the benefits do not materialize until sometime after the investments. It is easy to point out that there will be significant benefits in increased fish yield in 3-8 years and therefore that the measures leading to the benefits (setting quotas, management agreements within Marine Protected Areas or No Take Zones) are right for their medium- and long-term interests. However, the priorities and needs of the day will still remain and, unless addressed, there is a risk of either creating social hardship or leading to an ineffective implementation of the proposed instrument.

It is critical therefore that the losses are addressed and transition management solutions are found. In the case of fisheries, this can be with due zoning to allow catch in parts and not in others. In other cases it can take the form of compensation and training for complementary activities. If no measures are taken, the complementary or alternative activities will need to be sought later on in any case, often under higher pressure situations. An assessment and appreciation of opportunity costs, transition costs and participation in finding appropriate or at least acceptable solutions is critical.

Conclusions

It is clear from the state of the environment and the on-going degradation that the transition to a green economy will not happen with only a marginal increase in existing greening and green activities. It is unlikely that current and future efforts can avoid high and increasingly volatile resource prices (leading to more than relative decoupling) or go beyond slowing down the loss of biodiversity and other potentially irreversible environmental changes (e.g. as ecological thresholds are passed and ecosystems and climate systems move to new operations).

An acceleration in effort is needed if there is to be a real transition to a green economy that offers improved well-being and social equality, while significantly reducing environmental risks and ecological scarcities. There is a need to move from discrete cases of green economy transition to a

fundamental systemic transition warranted by scientific findings (UNEP 2012, EEA SOER 2010). This would not necessarily imply huge costs or indeed impacts on GDP. On the contrary, focused investment can lead to significant savings and efficiency gains. The transition needs careful management and engagement by government, business, communities and citizens to ensure its success. The follow-up to the Rio+20 Conference offers an important opportunity to commit to working with nature and driving the transition to a truly sustainable future that promotes social equity, poverty eradication and human well-being.

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[1] IEEP (The Institute for European Environmental Policy) is an independent not-for-profit institute. Based in London and Brussels, the Institute's major focus is the development, implementation and evaluation of policies of environmental significance, with a focus both on Europe and the global dimension. Website: http://www.ieep.eu.

[2] A green economy needs to be socially inclusive and address poverty both for ethical reasons – sacrificing people for the environment is not a defendable option – and for practical reasons – green economy can only be a "powerful tool" for achieving sustainable development if it fully complies with the social requirements of sustainable development, as facilitated engagement by different stakeholders in the transition

[3] www.greeneconomycoalition.org/sites/gec.dev.iiedlist.org/files/Principles%20of%20a%20green%20economy%20v3.pdf

[4] In the figure above "natural drivers" are noted to underline that nature's functions and processes can also drive change an create pressures on ecosystems and biodiversity – e.g. earthquakes, volcanoes and tsunamis.

[5] http://www.cbd.int/doc/publications/bd-brochure-en.pdf

[6] For CACID, see also http://www.equatorinitiative.org/index.php?option=com_content&view=article&id=443%3Acacid&catid=104%3Aequator-prize-winners-2002&Itemid=709 and The Social Network for Sustainability: http://wiserearth.org/organization/view/a27b53b42ba4347c6b88cc7f902611d4

For Ethiopia PSNP Program case study see also http://www.ifpri.org/publication/impact-ethiopias-productive-safety-net-programme-and-its-linkages http://go.worldbank.org/E4PE1DEGS0 http://www.odi.org.uk/work/projects/details.asp?id=1144&title=productive-safety-net-programme-psnp-ethiopia

[7] For more detailed figures: http://www.ifpri.org/sites/default/files/publications/ifpridp01086.pdf

[8] The term "heat island" describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1.8-5.4°F (1-3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality. Taken from http://www.epa.gov/hiri/

[9] Note that pollination is a local service, though of course the benefits, via the provision of food, can be local, national or even global.

[10] For a summary presented to the Copenhagen Consensus 2012 see: http://www.copenhagenconsensus.com/Default.aspx?ID=1628.

