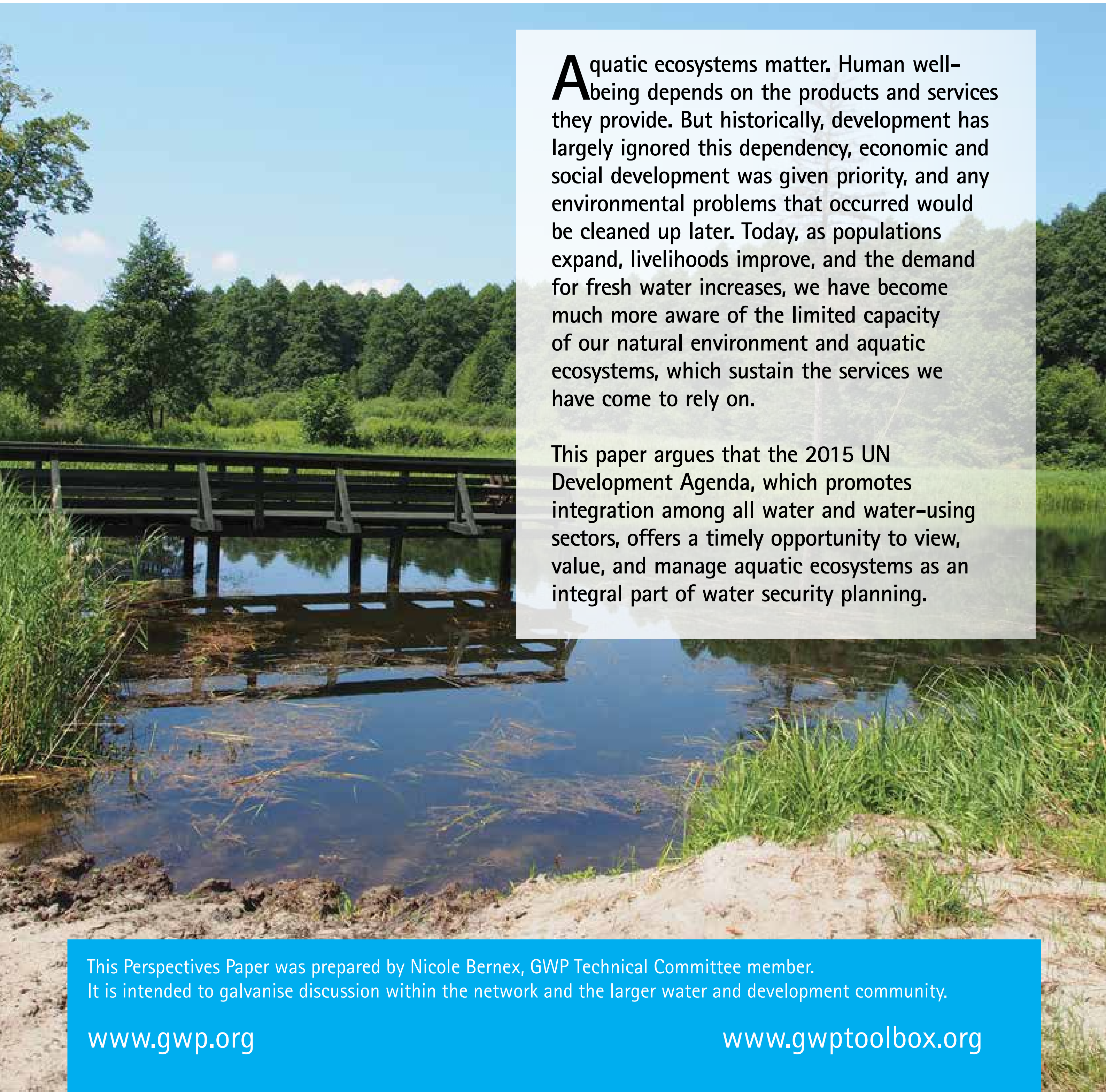
PERSPECTIVES PAPER

Global Water Partnership

Linking ecosystem services and water security

– SDGs offer a new opportunity for integration



Aquatic ecosystems matter. Human well-being depends on the products and services they provide. But historically, development has largely ignored this dependency, economic and social development was given priority, and any environmental problems that occurred would be cleaned up later. Today, as populations expand, livelihoods improve, and the demand for fresh water increases, we have become much more aware of the limited capacity of our natural environment and aquatic ecosystems, which sustain the services we have come to rely on.

This paper argues that the 2015 UN Development Agenda, which promotes integration among all water and water-using sectors, offers a timely opportunity to view, value, and manage aquatic ecosystems as an integral part of water security planning.

This Perspectives Paper was prepared by Nicole Bernex, GWP Technical Committee member.
It is intended to galvanise discussion within the network and the larger water and development community.

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About Global Water Partnership

The Global Water Partnership (GWP) vision is for a water secure world.

Our mission is to advance governance and management of water resources for sustainable and equitable development.

GWP is an international network that was created in 1996 to foster the application of integrated water resources management: the coordinated development and management of water, land, and related resources in order to maximise economic and social welfare without compromising the sustainability of ecosystems and the environment.

The Network is open to all organisations which recognise the principles of integrated water resources management endorsed by the Network. It includes states, government institutions (national, regional, and local), intergovernmental organisations, international and national non-governmental organisations, academic and research institutions, private sector companies, and service providers in the public sector.

The Network has 13 Regional Water Partnerships, 85 Country Water Partnerships, and more than 3,000 Partners located in 182 countries.

