



Purpose of this BN

This Briefing Note provides advice on how to prioritize and implement the adopted Ramsar principles and guidelines on wetland restoration (Annex 1). It also advises on the relevance of other guidance to assist the following audiences in restoring wetlands:

- Ramsar National Focal Points; national, subnational and local policy-makers; legislators and regulators; administrators; planning and implementing bodies involved in restoration of degraded wetlands; and
- Practitioners implementing wetland restoration activities on the ground, including inter alia wetland managers, NGOs, communities, corporations, and local/state/provincial councils and administrative units.

Authors

Sasha Alexander, STRP Representative of the Society for Ecological Restoration

Robert McInnes, STRP Representative of the Society of Wetland Scientists

The benefits of wetland restoration

The primary objective of this Briefing Note is to raise awareness, across all sectors, of the potential benefits of wetland restoration. Its intention is to catalyse efforts that stem the loss and degradation of wetlands, enhance ecosystem functioning, and thus increase wetland benefits. By highlighting the linkages with existing Ramsar documentation, this Briefing Note expands upon the existing guidance on wetland restoration while referencing other examples of publicly available documents in the last section.

Key Messages

Stop the global loss of wetlands

The world's wetlands continue to be lost and degraded at an alarming rate as a result of human activities. Consequently, the essential benefits provided by wetlands to people continue to be seriously eroded. These benefits, derived from wetland ecosystem services, are unique, varied and extend across many sectors, but their contribution and value is not always fully captured in wetland management decision-making. A better understanding of wetland benefits is required in order to make the case for halting further loss and degradation, and to support activities that assist in the recovery of their biodiversity and ecosystem functioning.

Prioritize the protection and restoration of wetlands

Removing the stressors or pressures on the ecological character of wetlands is the best practice for preventing further loss and degradation; when this is not feasible, however, or when degradation has already occurred, wetland restoration must be considered as a potential response option. The commitments and obligations under the Ramsar Convention clearly mandate wise use and the avoidance of wetland loss and degradation in the first instance. The Convention has also provided national governments and others with a framework on how to avoid, mitigate and compensate for wetland loss and degradation which includes opportunities for wetland restoration.

Understand the appropriate role for wetland restoration

Restoration is not a substitute for protecting and ensuring the wise use of wetlands, i.e., the potential to restore a wetland is not a justification or suitable trade-off for the continued degradation of wetlands. Furthermore, while restoration can play an important role in enhancing wetland benefits, experience shows that a "restored" wetland rarely provides the full range and magnitude of services delivered by a wetland that has not been degraded.

Encourage holistic wetland restoration objectives

In the past, some wetland restoration efforts have failed due to, among other things, narrow objectives which focus on one benefit or a partial suite of ben-

efits. The inability to recognize or appreciate the potential for achieving multiple benefits across sectors has, in some cases, precluded cost-effective, participatory approaches to wetland restoration that may be more successful in recovering benefits and delivering more sustainable outcomes for people and the environment.

Recognize the full suite of wetland restoration benefits Decision-makers are urged to take immediate and appropriate measures to recognize the full suite of environmental, cultural and socio-economic benefits from wetland restoration. For example, in the tropics, mangroves and peat swamp forests play a critical role in carbon storage and climate regulation. The failure to recognize these multiple benefits often greatly undermines the rationale for wetland restoration and compromises future well-being.

The importance of wetland ecosystem services

Introduction

The Ramsar Convention defines wetlands as “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres” (Article 1.1). The Convention also recognizes the interdependence of humans and wetlands and the irreplaceable resources they provide to society.

In all of their myriad forms, wetlands are collections of plants, animals and micro-organisms (biotic components) that interact with the non-living environment (abiotic components) and exist within and form an integral part of the larger landscape, i.e., watersheds, catchments and river basins. It is the unique range of hydrological conditions of wetlands which determines its biodiversity and ecosystem functioning. Due to their inherent diversity, wetlands are highly productive systems that play a fundamental and disproportionate role in providing a multitude of ecosystem services that sustain all life on the planet, regardless of the particular landscape in which they are found.

Wetlands perform many functions on local, regional and global scales – from providing wildlife habitat and basic necessities for humans to regulating atmospheric processes and geochemical cycles. While these benefits are not always obvious or measurable, they are nevertheless critical. Different wetlands provide a range of valuable services according to their type, size and loca-

Background

Resolution X.10 *Future implementation of scientific and technical aspects of the Convention*, Annex II, requested the Scientific and Technical Review Panel (STRP) to undertake two tasks under Thematic Work Area (TWA): Wetland Management – Restoration, Mitigation and Compensation. Task 9.2 specifically requested the STRP to:

Prepare proposals for updating and expanding existing Ramsar guidance on restoration and rehabilitation of lost or degraded wetlands, in the context of Resolution X.16 on *A Framework for processes of detecting, reporting and responding to change in ecological character*, including approaches to prioritization and links with other Ramsar tools and guidance, *inter alia*, those on climate change and on economic values of ecosystem services.

The initial phases of this review work were undertaken during 2009-2011 by the STRP, and its findings and recommendations are provided in a “Summary Report on Activities 2009-2012”. Amongst the recommendations presented in that report was a proposal to prepare an STRP Briefing Note on wetland restoration prior to Ramsar COP11 in July 2012.

tion. The influential Millennium Ecosystem Assessment recognizes the enormous global economic importance of wetlands, valued at up to US\$15 trillion dollars in 1997 (MA, 2005). Our increased understanding of the importance of wetland services has led to a greater appreciation of their value. The legal and/or cultural protection of wetlands by many societies and governments is an explicit recognition of the benefits they provide, although these measures have not, in many places, proven sufficient to stem the extent and rate of wetland loss and degradation.

Some wetland ecosystem services have direct market values or quantifiable benefits to specific sectors or stakeholders, such as the cost of water for agricultural production, or the value of fish to fisherfolk. Most wetland ecosystem services, however, such as water filtration and wildlife habitat, indirectly benefit society at large and are therefore classified as public or non-market benefits. The difficulty of assessing and quantifying these indirect benefits means that they are often given low priority within the competing demands for wetland services. In planning for the wise use of wetlands, governments and wetland managers must protect and restore these public benefits and work to ensure their equitable distribution. The non-competitive nature of these indirect or public benefits also provides a large

number of stakeholders with a powerful rationale to protect and restore wetlands.

Wetland loss and degradation

When wetlands are degraded, the broad range of benefits they produce begins to deteriorate and eventually vanish. In some cases, degradation occurs because one particular benefit is valued above all others, such as water supply for irrigation in agricultural production systems. Wetland degradation is defined as the alteration of an existing or intact wetland resulting in a simplification or disruption in its structure, function and composition and, in turn, a loss of biodiversity and ecosystem services. This is most often caused by human activities or disturbances that are too frequent or severe to allow for natural recovery. Not only have population pressures and other human-induced stressors resulted in the degradation of wetlands across the globe, but the effects of climate change (e.g., sea level rise, temperature increases, changes in flood and drought patterns) are also increasingly impacting the quality and flow of wetland services. The continued loss and degradation of wetlands will result in a further reduction in benefits and thus negatively impact human health and well-being into the future, particularly for the poor and disenfranchised who often depend disproportionately on these public goods and services.

The benefits of restoring degraded wetlands

The Ramsar Convention defines restoration in its broadest sense, including activities that promote a return to previous conditions as well as those that improve the functioning of a wetland without necessarily seeking to return it to its pre-disturbance condition (Ramsar HB19¹). This notion of restoration proceeds from the widely-cited definition of ecological restoration as “the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed” (SER, 2004). The attributes of successful wetland restoration activities include: 1) the utilization of native wetland species in characteristic assemblages and functional groups, 2) self-sustaining and resilient wetland ecosystems integrated within the larger landscape, and 3) the reduction or elimination of the drivers of wetland degradation (SER, 2004). In 2002, the Ramsar Convention adopted principles and guidelines for wetland restoration.

1 Reference to the Ramsar Wise Use Handbooks in this Briefing Note adopts the shorthand of “Ramsar HB[Number of the Handbook]”. All references are to the 4th edition of the Handbooks. The Handbooks are available for download in PDF format at www.ramsar.org/handbooks4.

Wetland biodiversity and ecosystem functioning

Biodiversity underpins ecosystem functioning which, in turn, produces “services”. These ecosystem services are defined as the benefits that people obtain from ecosystems (MA, 2005) and they include **provisioning services** (e.g., food, fibre, fuel, water); **regulating services** (e.g., climate, floods, disease, waste and water quality); **cultural services** (e.g., recreation, aesthetic enjoyment, tourism, spiritual and ethical values); and **supporting services** necessary for the production of all other ecosystem services (e.g., soil formation, photosynthesis, nutrient cycling).

A recent meta-analysis indicates that restoration activities that enhance biodiversity are positively correlated with the increased provisioning of ecosystem services (Rey Benayas *et al.* 2009). Figure 1 on page 7 portrays the causal relationship between different socio-economic sectors, wetland restoration activities, biodiversity and ecosystem functioning, and the delivery of benefits. Because the objectives of restoration activities have become increasingly focused on ecosystem services (Bullock *et al.* 2011), it is important to account for the impacts of wetland use on biodiversity and ecosystem functioning. When the drivers of wetland degradation cannot be reduced or eliminated, restoration activities can still play a role in reducing negative impacts and enhancing benefits.

Human health and sustainable livelihoods

The ability of wetlands to filter and supply fresh water is perhaps the single most important service impacting the health of urban, rural and coastal communities around the world. In addition to supplies of fresh water, many communities are dependent in one way or another on the services provided by wetlands for their subsistence and economic livelihoods, further increasing the urgency and importance of restoring degraded wetlands.