[11] Primary production is the production of organic compounds from atmospheric or aquatic carbon dioxide, mainly through photosynthesis

[12] The London Group is an informal group of experts primarily from national statistical agencies but also international organizations that discuss accounting and have been influential in the SEEA process, both on methodologies and on sharing practice. http://unstats.un.org/unsd/envaccounting/londongroup/

[13] For papers see http://unstats.un.org/unsd/envaccounting/seeaLES/egm/lod.htm for the December 2011 meeting in London and http://unstats.un.org/unsd/envaccounting/seeaLES/egm2/lod.htm for the May 2012 meeting in Melbourne.

[14] WAVES was launched in Japan in 2010 at the CBD COP11 in Nagoya.

[15] See also The World Database on Protected Areas http://www.wdpa.org/ and http://protectedplanet.net/

[16] http://thefinancelab.org/wp-content/uploads/2012/06/TEEB-for-Business-Coalition.pdf

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ANNEXES

Annex I: Greening sectors of the economy

The Green Economy Report identified an indicative list of sectors whose reform could potentially make significant contributions to shifting the economy as a whole towards a green economy. They have been chosen because they are considered to be the "defining trends of the transition to the green economy" including human well-being, social equity, and reducing environmental risks and ecological scarcities (UNEP, 2011a).

This indicative list of ten "sectors" examined in the Green Economy Report broadly falls into two categories. On the one hand, there are the sectors where goods and services are "derived from natural capital" (i.e. agriculture, fisheries, water and forests). In these sectors, there is a large untapped potential to use and manage ecosystems in a cost-effective way that would support nature in the delivery and maximization of benefits to humans in the long run.

For these sectors, investing in restoring and maintaining the ecosystem services (see Box A.1) that underpin these benefits is at the heart of a greening strategy. On the other hand, there are the sectors corresponding to "built capital" or "brown" sectors (i.e. energy, manufacturing, waste, buildings, transport, tourism, cities) of the economy. These sectors depend on natural resources as inputs or sinks to varying degrees. Many of the pressures from human activities on the natural environment, most notably resource extraction and pollution, depend on the absolute size of these sectors and the efficiency with which they operate. Here, the primary opportunities for greening the economy are investments in energy and resource extraction efficiency, leading to more effective use of resource inputs and lower adverse impacts on the natural environment over the life-cycle of products and infrastructures. Both types of investments can also yield important co-benefits in the form of economic growth, employment and increased equity.

Table A1: Green Economy Report "sectors" and potential green economy initiatives

Sector	Objectives	Potential activities – examples (in bold where relating to natural capital)
Agriculture	Investing in natural capital	• **Increasing investments in sustainable agriculture (developing countries) – notably increasing output from small scale farm holdings** • **Transforming to green agricultural practices** • **Protection and restoration of soils and land through sustainable management practises – e.g. from salinisation, land degradation and desertification**
Fisheries		• **Greening practices – from technical measures to minimise negative impacts of fisheries on marine environment to establishing marine protected areas and restoration of key fishery nurseries** • **Tackling overfishing and promoting ecosystem based management, within stock limits, such as through rights-based management** • **Reforming subsidies, investing in sustainable recreation and tourism**
Water		• Improving water supply and efficiency via water reclamation, grey water and rainwater systems **as well as via ecosystem-**based water provision (green infrastructure) • Securing water purification, low-water landscaping, storm water management, **including ecosystem based adaptation to climate change** • Water pricing (e.g. for full cost recovery, resource pricing and **payments for ecosystem services**) • Innovation and irrigation, reducing wastage – in use and distribution (leakage) • Improved measurement – from water metering, to statistics and **water accounts**
Forests		• **Reducing deforestation and increasing sustainable reforestation and restoration** • **Forests as sources of sustainable products and ecosystem services** • **Investing in sustainable recreation activities** • **Monitoring of forest stock and quality and ecosystem service flow**