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Cover photo: GWP CEE

Contents

Acknowledgements

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Dr Jerome Delli Priscoli
Chair of GWP Technical Committee

1 Why do ecosystems matter?

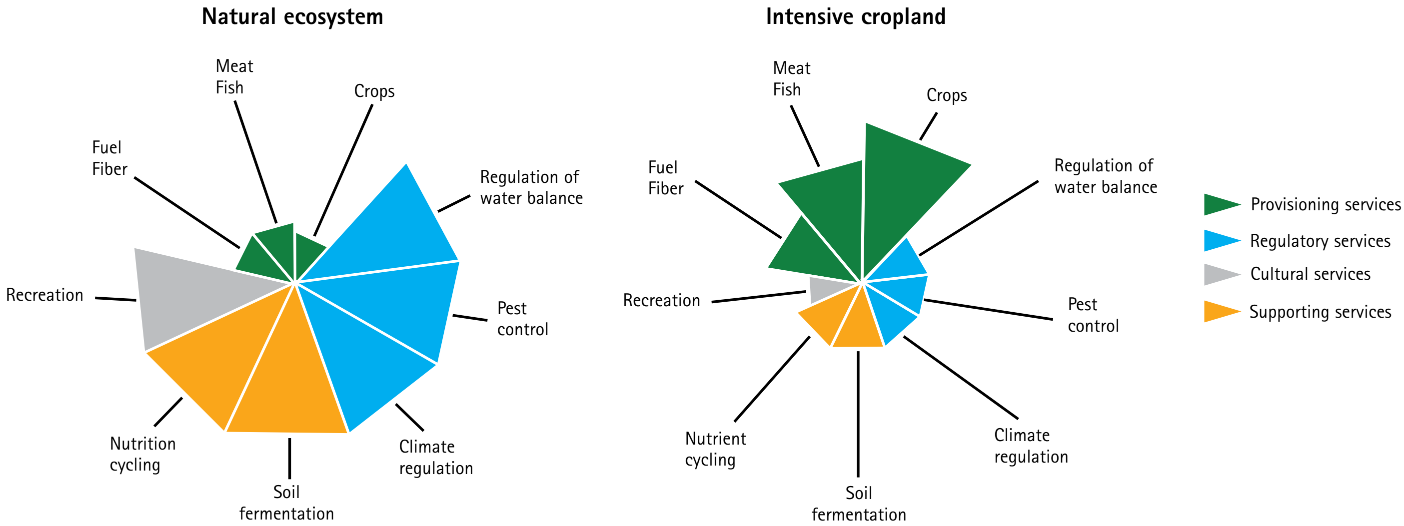
Water, unlike any other natural resource, touches every aspect of society and the environment; it is essential for producing our food and energy, and for our well-being. Historically, when water resources were more plentiful and water users were few, the drive to improve people's livelihoods and reduce poverty meant that development focused on economic growth and improving social conditions. Little thought was given to the impact that this might have on the environment and natural ecosystems, which we now realise provide the water and services we have come to rely on.

Today, it is a different story. Global populations are growing rapidly, as is the demand for water, food, and energy, and concerns are also growing about the capacity of our natural environment, particularly land and water resources, to meet these demands. In many countries, demand is so great that agricultural systems are taking over water and land on such a scale that they are degrading and even destroying the natural environment on which we depend (Figure 1). In 2011, the Food and Agriculture Organization of the United Nations (FAO) reported that in some regions achievements in food production were associated with degrading land and water resources, and causing related ecosystem goods and services to deteriorate. All this leads to a spiral of decline. Changes in land use reduce water availability and quality, and in turn water shortages and poor water quality affect our ability to produce more from the land. If this continues we are in danger of '*killing the goose that lays the golden eggs*'.

This has been the global trend over the past century, as increasing humanitarian demands have over-shadowed those of the environment. Priority was given to economic and social development, and if this caused environmental degradation the intention was to clean it up later.

As the pressures on water and land have increased, is this approach a sustainable option? This concerns all nations, but is particularly important in developing countries where population growth is highest, water scarcity is most acute, fragile ecosystems (deserts,

Figure 1 Contrasting services provided by natural ecosystems and agricultural systems



Source: Boelee, 2011; p. 19.

semi-arid lands, mountains, wetlands, small islands, and certain coastal areas) are extremely sensitive to changes, and needs for socio-economic development are highest. Is it now time to accept the conventional wisdom that ecosystems do matter? Rather than damaging the environment and then attempting to rehabilitate, should we seek to integrate ecosystem-based management into water resources planning and management?

This is not a new issue. Most decision-makers and planners are well aware of it and recognise it is a sensible course of action. Yet, for various reasons, few countries have taken practical steps to do something about it. Is this because we lack knowledge and understanding of ecosystems, how to manage and conserve them? Is there a lack of individual and institutional capacity at different levels to manage the environment? Is it about the additional costs involved?

> *"Rather than damaging the environment and then attempting to rehabilitate, should we seek to integrate ecosystem-based management into water resources planning and management?"*

It is not enough to say, yet again, that we must take ecosystems into account. We need strategies that will put this into practice. This paper argues that the 2015 UN Development Agenda, which promotes integration among water and water-using sectors, offers that opportunity for change – to view, value and manage the environment as an integral part of water resources planning and management.

2 Do we mean 'environment' or 'ecosystem'?

Terms like 'natural environment' and 'ecosystem' are in common use and are often assumed to have the same meaning. But they are different. The natural environment is a general term that describes the sum of all our surroundings, including natural forces, other living conditions and the whole interrelations and interactions that affect the growth, health, and progress of someone or something. Ecosystem refers to the entire assemblage of organisms or biotic community (plant, animal, and other living beings) living together in a certain space or biotope, functioning as a loose unit. Ecological functions are the interactive physical, chemical, and biological processes that contribute to the natural maintenance of ecosystems. Ecosystems vary enormously in size, from a temporary pond in a tree hollow to an ocean basin.

Biodiversity refers to the sum total of organisms, including their genetic diversity, and the way in which they fit together into communities and ecosystems.

Of most interest to water resources planners, managers and water users are, more specifically, freshwater aquatic ecosystems, although boundaries among the different categories of ecosystems are often blurred. An example is a flood plain – is it a terrestrial ecosystem or an aquatic ecosystem? For most of the time it is influenced by natural flora, fauna, and weather, but occasionally it can have a major influence on flood control, runoff, and maintaining base river flows in times of drought.

Aquatic ecosystems are among the world's most complex and biologically diverse ecosystems, and this adds to the concerns that planners and water managers have in taking them into account. Water resource managers live with uncertainty, but strive to manage this uncertainty as they seek to match water supply with demand. In contrast, ecologists live with and accept the uncertainty that characterises ecosystems in the way they function and how they respond to change, such as seasonal river flows, floods, and droughts. Engineering and technological interventions can add to the uncertainty around ecosystems. For example, building a dam interrupts connectivity along a river and it becomes a barrier for fish and other species. Stresses may also be generated due to natural seasonal changes in sedimentation, turbidity, and flows, and also from river maintenance work. This is why, according to the American Rivers organisation, 1,185 dams have been removed to date nationwide in the USA between 1936 and 2014 (72 dams in 2014), resulting in a variety of benefits to local communities, including restoring river health and clean water, revitalising fish populations and wildlife, improving public safety and recreation, and enhancing local economies.[1]

3 What do ecosystems provide?

Many ecosystems produce recognisable benefits, which we refer to as 'ecosystem services' (Figure 2). Freshwater aquatic ecosystems provide a wide range of essential services. They help to sustain the global hydrological cycle, the carbon cycle and nutrient cycles, and support water security. They provide natural freshwater storage, regulate flows, purify water, and replenish groundwater. Complementary services include maintaining forests, providing water for crops and fisheries, employment, energy generation, navigation, recreation, and tourism. Water mediates all these services, but they are also influenced by land management decisions made at different scales from local interventions by individual households, farmers, and industrials to those made at a catchment level by rural and urban planners and communities.

