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The “nexus” between water, food and energy is one of the most fundamental relationships and challenges for society. The importance of this nexus was re-

1. The "nexus" between water, food and energy is one of the most fundamental relationships - and increasing challenges - for society.

2. Water security is a major and increasing concern in many parts of the world, including both the availability (including extreme events) and quality of water.

3. Global and local water cycle are strongly dependent on wetlands.

4. Without wetlands, the water cycle, carbon cycle and nutrient cycle would be signi f cantly altered, mostly detrimentally. Yet policies and decisions do not suff ciently take into account these interconnections and interdependencies.

5. Wetlands are solutions to water security – they provide multiple ecosystem services supporting water

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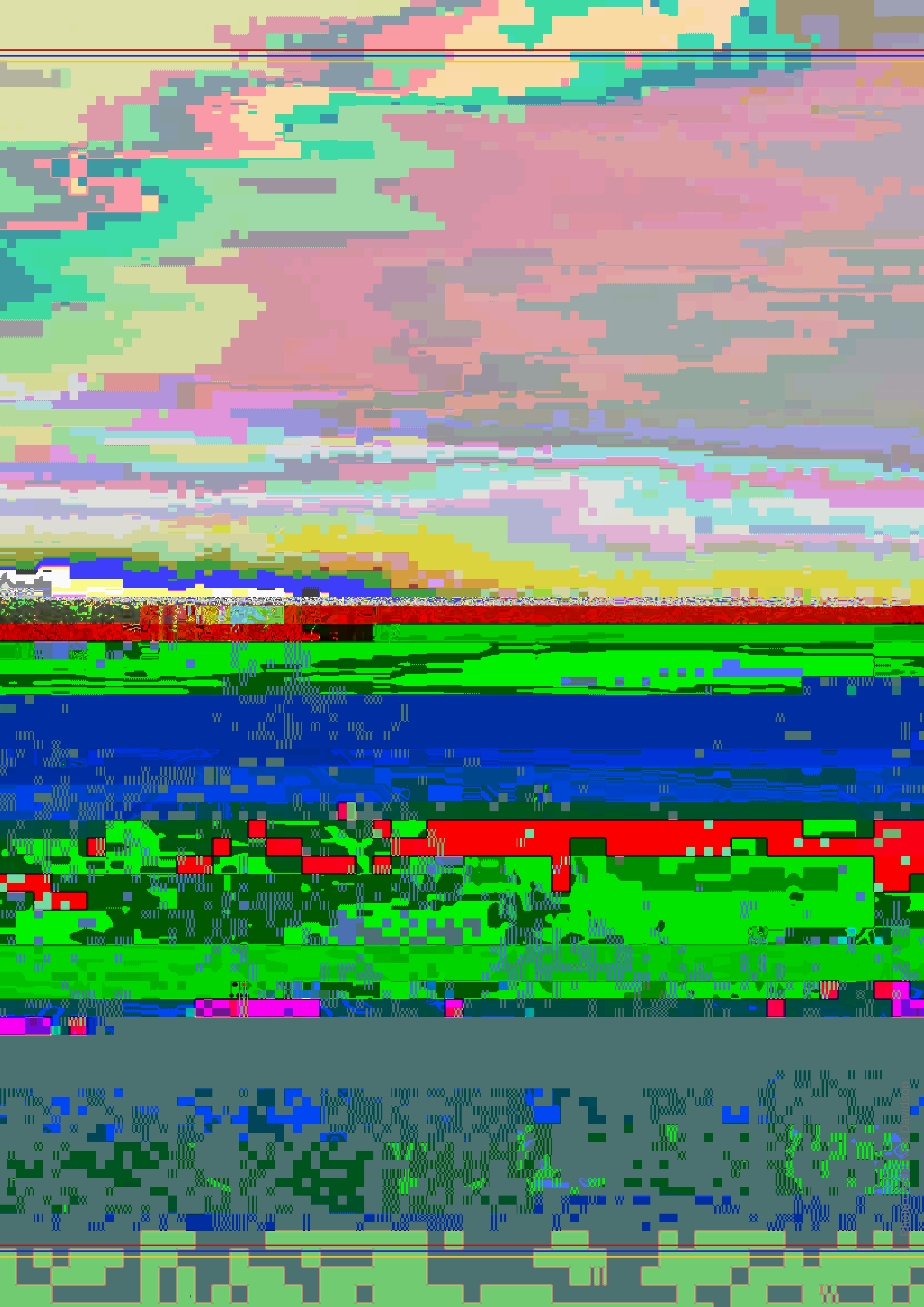


Photo credit: Mick Davidson

the “values” of the ecosystem services provided by water and wetlands, which can be expressed in a number of ways and methods. In some cases, the values of biodiversity and ecosystems can be presented qualitatively (e.g. which cities benefit from which wetland for water purification or flood control). In other cases, they can be in quantitative terms (e.g.

[illegible]

This report is for:

- Policy makers at the international level, to offer an evidence base and arguments to help promote synergies between MEAs (multilateral environmental agreements) and foster international collaboration between countries, including those with transboundary watersheds;

- Policy makers at the regional and national level interested in understanding the value of wetlands under their jurisdiction, and taking account of this value in policy development and investment decisions;

- Decision makers at local and regional level looking to ensure that the best decisions are taken in light of a fuller evidence base (e.g. municipalities and land use zoning and investment choices; permit authorities and land use change decisions);

- Businesses wishing to assess risks and dependencies on wetland-related ecosystem services of their activities and bottom lines;

- Environmental authorities and others involved in the management of wetlands who wish to know, demonstrate and manage the many values of the site for which they are responsible;

- In addition, it is also of relevance to community organisations, NGOs and the scientifc community interested in understanding, demonstrating and communicating the full picture of the values of wetlands – both the water-related ecosystem services and the wider set of ecosystem services from wetlands.

1.4 [illegible]

The report responds to the following questions by presenting insights from experience from across the globe:

- *Benefits and risks of loss:* what are the roles of wetlands in providing water and wider ecosystem services and what are their values?

- *Measuring to manage:* how can we improve what we are measuring to help improve governance of our natural capital?

- *Integrating the values of water and wetlands into decision making:* what needs to be done to improve the consideration of the values and benefts of water and wetland in policy developments and in practical decision making?

- *Transforming our approach to water and wetlands:* what are the recommendations for transforming the regional, national and international approaches for managing water, wetlands and their ecosystem services?

[illegible]

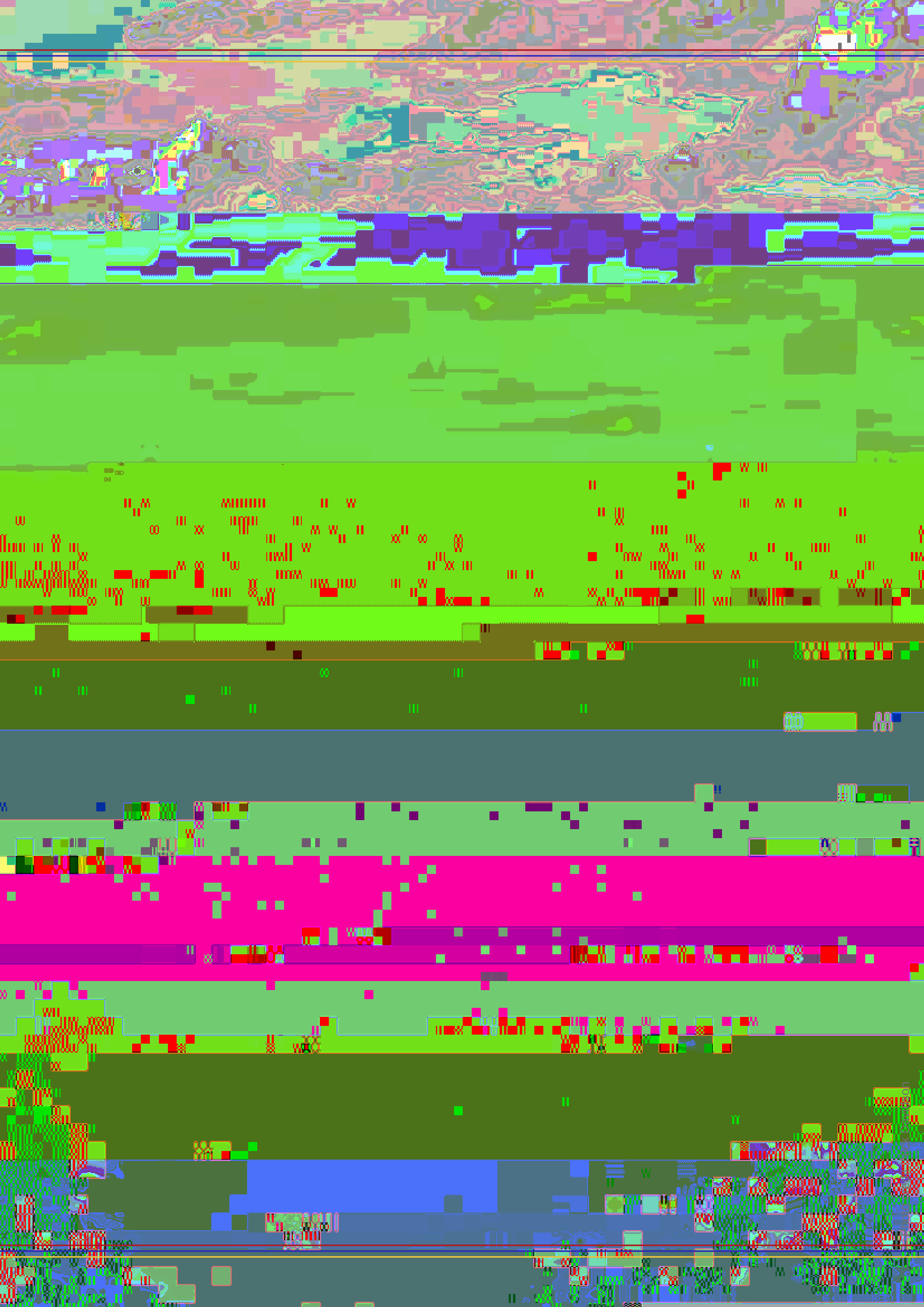
Chapter 2 explains the importance of the water cycle, the setting of wetlands within this, and the ecosystem services provided wetlands. It also presents an overview of the values of wetlands. It discusses the present state of water-related ecosystem services and wider wetlands ecosystem services, the impact of their loss and degradation on human welfare and the stakeholders particularly concerned with their degradation.