Water, food and energy security

Water, food and energy security in many countries are, in large part, dependent on wetland functioning and are necessary conditions for economic development and poverty alleviation. Wetland restoration is one tool to redress the over-exploitation of groundwater and the draining or diversion of surface water, particularly in low-income countries with significant population pressures and susceptibility to desertification, land degradation, and drought (DLDD). Food and energy security are also threatened by the same unsustainable uses and pressures that negatively impact the fisheries, agriculture, water supply and treatment, hydro-electric and transport sectors.

Resilience of socio-ecological systems

Protecting and restoring wetlands should be a critical element in national and global strategies to mitigate and adapt to climate change. Restoring degraded wetlands increases the adaptive capacity of these ecosystems and their dependent communities to absorb and adjust to extreme events and other disturbances, such as floods, droughts, and sea level rise. Wetland restoration activities that enhance resilience are therefore critical to the health and sustainability of socio-ecological systems. However, we must understand the nature of climatic and ecological changes that are likely to occur regionally in order to properly design wetland management and restoration plans at the mega-watershed level (Erwin, 2009).

Eco-cultural restoration of the Mesopotamian Marshes, Iraq

In the 1990s, in the aftermath of the first Gulf War, the government led by Saddam Hussein drained the Mesopotamian Marshes to punish the indigenous tribes, collectively referred to as the Marsh Arabs, for their support of the uprising in the aftermath of the conflict. The Marsh Arabs had been living in and traditionally managing the marsh ecosystem for over 5,000 years, and in this largely arid climate, the marshes were the only source of fresh water for wildlife and human livelihoods. A network of canals was built to divert water from the Euphrates and Tigris Rivers, reducing the marshes to less than 10% of their original size. As a result, the marshes dried or became saline, wildlife populations collapsed, and the Marsh Arabs were forced to leave. Since 2003, a number of NGOs have been working to remove large drainage canals and re-establish water flows to the marshes, and by 2007 approximately 50% of the marshes had been restored. Rare and endangered wildlife gradually returned, as did components of the livelihoods of the Marsh Arabs embodied in their traditional fisheries, gardens and water buffalo, an ecologically and culturally important species. The eco-cultural restoration of the Marsh Arabs in Iraq stills faces significant challenges, including dam construction, recent droughts, and reduced flows that are causing the marshes to dry again. As a result, the wildlife resurgence is under threat and the Marsh Arabs who did return face the prospect of having to leave again. An international framework for basin planning and the equitable allocation of water rights is urgently needed to protect the people and nature of the Mesopotamian Marshes.

Services enhanced: *water supply/recharge, agricultural productivity, livestock management, native biodiversity, cultural identity, carbon sequestration, etc.*

Sectors benefited: *agriculture, water, transport, climate change, livelihoods, etc.*

Stevens, M. 2011. Eco-cultural restoration of the Mesopotamian marshes, southern Iraq in *Human Dimensions of Ecological Restoration*. Springer, New York.

tion to assist decision-makers and wetland managers (Ramsar HB19).

Restoring lost or degraded wetlands represents a valuable and cost-effective opportunity for society to recover and enhance benefits for human health and well-being, including reduced risk from storms and other extreme events, improved food and water security, and the capacity to mitigate and adapt to climate change. The restoration of mangroves and near-shore habitats, for example, provides food (fish and invertebrates) and other basic necessities, habitat for birds, reptiles and mammals, carbon sequestration, and climate protection, and it contributes to enhanced socio-economic resilience among coastal communities. The total value of benefits that flow from a restored wetland can often be several times higher than the cost of restoration when added to the value of the benefits lost due to degradation. As nature characteristically provides ecosystem services at a lower cost than human-made systems, wetland restoration can be a cost-effective, long-term strategy for achieving conservation and development objectives simultaneously.

Although restoration can clearly play an important role in enhancing existing and recovering lost benefits, experience shows that a “restored” wetland rarely provides the full range and magnitude of services delivered by a wetland that has not been degraded (Moreno-Mateos *et al.* 2012). Thus, the first priority should be to conserve and sustainably use wetlands rather than allow

for their continued degradation. Regrettably, given the current state of loss and degradation, conservation alone is not sufficient to protect and enhance these wetland benefits. Restoration has now become a necessary wetland management tool in many countries to ensure a desirable and sustainable future.

Wetland restoration benefits multiple sectors

Wetlands have the potential to provide long-term benefits to multiple sectors concurrently, such as agriculture, fisheries, water, forestry, health, energy, extractive industries, recreation, transport, education, development, and indigenous and local communities. The relative importance given to various wetland benefits derived from restoration activities will depend to some extent on the degree of information available to decision-makers and wetland managers. When considering wetland restoration opportunities, an adequate evidence base is needed to demonstrate and communicate the full suite of benefits and their relevance across sectors.

Here, sectors are defined as discrete subdivisions within a socio-economic system such as private landowners and corporations, local, regional or national authorities, and components of civil society, including NGOs and indigenous and local communities. In the past, many wetland restoration projects and programmes have been driven by the nature conservation sector or the environment departments in governments, which often had

Mangrove restoration: Vietnam and the Philippines

Mangrove restoration in Vietnam and the Philippines has been ongoing for over 20 years. These efforts are described as “ecosystem-based” and “community-based” approaches to deal with the uncertainty surrounding anticipated climate change, associated sea level rise, and coastal erosion. Mangrove ecosystems protect communities and coastal habitats from storms and typhoons, efficiently store carbon, and play a critical role in maintaining fisheries which provide for economic livelihoods.

In Vietnam, an estimated 50,000 hectares of monoculture plantations of primarily *Rhizophora stylosa*, *Kandelia candel*, and *Sonneratia caseolaris* were planted from 1994 to 2006. Where successful, primarily in the north, benefits for coastal protection and fisheries have been significant. Although the overall project costs were estimated at US\$1.1 million, the investment has saved US\$7.3 million per year in dyke maintenance. It is estimated that some 7,750 families have benefited from mangrove restoration, including income generation, reduced vulnerabilities and improved nutrition from restored fish populations. However, the net increase in the total area of mangroves over this same time period was only 15,000 ha, which was probably due to encroachment into existing mangroves. In the Philippines, similar attempts at monoculture plantations of *Rhizophora spp.* on 40,000 ha of mudflats cost US\$17.6 million but with only limited success. Both of these examples illustrate that successful restoration can benefit local coastal communities with payments for plantings and increased incomes from improved fisheries, but large-scale failures are common. Ecological Mangrove Restoration is one approach that recommends a careful evaluation of existing topographic and hydrologic conditions prior to site selection as well as practitioner and volunteer training before implementation.

Services enhanced: *food/nutrition, fish/invertebrate habitat, climate protection, native biodiversity, carbon sequestration, etc.*

Sectors benefited: *fisheries, water, climate change, human health, livelihoods, etc.*

Lewis, R. R. 2009. Methods and criteria for successful mangrove forest restoration. Chapter 28, pp. 787-800 in G.M.E. Perillo, E. Wolanski, D. R. Cahoon, and M.M. Brinson (eds.) *Coastal Wetlands: An Integrated Ecosystem Approach*. Elsevier Press.

Powell, N., M. Osbeck, S.B. Tan, and V.C. Toan. 2010. *Mangrove restoration and rehabilitation for climate change adaptation in Vietnam*. World Resources Report Case Study.

Samson, M.S. and R.N. Rollon. 2008. Growth performance of planted mangroves in the Philippines: revisiting forest management strategies. *Ambio* 37:234-240.



Two year old mangrove restoration site through low-cost manual removal of dikes by the local fisherman and their families on the island of Tanakeke, Sulawesi, Indonesia (© R. Lewis)

the singular objective of recovering wildlife habitat. In order to gain support from multiple sectors with diverse interests in wetland restoration, stakeholders must be made aware of all the possible environmental, cultural and socio-economic benefits and given the opportunity to participate in planning and implementation.

Community and grass-roots participation in wetland restoration activities often contribute to their long-term success by educating local communities and focusing attention on the causes of degradation, as well as by creating employment and a more equitable distribution of benefits. However, care must be taken to properly train community volunteers and provide appropriate guidance from experienced managers and restoration professionals. Similarly, the use of indigenous or traditional knowledge can contribute to the long-term success of

restoration activities by providing critical insights into historical conditions that may improve the design and implementation of wetland restoration projects and programmes. These are essential components of the participatory approach advocated by the Ramsar Convention (Ramsar HB7).

Wetland restoration activities that optimize for a narrow range of ecosystem services and result in trade-offs in the delivery of competing services often preclude the provision of an equitable suite of benefits. For example, wetland restoration projects or programmes that exclusively target improvements in water quality and flow for the urban or agricultural sectors may neglect wildlife habitat, sedimentation, and nutrient cycling that support a wide variety of other services. In order to ensure greater equity and the long-term sustainability of wet-

The Working for Water Programme, South Africa

In the mid-1990s, South Africa initiated a national ecosystem restoration programme, modelled on Payments for Ecosystem Services. It is a replicable prototype for many developing countries and perhaps industrialised countries as well. Using restoration to address development issues as well as conservation objectives, the government-funded Working for Water (WfW) programme employs tens of thousands of people to clear mountain catchments and riparian zones of harmful alien invasive plants in order to restore natural fire regimes, hydrological functioning, native biodiversity, and the productive potential of the land. As the benefits of restoring hydrological processes have become more and more apparent, water utilities and municipalities are now contracting WfW to restore entire catchments in order to improve their water supplies. Despite some shortcomings, the WfW programme provides many valuable lessons for overcoming the conflicts that can arise when addressing complex economic, ecological and social issues.