Ecosystem services contribute to economic welfare in two ways: through generating income and well-being, and by preventing damage that inflicts costs on society (Defra, 2007). There are four recognised groups of ecosystem services: supporting services (or habitat services), which are essential for producing all other ecosystem services; regulating services, which regulate ecosystem processes; provisioning services, which provide material benefits such as food and fresh water; and cultural services, which provide many non-material benefits (Figure 3). Typical services provided in each category are listed in Table 1, together with the 'securities' that come with healthy ecosystems.

Figure 3 Ecosystem services

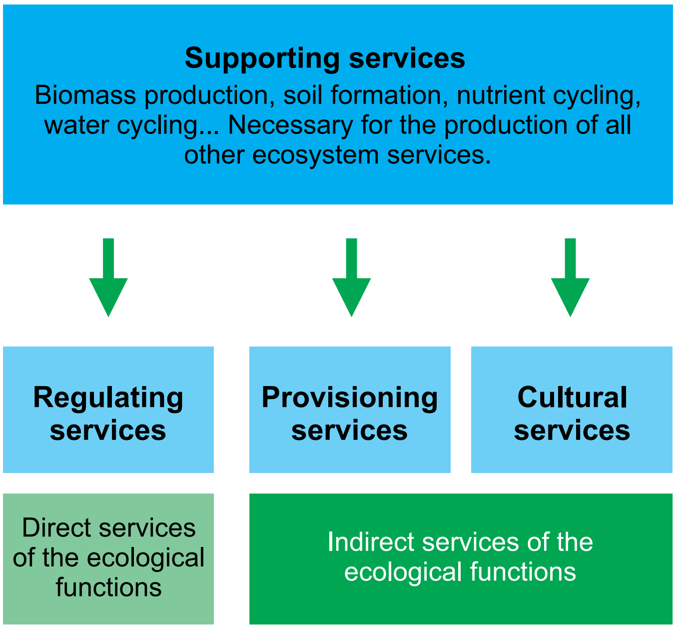
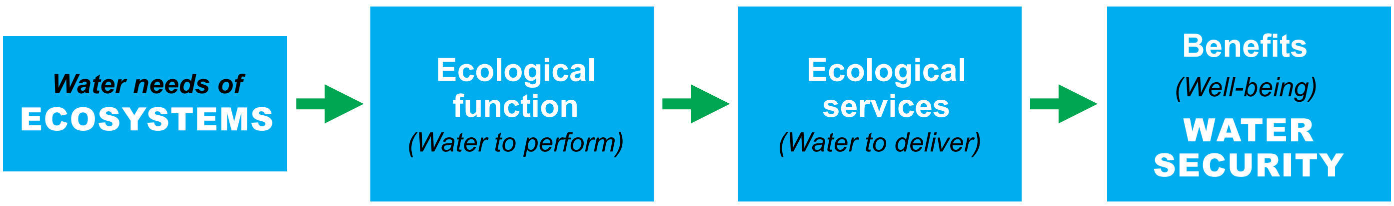


Figure 2 Pathway from ecosystems to benefits



[1] http://www.americanrivers.org/wp-content/uploads/2015/01/Dam-List-2014.pdf?29cb3b

Table 1 Ecosystem products and services

Supporting services – 'beneficial' ecosystem processes Services which make possible all the other ecosystem services, such as water cycling, nutrient cycling, and soil formation		
Regulating services (direct) Climate regulation Water regulation Wastewater treatment Flood protection and erosion control Pest and disease control	**Provisioning services (indirect)** Water quantity and quality for consumptive use Water for non-consumptive use (power generation and transport/navigation) Aquatic organisms for food and medicines	**Cultural services (indirect)** Recreation Enjoyment of nature Tourism Spiritual and aesthetic experiences
BENEFITS/SECURITIES: Water security, physical and climatic securities, food security, energy security, economic security, social peace		

Source: adapted from Millennium Ecosystem Assessment (World Resources Institute, 2005).

3.1 *The benefits of 'green infrastructure'*

Many benefits come from existing ecosystem services, but 'green infrastructure' can enhance the benefits of natural systems in both rural and urban areas and complement the more traditional built infrastructure. Green infrastructure includes reforestation, water harvesting, wetland restoration, and developing urban green spaces. Some of the benefits and co-benefits are listed in Table 2.

4 Do we value ecosystems?

Ecosystems provide essential services to society yet they are often treated as if they have no value. They are frequently managed for short-term gain at the expense of longer-term benefits for society (Burke et al., 2015). Large-scale human activities threaten ecosystems and the services they provide, and this is forcing society to rethink how to incorporate their value into its decision-making.

The Millennium Ecosystem Assessment (2005) has helped to bring the concept of ecosystem services to the attention of policy-makers and the business community. Economic arguments are also being used to assess the costs and benefits of ecosystem services in order to support decision-making. This is explored in an international initiative to draw attention to the global economic benefits of biodiversity – The Economics of Ecosystems and Biodiversity (TEEB)[2] – which produced the Ecosystem Service Valuation Database. Table 3 provides broad indicative values from the database for a range of ecosystems and highlights the significant potential value in monetary terms of wetlands as aquatic ecosystems.

However, progress in applying the economics of ecosystem services in practice in land-use planning and decision-making is slow (TEEB, 2015).

There are difficulties in valuing regulating services, which are mixed public goods and involve different use levels. For example, when a watershed is deforested it is the value of the timber and the cost of harvesting that timber that are generally accounted for in the economic analysis and price, not the clean water no longer being produced by the watershed or the carbon no longer being sequestered by the trees (UNEP, 2011).

The active involvement of society in the conservation of water resources is an integral part of maintaining services. An example is open access fisheries, which provide valuable harvests but often suffer from over-exploitation that leads to a decline in fish populations and poor future harvests. At a local level, individuals and groups often do not have incentives to maintain ecosystems for continued service provision.