Chapter 3 discusses the importance of monitoring the state of wetlands and understanding the value of the fow of ecosystem services. It covers indicators, mapping, accounting, and valuation of ecosystem services using qualitative, quantitative, and monetary methodologies.

Chapter 4 deals with the integrated management of land, water and wetlands. It outlines the different policy instruments that can be used to foster conservation and restoration, including site management, regulation and land use planning, property rights and market-based instruments.

Chapter 5 calls for transforming our approach to water and wetlands in order to avoid wetland loss, encourage restoration and ensure that policy makers acknowledge that wetlands represent in many cases a solution to water security problems. It underlines the importance of transition management, the role of traditional knowledge and presents synergies between wetlands restoration/conversion and poverty alleviation. Finally, it presents recommendations for different stakeholders on how to respond to an improved understanding of the wide array of ecosystem service benefts from wetlands.

This is complemented by Annexes I and II, presenting additional case studies and an overview of the available literature on the multiple ecosystem service values of wetlands, and identifes the gaps in that knowledge-base.



Also, in many instances the services delivered by wetlands are underpinned by a combination of ecosystem functions arising both within and beyond the wetland and the surrounding landscape. For example, the hydrology of wetlands is determined by

2.2 [illegible]

2.2
(Int.$/ha/yr2007/PPP-corrected)[6]

Climate regulation
stabilisation

(2012)

ecological productivity

Jenkins et al. (2010)
and Barbier (2001), Islam

2.1

productivity

Water purification and pollution uptake, as
recharge
(2001)

[illegible] 2.2 [illegible] ([illegible] $/[illegible] [illegible], 2007 [illegible])[7,8]

[illegible]	[illegible]	[illegible]	[illegible] ([illegible] $/[illegible])	[illegible] ([illegible] $/[illegible])
[illegible]	provisioning services	33	6	20,892
	regulating services	17	8	33,640
	habitat services	8	0	56,137
	cultural services	43	0	1,084,809
	[illegible]	**101**	**14**	**1,1 5,478**
([illegible] & [illegible])	provisioning services	19	1	7,549
	regulating services	4	170	30,451
	habitat services	2	77	164
	cultural services	7	0	41,416
	[illegible]	**32**	**248**	**7 ,580**
[illegible] **-346**	**(77) 10.76 0 (164) -34.2**	**224.**	[illegible] **57** [illegible]	

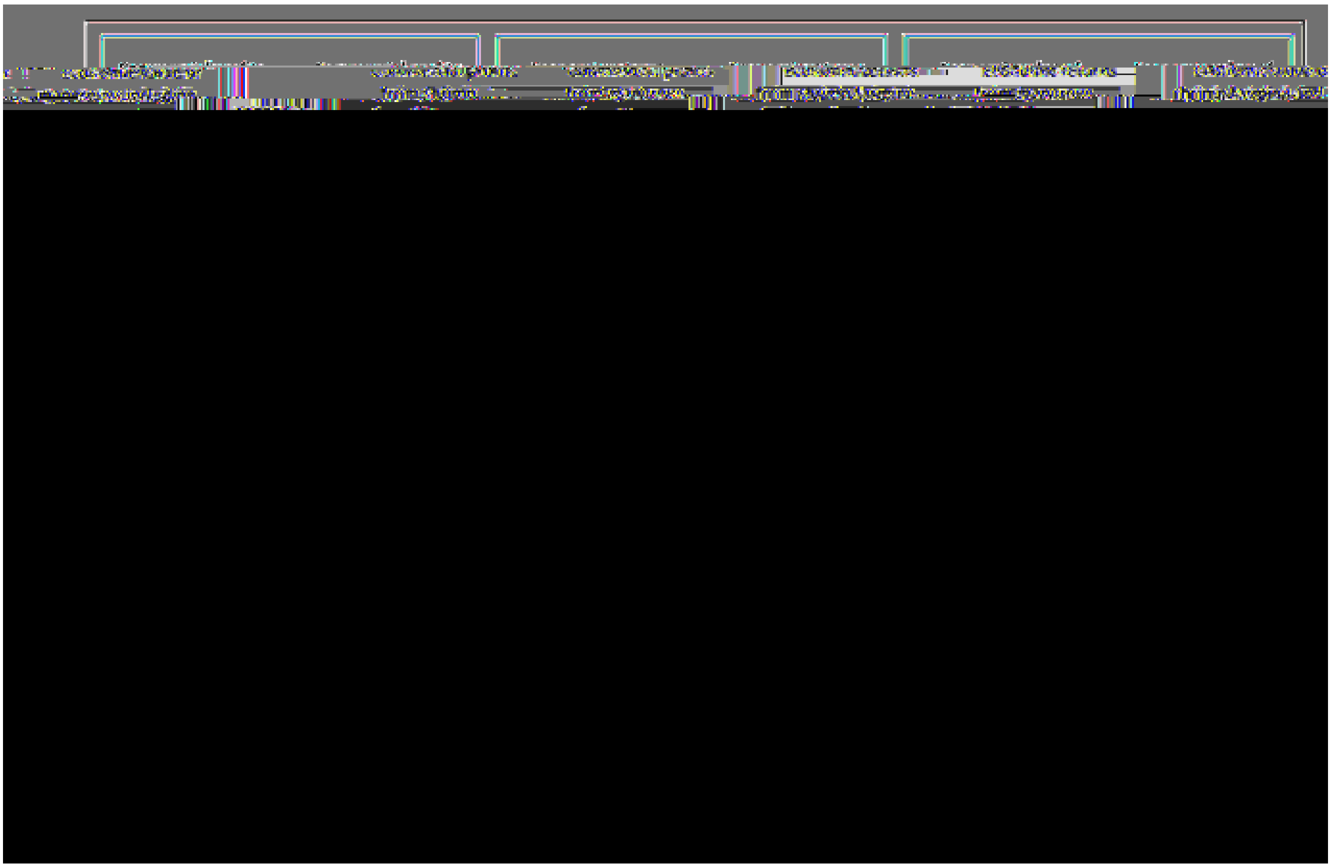
Sources: TEEB (2010); de Groot et al. (2010); See also Brander et al. (2006, 2011), Ghermandi et al. (2011), Barbier 2011 and TEEB (2010) for other overviews of valuation studies and associated meta-analyses.

As regards regulating ecosystem services, peatlands and mangroves act as essential carbon storage areas (Wilson et al., 2012; Siikamäki et al., 2012 – see section 3.5 and Box 5.1) and are important for coastal protection against storms and erosion. Some wetland areas can play important roles in food mitigation and thereby provide an important regulating ecosystem service, since approximately 2 billion people live in high food risk zones (MA, 2005b). Not all wetlands offer food mitigation benefts, because the food mitigation potential depends on the geographic situation, the interaction of the wetland area with other food defences, the potential food waters, and what the alternative land uses could have been (Posthumus et al., 2010; Rouquette et al., 2011). This role will be increasingly important in the light of increasing sea levels, storms and other extreme events that may arise from climatic change.

Furthermore, wetlands are often characterised by beautiful landscapes and rich biodiversity, thereby providing important aesthetic, educational and recreational ecosystem services that contribute to human wellbeing, cultural identity and economy. Wetlands may hold important spiritual values for some cultures. Many people across the world have cultural value links with water and wetlands that may be overlooked when changes occur to these habitats. While these are not monetary values, it is essential to recognise that such values are important for local communities.

It is also important to note that the ecosystem services that wetlands provide are not always synergistic with each other. Maximising ecosystem services for water supply $ I

[illegible] 2.3 [illegible] ($/) [illegible]



Sources: Barbier et al, 2007 and Hanley and Barbier, 2009

In developed countries, water security has been improved largely through building often expensive infux of saline water into the lower delta. The dam led to hyper-salinisation, expansion of area covered by invasive weeds, a reduction of daily income per fsher to less than US$3 per day, a decrease in the number of women able to gather grasses for weaving to less than 20 women, and the disappearance of cattle grazing in the delta. When the seasonal fooding of the delta was restored by changing the timing of the food releases of the dam, the income per fsher increased to over US$20 per day, more than 600 women were able to gather weaving materials from the delta, and livestock grazing was again possible (more than 150,000 cattle days per year) (Krchnak et al., 2011; Hamerlynck and Duvail, 2008). Thus changing the performance of the built infrastructure allowed for re-building of the natural infrastructure.

2.3 [illegible]

[illegible]

People have been progressively draining, in-flling and converting both coastal and inland wetlands for many centuries, since at least Roman times in Europe and since the 17th century in North America. This destruction and degradation continues. Major drivers of loss and degradation have been (and continue to be) conversion to frst extensive and then intensive agriculture (croplands), changes in water use and availability, increasing urbanisation and infrastructure development and, on the coast, also port and industrial developments and aquaculture.

Overall, estimates suggest that since 1900 the world has lost around 50% of its wetlands (UNWWAP, 2003), with 60% loss in Europe (55-67% losses in different countries; EEA 2010) and 54% loss since the 18th century in the USA (exceeding 90% loss in some states; Dahl 1990) and further 5% losses of both inland and coastal wetlands more recently (Dahl 2006). Highest rates of loss in these countries were in the 1950-1980 period, with losses continuing but more slowly since then. For example, in Europe whilst a further 2.7% of inland vegetated wetlands were lost between 1990 and 2006, open waters increased by 4.4% and coastal wetland area remained stable (EEA 2010).

Whilst wetland losses have generally slowed in North America and Europe, this is not the case everywhere else. In China, natural inland wetlands decreased in area by 33% between 1978 and 2008, whilst artifcial inland wetlands increased by 122% over the same period, and 31% of coastal wetlands were lost (Niu et al. 2012). Overall losses of coastal wetlands in East Asia over the 50 years to 2005 have been high: 51% in China, 40% in the Republic of Korea and >70% in Singapore (MacKinnon et al. 2012). In addition to the large total areas of coastal wetlands land-claimed in East Asia, chiefy for urban, infrastructure and port and industrial developments, annual rates of loss have also been particularly high, at up to 6 times more rapid than rates of loss reported from elsewhere. In addition, further major coastal land-claims are on-going or have been approved in this region, totalling at least a further 6,000 km^2 (MacKinnon et al. 2012).