Services enhanced: *water supply/recharge, agricultural productivity, livestock management, native biodiversity, carbon sequestration, etc.*

Sectors benefited: *agriculture, water, climate change, livelihoods, etc.*

Turpie, J.K. *et al.* 2008. The working for water programme, South Africa. *Ecological Economics* 65: 788–798

land restoration outcomes, an Ecosystem Approach is often best suited to effectively manage the design and implementation of restoration activities as well as prioritize the inevitable trade-off in benefits.

The Ecosystem Approach is a strategy for the integrated management of land, water, and biological resources that promotes conservation and sustainable use in an equitable way (Finlayson *et al.* 2011). The Ramsar Convention's concept of wise use is perhaps the oldest example of the Ecosystem Approach among the intergovernmental processes concerned with the conservation and sustainable development of natural resources. In addition to understanding ecological processes within the context of the larger watershed or river basin, restoration projects and programmes must be designed and implemented with the aim of fostering multisectoral cooperation and stakeholder participation to allow for the pooling or leveraging of knowledge and resources, the resolution of long-term governance issues, and equitable socio-economic development. Under these circumstances, wetland restoration can be a "win-win" propo-

Participatory approaches and stakeholders

Involvement of local and indigenous people in wetland restoration falls within the general resource management approach known as *participatory management*. Terms such as collaborative, joint, community-based or co-management are more or less synonymous in this context. *Stakeholders* are taken to be bearers of separate interests and/or contributions for the management of a wetland, with a particular focus on *interest groups* within local and indigenous communities. The government agencies responsible for wetland management and local authorities may also be considered as stakeholders.

The term *community* as used in the Ramsar Handbooks can be understood at two levels. On one level it represents a more or less homogeneous group that is most often defined by geographical location (e.g., a village), but possibly by ethnicity. At this level, the community may have very distinct interests compared with other major stakeholders (e.g., government agencies, businesses and NGOs). On another level, it represents a *collection* of different interest groups such as women and men, young and old, fisherfolk and farmers, wealthy and poor people, and different ethnic groups. Even in relatively unified communities, it is likely that these subgroups have different interests and perspectives that need to be taken into account in the participatory management process and specifically in setting targets for wetland restoration.

Ramsar Convention Secretariat, 2010. *Participatory skills: Establishing and strengthening local communities' and indigenous people's participation in the management of wetlands*. Ramsar handbooks for the wise use of wetlands, 4th Edition, vol. 7. Ramsar Convention Secretariat, Gland, Switzerland.

sition that, with limited resources, enhances the quality of life for both people and nature (Figure 1).

The CBD's Ecosystem Approach outlines twelve principles, two of which are particularly relevant to wetland restoration considerations (CBD, 2004). Principle 1 recognizes that sectors often have different economic, cultural and societal needs which determine the benefits they seek from wetland restoration activities. It therefore encourages communication and collaboration among different sectors in order to establish common ground, determine the types of activities to be undertaken, and equitably manage the trade-offs between multiple benefits. Principle 3 encourages sectors and stakeholders to consider the impacts of wetland restoration activities on other ecosystems and in the context of the wider landscape.

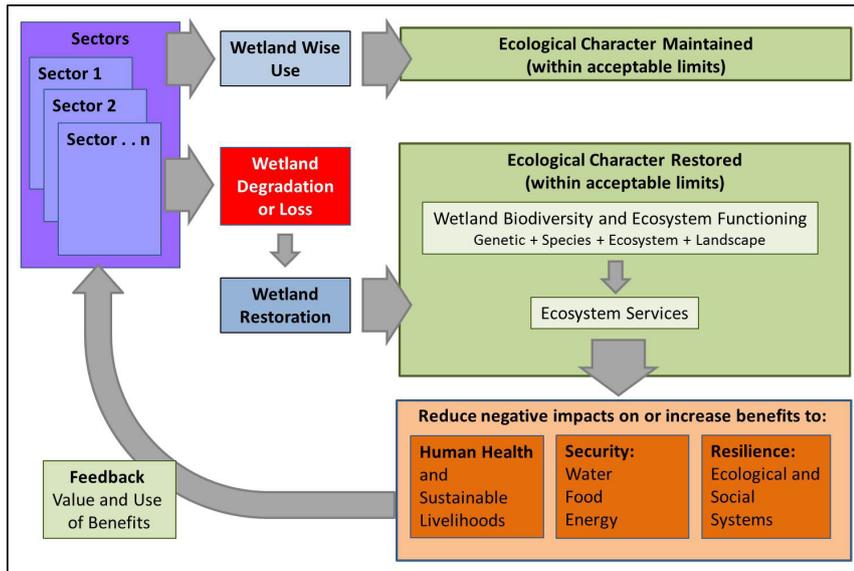


Figure 1: Relationship between sectoral use of wetlands and the delivery of benefits (modified from TEEB 2010).

Wetland functioning and benefits in the wider landscape

Whenever possible, wetland restoration planning and design should be conducted at the river basin, watershed or catchment level. A multi-scale approach, both spatial and temporal, to wetland restoration that fully accounts for connectivity within the larger landscape is best suited to enhance biodiversity and ecosystem functioning over the long term and deliver multiple benefits. Since wetlands connect terrestrial (upland), tidal and marine environments, these linkages must be strengthened so as to optimize wetland functioning while avoiding negative impacts on adjacent ecosystems, both aquatic and terrestrial.

Wetland restoration activities that focus on re-establishing a specific hydrologic regime must consider how this might alter the hydrology and functioning of adjacent ecosystems. Restoration outcomes or benefits may not always be favourable to or desired by the surrounding communities. Thus, the enhancement of benefits from wetland restoration must be considered at the landscape or regional scale. For example, diverting water from a river to restore a wetland might reduce the flow of freshwater to an estuary and affect salt-sensitive fish species which, in turn, could negatively impact the livelihoods of fisherfolk. However, the lack of detailed scientific data at larger landscape scales should not deter the planning and implementation of smaller wetland restoration projects and programmes which still require appropriate site-specific information.

Restoration activities should also strive to maintain the diversity of wetland ecosystems within the landscape so as to protect overall species, habitat and functional diversity while recognizing that the benefits delivered by wetland restoration may accrue at some distance from site-specific activities, such as groundwater recharge or migratory bird habitat. Integrated river basin management (Ramsar HB9) and coastal zone management (Ramsar HB12) strategies recognize that wetland conditions are determined by landscape-scale ecological processes, such as water supply, sedimentation, and geomorphology. These, in turn, are often influenced by socio-economic factors that tend to drive wetland loss and

degradation, such as population growth, conversion of wetlands for agriculture, and the felling of forests in upland areas. In order for wetland restoration to be effective and realize multiple benefits, a shared vision and on-the-ground planning and coordination among the relevant public and private stakeholders is critical, and so is an understanding of the ecological history of the proposed restoration site. In doing so, the education, recreation and income-generating benefits of wetland restoration have the potential to reach a broad community of stakeholders.

Prioritizing and making the case for wetland restoration

Restoration in national decision-making

Wetland restoration is needed to counteract the loss and degradation of wetland ecosystems and their benefits in many countries (Acreman *et al.* 2007). The catalysts for initiating wetland restoration activities are present at a number of levels, from obligations under international treaties to local opportunities and community-based initiatives. This Briefing Note does not present a prioritization framework. Rather it highlights the circumstances under which wetland restoration should be considered and provides recommendations on how wetland restoration can be prioritized by decision-makers. The essential element in prioritizing wetland restoration is to recognize the benefits it can deliver to people. However, the recognition that wetland restoration has relevance across multiple sectors is dependent on a broad understanding and awareness of these opportu-

nities. The need for awareness extends both across and among government departments or socio-economic sectors and vertically within the same departments and sectors. Examples of policy sectors where wetland restoration can play a role include, among others, climate change, economic investment, development planning, housing, sanitation and water resources, food production, transport and education. Governments need to encourage dialogue and leadership across these sectors to ensure that social, economic and environmental benefits are delivered.

Many countries have national policies and laws which explicitly or implicitly call for wetland restoration. Some of these encourage a strategic approach to wetland restoration, such as targeting the restoration of degraded ecosystems in order to deliver on their commitments to achieving the Aichi Biodiversity Targets for 2011-2020, and they are thus embedded in National Biodiversity Strategies and Action Plans (NBSAPs). Similarly, there are a range of international conventions with commitments which, whilst not explicitly referencing restoration, can be delivered by restoring degraded wetlands. For instance, wetland restoration has a role to play in meeting the Millennium Development Goals, especially with regard to the environmental sustainability objectives, and also for achieving the targets under the United Nations Framework Convention on Climate Change by reducing emissions and enhancing carbon stocks in forested wetland ecosystems (Alexander *et al.* 2011).

Under the commitments of the Ramsar Convention, and manifest in National Wetland Policies, a strategic approach should consider prioritizing wetland restoration in order to avoid or mitigate impacts on designated Ramsar Sites or, if degraded, to reinstate their ecological character. Wetland restoration in this context should be carried out within the framework of the overall management of protected areas, the protected area network, and the surrounding land- or seascape. A number of factors can influence decision-making, such as whether restoration is an appropriate intervention, whether it is economically and ecologically feasible, whether it is a relatively high or low priority for the specific site or system, who should be involved, and what the appropriate goals and outcomes might be. An evaluation of information, such as management objectives for the site and relevant local or national policies and legislation, is an obvious starting point. A review of regional and international conservation strategies, goals, programmes and policies could help define the design of a wetland restoration project. For example, national, regional or global

action plans associated with issues such as invasive species or climate change adaptation and mitigation may influence the selection of restoration objectives. However, local opportunities and circumstances to restore wetlands will also arise, for instance the restoration of mangroves or salt marshes in order to protect communities and coastal infrastructure from storms.