[2] http://www.teebweb.org

Table 2 Benefits and co-benefits from green infrastructure

Green infrastructure	Water management benefits	Co-benefits
Reforestation and forest conservation	Water supply regulation Water purification and biological control Erosion control Flood mitigation	Healthy ecosystems Carbon sequestration Air quality improvement Climate regulation Soil conservation Recreational benefits and aesthetic value
Water harvesting and 'sowing'	Groundwater recharge Water supply regulation Water quality regulation	Recovery of natural connectivity Climate change adaptation Increased food security Protection and valuation of traditional knowledge
Wetland restoration/conservation and constructed wetlands Reconnecting rivers to floodplains	Restored ecosystems for service provision Water purification and biological control Water temperature control Flood control	Healthy ecosystems Carbon storage and sequestration Biodiversity benefits Climate regulation Recreational benefits
Urban green spaces	Groundwater recharge Water supply regulation Temperature control Flood mitigation	Carbon sequestration Air quality improvement Decrease of urban heat island effect and noise Sustainable urban drainage systems Biodiversity benefits Aesthetic value (landscapes)

Source: adapted from UNEP (2014).

4.1 Payment for ecosystem services

Ecosystems can have tangible value when people are willing to pay for services. Payment for ecosystem services (PES) is a means of creating markets and adding value to ecosystem services. They link those who value a given service with those who can provide it. In a watershed context PES schemes link upstream land use with downstream water use. An example would be land owners at the head of a catchment agreeing to change their land-use practices in order to release water for use by farmers and urban dwellers further downstream (see Box 1). This can be a valuable source of additional water for growing urban populations. It is a service that cities may be willing to pay for. Another example would be low-land owners allowing their land to be flooded to protect urban areas from costly damage.

Table 3 Monetary values of the bundle of ecosystem services per biome (2007 price levels)

Biome	Total of service mean values (US$/ha/year)
Open oceans	491
Coral reefs	352,915
Coastal systems	28,917
Coastal wetlands	193,845
Inland wetlands	25,682
Rivers and lakes	4,267
Tropical forests	5,264
Temperate forest	3,013
Woodland	1,588
Grasslands	2,871

Source: de Groot et al. (2012).

In the Himalayas, to preserve storage in a small village water supply dam, the community paid a village upstream of the dam to stop livestock grazing, which was causing soil erosion and silt to accumulate in the reservoir.

Source: CSE (not dated)

In the Andes, to recharge the aquifer, the city of San Jeronimo (Cusco, Peru) paid the rural community of Huacoto upstream for improving grazing and facilitating rainwater infiltration. The aquifer recovered after five years.

Source: Bernex, N. et al. (2015).

Many of the early PES initiatives were in Latin America, but other schemes are being established in parts of Asia and Africa. They are increasingly popular with donors, though one drawback of particular importance to developing countries is that they are not a tool for poverty reduction. The emphasis is on creating i.e. markets, putting economic value on environmental services and linking buyers with sellers. Poor rural people may not be the best vehicle to achieve this (IFAD, 2009).

Ecosystem services need conservation and management if they are to continue to have market value. What is often ignored is the cost of losing a service should the ecosystem go into decline. This may include the cost of additional technologies to enable services to continue, and the opportunity cost of maintaining the service. The most common example is the problem of discharging untreated urban domestic and industrial sewage effluent into watercourses. This impacts water quality and human health, and, in turn, reduces fresh water availability. The cost of taking pre-emptive action to treat effluent before it is discharged needs to be weighed against the cost of losing fresh water resources and having to clean up the affected watercourses.

4.2 Ecosystem decision-making

Figure 4 offers a model for including all the values of ecosystem services in decision-making. Clearly, if only one or two services are accounted for, which is the most common approach, planning and management will continue in a 'silo' approach that will ignore the natural connectivity between the biological, physical, and human dimensions.

5 What are the threats?

Since the late nineteenth century, changes to ecosystems have been extensive, largely due to population growth and development. Indeed, most ecosystems are now influenced by human activities. Some believe that degrading ecosystems were one of the barriers to achieving the Millennium Development Goals (Millennium Ecosystem Assessment, 2005). Influences that degrade and threaten ecosystems include human activity and concerns about water, food, energy, health, and climate change.

5.1 Threats from human activity

Most degradation comes from human activity in both rural and urban areas, such as building dams, dykes, and levees; cutting down forests; draining wetlands; riparian clearing; reducing pervious surfaces; modifying channels; water abstraction; and discharging polluted effluents into streams (Table 4).

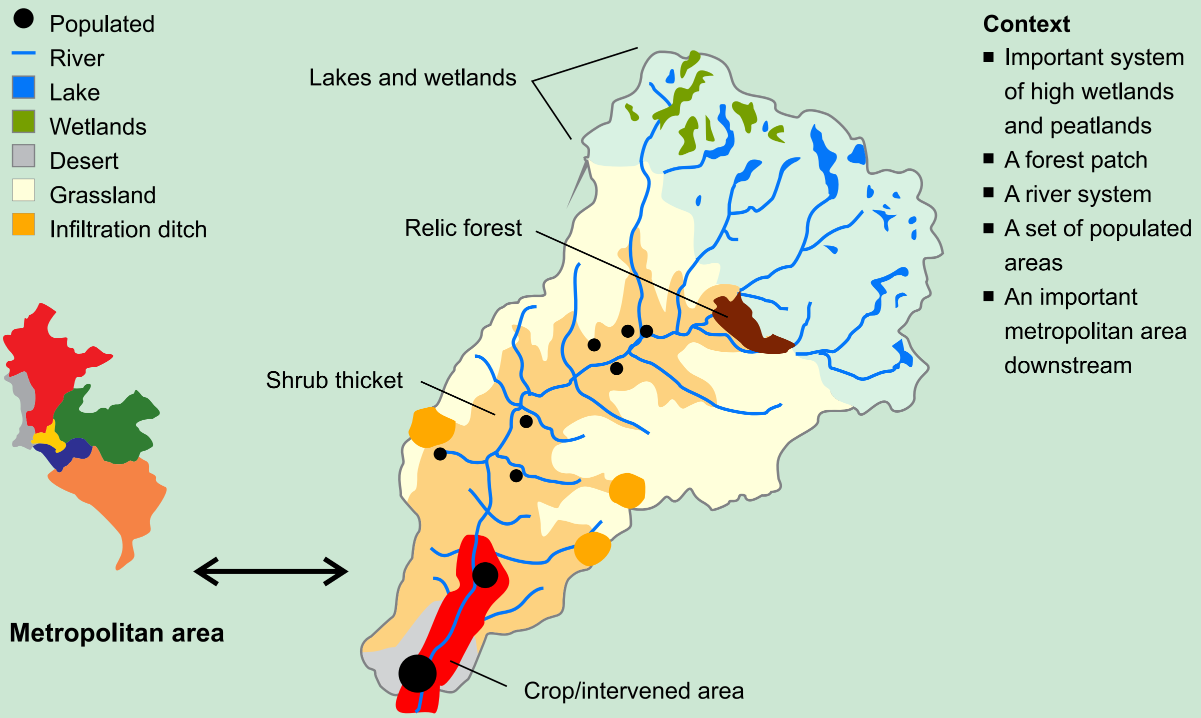
5.2 Concerns about water, energy, food, and health