Trends in areas of different wetland types refect these generaloss500400s005000550tinuing but mo(0 5./6.008 Tw T*in this estuaries had been lost by the 1990s (Davidson et al.

in many river basins, through reductions or changes

Box 2.6

Waza floodplain, Cameroon

Loth (2004) calculated that engineering works to reinstate the flooding regime in the Waza floodplain (8,000 km²), which was damaged in the 1970's by the construction of a large irrigated rice scheme, would cost approximately US$11 million. The same study calculated that the economic effects

Photo credit: Nick Davidson

3 IMPROVING MEASUREMENT AND ASSESSMENT FOR BETTER GOVERNANCE

[illegible]

- Information on the location and extent of water and wetland resources should underpin land and water management decisions.
- An appreciation of the hydrological functions of wetlands is essential to understanding their water related benefts to society and the economy.
- Understanding the reasons for wetland ecosystems degradation is crucial to identify opportunities where a focus on ecosystem services can help improve the management of water resources and wetlands.
- The management of water and wetlands can beneft from improved understanding of the ecosystem functions and the fow of ecosystem services. These in turn can be improved through better hydrological, biophysical and socio-economic data (e.g. indicators, mapping and accounting) that meet the needs of stakeholders and decision makers.
- Monetary valuation can signifcantly help demonstrate the importance of wetlands to society and the economy and thereby help argue for their protection, wise use and restoration. However, a single methodology cannot refect all values embedded in water and wetland-related ecosystem services. It is important to combine different approaches including bio-physical indicators, monetary valuation and participatory methods.

3.1 [illegible]

The increasing appreciation of ecological processes, functions and services, as well as of the interaction between nature and the economy, leads to improved governance of water and wetlands.

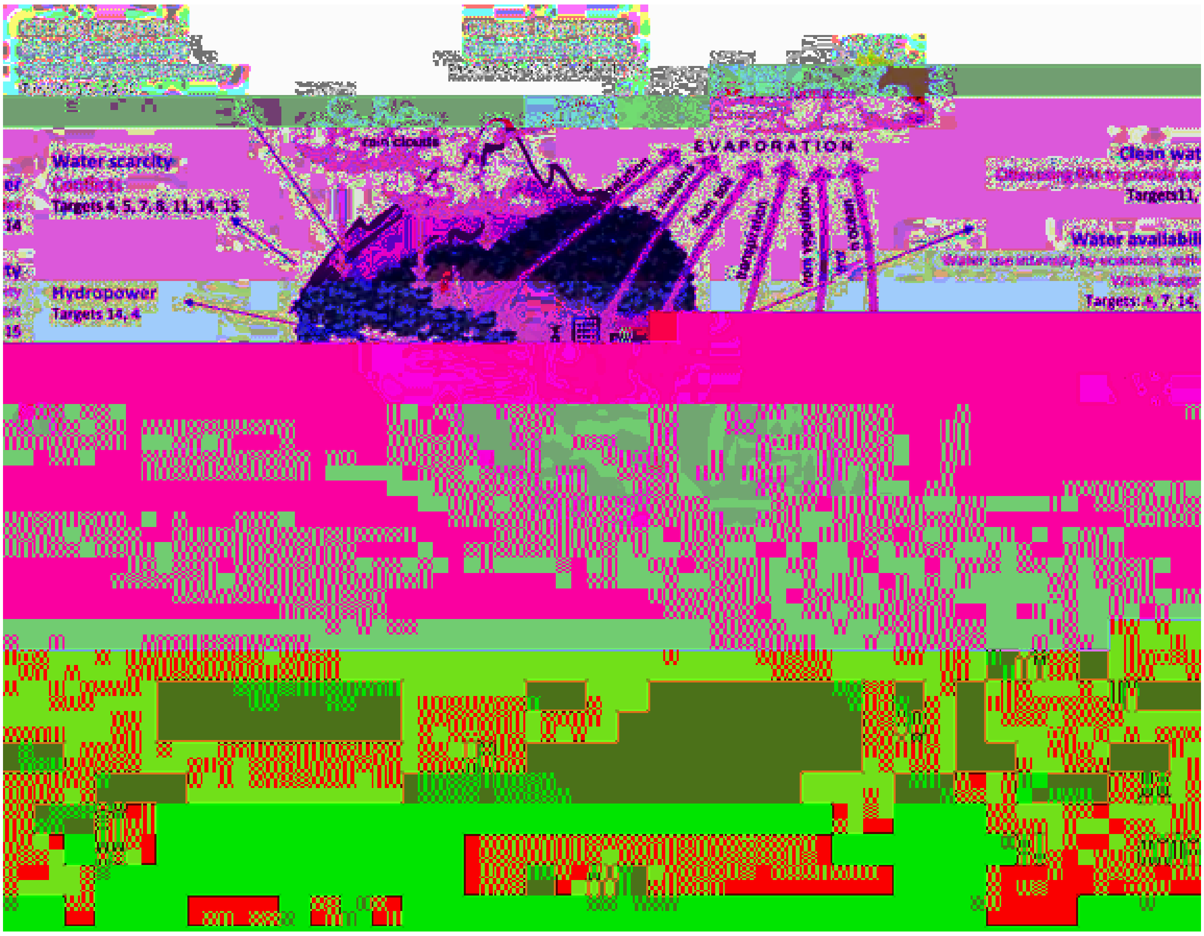
Figure 3.1 presents a simplifed illustration of the interconnections between the ecosystem functions (e.g. hydrological functions) and service fows (e.g. clean water provision); the drivers and implied pressures affecting the state, functions and fows; and the benefts that people, society and the economy

Figure 3.1 [illegible]

and describe in a qualitative or quantitative way possible changes in service delivery and their socio-economic consequences (see the pathway as depicted in Fig. 3.1). The key challenge of these models is to capture the complexity of ecosystem processes and ecosystem service valuation, while remaining transparent and user-friendly tools. Examples of these approaches include Bayesian belief networks, which allow the use of qualitative, quantitative, monetary, appreciation data, while involving stakeholders (van der Biest et al, 2013; Haines, 2011).

Indicators can be designed for a variety of policy objectives. For example, Box 3.1 shows information on a set of indicators being considered by the Subsidiary Body on Scientifc, Technical and Technological Advice

3.2 (Strategic Plan for Biodiversity 2011 to 2020 and MDGs)



In the above figure, ecosystem services are shown in bold red, Aichi Biodiversity Targets in black and in regular red are shown some relevant indicators in use by other processes including for agencies monitoring human development targets and sector agencies (e.g. the FAO). (Technical explanation of this figure is provided in SCBD 2011 together with sources of data). Source: redrawn from MRC (2003)

3.3

Geospatial mapping is a powerful instrument to demonstrate where the source of value comes from (i.e. the location and the extent of water and wetlands resources), who the benefciaries are, and what the interconnections between the two are. Demonstrating spatially which communities beneft from water supply, purifcation, food control or food from a given wetland can be a powerful tool to communicate the value of a wetland in the local socio-economic context. Mapping can also signifcantly help the design and evaluation of environmental policies.

Many research efforts are being carried out to combine information on ecosystem services and geographical information. As an example, Naidoo et al. (2008) mapped four proxies for assessing the ecosystem services provided by ecosystems worldwide, i.e. carbon storage and sequestration, grassland production for livestock and fresh water provision. Another example is the BIOMES project at the Joint Research Centre of the European Commission (JRC) (Maes et al., 2011), which aims to provide a spatially explicit assessment of European ecosystem services. Research mapping of the interrelationships between ecosystems, population centres and man-made infrastructures, such as the one realised by Vörösmarty et al. (2010), is very helpful for understanding the links and the interdependencies between them. There are also many research efforts that apply geospatial tools to the analysis of specifc wetlands, see for example Nagabhatla et al. (2008) in Sri Lanka and Gumma et al. (2009) in Ghana.

Within the Natural Capital Project[14], the tool InVEST (Integrated Valuation of Environmental Services and Trade-offs) was developed for the spatial assessment of ecosystem services. For example, hydrological services including sediment and water retention, water yield and water purifcation have been assessed for informing land use decisions in the Yangtze River basin in China. In Boaxing County, China, this tool helped establish development zones while protecting areas with high ecosystem service value for erosion control and food protection by setting aside key conservation areas (Yukuan et al., 2010). The same instrument has also been used to help inform the establishment of

3.4 [illegible]

Monetary valuation can translate part of the information obtained through qualitative and quantitative indicators into monetary figures. For example, the wastewater purification service provided by healthy wetlands can be valued in monetary terms through the equivalent cost of a wastewater treatment plant that would provide a similar service. Additionally, the revenues generated from tourism can give an indication of the importance of the cultural ecosystem services provided by wetlands. Some ecosystem services have a direct economic value that can be readily monetised, such as the local economic value of fish catches.

Monetary valuation can give an indication of the society's preferences that is easily understandable and communicable. It can help make explicit preferences that are normally hidden and not reflected in market prices (e.g. the preference for clean water).

In many cases, provisioning ecosystem services (such as food or timber) are more visible and are favoured in the policy-making process because they have a market price, but there are many other ecosystem services that are less visible and often overlooked or underrepresented in the policy-making processes. The calculation of the economic value of traditionally less well covered provisioning services (e.g. the value of some genetic materials or of water provision from wetlands) and non-provisioning ecosystem services (e.g. water purification, waste water treatment, and erosion control) contribute to the arguments for conservation, wise use and restoration.

For example, a study carried out in 2009 by the International Union for Conservation of Nature (IUCN) together with the Environment and Agricultural Research Centre and the Economic and Social Policy Analysis Centre estimated that the annual economic benefits derived from agriculture in the Sourou Valley, Burkina Faso, were only 3% of the total ecosystem services (valued at US$21.2 million), despite the fact that in the mid-1990s the government had launched a master plan for agricultural development in the region. Timber products instead accounted for 37%, non-timber forest products for 21%, pastures for 18%, and both fishery and transportation on water for 10% (Somda and Nianogo, 2010). As another example, a recent study demonstrated that most potential carbon emissions due to mangrove loss could be avoided at a cost between $4 and $10 per ton of CO_2 (Siikamäki et al., 2012).