Whilst precise information on the scale of global and national wetland loss is still limited, wetland inventories and an understanding of the degree of degradation and the level of importance in terms of benefits can be used to establish local or national priorities for restoration. Wetland restoration can deliver a range of benefits to social, economic and environmental sectors that extend beyond the conservation of protected or threatened species. Local or national policies which do not directly or explicitly address biodiversity conservation, such as water resource management or disaster reduction strategies, may assist in prioritizing or highlighting such wetland benefits. Prioritization is only possible if the potential benefits of wetland restoration are first acknowledged by multiple sectors and subsequently integrated across disparate policy areas in order to identify win-win outcomes.



Restored Anne Valley Stream (© Robert J. McInnes)

When both government and non-governmental organizations are considering the prioritization of wetland restoration activities they should consider not just single wetland sites, but multiple wetlands at a variety of scales within the land- or seascape. Any assessment should also consider the feasibility and ecological necessity of restoration activities and their long-term management and sustainability. Feasibility is often dictated by the availability of finite and limited resources. By addressing the priorities from multiple sectors it may

be possible to pool limited resources in order to optimise the scope of wetland restoration and the range, quality and quantity of benefits delivered.

Opportunities for proactive wetland restoration

The following examples illustrate opportunities for wetland restoration that assist in delivering on a range of objectives beyond simply the recovery of biodiversity.

Degraded wetlands

Human activities have left a legacy of contaminated and degraded landscapes across the globe. In many cases, wetlands have been polluted, transformed or infilled. The revitalization and restoration of contaminated landscapes by restoring wetlands can recover ecosystem functioning which provides sustainable habitats, economic use and social benefits, such as educational activities, improvements in water quality, provision of wildlife habitat, and recreational pursuits. In some cases, wetland degradation is so severe that restoring a historical wetland type is not possible, such as the complete loss of organic soils forcing restoration to take place on a mineral substrate. Even in these circumstances, opportunities can still exist to reanimate wetland processes and restore important ecosystem services rather than specific wetland types. Further information on the restoration of degraded land is available here: http://www.cluin.org/download/issues/ecotools/ecological_revitalization_turning_contaminated_properties_into_community_assets.pdf.

Wetlands, water and sanitation

People's health and well-being are dependent on access to water and sanitation. Currently, a significant portion of the global population lacks basic sanitation. Interventions to improve this access have long been an important part of the development agenda and wetland restoration can play a crucial role as a targeted and sustainable intervention. Finding solutions to water supply and sanitation issues can often be a complex and demanding process, often because wetlands and water supply and sanitation are dealt with by different government departments and separately planned for. This is a missed opportunity for securing sustainable development and ecosystem improvements. Actions should be integrated beyond the normal boundaries of implementation, for instance through river basin plans which value all forms of water supply and wetlands, and seek to find solutions which enhance human well-being and biodiversity in a more holistic manner. For further

reading, please see: <http://wetlands.org/WatchRead/Currentpublications/tabid/56/mod/1570/articleType/ArticleView/articleId/2467/Default.aspx>.

Declining fisheries

Globally, fish are the main source of protein for over a billion people. Two thirds or more of all fish consumed by humans depend upon coastal wetlands, such as mangroves and estuaries; these coastal wetlands are in turn reliant on a range of interdependent inland wetlands, including lakes which connect via rivers and streams to the coast. Whilst 80% of the global fishery production takes place in developing countries, the value of recreational fisheries also has huge economic significance in the developed world. It has been estimated that the overall economic impact of recreational angling in the USA is approximately \$116 billion per annum (MA, 2005). Wetland restoration can stem the decline and loss of both commercial and recreational fisheries, thus enhancing both human health and economic well-being. For further reading on sustainable fisheries see <ftp://ftp.fao.org/docrep/fao/006/y4773e/y4773e00.pdf>.

Declining water resources

Wetlands play a vital role in the protection and delivery of water resources to human populations, including private concerns such as agriculture, mining and industry. The wise use and restoration of wetlands can help secure vital water resources for those uses in the long term and provide wider economic benefits for others. An example from North West England has demonstrated that the restoration of upland peatlands has improved the quantity and quality of water supply to over seven million residents. It has also secured livelihoods for tenant farmers and restored important biodiversity whilst reducing water treatment costs. For further information, see <http://corporate.unitedutilities.com/scamp-index.aspx>.

Tourism and poverty reduction opportunities

Tourism benefits from wetlands. Tourists like to swim and bathe, canoe, dive or snorkel, watch wildlife, learn about nature or just enjoy attractive scenery. Local and international tourism are often dependent on coastal areas, lakes, rivers, mangroves and other wetland ecosystems. Similarly, in many parts of the world, but especially in the developing world, millions of people rely to a great extent on wetlands for their livelihoods and food security. Experience has shown that where wetlands are degrading, poverty generally increases, escalating pres-

tures on the remaining wetland resources and leading to further wetland degradation and poverty (Kumar *et al.* 2011). By exploring the synergies between wetland restoration outcomes, such as generating tourist revenues and improving local livelihoods, multiple benefits can be realized. For further information on tourism, poverty reduction, and wetland restoration, please see <http://www.wetlands.org/WatchRead/Currentpublications/tabid/56/mod/1570/articleType/ArticleView/articleId/1640/Default.aspx>.

Achieving sustainable urban drainage

Wetlands can reduce peak urban runoff while providing other benefits such as improved water quality, enhanced biodiversity, and increased recreational opportunities. The restoration of wetlands can reduce or eliminate the need for expensive, hard-engineered systems to deal with flood waters and/or manage the release of untreated water downstream. With careful design of a wetland area, the quality of the stormwater can be improved whilst creating attractive multi-functional open urban areas. Urban dwellers can gain additional social, cultural, and psychological benefits from physical or visual access to restored 'natural' spaces. For information on how wetland restoration can be integrated into sustainable urban drainage, please see <http://publications.environment-agency.gov.uk/PDF/GEHO0308BNST-E-E.pdf>.

Regulating urban climate

Urbanisation has been shown to increase annual mean air temperatures by at least 1°C when compared to surrounding countryside, reduce solar radiation by 20%, and lower wind speeds by between 10 and 30%. The result is the creation of urban heat islands which can negatively impact both local human health and the global climate. In Bangalore, it has been estimated that between 1973 and 2009 the urban area increased by 632%, and over the past decade air temperatures have increased by between 2 and 2.5°C. During the same period almost 80% of the city's water bodies and wetlands have been lost or severely degraded. The restoration of these degraded ecosystems is advocated as a crucial element in moderating the changing urban climate. The restoration of wetlands within urban areas can help to cool the local climate, reduce urban heat island effects, and provide a range of ancillary benefits to city dwellers. For information on strategies for reducing urban heat islands and understanding the role that wetland restoration can play, see <http://www.epa.gov/heatid/resources/pdf/BasicCompendum.pdf>.

Wetland restoration within the avoid-mitigate-compensate framework

In addition to their commitments under the Ramsar Convention, many governments have adopted some form of an avoid-mitigate-compensate approach to wetland loss and degradation (Ramsar HB19). The default position should be to avoid negative changes in ecological character. However, where an impact is considered unavoidable, wetland restoration can be used to both mitigate and compensate for wetland loss and degradation both in terms of area and function. Figure 2 demonstrates various roles that wetland restoration can play in the avoid-mitigate-compensate framework, including avoiding (Figure 2C), mitigating (Figure 2D) and compensating (Figure 2E) impacts. In summary, the role of wetland restoration in the avoid-mitigate-compensate framework can be described as:

Avoid	Achieved through <i>ex situ</i> wetland restoration to avoid <i>in situ</i> degradation to a wetland.
Mitigate	Achieved through <i>ex</i> or <i>in situ</i> restoration to reduce impact on a wetland.
Compensate	Achieved by <i>ex situ</i> wetland restoration to compensate for <i>in situ</i> loss of a wetland.

Consideration of the benefits of wetland restoration

Wetland restoration has the potential to deliver a range of benefits to multiple stakeholders. Often the largest single barrier to achieving this is the failure at the outset to simply recognize the wide range of benefits that could potentially be delivered. There are a number of other barriers which lead to missed opportunities.