The lack of a holistic approach towards water, energy, and food security increases the potential for conflicts and increases risks for ecosystem services. Bazilian et al. (2011) state that there are "*...billions of people without access to [water, food, and energy]; there is rapidly growing global demand for each of them; each faces resource constraints; each depends upon healthy ecosystems; each is a global good with trade implications; each has different regional availability and variations in supply and demand; and each operates in heavily regulated markets*".

One of the most significant ecosystem degradations in many countries concerns cutting down trees and changing the land use to agriculture. Forests offer high levels of plant diversity, water infiltration, and soil storage for nitrogen and carbon. Agriculture offers very different and more tangible services, such as food, fibre, and energy. Both are needed; the challenge is reaching the right balance between the two. Figure 1 illustrates the contrasts between natural ecosystems, which provide supporting, regulating, and cultural services, and

Box 1 Evaluating ecosystem services in Peru

One of the most vital and immediate ecosystem services is the provisioning and regulating of water resources involving forests, rivers, and wetlands. At a watershed scale, benefits and costs are highlighted according to which benefits are produced and where they are used, their values where used and produced, and the economic costs of conserving benefits (where paid and where generated).



Upper and middle stream	Downstream
Benefit production Water purification Protection of riparian areas Biodiversity control Erosion control	**Benefit use** Agricultural use of good-quality water Domestic users of clean water Touristic use of fresh water
Economic value of benefit, where produced Importance of economic value depends on importance of benefit production Only areas producing services that are being used have economic value	**Economic value of benefit, where used** Good-quality, clean water has economic value depending on demand, which increases with population growth and urbanisation
Economic cost of conserving benefit generated The overall economic costs of conserving the benefits can be 'back-mapped' into wetlands, aquatic ecosystems, and forests	**Economic value of conserving the benefit paid** Rainwater harvesting and infiltration to recharge groundwater, by means of PES Conserving the wetlands and forests that help with water purification, biological control, and erosion control

Source: adapted from Nicole Bernex, GWP South America, WACDEP (2015) and Balmford et al. (2008).

agriculture, which is almost entirely focused on provisioning services.

Diseases that flourish in and around water are many and claim many lives. They persist because of the limited understanding of the relationship between different human activities, water quantity and quality, the aquatic environment, and the diseases associated with water. Understanding these relationships can lead to environmental interventions that benefit both human health and prosperity, and improve ecosystems.