The outcomes of any valuation process depend on what the various stakeholders value, whose values

makers, managers, and the general public. (TEEB, 2010; TEEB 2011). Some examples are provided in Box 3.4.

its state is essential for nature to be taken into account in the decision-making processes. Natural capital and environmental-economic accounts can play a key role in systematically collecting information on the links between the economy and the environment.

One of the approaches to complementing economic accounts with environmental statistics is represented by the National Accounts Matrix including Environmental Accounts (NAMEA). NAMEA associates information on environmental impacts (in physical units) to standard economic accounts. It is organised in a matrix based on the input-output methodology developed by the economist Leontief. The environmental data collected in NAMEA are pressure indicators, and include two environmental sets of data: one for environmental problems (i.e. the greenhouse effect) and another for pollutants. The environmental problems and pollutants to be included depend on the political priorities of each country.

Water NAMEA is currently in use in many countries. It provides valuable information for water management (e.g. water use per added value of each sector), including not only direct use, but also all water use along the production chain.

Another complementary approach is represented by the System of Environmental-Economic Accounts (SEEA). Launched in 1993 by the United Nations and the World Bank, SEEA provides an internationally agreed methodology for environmental accounting. The SEEA framework has a similar structure and definitions as the SNA, and therefore it can be used together with economic statistics and indicators. A revision of the SEEA is currently being prepared by the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA). The new SEEA will include:

1) The core environmental resource accounts, which measure in physical terms the energy, water and material flows that cross the boundary between the economy and the environment and circulate within the economy (Volume 1, published in 2012,

Photo credit: Marco Raugei

4 INTEGRATING THE VALUE OF WATER AND WETLANDS INTO DECISION-MAKING

- Integrated management approaches such as Integrated Water Resource Management (IWRM), Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP), if properly applied, allow decision makers to simultaneously achieve multiple objectives (e.g. ensuring water, food and energy security, mitigating and adapting to climate change, alleviating poverty) and to deal with the synergies and trade-offs among them.

- In order to better manage and protect water and wetland ecosystem services, a range of different instruments and management approaches should be combined. These include improving site management, regulation and land use planning, property rights, improving or creating markets by information, pricing and incentives, and direct investments.

- Market-based instruments like taxes, fees, subsidies and their reform, tradable permit schemes, banking and Payment for Ecosystem Services (PES) programmes can play an important role in that they can encourage the eff cient use of resources, foster environmental protection, and involve a variety of social actors. These are however not a panacea, but should be seen as a complement to environmental regulation in the context of good governance.

4.1

Understanding the value of water and wetland ecosystem services is only the f rst step. To use this understanding to help promote these services, and thereby help protect wetlands, requires its integration into appropriate types of decision making. A wide range of decision making contexts and tools directly or indirectly affect water and wetlands. Spatial planning approaches have been adopted in many cases, such as Integrated Water Resource Management (IWRM),

4.3

On-site integrated management is crucial for the restoration and protection of water and wetland related ecosystem services. However, to do this requires site managers to understand the values of the ecosystem services provided by water and wetlands by working with experts and local communities and also to have funds available for management. For example, decentralised flood protection measures (i.e. a set of small technical interventions distributed throughout an entire drainage area such as: retention basins, small dams, artificial lakes, restoration of meanders and vegetation near river channels, afforestation of flood plains, and better soil management) can significantly reduce the occurrence and intensity of floods (Reinhardt et al., 2011). The damage potential of storms for coastal areas, river floods and landslides can be considerably reduced through a combination of careful land use planning and ecosystem maintenance or restoration to enhance buffering capacity (Maltby and Acreman, 2011).

As regards site designation, there are currently 2,065 registered Ramsar sites, covering 197,347,539 hectares[21]. There are many more wetland sites that are under national or other designations (e.g. EU's Natura 2000). Designation itself, when complemented by wise use of the wetland, due site management and associated investment, can lead to important improvements in ecological status of the site and increases in ecosystem service provision. A key challenge is to obtain the funding needed for due management. This can be facilitated by site designation and clear communication as to the importance and benefits of the sites for biodiversity and also wider socio-economic benefits (Kettunen et al., 2010, and Kettunen et al., 2013).

Box 4.2 provides an example of good on-site management practices.

4.4

In order to translate an assessment of the value of water and wetland ecosystem services into improved decision making, there has to be an effective governance framework in place. Effective and efficient regulation of activities that impact water and wetlands is, therefore, necessary to halt losses, stimulate restoration, and maintain the integrity of ecosystems and the ecosystem services they provide to people. This not only includes the basic legal and institutional frameworks for regulatory action, but also a situation where there is respect for the rule of law (i.e. laws are implemented). Corruption can be a major impediment which cannot be overcome simply by improving the evidence base for water ecosystem services through better valuation of the benefits nature provides. This is particularly true for water where built infrastructure involves large capital and operational investment and high opportunities for corruption.

There are three main types of environmental regulatory approaches (TEEB, 2011):

1. Regulation of water discharges that sets standards for emissions, ambient quality and technical practice (e.g. best available techniques), performance (e.g. water quality objectives) or management (e.g. agricultural activities) practices; water quantity regulation (e.g. limits on abstraction);

2. Regulation of products, which sets restrictions on product use (e.g. activities damaging endangered species) or production standards (e.g. certifcation, best practice codes);

3. Spatial planning, which regulates land uses and establishes protected areas (e.g. spatial planning frameworks such as IWRM, ICZM and MSP).

Examples of regulation and spatial planning to improve water and wetland management include the control of pollution from waste water treatment plants to protect the quality of surface water for other users, the designation of areas protecting drinking water sources from nitrate contamination, and the design of non-conversion zones in order to safeguard mangroves that provide important benefts or the establishment of protected areas. Further examples can be found earlier in this report (e.g. Box 4.1). Effective regulation and careful spatial planning help control some critical pressures on wetlands, including water abstraction and pollution, which in turn make the ecosystems less vulnerable to external challenges such as climate change, foods and storms.

4.5 [illegible]

Institutional arrangements, such as property rights, mediate the linkages between wetland ecosystem services and human societies. These are often based on customary and traditional management practices linked to wetlands.

These rights set up the rules that delimit the range of activities granted to individuals (or groups) over specifc (or range of) ecosystem services), including, but not limited to: defning access (right to enter a defned physical area and enjoy non-subtractive benefts), withdrawal (right to obtain resource units or products of resource systems), management (right to regulate internal use patterns and transform resource by making improvements), exclusion (right to determine who will have an access right, and how that right may be transferred), and alienation (right to sell or lease exclusion, management or withdrawal rights) (Schlager and Ostrom, 1992).

The complexity of property rights has an infuence on the way costs and benefts of ecosystem services are distributed and shared across societies and thereby have an important infuence on the way priorities on ecosystem services are generated, managed and trade-offs negotiated.

Furthermore, lack of clearly defned property rights and the degree of ft with ecosystem structure and processes that underpin ecosystem services can [illegible] was determined based on the species they specialised in catching. However, from 1984-85 prawn culture was introduced in Chilika to provide low-income families with a supplementary income. Prawn and shrimp export potential thrived thanks to increasing international demand, devaluation of the Indian Rupee, and trade liberalization. This triggered a massive infux of workers from farming communities into culture fshery ultimately leading to occupational displacement and loss of fshing grounds of traditional fshers in addition to confcts

4.6

The behaviour of companies, nations and citizens is strongly infuenced by the prices they pay for goods and services. However, the prices of goods and services often do not take account of the economic losses caused by the degradation of water and wetland ecosystems and, therefore, the loss of value from degraded ecosystem services. A range of different Market-Based Instruments (MBIs) can play an important role in integrating the costs associated with such loss of value into decision making and consequently infuencing the behaviour of citizens and companies. Examples include taxes and charges, phasing out or reforming environmentally harmful subsidies, quantity-based instruments, liability rules, and payment for ecosystem services (TEEB, 2011). Examples of how each of these is used in the context of protecting water and wetland ecosystem services are described below.

Taxes, fees and charges discourage environmentally harmful activities by increasing their costs compared to other more environmentally friendly alternatives (see Box 4.4 for an example). Subsidies, where duly targeted, reduce the costs related to sustainable activities or products, thereby increasing their market competitiveness. In theory, environmental taxes are more effcient than regulation because they make agents with lower abatement costs pollute (and pay) less than those with higher costs. In fact, the former will fnd it more convenient to reduce their environmental impact than to pay the tax, whereas the latter will prefer to continue polluting and paying the tax. As a result, costs to society as a whole are lower. Besides, tax policies encourage economic agents to continuously try to reduce their environmental impact, instead of binding them to a certain standard (Pearce and Turner, 1990). In addition, environmental taxes provide a source of funding that may be used to support environmental-friendly practices.

Liability-based instruments assign responsibility for preventing and remediating environmental impacts to those who cause them. Liability rules create an economic incentive to developers/users to incorporate the risk of a potential hazard and the value of remediation into their decisions. They establish that those who damage the environment beyk because monetary valuation is generally a lengthy and expensive process and reverse auctions involve high transaction costs and uncertainties. The development of PES schemes has been most widely used for the protection of water-related ecosystem services.

Box 4.9 provides some examples of PES schemes on water-related ecosystems and wetlands (see also the Peru case in Annex I). These examples show the importance of taking a wider catchment-based approach to understanding how water-related ecosystem services are threatened, in order to develop a PES scheme to target these pressures and so protect the services provided.

4. [illegible]

The PES programme in Costa Rica

A PES scheme in Costa Rica remunerates four kinds of forest-related ecosystem services: 1) the storage of carbon in forest biomass, 2) the supply of water for human consumption, agriculture and energy production, 3) the conservation of biodiversity, 4) the landscape beauty. The majority of funding comes from fuel taxes, although various international institutions help finance the project. To receive payment, forest owners must submit a plan and carry out sustainable forest management practices, such as firewalls or reforestation plans.

Source: Pagiola (2008)

The Payment for Hydrological Environmental Services programme, Mexico

The Programme was established to finance the hydrological ecosystem services provided by forests, and in particular, the protection of watersheds and aquifer recharge. The programme is financed through part of the federal taxes on water, and remunerates forest owners for maintaining the forest cover in areas where forests have a high impact on the water ecosystem services and are subject to high risk of deforestation.