- Institutional and sectoral constructs, and especially planning systems, may generate a 'silo' mentality where decisions are made for the sole benefit of one sector. For instance, a water company may internalise the decision-making process to restore a wetland area to treat or 'polish' wastewater, resulting in a one-dimensional solution. The water treatment required could have been delivered through a similar but modified solution which engaged other stakeholders from outside of the confines of the water company's singular focus to deliver on a wider range of benefits.
- The limitations resulting from institutional constructs are often manifest in the adoption of formulaic solutions as a result of a lack of lateral thinking in the decision-making process. This is the 'busi-

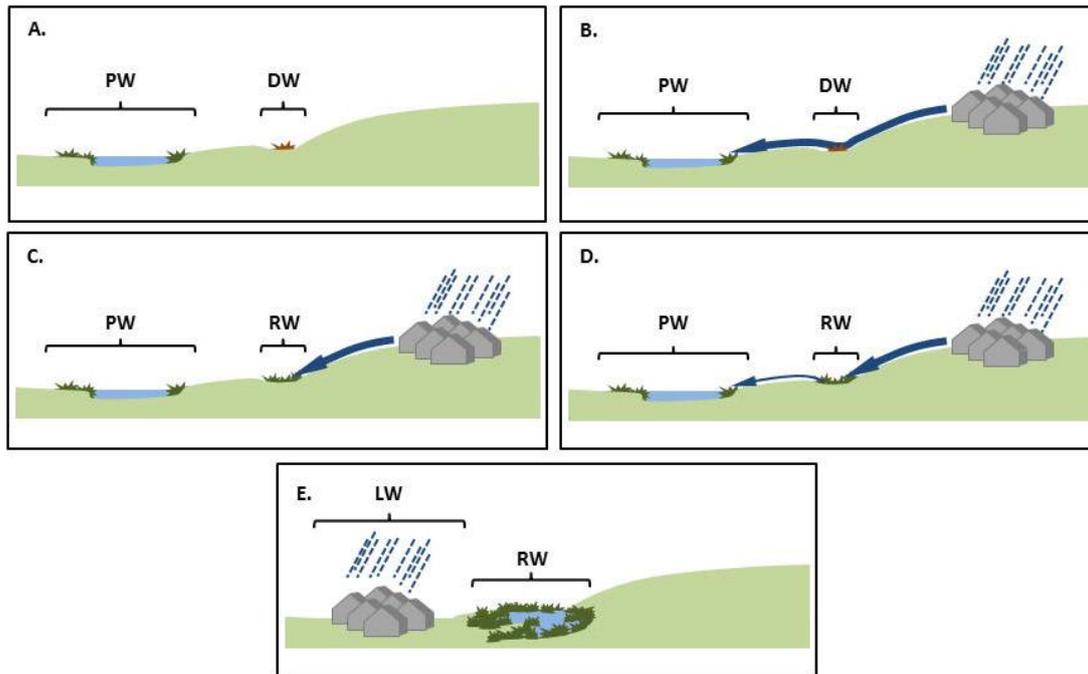


Figure 2. Schematic representation of wetland restoration options for avoiding, mitigating and compensating for wetland loss or degradation. (A) Starting conditions. (B) Development with no avoidance or mitigation of impacts to a protected wetland from polluted surface water run-off. (C) Wetland restoration (with no discharge) to avoid impacts of development on a protected wetland. (D) Wetland restoration (with controlled discharge of appropriate quality and quantity) to mitigate impact of development on a protected wetland - compensation for any residual impact may still be required. (E) Wetland restoration to compensate for the loss of a wetland through development. (Note: PW Protected wetland; DW Degraded wetland; RW Restored wetland; LW Lost wetland).

ness as usual' scenario where yesterday's solution is applied to tomorrow's problem without thinking about novel or innovative solutions. Often this simply stores up problems for the future and fails to apply the latest knowledge available.

- Limited resources, both in terms of expertise and finances, can, perversely, narrow the range of solutions considered rather than broaden the opportunities to engage more widely and consider multiple benefits and stakeholders.
- There may be a lack of understanding of the value of potential but less obvious benefits delivered by wetland restoration or the limitations in approaches to proper benefit valuation.
- There may be a potential or perceived conflict between restoring wetlands to create wildlife habitat, or as areas for protected or threatened species, and the ability of the same wetland to deliver a range of other valuable benefits to people.

A first step in the decision-making process should be to recognize all the possible benefits that wetland restoration activities could provide. This might include using check lists of benefits (ecosystem services) and it should involve multiple stakeholders in a participatory process. The identification of multiple benefits, spreading across

many sectors and stakeholders, can strengthen the economic rationale for wetland restoration projects or programmes as the benefits increase relative to the costs.

Where multiple benefits have been identified and resources are limited, trade-offs must be considered. For instance, the benefits associated with the restoration of wetlands in order to manage flood risk need to be considered against other competing benefits, such as human access and recreation. In any scenario, cross-sectoral approaches will be necessary to resolve possible trade-offs. The key issue is not the method adopted to manage trade-offs but the simple message that trade-offs often exist and will need to be considered early in the wetland restoration planning process.

The cost of restoring a wetland may differ widely according to wetland type, the degree of degradation, the restoration objectives, and the local circumstances. Trade-offs may also arise from changes in the ecosystem services provided before and after restoration. For instance, individual landowners and local communities may receive funding to protect and restore forested wetlands, in order to conserve biodiversity, reduce greenhouse gas emissions, protect soils, and mitigate natural disasters rather than to continue to intensify

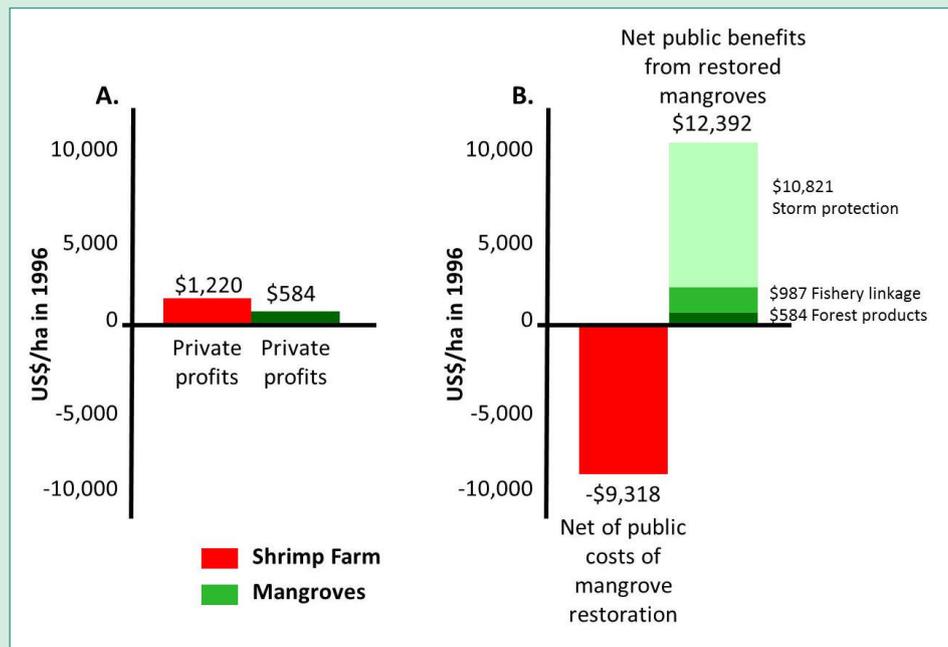
Costs and benefits of mangrove restoration and shrimp farms in Thailand

A study from Thailand illustrates the importance of recognizing and capturing the potential value of wetland restoration in order to inform management decisions. Since the tsunami in 2004, there has been considerable interest in restoring mangrove forests on degraded and abandoned coastal ponds for both commercial and non-commercial purposes. Aquaculture can provide both direct and indirect income to local stakeholders. When comparing the monetary benefits associated with different uses, private shrimp farms can generate a return of US\$1,220 per hectare, whereas the forest products from the restored mangroves will return only US\$584 per hectare (values calculated over a nine year period with a 10% discount rate) (see figure below). This supports a commercial case for shrimp farming as opposed to the restoration of mangrove systems. However, when other ecosystem services are considered, including the important role of mitigating the impacts of storm damage as well as the value of the fishery-habitat linkage, the net benefits of mangrove restoration clearly provide a long-term value which is greater than the costs of restoration.

Services enhanced: storm protection, food production, fisheries support, climate regulation, carbon sequestration, native biodiversity, etc.

Sectors benefitted: fisheries, disaster protection, rural economy, climate change, livelihoods

Barbier, E. B. 2007. Valuing ecosystem services as productive inputs. *Economic Policy*. Vol. 49, p.178–229.



agricultural practices (often termed *payments for ecosystem services*).

Cost benefit analysis should refer to the appraisal of a project from the perspective of all of society rather than from simply the perspective of those directly involved in project decision-making. This is not always the case, however. All wetland restoration costs and benefits need to be considered in this decision-making process and the failure to capture all the ecosystem services delivered by a wetland restoration project, and the range of beneficiaries and the time-scale over which benefits will accrue, can influence the outcome of even the most rigorous cost benefit analysis. It is well understood that most economies are characterised by market failure, primarily due to the limited availability of market determined prices for many ecosystem services. Whilst there is complexity surrounding the valuation of non-market goods and services and how they are considered in cost

benefit analysis, methods exist to incorporate these issues in decision-making. Irrespective of the approach, however, the assumption has been that all the benefits are defined. In the case of wetland restoration, this has often not been the case.

In addition to the failure to recognize the occurrence and value of certain ecosystem services, there are other reasons why wetland values are not taken into account properly or fully in decision-making. These include:

- *market failures* where many wetland benefits are considered *public goods* provided for free by a wetland ecosystem, or so-called *externalities*, when the market does not truly reflect the social costs or benefits of a change in the delivery of an ecosystem service;
- *perverse incentives* where policies or subsidies provide the inducement for economic activity which



Abandoned shrimp aquaculture ponds at Puntondo, Sulawesi, Indonesia (© R. Lewis)

unintentionally impedes wetland restoration or further degrades wetlands;

- *unequal distribution of costs and benefits* where the stakeholders who benefit from the ecosystem service are not the same as the stakeholders who bear the cost of maintaining the benefit; and
- *no clear ownership* or tenure, as indicated by clear boundaries, thus making the allocation of benefits difficult to define.

In the wetland restoration planning process these factors need to be considered carefully to ensure that the full social costs and benefits are accounted for, that future perverse outcomes are not delivered, and that equity of distribution of costs and benefits is understood.