Figure 4 Ecosystem values in decision-making

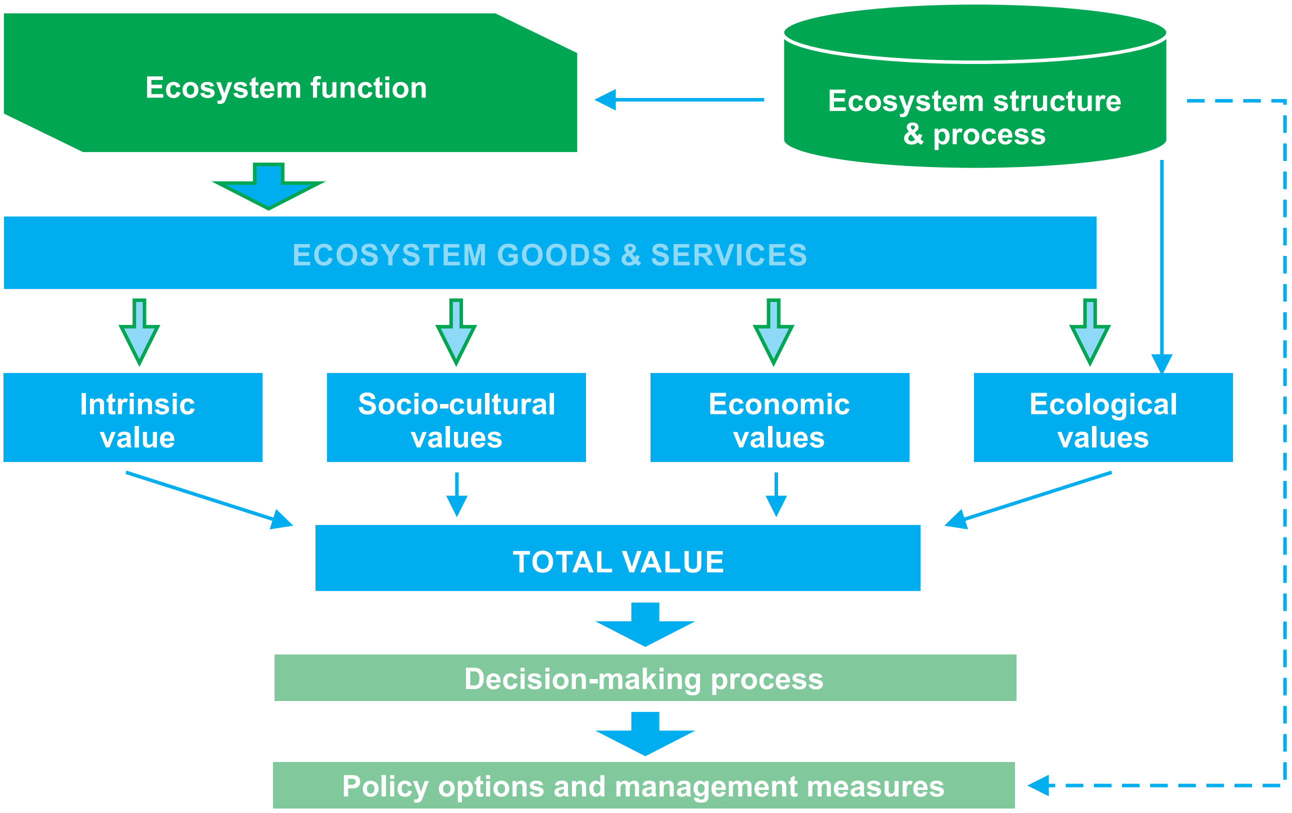


Table 4 Threats from human activity to aquatic ecosystems

Human activities associated with land-use changes and urban development	
Impact on ecosystem integrity	Impact on biologic communities and human societies
Degrading habitat structures and biotic interactions Altering the hydrologic cycle, flow regime, and runoff patterns Limiting and inhibiting groundwater recharge Increasing pressure on water resources and water quality Offering energy sources and carbon sequestration Floods/droughts	Changing diversity, abundance, trophic structure, life history, behaviour, and other functional characteristics Increasing poverty, risks of natural disasters, and population vulnerability. Generating new expenses and social conflicts Increasing water-related diseases

5.3 Concerns about climate change

Climate change is "*…the mother of all externalities, larger, more complex, and more uncertain than any other environmental problem*" according to Tol (2009; p. 29) Climate change magnifies all the ecological uncertainties. It adds to the uncertainties that already exist in predicting the future vulnerability of socio-ecological systems and to the challenges facing water planners and managers.

Ecosystem management and restoration will play important parts in adapting and mitigating the impacts of climate change. For the poor and vulnerable, who are most at risk, initiatives such as community-based adaptation already empower local communities to share knowledge and work together in order to better cope with climate change.

In the same way, ecosystem-based adaptation is seen as an opportunity to use biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change (CBD, 2009; Doswald and Osti, 2011). There are concerns that this approach is being overlooked in national and international policy processes. These initiatives in themselves are laudable and would benefit from being fully integrated with the many other initiatives that promote ecosystem conservation and water management for sustainable growth.

"It can be expected that the paradigm of Integrated Water Resources Management will be increasingly followed around the world… which will move water, as a resource and a habitat, into the centre of policy-making. This is likely to decrease the vulnerability of freshwater systems to climate change."

Kundzewicz et al., 2007; p.181.

6 Ecosystems are water users

We are learning that our natural ecosytems, as well as providing water, are also essential water users. Recognising this is just as important to human well-being as sustaining our capacity to grow more food and produce more energy. But to account for this, the key question that water planners and managers are asking is: 'How much water do ecosystems need?'

There is no simple answer because of our limited knowledge and understanding of ecosystem water needs. We do not fully understand how complex ecosystems behave at very different scales and under the stresses of changing patterns of climate and water availability, and increasing water demand.

Many countries avoid the detail in the question by agreeing to 'environmental flows', which are based on the 'precautionary principle' for managing risk. If there is a risk that an action will cause harm, in the absence of scientific evidence to the contrary the burden of proof that it is not harmful falls on those taking the action. An example of this principle in practice is the EU Water Framework Directive (WFD), a legally binding agreement that provides a common framework for EU Member States to deal with the problems of water quality deterioration, loss of aquatic ecosystems, and increasing water scarcity. All water bodies are expected to reach 'good' ecological and chemical status within a specified time frame. The implication of this is that in times of water shortages, cuts in water use in other water-using sectors will be needed in order to maintain 'good' status. This may lead to conflicts and trade-offs, which will demand a high level of cooperation between water managers, water users, and ecologists to decide just how much water can be taken without doing irreparable damage to the environment.

The EU WFD is not some watershed exercise that is independent of other water management issues. It incorporates the key principles of integrated river basin management and stakeholder participation, which are now enshrined in the 2015 UN Development Agenda. Across Europe, EU WFD is seen as synonymous with integrated water resources management (IWRM) (GWP, 2015a).

The precautionary principle offers a sensible approach to dealing with risk, but it is a blunt instrument that can damage people's livelihoods. It can be particularly damaging to the poor and disadvantaged, who may not be able to defend their rights as water users, and so it must be used wisely.

Adaptive watershed management offers an approach that takes account of new knowledge and experiences, which refine the expert opinions behind the precautionary principle. This approach, or 'learning by doing', has been advocated in ecological circles since the 1970s, but the need for long-term investigations has meant that experiments are difficult to establish and maintain. Conniff (2014) writes that a new approach is being promoted in countries like China, which incorporates experiments into landscape restoration projects to determine what works in the long term and what does not. This approach should enable water resources managers to adapt and improve long-term sustainable water supplies.

7 Mainstreaming ecosystems for water security

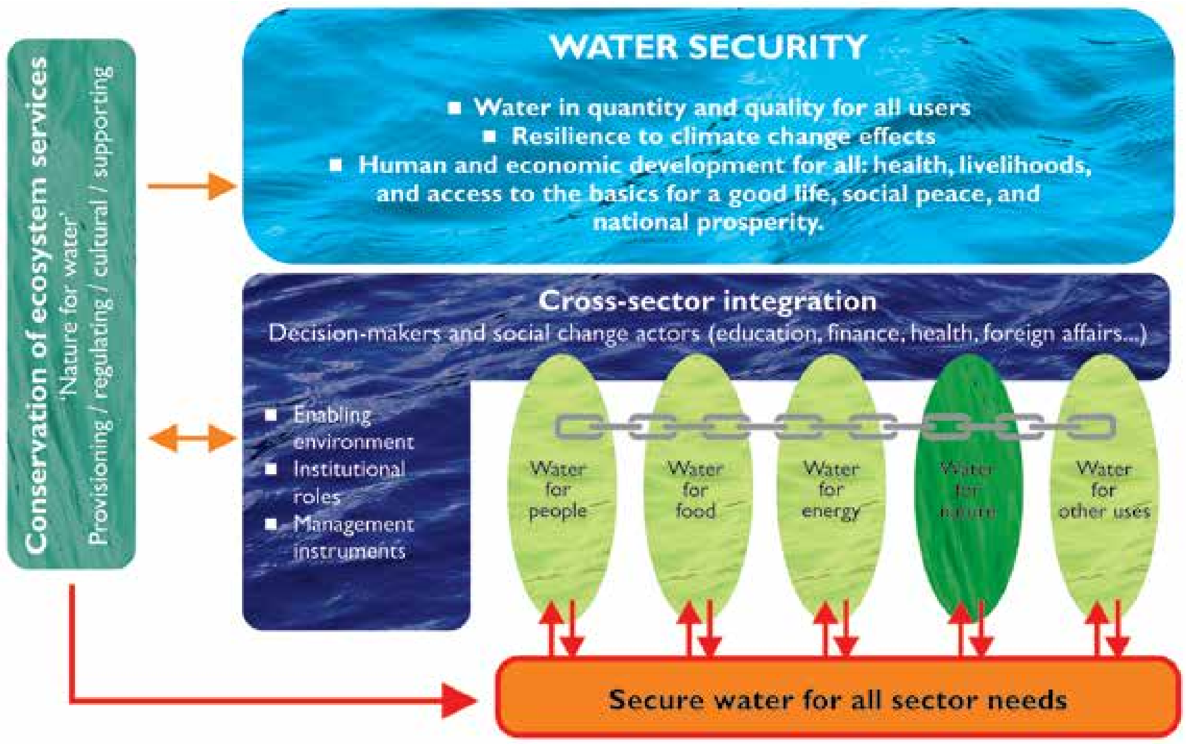
It would be myopic today to think that water planning and management can take place without including the environment and aquatic ecosystems. The symbiotic relationships between water, the natural environment, and sustainable economic growth are now part of conventional water wisdom. Water, unlike any other natural resource, touches every aspect of society, including the environment, and is essential for our well-being. Water is embedded in all aspects of natural resources management for inclusive and sustainable growth, in energy, in agriculture, and other productive activities and in sustaining the ecosystems on which everything else depends (GWP, 2012) (Figure 5). UN-Water (2013) fully recognised this when it stated that:

"*Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.*"

Yet in 2015, UN-Water also stated that:

"*All freshwater ultimately depends on the continued healthy functioning of ecosystems, and recognising the water cycle is essential to achieving sustainable water management. Yet most economic models do not value*

Figure 5 Water security and its relation to IWRM and the conservation of ecosystem services



Source: GWP, 2014.

the essential services provided by freshwater ecosystems. This leads to unsustainable use of water resources and ecosystem degradation. Pollution from untreated residential and industrial wastewater and agricultural runoff also weakens the capacity of ecosystems to provide water-related services. There is a need to shift towards environmentally sustainable economic policies that take account of the interconnection between ecological systems." (WWAP, 2015).

Appreciation among decision-makers of the need to incorporate aquatic ecosystem-based management into water resources planning and management is strong, but the practice is weak, particularly in many developing countries. The reasons for this are set out in this paper.

The first is that the main priority, water for people and economic growth, over-shadows everything else. It is only when living standards improve that concerns grow about water for the environment and, if damage has been done, attempts to clean up begin.

Secondly, there is a lack of individual and institutional capacity in the water and water-using sectors to take account of ecosystems and to fully integrate them into water resources planning and management. Indeed, in some countries, institutions, notably markets, often provide perverse incentives to increase growth at the expense of conserving ecosystems (TEEB, 2015).

Finally, there is the wider issue of putting IWRM, of which ecosystem-based management is a part, into practice. Many countries have plans to do this, but few have taken the steps to fully implement IWRM. Fewer still have plans to incorporate ecosystem thinking.

All these are serious drawbacks, but opportunities do exist for change.

7.1 What are the options?

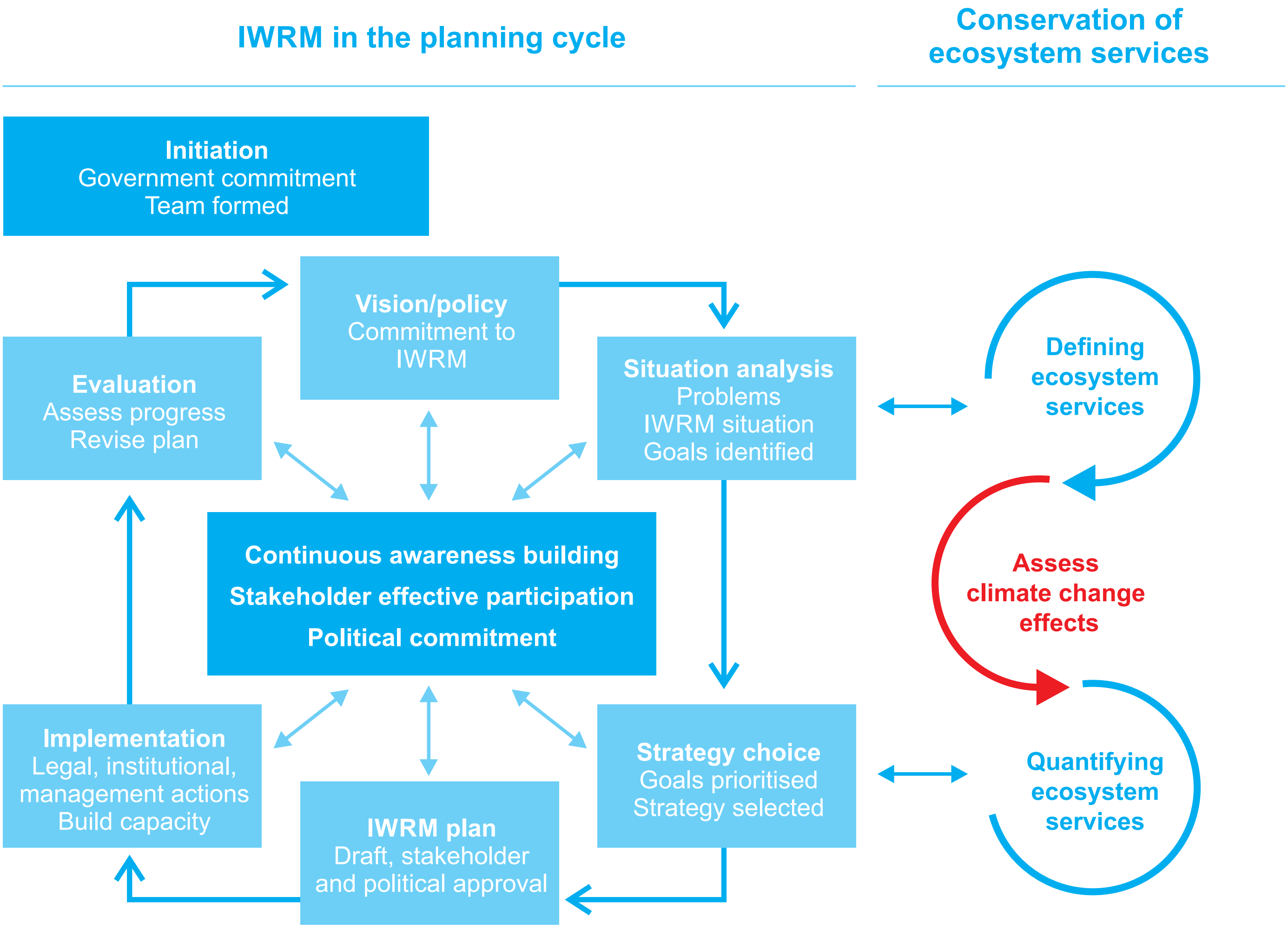
The most important opportunity comes with the new 2030 UN Development Agenda, and the Sustainable Development Goals (SDGs), which all 193 Member States have adopted. Water is embedded in almost all the SDGs and managing water is now an integral and inseparable part of the development agenda, in particular in those water-using sectors of food, energy, and the environment. But in recognising that water is now everyone's business there is a danger of water becoming no one's responsibility. This dilemma was resolved by the inclusion of a dedicated 'Water Goal' (SDG 6), which champions the need for an integrated approach to water management. SDG 6.5 mandates nations to "*implement integrated water resources management (IWRM) at all levels*" (WWAP, 2015).