Source: Muñoz-Piña et al. (2008)

Pimampiro PES programme, Ecuador

A PES programme is being carried out in Ecuador to protect the water catchment area of the Pimampiro municipality. The programme was designed to protect the water quality and quantity of the river basin Palaurco through the conservation of native forests. The beneficiaries of the payment are 19 farms. The funding is derived from a surcharge of 20% in the water prices paid by the 1,350 families with water metering, plus some funds of the Pimampiro municipality and the interests of a fund made available by the FAO and the Inter-American Foundation.

Source: Wunder and Alban (2008)

The Vittel PES programme, France

At the end of the 1980's, Vittel, a French mineral water company, initiated a PES programme to preserve the quality of its bottled water, which was threatened by the presence of nitrates and pesticides associated with the intensification of agricultural and livestock raising practices upstream. After approximately ten years of negotiations between the company and the farmers, a package of incentives available to farmers in the area was established, including: 18 and 30 year-contracts to ensure continuity; the abolition of the debt associated with the purchase of land by farmers; an average of €200 per hectare per year for five years to cover the costs related to the transition to the new, more sustainable agricultural model; a lump sum of up to €150,000 per farm to meet the initial costs; workers paid by Vittel to produce organic fertilizer for the farmers; technical assistance and free introduction to new social and professional networks. The programme was a success: 26 of the 27 farms in the area adhered and chose 30-year contracts, allowing the protection of 92% of the water catchment area.

Source: Perrot-Maître (2006)

The SCaMP programme in the UK

United Utilities (UU) Group PLC is the UK's largest water business and provides water and wastewater services to approximately 7 million people in the north west of England. It also owns 57,000 ha of land, much of which in protected areas. In 2005, UU launched a PES scheme called Sustainable Catchment Management Programme (SCaMP), with the objective of improving water quality. Between 2005 and 2010, the SCaMP covered an area of 20,000 ha and invested £10.6 million in a set of environmental measures to restore drained, burnt and overgrazed moorland and degraded blanket bog, as well as to increase diversity of hay meadow/rush pastures and woodlands. In order million between 2010 and 2015. The measures included in this second project are similar to the ones of SCaMP and are mainly focussed on water quality improvement.

While aimed at improving water quality, the

Voluntary offsetting schemes also exist that encourage private, companies and public bodies to offset their impacts by financing restoration or conservation projects (see TEEB 2011).

Currently, the most used offsetting schemes are voluntary carbon credits programmes, which in recent years have shown a promising growth rate. Mechanisms need to be established to ensure transparency, additionality and a direct link between the payment and the CO_2 reduction, as well as the permanence of the CO_2 in time and a low environmental impact. In this regard, the role of the intermediary institutions, which manage the programme, finance the mitigation projects and sell the carbon credits to the interested citizens or companies, is very important in ensuring credibility and effectiveness. To increase the level of reliability and transparency of voluntary compensation schemes, international certification programmes have been established, such as for example the Greenhouse

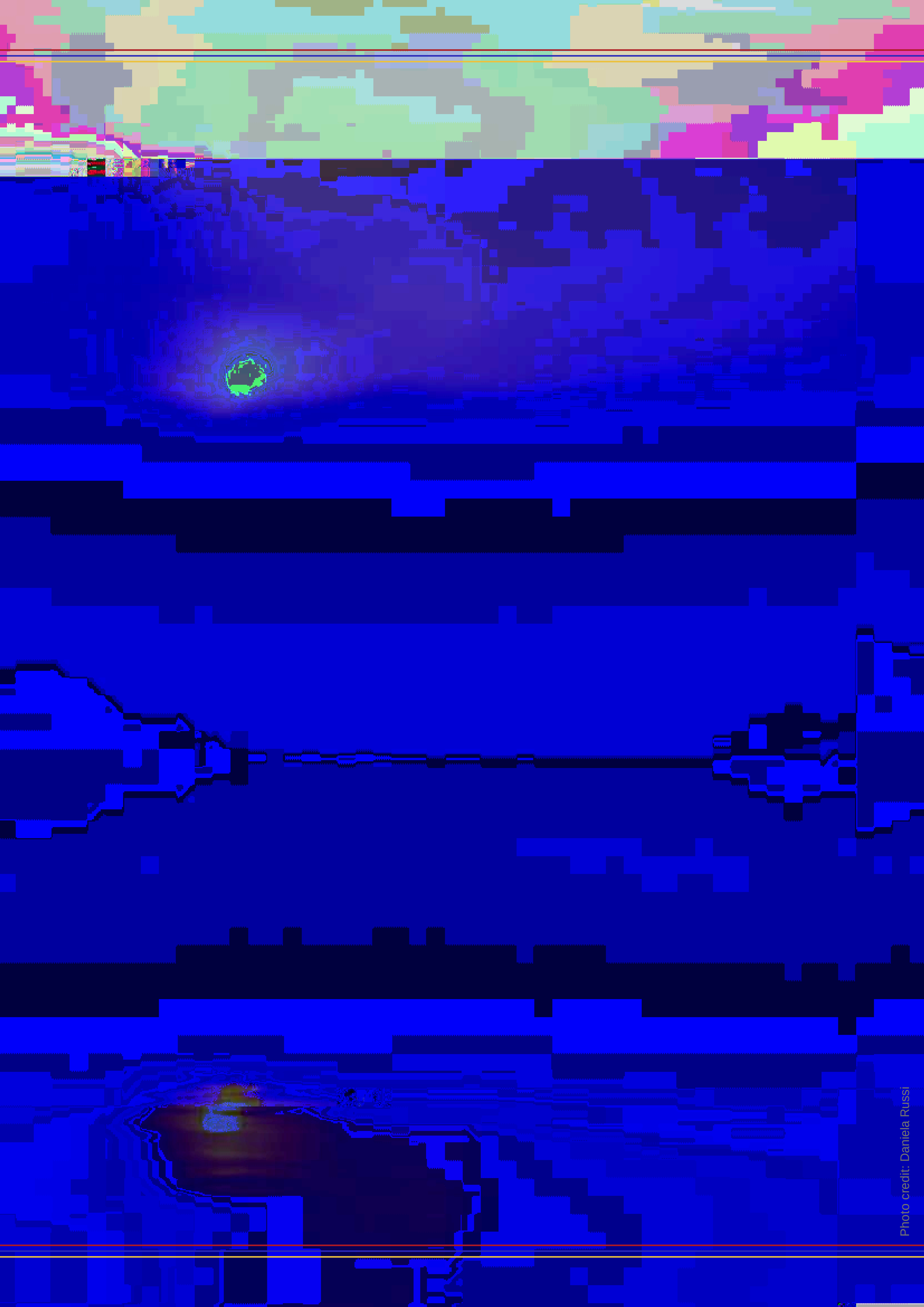
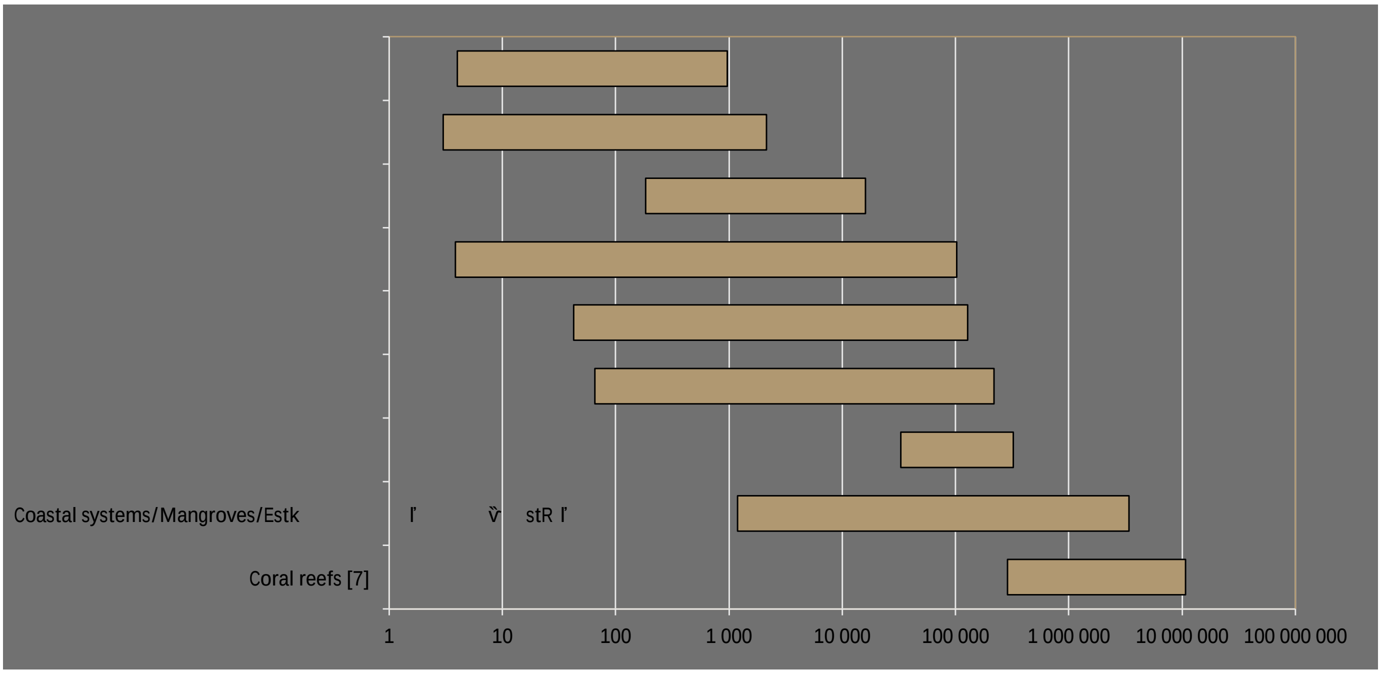


Photo credit: Daniela Russi

There remains an important economic argument (inter alia) for subsequently restoring or rehabilitating the degraded ecosystems where a precautionary approach was not adopted or successful and degradation occurred. In fact, their restoration and the associated improvement in ecosystem service fows can often provide new or improved benefts to people. These benefts include climate change mitigation and adaptation, protection from extreme events, water, energy and food security and livelihood for local communities. Restoration also helps achieve biodiversity targets for highly depleted ecosystem types and threatened species.

5.1



Bars represent the range of observed costs in a set of 96 studies reviewed for this study. The numbers refer to specific studies identified and listed below as illustrative examples of the studies in which cost data have been reported in sufficient detail to allow analysis and comparison.