Valuing wetland services

The Ramsar Convention has published technical information on the valuation of wetland ecosystem services (Ramsar Technical Report No. 3 by de Groot *et al.* 2006). A five-stage framework is proposed for conducting an integrated assessment of wetland ecosystem services (Figure 3). The main steps in the guidance are:

- Policy Analysis
- Stakeholder Analysis
- Function Analysis (inventory: identification and quantification of services)
- Valuation of services.
- Communication of the value of wetlands to all stakeholders and decision-makers.

These five steps are also linked to cost benefit analysis, multi-criteria analysis, and participatory approaches. This framework demonstrates the importance of recognizing value before moving on to quantification of the individual and multiple benefits. This construct is also reflected in the approach proposed by The Economics of Ecosystems and Biodiversity (TEEB). The TEEB approach adopts a tiered structure whereby the valuation of biodiversity and ecosystem services is accomplished in a more or less explicit manner according to the site-specific activities under consideration.

TEEB states that the first step is to *identify* and assess the full range of ecosystem services affected by a project or plan and to consider the implications for different sectors and stakeholders. The second step is to *recognize* value, which can then lead to the third which attempts to estimate and *demonstrate* the value of ecosystem services. The fourth step involves *capturing* the value of ecosystem services and, when required, seeking solutions to overcome their undervaluation. Finally, solutions should be sought based on the outcomes generated by this approach.

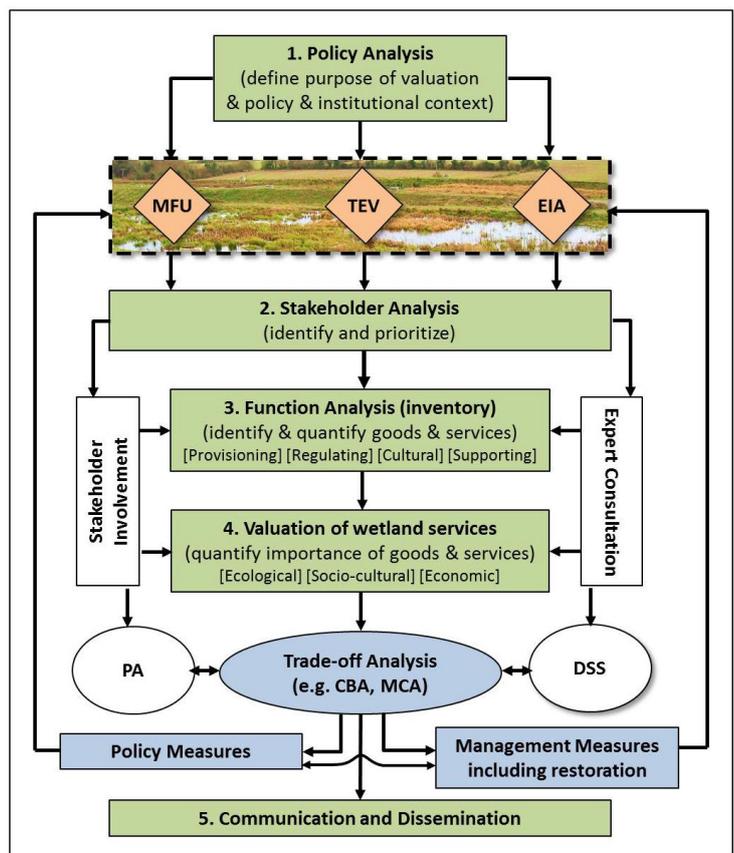


Figure 3. Framework for integrated assessment and valuation of wetland ecosystem services (from de Groot *et al.*, 2006). (Abbreviations: MFU – multifunctional use of wetlands; TEV – total economic value; EIA – environmental impact assessment; PA – participatory approaches; DSS – decision support system; CBA – cost benefit analysis; MCA – multi-criteria analysis).

Raising awareness of value – The Economics of Ecosystems and Biodiversity (TEEB)

In 2007, before the magnitude of western economic downturn was truly manifest, the environment ministers from the governments of the G8+5 countries agreed to “initiate the process of analysing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation.” This initiative was termed *The Economics of Ecosystems and Biodiversity* (TEEB).

The TEEB study drew attention to the economic benefits of biodiversity and has developed a basis for evaluating the stock of natural capital and the flow of ecosystem services through a tiered approach which seeks to recognize, demonstrate and capture value. Under some circumstances the ability to simply recognize value may be sufficient to highlight important ecosystem services so that monetary valuation may be unnecessary, or even counterproductive if it is seen as contrary to cultural norms or fails to reflect a plurality of values.

The Economics of Ecosystems and Biodiversity (TEEB). 2010. *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis*. Retrieved August 15, 2011, from <http://www.teebweb.org>.

Linkages with existing guidance

Types of guidance

A multitude of wetland restoration guidance exists for various end-users including policymakers, implementing agencies, and practitioners on the ground. Guidance takes many forms from published literature (both grey and peer-reviewed), case studies, web-based resources, and training courses. In addition, Ramsar has produced a range of adopted guidance which should be considered when wetland restoration is being planned. Similarly, there is a considerable body of knowledge on wetland restoration contained in the Ramsar Wise Use Handbooks (see Annex 1).

Publicly available guidance, tools and technologies

Many publicly available guidance, tools and technologies for restoration exist, produced and distributed by

national and local governments, NGOs, researchers, and community-based organizations around the world. They target various audiences with different levels of specificity, including policy- and decision-makers, implementing agencies, and on-the-ground practitioners. General guidance often takes the form of instruction, advice or direction that explains the fundamentals of restoring a degraded wetland, while tools and technologies describe specific methods, materials, and devices used to design, implement and monitor wetland restoration. The Convention on Biological Diversity is now compiling and consolidating publicly available guidance, tools and technologies for ecosystem restoration for distribution at CBD COP11 in October 2012.

The following are a few examples by wetland type that illustrate the wide availability of guidance. This is not meant to be a comprehensive list nor is it to be inferred that these guidance documents have universal applicability. In addition, it is important to note that these illustrative examples are not endorsed by the authors or the Ramsar Convention, but are meant to encourage wetland managers and others interested in wetland restoration to access the available guidance, tools and technologies, including cases studies and best practices, for information that is most relevant to their site-specific circumstances. An Internet search engine is a good place to start.

All Wetlands

The Wetland Restoration Specialist Group (Wetlands International), through its publications, expert database and case studies, promotes the successful restoration and conservation of wetlands worldwide by developing networks and by encouraging information exchange and cooperation. <http://www.wetlands.org/Aboutus/Specialistgroups/WetlandRestorationSpecialistGroup/tabid/1120/Default.aspx>

Wetland Habitats: A Practical Guide to Restoration and Management (CSIRO Publishing, Australia) is a practical and easy to use manual for wetland restoration and conservation of diverse animal species. <http://www.publish.csiro.au/nid/21/pid/6349.htm>

An Introduction and User's Guide to Wetland Restoration, Creation, and Enhancement (US Environmental Protection Agency) is written for the public containing 1) background on wetlands and restoration, 2) information on project planning, implementation, and monitoring, and 3) lists of resources, contacts, and funding

sources. <http://www.epa.gov/owow/wetlands/pdf/restdocfinal.pdf>

Restoring a Wetland (Waikato Regional Council, New Zealand) presents a simple flowchart to find out more about each step in the restoration process and allows the users to create their own Wetland Plan. <http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/>

Peatlands

The Global Peatland Restoration Manual (Greifswald University, Germany) presents a science-based and practical guide to peatland restoration for policy-makers and site managers. The work has relevance to all peatlands of the world but focuses on the four core regions of the UNEP-GEF project "Integrated Management of Peatlands for Biodiversity and Climate Change": Indonesia, China, Western Siberia, and Europe. http://www.imcg.net/media/download_gallery/books/gprm_01.pdf

The Peatland Restoration Guide (Canadian Sphagnum Peat Moss Association and New Brunswick Department of Natural Resources and Energy) was developed as a practical tool for restoring milled peatlands. <http://www.peatmoss.com/pm-restguide.php>

Rivers and Lakes

Manual of River Restoration Techniques (River Restoration Centre, UK) is presented in 11 separate parts, each part encompassing a significant activity, or objective, that may typically be included in a restoration project brief, with examples of techniques that may be useful in achieving the specific objectives. http://www.therrc.co.uk/rrc_manual.php

River Restoration Manual (Government of Western Australia) is a series of guidelines that provide a guide to the nature, rehabilitation and long-term management of waterways in Western Australia and are intended to be used by river restoration group coordinators and other people who are actively involved with river restoration. <http://www.water.wa.gov.au/Managing+water/Rivers+and+estuaries/Restoring/River+restoration+manual/default.aspx>

The Lakes Handbook, Volume 2: Lake Restoration and Rehabilitation (Wiley Publisher, UK) provides an up-to-date overview of the application of ecologically sound approaches, methods and tools with particular emphasis on sustainability, restoration and rehabilitation. <http://onlinelibrary.wiley.com/book/10.1002/9780470750506>

Estuaries and Tidal Wetlands

EC Guidance on the Implementation of the EU Nature Legislation in Estuaries and Coastal Zones (European Commission) provides sector-specific guidance on the implementation of the Birds and Habitats Directives in estuaries and coastal zones, and also helps citizens and stakeholders to better understand key provisions of the Directives. http://ec.europa.eu/transport/maritime/doc/guidance_doc.pdf

Restoration Science Strategy: A Framework (US National Estuarine Research Reserve System) describes the current and potential role of the NERRS in restoration science and provides a framework for how the reserve system can contribute more fully to the successful restoration of estuaries through science and education. <http://nerrs.noaa.gov/Doc/PDF/Stewardship/NERR-SRSSFramework.pdf>