Sector	Objectives	Potential activities – examples (in bold green where relating to natural capital)
Energy / renewable energy	Investing in energy and resource efficiency	• Renewable energy mixes: Solar, wind, geothermal, marine, biogas and fuel cells • **Reforming subsidies from fossil fuel-based sources to renewables** • **Innovation in wood ovens (developing countries)** • Smart electricity grids and investments into a grid change capable of renewable energy supply base • Innovation and energy efficiency gains in conventional power plants • Spatial planning, EIA, risk assessments for energy infrastructure • Energy appliance efficiency and green purchasing
Manufacturing		• Improving resource and energy efficiency and wider innovation • Ecodesign including green engineering and green chemistry, design for environment/sustainability **(building in lessons from nature – biomimicry)**
Waste		• Preventing waste; construction, industrial, municipal, in particular electronic and food waste • Investment in waste collection; reuse, recycling/**composting** and disposal infrastructures • Increasing and improving reuse, repair, recycling in products and infrastructure
Buildings		• Resource and energy efficient buildings – in new builds (design) and in retrofitting existing buildings – sustainable materials, insulation, energy efficiency and energy production (solar) • Sustainable land-use – spatial development • **Green infrastructure – green roofs**
Transport		• Avoiding or reducing transport and its impacts via spatial development and impact assessment • Increasing investment in public transportation and **greening of grey infrastructure**(road, rail) • Reforming subsidies for fossil fuels, road infrastructure, vehicle use (commuter subsidy, company car)and introducing or reforming vehicle and road charging • Encouraging modal shifts (passengers and freight) • Improving vehicle and fuel technologies (efficiency) and managing the shift to electrification (vehicles and infrastructure) based on renewable energy sources • Driver information and behaviour; facilitating car sharing and pooling
Tourism		• **Sustainable ecotourism** • **Natural capital enhancement and protection to enhance (eco)tourism (e.g. investing in protected areas, green spaces and infrastructure, and healthy ecosystems and landscapes)** • Sustainable infrastructure (public transport, buildings) and charging for services(water, waste, clean up)
Cities		• Designing for low impacts – transport, buildings, spatial planning (including densification) • Providing integrated public transport systems, restricting parking in urban areas, congestion/parking charges to discourage personal car use • **Creating and maintaining natural and semi-natural habitats – woods, parks, community gardens** • **Investing in urban green infrastructures (green roofs, spaces, road verges)** • **Growing local food and supporting community assisted agriculture schemes**

Annex II: The challenge of food security and importance of diet and connections to water security

Food and water security is likely to represent a major challenge to world's societies in the future and are significantly interlinked. Given the global population trends, the demand for food will increase, as will the associated demand for agricultural land. It has been estimated that by 2050, a world with 2.3 billion more people will need around 70% more food (Bruinsma, 2009). Moreover, the food production is majorly interlinked with other inputs – it uses about 70% of freshwater and 20% energy production (Aiking, De Boer, & Vereijken, 2006). As such, it can be expected that the increasing food demand will have a major impact on water resources and scarcity (see below).

Food and diets

A major share of the global environmental pressure is associated with food-related activities (Bruinsma, 2002; Evans, 1998). These impacts include resource depletion and pollution on scales from local to global (Aiking, 2011). Examples include impacts on biodiversity, climate change and pollution by pesticides. In particular the extensive use of fertilisers and associated leakage of nitrogen to the environment has a major impact on the natural nitrogen cycle. Consequently, it is estimated that the anthropogenic contribution to the natural cycle is between 100% and 200%, which makes it one of the three planetary boundaries which are being crossed (alongside biodiversity loss and climate change; Rockstrom et al., 2009). Moreover, the nitrogen pollution is considered as one of the three biggest threats to global biodiversity (Townsend & Howarth, 2010).