Source: Aronson et al. 2010, and additional sources: [1] Eelgrass restoration in harbour, Leschen 2007; [2] Restoration of coral reefs in South East Asia, Fox et al 2005; [3] Restoration of mangroves, Port Everglades, USA, Lewis Environmental Services 2007; [4] Restoration of the Bolsa Chica Estuary, California, USA, Francher 2008; [5] Restoration of freshwater wetlands in Denmark, Hoffmann 2007; [6] Control for phosphorus loads in storm water treatment wetlands, Juston and DeBusk 2006; [7] Restoration of the Skjern River, Denmark, Anon 2007a; [8] Re-establishment of eucalyptus plantation, Australia, Dorrough and Moxham 2005; [9] Restoring land for bumblebees, UK, Pywell et al 2006; [10] Restoration in Coastal British Columbia Riparian Forest, Canada, Anon 2007b; [11] Masoala Corridors Restoration, Masoala National Park, Madagascar, Holloway et al 2009; [12] Restoration of Rainforest Corridors, Madagascar, Holloway and Tingle 2009; [13] Polylepis forest restoration, tropical Andes, Peru, Jameson and Ramsey 2007; [14] Restoration of old-fields, NSW, Australia, Neilan et al 2006; [15] Restoration of Atlantic Forest, Brazil, Instituto Terra 2007; [16] Working for Water, South Africa, Turpie et al 2008

Restoration can be very expensive, although not always, but many experiences across the globe suggest that restoration and rehabilitation of degraded ecosystems can bring considerable benefts to people and often provide ecosystem services at a lower cost than alternative man-made infrastructures (see Box 2.5). Restoration often provides a suite of economically and socially essential ecosystem services, such as water treatment and soil stabilisation.

Depending on the extent of the degradation suffered by wetlands, restoration can be achieved through "passive restoration" (strategies to allow ecosystems to regenerate themselves by eliminating key threatening processes) or, when spontaneous self-regeneration is not possible, active interventions (TEEB, 2011, Chapter 9). Examples of active interventions are tree planting and rewetting drained peatlands and coastal wetlands by reducing water losses (e.g. through blocking drains and reducing groundwater extraction). In many cases, restoring a site will not lead to the same level of biodiversity and ecosystem service flows, because ecosystem degradation has entailed that one or more thresholds of irreversibility (e.g. species extinction) has been passed. In these cases, rehabilitation can be carried out, in order to restore/rehabilitate at least some ecosystem processes and allow the provision of certain ecosystem services.

Box 5.1 provides some examples of wetlands restoration and the benefits they provided to people.

5.1

<u>Peatland restoration in Mecklenburg-Western Pomerania, Germany</u>

In Germany over 930,000 ha of peatlands were drained to allow for agricultural production. In the Mecklenburg-Western Pomerania state in North-Eastern Germany, 97% of the 300,000 ha of peatland was drained. As a consequence, the carbon stored in the peat was degraded leading to carbon emissions. In the last two decades, cattle rearing decreased in this area, reducing the need for grazing areas and fodder production, reducing the agricultural opportunity costs. In addition, an increased need for water storage was foreseen in view of the future effects of climate change in the area. For these reasons and for the high costs of maintaining drainage infrastructure and equipment, the Ministry of Agriculture, the Environment and Consumer protection (MLUV) of the Mecklenburgorder to avoid and mitigate floods in the Napa River Basin, a US$ 400 million project was initiated in 2000, with the objective of increasing the capacity of the wetlands adjacent to the river to handle flood waters, while maintaining and restoring its original shape and alignment. Local stakeholders including residents, researchers, business owners, representatives from the state and civil society, came up with a new plan called the "Living River Guidelines." Existing floodwalls and levees were replaced with terraced marshes, wider wetland barriers, and restored riparian zones. Also, the river was restored closer to its original shape, allowing it to meander as much as possible. Over 700 acres around the Napa city were converted to marshes, wetlands and mudflats. 50% of project costs were financed locally through a 1% yearly sales tax increase for 20 years, and the other 50% by federal sources, grants and loans from the state. The project reduced the risk of floods, increased property values and tourism, and improved the water quality and wildlife habitats. Extensive private investment in property development totalling US $400 million has occurred since the approval of the flood project. Flood insurance rates for about 3,000 properties will either be be lowered or eliminated when the regulatory flood maps are changed through the Federal Emergency Management Agency (FEMA).

Source: Almack (2010)

<u>Mangrove restoration in Senegal</u>

45,000 ha of mangroves in the estuaries of Casamance and Sine Saloum, out of 185,000 ha, have been lost since the 1970s due to droughts, reduced [illegible]

5.3

Traditional practices and local knowledge can play an important role in the wise use of wetlands, and need to be taken into account in wetland management. Recognising and strengthening the link of local communities to wetlands can contribute to conservation by involving a wide range of stakeholders. Also, local and traditional knowledge should be considered key in managing wetland ecosystem services. In many cases, traditionally evolved techniques of ecosystem management are better tailored to local conditions than external management approaches. Moreover, involvement of local communities is a key factor for successful policy change and its acceptance.

The integration of traditional water and related resource management practices can often increase the cost-effectiveness of restoration projects by, for example, reducing the need for outside expertise, tools and technologies or increasing community involvement due to the accrual of valuable co-benefts.

Box 5.2 shows one of the 33 examples presented in a recently published book on the relationship between culture and wetland protection in Japan (Tsujii and Sasagawa, 2012) and one of the case studies analysed in a report on the cultural values in the Mediterranean (Papayannis and Pritchard, 2011).

5.2

Pond dredging and clean-up, Sakata, Niigata City, Japan

Katabushin is a traditional form of lagoon management, which consists of dredging the lagoon to remove debris, which is then used to fertilise surrounding rice paddies, together with reed cutting and rubbish collection on the banks. The Sakata lake ecosystems were degraded since the 1960s, and threatened with succession and eutrophication after the Katabushin practice ceased. Katabushin was revived in 2002, after interviewing elders who remembered the state of the lake before degradation. The Sakata conservation group organises every year a Katabushin event, which attracts between 200 and 300 participants and is crucial for the conservation and restoration of Sakata. The event plays a key role in preserving Sakata's culture by allowing participants to sample lotus and water chestnut dishes. Also, lessons on dry lotus blossom arrangement are organised during the event.

Source: Tsujii and Sasagawa (2012)

Prespa Lakes, Greece, Albania and the FYR of Macedonia

The Micro and Macro Prespa Lakes are among the oldest lakes in Europe. They are very rich in biodiversity and host many endemic species. In the past, many traditional activities were linked to the conservation of wet meadows. Until the 1980s, cattle grazing maintained the diverse and short vegetation of the wet meadows, allowing the presence of rare bird species such as pelicans and the then rare cormorants. Reeds were used as a building and insulation material, as a resource for making household objects and as animal feed. Buffalo grazing controlled the spread of the reed beds and allowed the presence of wet meadows. Wet meadows play an important role in the ecosystems of the lake (they are used as spawning grounds by some fsh species and as feeding and nesting areas for water birds, and support a large number of invertebrate, amphibians, reptiles and mammals). A programme is now being carried out by the Society for the Protection of Prespa (SPP) for the integrated management of water resources in the two Prespa lakes, which will aim to reconnect with traditional practices; one of the main activities of the programme is the re-introduction of the traditional management of reed beds through grazing by buffaloes.

Source: Papayannis and Pritchard (2011)

5.4

Sustainable tourism can contribute to transition management, since it is a way of supporting local livelihoods and local cultures, while generating incentives for the conservation and management of natural resources. In addition, sustainable tourism in wetlands can help provide means for conservation and improvement of ecosystem services. In many cases, it also facilitates the acceptance and enforcement of environmental regulation by local populations and businesses, and can be combined with communication and education activities, targeted both to local communities and tourists. According to the UNWTO defnition, sustainable tourism should "make optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity" (Ramsar and UNWTO, 2012). Key elements of sustainable tourism are appropriate planning, regulating and monitoring of tourist activities, as well as the involvement of local communities e.g. though training activities and credit schemes to set up small tourism businesses (UNEP, 2011).

Tourism in wetlands depends on the water-related ecosystem services delivered by healthy wetlands (e.g. freshwater, food protection), and also on other ecosystem services (e.g. beautiful landscapes), and therefore constitutes and additional motivation for restoration and conservation

Box 5.3 presents some examples of sustainable tourism management that brings benefits to local communities.

5.3 [illegible]

Tubbataha Reefs Natural Marine Park, Philippines

The Tubbataha Reefs Natural Marine Park was created in 1988, which banned fisheries, as destructive fishing was increasingly threatening the function of the reef as a nursery ground for the Sulu Sea. Intact reefs are also attractive for dive tourists providing an important source of income. However, the ban alone was insufficient to solve the problem. Interests were divided between those pushing for a fishing ban within the park and the fishers claiming their rights to extract resources in the park. Externally imposed park rules were not respected.

5.5 [illegible]

Improving and restoring wetlands can be a cost-effective way of meeting a range of policy, business, and private objectives. This includes not only water security, but also food and energy security, since water plays a key role in agriculture and energy production (see Chapter 2). Moreover, wetlands have a central role in climate change adaption and their sustainable management in many cases is able to improve their resilience to climate change by mitigating its effects (e.g. increased storms, droughts and foods). Well-preserved wetlands also contribute to social cohesion and economic stability by ensuring livelihood for local communities and to preserving cultural identity. For all these reasons, ensuring healthy and well-preserved wetlands is crucial to alleviate poverty and meet the UN Millennium Development Goals for 2015 (WWAP, 2012). They are also expected to be instrumental in contributing to meeting the Sustainable Development Goals that will be set post- 2015.

Reallocating investments to protect water-related ecosystem services and natural water infrastructures, including wetlands, will be crucial in fulflling these objectives. For example, water and sanitation can be improved through wetland restoration. Access to clean freshwater can be ensured by healthy wetlands like rivers and lakes. Investments in water and wetland management will provide long-term economic benefts, reduce overall costs, and may be cheaper than the alternative technological solutions (see Box 2.5 for some examples). Also, restored wetlands can provide livelihood for local communities (e.g. by supporting viable fsh populations or attracting tourists). Box 5.4 shows some examples of poverty alleviation associated to wetland restoration projects.