Saltmarsh Management Manual (UK Department of the Environment, Food and Rural Affairs) describes what it is that needs to be managed and aims to help develop an understanding of how to evaluate the need for management intervention and the form that intervention might take. <http://publications.environment-agency.gov.uk/PDF/SCHO0307BMKH-E-E.pdf>

Community Estuarine Monitoring Manual (South Australia Environment Protection Agency) presents an estuarine monitoring framework that is suitable for use by a wide range of community groups, including a range of activities that these groups may wish to explore. http://www.epa.sa.gov.au/xstd_files/Water/Report/cemm_a.pdf

Design Guidelines for Tidal Wetland Restoration in the San Francisco Bay (Philip Williams & Assoc., Ltd., The Bay Institute, and the California State Coastal Conservancy) was produced for all individuals who have some degree of responsibility for decisions made on tidal wetland restoration design, including regulatory agency staff, land managers, resource managers and restoration practitioners. http://www.wrmp.org/design/Guidelines_Report-Final.pdf

Mangroves

Five Steps to the Successful Ecological Restoration of Mangroves (Mangrove Action Project) illustrates five important steps that should be tailored to each unique situation and coastal region where mangrove restoration is being attempted. http://www.mangroverestoration.com/pdfs/mangrove_restoration.pdf

Best Practice Guidelines on Restoration of Mangroves in Tsunami Affected Areas (Wetlands International) provides the reader with appropriate knowledge and understanding of mangrove silviculture (planting) for coastal protection. <http://www.wetlands.org/LinkClick.aspx?fileticket=EaD3s%2Bil5Mw%3D&tabid=56>

Mangrove Forest Restoration in Andhra Pradesh, India (MS Swaminathan Research Foundation, India) reflects the process and results of restoration activities carried out over seven years by the project Coastal Wetlands: Mangrove Conservation and Management and is meant for foresters, field technicians, researchers and others interested in restoration of degraded mangroves. http://www.globalrestorationnetwork.org/uploads/files/CaseStudyAttachments/60_andhra-pradesh.pdf

Coral Reefs

Reef Restoration Concepts and Guidelines (The Coral Reef Targeted Research & Capacity Building for Management Programme) contains simple advice on coral reef restoration for coastal managers, decision makers, technical advisers and others who may be involved in community-based reef restoration efforts. http://www.gefcoral.org/Portals/53/downloads/Summary_brochure%20and%20restoration%20guidelines/Reef%20Restoration%20Concepts%20%26%20Guidelines.pdf

Manual for Restoration and Remediation of Coral Reefs (Japan Ministry of Environment) collects the methods, achievements, and problems of measures including 1) seeding production and settlement induction by utilizing coral sexual reproduction, 2) transplantation of coral fragments by utilizing asexual reproduction, 3) transplantation of colonies or entire reef, and 4) management of settled seeding, transplanted colonies and coral communities. <http://www.coremoc.go.jp/report/RSTR/RSTR2004a.pdf>

Seagrass Meadows and Shellfish Beds

Restoration of Seagrass Meadows (Oceania) describes recent techniques for seagrass restoration that may be divided into two basic groups: 1) activities focused on collecting and transplanting plants, and 2) activities focused on obtaining and planting seeds. http://www.pradariasmarinhas.com/restoration_manual.pdf

Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters (US National Oceanic and Atmospheric Administration) discusses important issues that should be addressed in planning seagrass restoration projects, describes differ-

ent planting methodologies, and proposes monitoring criteria and means for evaluating success. <http://www.seagrassrestorationnow.com/docs/Fonseca%20et%20al%201998.pdf>

A Practitioner's Guide to the Design & Monitoring of Shellfish Restoration Projects (The Nature Conservancy) was written to help restoration practitioners design and monitor shellfish restoration projects that restore not only the populations of target shellfish species – primarily clams, oysters, scallops – but also the 'ecosystem services' associated with healthy populations of these organisms. http://www.habitat.noaa.gov/pdf/tncnoaa_shellfish_hotlinks_final.pdf

Wetland restoration training

Whilst there is considerable literature available, the skills and experience required to implement wetland restoration on the ground should not be underestimated. Formal training in both the science and practice of wetland restoration and "lessons learned" from past failures is essential to overcome the endless cycle of repeated failures and wasted funds common for some wetland restoration project types. Given the rate of wetland loss and degradation, there is an urgency to ensuring that there are adequately trained personnel who both understand the principles underpinning wetland restoration and recognize the benefits that wetland restoration can deliver.

References

- Acreman, M.C., Fisher, J., Stratford, C.J., Mould, D.J. & Mountford, J.O. 2007. Hydrological science and wetland restoration: some case studies from Europe. *Hydrology and Earth Sciences*. Vol. 11(1), p.158-169.
- Alexander, S., *et al.* 2011. Opportunities and challenges for ecological restoration within REDD+. *Restoration Ecology*. Vol. 19(6), p.683-689
- Bullock, J.M. *et al.* 2011. Restoration of ecosystem services and biodiversity: conflicts and opportunities. *Trends in Ecology and Evolution*. Vol. 26, No. 10, p.541-549.
- Erwin, K.L. (2009). Wetlands and Global Climate Change: The Role of Wetland Restoration in a Changing World. *Wetlands Ecology and Management* 17: 71-84.
- Finlayson, C. M., Davidson, N., Pritchard, D.E., Milton, G.R. & Mackay, H. 2011. The Ramsar Convention and ecosystem-based approaches to the wise use and sus-

tainable development of wetlands. *Journal of Wildlife Law and Policy*. Vol. 14, p.176-198.

de Groot, R.S., Stuip, M.A.M., Finlayson, C.M. & Davidson, N. 2006. *Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services*, Ramsar Technical Report No. 3/CBD Technical Series No. 27. Ramsar Convention Secretariat, Gland, Switzerland & Secretariat of the Convention on Biological Diversity, Montreal, Canada. 46pp.

Kumar, R., Horwitz, P., Milton, G.R., Sellamuttu, S.S., Buckton, S.T., Davidson, N.C., Pattnaik, A.K., Zavagli, M. 2011. Assessing wetland ecosystem services and poverty interlinkages: a general framework and case study. *Hydrological Sciences Journal*. Vol. 56(8), p.1602-1621.

Millennium Ecosystem Assessment (MA). 2005. *Ecosystems and Human Well-being: Wetlands and Water Synthesis*. World Resources Institute, Washington, DC.

Moreno-Mateos D. *et al.* 2012. Structural and Functional Loss in Restored Wetland Ecosystems. *PLoS Biol* 10(1): e1001247. doi:10.1371/journal.pbio.1001247

Rey Benayas, J.M. *et al.* 2009. Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *Science* 325, 1121–1124

Secretariat of the Convention on Biological Diversity, 2004. *The Ecosystem Approach* (CBD Guidelines). Montreal: Secretariat of the Convention on Biological Diversity. 50 p.

Society for Ecological Restoration (SER) Science and Policy Working Group. 2004. The SER International Primer

on Ecological Restoration. www.ser.org & Tucson: Society for Ecological Restoration

The Economics of Ecosystems and Biodiversity (TEEB). 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis. Retrieved August 15, 2011, from <http://www.teebweb.org>.

Acknowledgements

Thanks are due to the government of Finland for providing funding for development and production of this Briefing Note; to Robert Oates, Executive Director of the Thames Rivers Restoration Trust, for his contribution to the writing workshop and helpful comments on draft text; to STRP member Kevin Erwin for his overall coordination of the Thematic Work Area 8 and inputs to early drafts of the Briefing Note; and to Nick Davidson of the Ramsar Secretariat for his support and advice.

The final production of the Briefing Note has been aided greatly by the comments and suggestions made by members the reference review group, and thanks are also due to Hiromi Yamashita (Japan), Mark Bachmann (Australia), James Aronson (France), Robin Lewis (USA), An Cliquet (Belgium), Anne Tolvanen (Finland), Cui Lijuan (China), Rory Harrington (Ireland), Tuomas Haapalehto (Finland), Max Finlayson (Australia), Elif Okomus (Turkey), Lars Dinesen (Denmark) and Francisco Comin (Spain).

Dwight Peck and Monica Zavagli of the Ramsar Secretariat are thanked for their assistance with formatting and publication of this Briefing Note.