SDG 6 calls for the water and water-using sectors to collaborate and move beyond their traditional fragmented 'silos' to include the environment and ecosystems and manage water to achieve impact-oriented integration. Indeed, SDG 6.6 specifically mandates nations to "*protect (by 2020) and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes*". In addition, SDG 15.1 (by 2020) mandates to "*ensure conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements*" (by 2020).

The drivers for implementing this Agenda are synonymous with those of IWRM and increasing water security, which both call for including ecosystem-based management in water resources planning and management.

The signs so far are encouraging as many governments have already embraced IWRM as a means of managing limited water resources among many competing and often conflicting demands. IWRM planning is already underway in many countries and some have enacted IWRM into legislation, but not many have taken the next step, which is implementation. A UN survey of 133 countries (UNEP, 2012) reported that 82 percent had embarked on water management reforms, 65 percent had developed IWRM plans, but only 34 percent were at an advanced stage of implementing them.

Figure 6 Bringing ecosystem thinking into IWRM planning



Source: adapted from Cap-Net et al. (2005).

7.2 *Putting ecosystem thinking into practice*

As most countries examine the implications of the UN Agenda and the realities of putting IWRM into practice, this opens opportunities to put ecosystem thinking where it belongs, in mainstream water resources planning and management (Figure 6 and Table 5).

A critical and timely GWP Background Paper (2015b), reviewing progress in implementing IWRM to support the SDGs, offers a framework to answer the 'how' question. How to put IWRM successfully into practice? The paper suggests that rather than trying to implement a 'package' of IWRM measures as has been tried in the past, success is more likely if measures are introduced based on a nation's level of social and economic development. The measures that are likely to work in a rich country, for example, are not necessarily those that would work in a fragile state. A framework of actions is proposed comprising four stages of socio-economic development. The framework includes all aspects of IWRM and so offers opportunities to incorporate ecosystems at the outset rather than as an afterthought.

Ecosystem-based management is defined by the United Nations Convention on Biological Diversity (CBD) as a "strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way".

Source: WWAP, 2015; p. 29.

Table 6 Bringing ecosystem thinking into IWRM planning

IWRM planning cycle	Ecosystem-based management inputs
Vision: Provides guiding principles and direction for future actions about water resources and sustainable development	Ecosystem approach will support sustainable use of water resources
Situation analysis: Identifies strengths and weaknesses in the water resource management, and points out aspects that need to be addressed in order to reach the vision	Ecosystem-based management will facilitate transdisciplinary approach and enhance monitoring of services dynamics, flows, impacts of land use changes
Strategy choice: Identifies goals and priorities, analyses solutions, considers requirements, advantages and disadvantages, and feasibility	Ecosystem supplies, values, and priorities help clarify discussions and allow stakeholders to use scenario planning for water-basin management
IWRM plan: Identifies instruments and tools and implementing agencies, prepares drafts for government approval, which is essential for resource mobilisation and implementation	High levels of collaboration from stakeholders facilitated by a benefit-sharing approach illustrated with ecosystem concepts
Implementation: (Adaptive management approach). IWRM principles developed at each step to improve planning, management. Set up an effective and integrated management team	Incorporate ecosystem management principles using instruments, such as payments for ecosystem services, to strengthen willingness to pay to conserve healthy ecosystems and their services (green infrastructure development)
Evaluation: Develop indicators at various levels, include IWRM principles in national water policy, national budgets, involve stakeholders, build capacity, mainstream gender and their impact on sustainability	State and value ecosystem services used as indicators of conservation, prioritised services, and social, economic, and environmental sustainability

The paper also reminds us that IWRM is an applied and integrated focus not easy to put into practice. Incorporating the ecosystem focus is the way to consolidate the IWRM process. Each nation will need to learn how to manage its own unique environmental systems alongside its unique mix of physical, social, economic, and political circumstances, which will determine how IWRM is implemented. GWP (2015b) offered the following advice:

"*Too much of the former, and nations may come unstuck because organising water economies in poor countries is very different [to rich countries]. But if poor countries only revel in their exceptional circumstances, they may forfeit the opportunity to learn from the mistakes and successes of others and waste time and energy in 'rediscovering the wheel.'*"

7.3 More capacity will be needed

Ecosystem management is everyone's responsibility and needs the involvement of people at every scale, from individual households and communities to professionals working at watershed and national levels. Policies to implement and incorporate ecosystem-based management are important, but if the messages and understanding of what this means in practice do not go right down to the grass roots, individuals are likely to continue polluting streams and groundwater sources.

Individuals need to better understand ecosystems, how they impact people, how they can be conserved, and how to define and monitor the desired balance. This knowledge will be needed at all levels, from farmers working at the grass roots level to professionals across the water and water-using sectors. The issues will be the same, but the messages will need to be tailored to suit the many different groups and disciplines. This does not mean turning water engineers into aquatic ecologists; it will be about understanding the importance of ecosystems in water management. Better to bring ecologists into planning, design, and management teams to 'champion' ecology and build lasting relationships across disciplines.

Equally, water management institutions will need well thought out, environmentally sensitive policies and strategies, and appropriate tools to regulate and manage water resources.

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