5.6 [illegible]

Some types of wetlands have a negative image in the eye of the general public. For example, swamps, marshes and bogs are often seen as insalubrious places, which favour the spread of diseases like malaria. Furthermore, protection and restoration of wetlands can not only bring (direct or indirect) economic benefts to many people, but they can simultaneously negatively impact other stakeholders (e.g. restoring coastal mangroves for storm protection can impact the livelihood of shrimp farmers). In many cases a trade-off is found between the conservation or improvement of supporting and regulating ecosystem services (e.g. food protection, sediment transport and water purifcation) and the delivery of provisioning ecosystem services (e.g. agricultural products and timber); see section 4.2 for further details. The resulting loss in employment opportunities may cause local populations to oppose sustainable wetland management.

Reducing the magnitude of the negative impact of wetland restoration can only be achieved by taking into account the bundle of ecosystem services that are affected by the measures instead of looking at the effects on services individually. As transitions almost always involve trade-offs, it is key to reduce the extent of the trade-offs by looking at the sum of the effects on the different ecosystem services and do this on a larger spatial scale. Integrative modelling approaches such as Bayesian belief networks are being successfully applied (van der Biest et al, 2013; Haines, 2011) to evaluate bundled services. Coupling spatial planning and trade-off analysis improves functional understanding of ecosystem service trade-offs, determines the overall impact of land use shifts on ecosystem service supply and can determine the

For this reason, a careful management of the transition process towards an improved protection of water-related ecosystem services and wetlands is crucial, not only from an ethical point of view but also for the wide acceptance of the needed reforms. Disseminating knowledge on the benefts that wetlands provide to local communities can help counterbalance the negative vision on wetlands some stakeholders may have. In addition, it helps build a balanced view on the trade-offs involved with wetland management, thereby increasing acceptance and participation in the required transition policies and actions. Ensuring an equitable sharing of the benefts may imply compensating those whose benefts are eroded as a consequence of the enhancement of other ecosystem services.

For a successful transition, it is important that the needs of all relevant stakeholders are addressed (and especially the most vulnerable ones).

In the case of the Tubbataha Reefs Natural Marine Park (see Box 5.3 and Annex 1) simply establishing a no-take zone did not solve the problem of reef degradation as fshermen continued entering the area applying unsustainable fshing methods. Only when a compensation payment generated through a fee on dive tourism was introduced did fshermen agree on respecting the no-take zone. As a result, fsh populations within the park regenerated leading to a “spillover effect” to the areas outside the park which in turn increased the catch of fshermen beyond what they caught earlier without the no-take zone. The compensation payment allowed fshermen to receive immediate benefts from a no-take zone and helped to overcome the time lag in the recovery of the reef ecosystem.

The example of Kala Oya in Sri Lanka (Box 3.9) illustrates how the re-introduction of traditional practices for water management can help local communities to realise multiple benefts from ecosystem services provided by the traditional man-made water tank system and inform restoration strategies. In a stakeholder process costs and benefts of different management options for water tanks with regards to ecosystem services were assessed. It was found that rice cultivation is only one beneft besides many others including water provisioning for domestic use and livestock, fsheries and harvest of lotus fowers. Although manual removal of silt was the most labour and therefore cost intensive option for rehabilitating the tank system, local communities opted for this strategy as they could apply it themselves having better control over their resources.

In the case of the restoration of the Napa River (see Box 5.1), not only did the extreme food events mobilise decision makers to restore the river bed but local stakeholders, including residents, researchers, business owners, and representatives from the state and civil society, came up with a new plan called the “Living River Guidelines.” They were important change agents for proposing strategies that created multiple benefts for the local community including reduced potential food damages, improved water quality and habitats, and creating higher recreational values. Eventually also insurance rates are expected to decline due to lower food risks.

Box 5.5 provides some further case examples for a successful transition management.

5.5

Water Funds in Latin-America

The Northern Andes region faces three critical problems: 1) natural ecosystems, mainly páramo and mountain forests – the key hydrologic regulators of the region – are threatened by conversion to crop and ranch land; 2) ranchers and farmers depend on the land for their livelihoods; and 3) growing population and demand for water. Coupled with unpredictable impacts of climate change, there is a threat to the long term availability of natural resources in the region.

Preventing access to the natural ecosystems would harm the farmers’ livelihoods. However, allowing continued conversion increases the likelihood of ecosystem degradation and threatens access to water services, such as clean drinking water for these same people, as well as downstream users and benefciaries such as cities, water utilities, agricultural and beverage industries.
Water funds aim at solving this confict by establishing long-term fnancial mechanisms that involve a public-private partnership of water users who determine how to invest fnancial resources e expected t4isurancedustries.
s in ₡ ¿ s g

beverage companies, agriculture associations), citizens (e.g. in cities paying fees, taxes, for water use), grants and private foundations, bilateral and multilateral donor agencies and the financial returns generated from the trust fund.

3) Establish a multi-stakeholder institutional mechanism, which includes representatives of all stakeholders (public and private). It should make decisions about how to spend money in the watershed, prioritising investment based on feasibility studies and, in some cases, on the advice from a technical committee.

4) Implement concrete actions to generate services and conservation benefits, e. g. securing protection of natural ecosystems; and implementing best management practices on productive systems to provide ecosystem services.

5) Establish an accountability system to ensure delivery of services and protection of natural ecosystems including indicators that allow measuring the impact of the action on the ecosystems, the services they provide and on the livelihoods of people.

Creating a water fund requires time, leadership, particular biophysical and social conditions, and a "fit" with national and regional laws. Developing feasibility studies, identifying good regions for the water fund approach, engaging stakeholders, selling the model, and establishing relationships involve large upfront costs. Effective replication in new regions requires people to undertake these tasks and charismatic leadership to engage new stakeholders.

Despite these hurdles, water funds are proliferating throughout Latin America particularly through a relatively new initiative: the Latin American Water Funds Partnership, an alliance supported by The Nature Conservancy, FEMSA Foundation, Inter-American Development Bank (IADB) and Global Environment Facility (GEF), created to preserve healthy watersheds and help protect water supplies in the region. The Partnership comprises investments of over US 27 million that will create, implement and capitalise at least 32 water funds in Ecuador, Colombia, Peru, Brazil, Mexico and other countries in Latin America and the Caribbean. These will support the conservation of watersheds that in turn could benefit around 50 million people in rural and urban areas.

Sources: Calvache et al. (2012); Goldman et al. (2010a); Goldman et al. (2010b)

<u>The Quito Water Conservation Fund</u>
About 80% of the water for the nearly two million inhabitants of the city of Quito, Ecuador, comes from three protected areas. A variety of activities threaten the availability of this regular clean water supply mainly due to land conversion for farming in the watershed.

The Quito Water Conservation Fund (Fondo para la Conservación del Agua – FONAG) was created with an initial investment of US$ 1,000 from The Nature Conservancy (TNC) and US$ 20,000 from the Quito water company. Other water users have since joined the water fund, such as the Quito electric company and private organizations including a beer company (Cervecería Nacional), a water bottling company (Tesalia Springs Co.) and a Swiss Cooperation (COSUDE). The endowment reached US$ 5.4 million at the end of December 2008 and is now almost US$ 8 million. In 2008 alone, the endowment yielded US$ 800,000 which FONAG invested in conservation projects. After a 7-year process a municipal by-law was passed by which the Quito water company will provide 2% of their revenue to the water fund (up from the initial 1% commitment).

FONAG uses the revenue from the water fund to finance various programmes and projects including control and monitoring of protected areas, restoration of natural vegetation, environmental education and outreach, training in watershed management, productive projects with local communities and a hydrological monitoring programme. One of the main beneficiaries of the activities is the local communities that live close to the water sources.

Showing results has been crucial for maintaining support. According to Arias et al. (2010), during 10 years FONAG has:

- Helped conserve the watersheds that provide 80% of the water upon which the citizens of Quito, a population of 1.8 million, depend;
- Involved 500,000 ha of land;
-

5.7

[illegible]

At the [illegible], there is a need to ensure implementation of the Strategic Plan for Biodiversity 2011-2020, the Ramsar Strategic Plan 2009-2015, the UNFCCC, the MDGs, and strategic planning and implementation of the many Multilateral Environmental Agreements (MEAs). The role and value of water and wetlands should be integrated in each of these, in order to improve water security and other water-related benefits. It is an awareness and governance challenge, with potential for significant synergies and efficiency gains, because investments in wetlands are investments in human welfare.

[illegible]

- Integrate the values of water and wetlands into decision making and national development strategies – in policies, regulation and land use planning, incentives and investment, and enforcement. Make full use of the NBSAPs (National Biodiversity Strategies and Action Plans) process to help with integration;
- Ensure that wetland ecosystem services options and benefits are fully considered as solutions to land and water use management objectives and development;
- Develop improved measurement and address knowledge gaps, using biodiversity and ecosystem services indicators and environmental accounts. This requires an improved science-policy interface and support for the scientific/research communities. The recently established Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[5] could contribute significant co [illegible];
- Reform price signals via water cost recoverc, resource pricing and reforming environmentally harmful subsidies, so that they promote sustainability;
- Commit to restoration t [illegible] land/or programmes, improving ecosystem health and functioning, thereby achieving the multiple benefits of working with nature.

[illegible]

- Assess the interactions between wetland ecosystems, communities, man-made infrastructures and the economy and ensure the evidence base is available to decision makers, whether spatial planners, permit authorities, investment programme authorities, inspectors or the judiciary;
- Integrate planning systems - e.g. water supply and management to t [illegible] into account both ecosystem-based infrastructures and man-made infrastructures;
- Ensure due engagement/participation of communities [illegible] indigenous peoples) and ensure that traditional knowledge is duly integrated into management solutions.

[illegible]

- Assess the status and trends in wetland ecosystem services, including identification of components and processes that are required to sustain the provision of these services[6];
- Assess the interlinkages between livelihood systems and ecosystem services, particularly property rights and distribution of costs and benefits associated with ecosystem services provision[7];
- Develop site management plans to ensure wise use of wetlands, including sustained provision of ecosystem services[8];
- Use valuation of ecosystem services as a means to communicate the role of wetlands in the local and regional economy, support resource raising, or inform decision makers of the impacts and trade-offs linked with developmental policies impacting wetlands[9];
- Include mechanisms for capturing ecosystem service values as incentives for the stewardship of local resource use within management plans. Where possible and relevant, use tools such as payments of ecosystem services, taxes and other economic instruments to rationalise incentives linked with ecosystem services;

- Identify co-benefit opportunities for achieving development sector outcomes (for example, food and water security) by mainstreaming wetland ecosystem services in sectorial policies;
- Communicate ecosystem service values at the local level - to get buy-in for site management, attract funding for protection and management measures, and reduce the pressures on wetlands, including risks of land use permit decisions that may undermine public goods[10].