Dietary habits, and particularly the demand for meat, play a significant role in the above problems. The demand for meat has increased fivefold during the second half of 20th century and it is expected to double by 2050 (Steinfeld et al., 2006). As the conversion of plant into animal protein is inherently inefficient, meat production is responsible for a disproportionate share of environmental pressures (e.g. Steinfeld et al., 2006). On average, about 6 kg of plant protein is needed to produce 1 kg of animal protein, making about 85 percent of the protein used in the process wasted (Pimentel & Pimentel, 2003). A significant portion of agricultural produce is used as a livestock feed. This has a direct impact on environment, due to a demand on agricultural expansion and associated detrimental impacts on natural habitats and ecosystems. Meat and dairy products are playing a crucial role in the areas of biodiversity loss, nitrogen and carbon cycles (three already crossed planetary boundaries). Furthermore livestock production is significantly involved in other three planetary boundaries under threat of being exceeded (land-use change, freshwater use and the phosphorus cycle) (Aiking, 2011; Rockstrom et al., 2009). Furthermore, given that production of meat and cattle feeding is one of the most water-intensive economic endeavours, dietary habits also have a direct influence on the availability of freshwater (see also below). Given the above outlined impacts of meat production, it can be therefore said that the dietary habits plays a crucial role in any potential transition towards sustainability and/or green economy.

Changes in dietary habits and major change in the food industry can play a role in this transition. In particular, partial replacement of meat protein with plant protein products in the human diet can offer a promising solution. For instance, it has been showed that doing so might result in 3-4 fold lower requirements on agricultural land and freshwater (Aiking, 2011). The change in diets would hence have significant impacts on biodiversity. For instance, it has been estimated that reducing the average meat consumption to 65g/day/capita would save approximately 10 million km^2 of natural areas by 2050, which would reduce the net loss of natural area to about zero (PBL, 2010). Moving to a full vegetarian diet would save around 18 million km^2, which would reverse the loss of natural area into 8 million km^2 gain compared to the year 2000. In terms of mean species abundance (MSA), the projected loss by 2050 would be reduced by 35 per cent and 55 per cent respectively (Ibid). However, given the cultural prominence of meat, consumer taste, or the lack of the reflection of the full environmental and social costs of meat production in meat prices, it is clear that the change towards less meat-intensive diet will be difficult. As such, education and awareness-raising play a key role in this transition. Furthermore, the food industry can also play a role in this transition. Innovation and R&D directed at the development of better Novel Protein Food products (NFPs) can be a significant contribution of food industry, as well as

lead to a reduction of waste throughout the food production chain. Food industry should be receptive to consumer demands, but should as well play a role in consumer education, as industry position in the food supply chain is ideally suited for it (Aiking, 2011).

Water Scarcity

The above issues are also connected to the availability of fresh water, as water scarcity is expected to be one of the big challenges of this century. Water scarcity already affects every continent. Around 1.2 billion people, or almost one-fifth of the world's population, live in areas of physical scarcity, and 500 million people are approaching this situation (UN, 2012). Water is becoming scarce and water stress is projected to increase with more than half the world's populations expected to live under conditions of severe water stress by 2025 (WBCSD, 2010) and water supply satisfying only 60 per cent of world demand in 20 years (McKinsey, 2009). The pressures on water resources are increasing across the world. Water scarcity occurs where insufficient water resources are available to satisfy long-term average requirements. Population growth, more intensive agriculture, energy and manufacturing needs and tourism all contribute to increasing water use alongside its inefficient management. In many regions, water resources are already under threat and climate change will only exacerbate this further.

Biodiversity and ecosystems, with a prominent role of wetlands, play a crucial role in the supply of water and the water cycle in general (ten Brink et al., 2012). Many of ecosystem services are related to water. These include water provision; water purification and waste water treatment; as well as groundwater replenishment and water regulation, including the regulation of extreme events such as floods and droughts. Some of the examples of working with nature, related to these ecosystem services, have been shown in the previous chapter and generally throughout the report. It is increasingly being understood that informed management of our natural capital plays a key role in addressing the future challenges of water scarcity and hence needs to lie at the core of green economy.

Source: McKinsey (2009), Farmer (2011), UN Water for Life Decade Webpage (http://www.un.org/waterforlifedecade/scarcity.shtml).


The Economics
of Ecosystems
& Biodiversity