Reflooded farmland in Germany (© Robert J. McInnes)

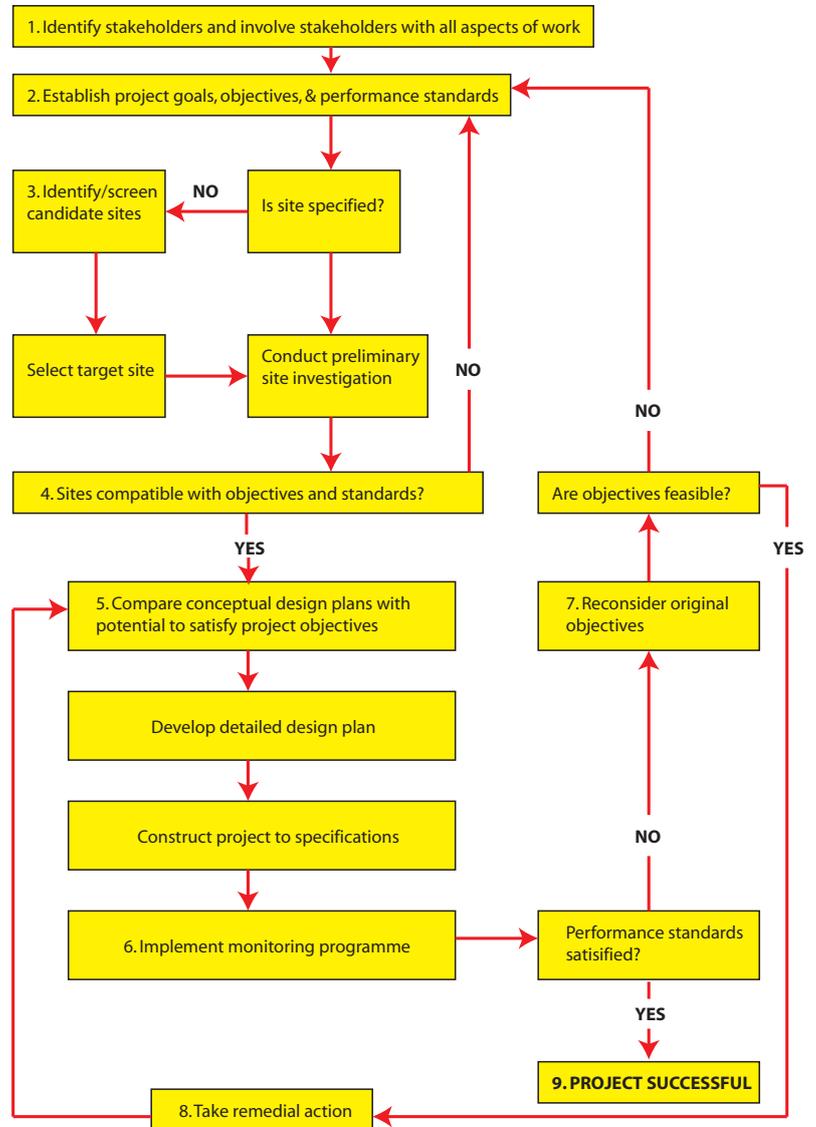
Annex 1: Linkages with existing Ramsar guidance

The Conference of the Parties to the Ramsar Convention have agreed principles and guidelines for wetland restoration (adopted as the annex to Resolution VIII.16 (2002), available as Section F of Ramsar Wise Use Handbook 19 (*Addressing change in wetland ecological character*), 4th edition, 2010). Throughout the step-wise application of these principles (see Flowchart 1), there are both explicit and implicit linkages to a range of other Ramsar-related guidance in the form of Wise Use Handbooks (HB) and Ramsar Technical Reports (RTRs).

In addition to the restoration-related guidance, the Ramsar Convention has also adopted Resolutions on the subject, often with supporting documentation which are sector-specific. Information contained within the sector-specific Resolutions also relates to wetland restoration. The following identify some of the adopted sector specific guidance:

- Environmental Impact Assessment (Ramsar HB13)
- Strategic Environmental Assessment (Ramsar HB13)
- Extractive industries (Resolution X.26)
- Urban and peri-urban planning (Resolution X.27)
- Health (Resolution X.23; RTR6)
- Agriculture (Resolution VIII.34)
- Climate change (RTR5)

Cross references to the existing Ramsar Wise Use Handbooks are provided throughout this Briefing Note. In order to expand and clarify these linkages with the various issues and concepts identified in the Briefing Note, explicit references are provided in the following table.



Flowchart 1. Guidelines for wetland restoration. Numbers correspond to numbers in column one of the table below.

Section of Ramsar Convention's guidelines for wetland restoration	Ramsar Wise Use Handbook	Section of Handbook	Issues addressed
1. Identify/involve stakeholders	HB7 Participatory Skills	Section I: Guidelines for establishing and strengthening local communities' and indigenous people's participation in the management of wetlands	<ul style="list-style-type: none"> How to engage with local communities Building trust with stakeholders Knowledge exchange Understanding wetland values and benefits to local communities
		Appendix 1: Case study summaries	<ul style="list-style-type: none"> Case studies Author contact details
2. Establish project goals	HB1 Wise Use of Wetlands	Section I: A Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character	<ul style="list-style-type: none"> Definition of wise use Definition of ecological character Millennium Ecosystem Assessment response options
		HB2 National Wetland Policies Section 3.4: Policy implementation strategies Appendix 1: Priorities for establishment of wetland policies Case Study 6: Compliance strategies	<ul style="list-style-type: none"> Measures of implementation Actions to be undertaken Case study including wetland restoration
3. Identify / screen candidate sites	HB9 River Basin Management	2.3 Understanding integration in the context of Ramsar, wetlands, and river basin management	<ul style="list-style-type: none"> Context of restoration within river basin management
		Guidelines Box J: Guidelines for Contracting Parties relating to inventory, assessment and enhancement of the role of wetlands in river basin management Additional Information: Economic instruments, including Payment for Ecosystem Services in Watersheds 6.3 Planning phase at river basin level	<ul style="list-style-type: none"> Consideration of wetland restoration within river basin plans Economic benefits of wetland restoration within a river basin context Consideration of wetland restoration in river basin planning
		Guidelines Box L: Guidelines for Contracting Parties for prioritizing the protection and restoration of wetlands and their biodiversity	<ul style="list-style-type: none"> Prioritization of wetland restoration within river basin plans
		HB12 Coastal Management	Guideline No. 4: Ensuring the recognition by Contracting Parties of the key role of wetlands in coastal processes Guideline No. 5: Ensuring the recognition by Contracting Parties of the role of coastal wetlands in regulating water flows and water quality Guideline No. 6: Ensuring the recognition by Contracting Parties of the role of coastal wetlands in mitigating impacts of climate change and sea-level rise
Principle 7: Coastal wetlands are highly vulnerable to degradation and loss, but although easily degraded their restoration is costly and sometimes impossible	<ul style="list-style-type: none"> Issues relating to problems of restoring lost and degraded coastal wetlands 		
Guideline No. 11: Ensuring that Contracting Parties consider issues related to the degradation, loss and restoration of coastal wetlands	<ul style="list-style-type: none"> Consideration of wetland restoration in coastal management 		
	HB13 Inventory, Assessment and Monitoring	Appendix: Assessment tools contained within the Integrated Framework for Wetland Inventory, Assessment and Monitoring	<ul style="list-style-type: none"> The role of wetland restoration in mitigating impacts

5. Develop detailed design plan	HB15 Wetland Inventory	Background and context	Using inventories to set priorities for wetland restoration
	HB9 River Basin Management	2.3 Understanding integration in the context of Ramsar, wetlands, and river basin management	<ul style="list-style-type: none"> Context of restoration within river basin management
	HB10 Water Allocation and Management	<p>Section 5: Tools for determining water allocations for wetland ecosystems</p> <p>Section 7: Management tools for the implementation of water allocations to wetland ecosystems</p>	<ul style="list-style-type: none"> Requirements for water quantity and quality Methods for determining water allocation for wetlands Understanding water supply and demand issues Implications of catchment management
6. Implement monitoring programme	HB11 Managing Groundwater	<p>Section 3: An Overview of groundwater-related wetlands</p> <p>Section 4: Understanding groundwater-related wetlands</p> <p>Annex 1: Water transfer mechanisms in groundwater-related wetlands</p>	<ul style="list-style-type: none"> Understanding groundwater-surface water interactions Understanding water balance components of wetlands Hydrological relationships for different wetland types
	HB18 Managing Wetlands	Section C: Developing a management planning process	<ul style="list-style-type: none"> Guidance on managing and monitoring wetlands after restoration
	HB13 Inventory, Assessment and Monitoring	Appendix: Assessment tools contained within the Integrated Framework for Wetland Inventory, Assessment and Monitoring	<ul style="list-style-type: none"> Methods for the long-term monitoring of restored wetlands

Briefing Notes series

This series is prepared by the Ramsar Convention's Scientific and Technical Review Panel (STRP) in order to share relevant, credible and interesting scientific and technical information on wetlands with a broad audience. Briefing Notes are reviewed internally by STRP members and a small internal editorial panel, comprised of the STRP Chair and the responsible Thematic Work Area lead or task lead, assisted by the Convention's Deputy Secretary General.

Briefing Notes are published by the Ramsar Convention Secretariat in English in electronic (PDF) format. When resources permit, they will be published in French and Spanish as well (the other official languages of the Ramsar Convention) and in printed form.

A full list of current Briefing Notes can be found at www.ramsar.org/BN. Information about the STRP can be found at: www.ramsar.org/STRP-main/. For more information about Briefing Notes or to request information on how to correspond with their authors, please contact the Ramsar Secretariat at stp@ramsar.org. Design & layout: Dwight Peck.

© 2012 The Ramsar Convention Secretariat

Authors: Sasha Alexander, STRP Representative of the Society for Ecological Restoration. Contact: sasha@ser.org; Robert J. McInnes, STRP Representative of the Society of Wetland Scientists. Contact: rob@rmwe.co.uk.

Citation: Alexander, S., and McInnes, R. 2012. *The benefits of wetland restoration*. Ramsar Scientific and Technical Briefing Note no. 4. Gland, Switzerland: Ramsar Convention Secretariat.

The views and designations expressed in this publication are those of its authors and do not represent officially-adopted views of the Ramsar Convention or its Secretariat.

This publication may be reproduced for educational or non-commercial purposes without special permission from the copyright holders, provided acknowledgement of the source is made. The Secretariat would appreciate receiving a copy of any publications that use this document as a source.

The Convention on Wetlands (Ramsar, Iran, 1971) – called the Ramsar Convention – is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories.

Ramsar Convention Secretariat
 Rue Mauverney 28
 CH-1196 Gland, Switzerland
 Tel.: +41 22 999 0170
 Fax: +41 22 999 0169
 E-Mail: ramsar@ramsar.org
 Website: www.ramsar.org