[illegible]

- Contribute to fill knowledge gaps on the values of water and wetlands, on improved governance solutions, on measures and tools to support the development of environmental accounts;
- Improve knowledge of the hydrological functions of wetlands and how these influence ecosystem services within and beyond wetlands;
- Improve the understanding of public goods and the trade-offs between public goods and private benefits from policies and investment choices.

[illegible]

- Integrate the appreciation of the multiple values of wetlands and potential cost savings to meet the objectives of development cooperation (e.g. ecosystem restoration to improve water security, poverty alleviation, local development and wellbeing; investment in ecosystem-based adaptation to climate change).

[illegible]

- Support wetland management via funding and expertise, including engaging volunteers to help with monitoring, science and restoration;
- Understand, demonstrate and communicate the value of wetlands. Work with other stakeholders to help identify and carry out practical responses.

[illegible]

- Identify impacts and dependencies of business on water and wetlands related-ecosystem services in the short to long term. Assess the risks and opportunities associated with these impacts and dependencies;
- Develop corporate ecosystem valuation and environmental profit and loss accounts to improve disclosures;
- Take action to avoid, minimise and mitigate risks to biodiversity and ecosystem services. Realise opportunities for synergies between private interests and public goods, whether via restoration activities, engagement in markets or wider commitments to no net loss of biodiversity (or net gain). Commit to water footprint reduction, in order to safeguard future resource availability for private and public benefits.

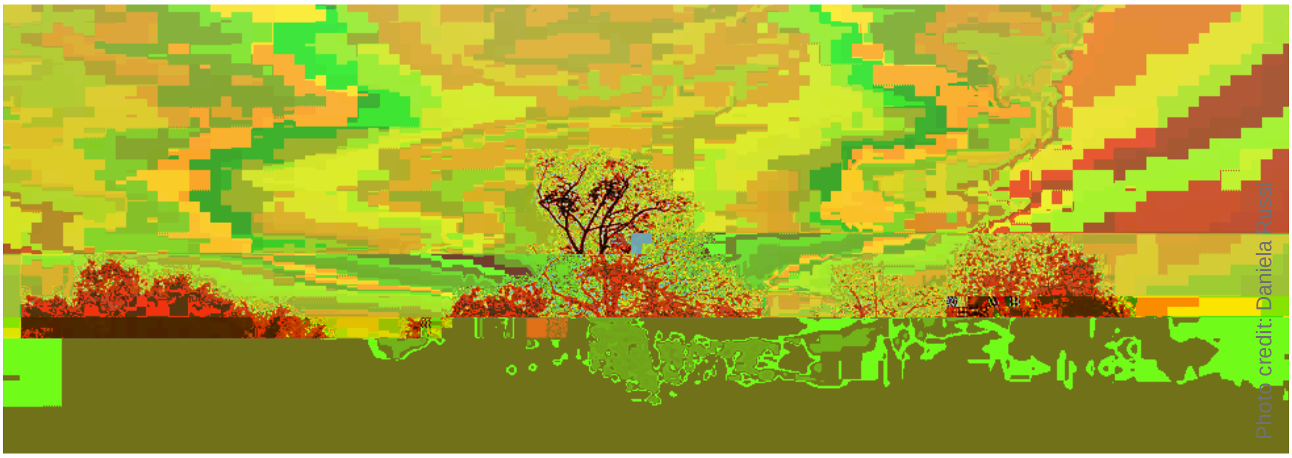


Photo credit: Daniela Russi

[illegible]

[illegible] ([illegible] 2012, 245, [illegible] 2010)

[illegible] 1 [illegible]

The water supply for Moyobamba, a city of about 42,000 inhabitants located in the Andean foothills in northern Peru, depends on the three watersheds: Rumiyacu, Mishquiyacu and Almendra. These biodiverse areas were impacted by land-use change during the last decades. As a consequence, the quality and quantity of water coming from these watersheds declined, which negatively impacted city inhabitants. The public company EPS is responsible for supplying the city with water and considered increasing measures for water treatment and to restrict water supply. This would have increased the costs for potable water production (León and Renner, 2010; Renner 2010). A signifcant improvement in land use was needed for the conservation and restoration of ecosystem services that support water quality and supply, in order to satisfy demand from water of companies and citizens, while improving farmers' livelihoods.

Public authorities and representatives from civil society, with advice from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), an institution working in the feld of international cooperation, started a dialogue in order to identify the causes for the degradation and the necessary actions for improving the management of the watersheds (León and Renner, 2010). As there was no scheme for water management, a steering committee that included the relevant upstream and downstream stakeholders, was established.

[illegible] 2 [illegible]

Preliminary assessments pointed out that the underlying cause of ecosystem degradation and deteriorating water quality was in particular the migration of poor families from the high Andean regions. Due to lack of knowledge on appropriate land practices for the Amazon ecosystem and economic alternatives, they converted forests of the upstream areas to agriculture, causing changes in the provision of ecosystem services. [illegible]

[illegible] 4 [illegible]

Following a request by government decision-makers, InVEST is being applied by the World Wildlife Fund as part of the forum of NGOs who are assisting with land-use planning in Sumatra, known as Forum Tata Ruang Sumatera. The results were (ForTRUST). InVEST provides mapped information on where, and how much, ecosystem services are supplied, and how these patterns might change under future land-use scenarios. It can be overlaid with biodiversity information to see where ecosystem services and conservation priorities overlap. InVEST was used to model the quantity and location of high-quality habitat, carbon storage and sequestration, annual water yield, erosion control and water purifcation under two scenarios: the Sumatra ecosystem vision as proposed in the Roadmap Action Plan and a business-as-usual scenario corresponding to the government's current spatial plan.

[illegible] 5 [illegible]

In June 2010, the results were disseminated and preliminary recommendations were offered to government representatives from 18 districts in central Sumatra. The results were based on the potential gains or losses in ecosystem services if the ecosystem vision (as outlined in the Roadmap Action Plan) was

dependent (TEEB, 2010). Nevertheless, information about the economic importance of ecosystems is an essential tool for supporting better informed decisions regarding the trade-offs in land-use options and resource use.

Tables AII, 1-5 provide an overview of the monetary values of ecosystem services for fve categories of wetlands: 1) coral reefs; 2) coastal systems (habitat complexes e.g. shallow seas, rocky shores & estuaries); 3) mangroves and tidal marshes 4) inland wetlands (foodplains, swamps/marshes and peatlands); and 5) rivers and lakes. An analysis of the coverage and gaps in this area of research is provided in the next section.

.2

(habitat complexes e.g. shallow seas, rocky shores & estuaries)
Int.$/ha/year – 2007 values

Sources: TEEB (2010); de Groot et al. (2010)

[illegible] .3 [illegible] & [illegible]

Int.$/ha/year – 2007 values

Sources: TEEB (2010); de Groot et al. (2010)

No. of used

[illegible] PROVISIONING SER[illegible] (Int.$/ha/y)Maximumvalues(Int.$/ha/y) TOTAL:

.4 [illegible]
(foodplains, swamps/marshes and peatlands)
Int.$/ha/year – 2007 values

[illegible]	[illegible]	[illegible] (.$/. /)	[illegible] (.$/. /)
[illegible]	86	86	44,5 7
[illegible]	34	34	.70

Sources: TEEB (2010); de Groot et al. (2010)

.5 [illegible]
Int.$/ha/year – 2007 values

Sources: TEEB (2010); de Groot et al. (2010)

T

.8. Gap assessment

	Coral reefs		Mangroves & tidal marshes	
Ecosystem services	Relative ecosystem service importance	No. of valuation studies	Relative ecosystem service importance	No. of valuation studies
Provisioning				
Food	●	22 **J**	⬤	12 **K**
(Fresh) water supply	n/a	n/a	•	3 **K**
Raw materials	•	6 **K**	⬤	18 **J**
Genetic resources	•	1	•	0
Medicinal resources	•	0	•	2 **K**
Ornamental resources	●	5 **K**	•	0
Regulating				
Infuence on air quality	•	0	•	1
Climate regulation	●	1	●	6 **J**
Moderation of extreme events	⬤	13 **J**	⬤	13 **J**
Regulation of water fows	n/a	n/a	•	0
Waste treatment/ water purifcation	•	2 **K**	⬤	4
Erosion prevention	•	1		3
Nutrient cycling/ maintenance of soil fertility	●	0		1
Pollination	n/a	n/a	•	0
Biological control	•	2 **K**	⬤	0
Habitat				
Lifecycle maintenance (a.k.a. biodiversity)	●	0	●	33 **J**
Gene pool protection	?	8 **K**	?	5 **K**
	⬤	12 **J**	●	0
Recreation/ tourism opportunities	⬤	31 **J**	●	13 **J**
Inspiration for culture, art & design	⬤	0	●	0
Spiritual experience	⬤	0	●	0
Cognitive information (education & science)	•	0	•	0

Sources: TEEB (2010); de Groot et al. (2010); MA (2005b); Danone Fund for Nature (2010).

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1 http://www.unece.org/env/water/

2 The phrase “in the context of sustainable development” is intended to recognise that whilst some wetland development is inevitable and that many developments have important benefts to society, developments can be facilitated in sustainable ways by approaches elaborated under the Convention, and it is not appropriate to imply that ‘development’ is an objective for every wetland.

3 Ramsar COP9 Resolution IX.1 Annex A (2005).

4 Mekong River Awareness Kit: interactive self-study CD-Rom. Mekong River Commission. P.O. Box 6101, Unit 18 Ban Sithane Neua, Sikhottabong District, Vientiane 01000, Lao PDR.

5 This classifcation, while internationally broadly accepted, is not the only possible one, and indeed other classifcations have been proposed. The choice on the classifcation to be adopted depends on the purpose for which it is used (Fisher et al., 2009; Costanza, 2008). The MA’s classifcation in Box 2.2 is a powerful instrument for environmental education and awareness-raising. However, it does not fully distinguish between intermeeeĞiʊ א use " ʿ vIcöʊ ᴺ ʊ ᵥ a oert er