
1 Introduction

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Fresh water is vital for the function of all terrestrial ecosystems – the flora and the fauna that make up those ecosystems, and, of course, for humans. Humanity relies on water not just for drinking, but also for food production, dealing with waste, providing energy and transport, to name but a few. To meet its needs humanity harnesses water through dams, irrigation networks, and pumps and pipes that supply drinking water and remove wastes. It is estimated that humanity consumes 1000–1700 m³ of the globe's surface and groundwater resources per year; that is between 22% and 150% of the annual global supply of fresh water (Hoekstra & Wiedmann 2014). This proportion is likely to increase as the global human population increases in the next 30 years and the demands for water in developing countries catches up with that of developed countries. According to the Intergovernmental Panel on Climate Change, changes in climate will amplify existing stress on water availability and will exacerbate different forms of water pollution, with impacts on ecosystems, human health, and water system reliability in large parts of the world (Stocker *et al.* 2013).

For a number of years, academics have tried to understand the linkages between the water system and human needs and the impacts that anthropogenic activities have on the water system itself. In the early days, the scientific approach sat within individual domains (e.g. hydrology for the water cycle (Thompson 1999); ecology for ecological impacts of water pollution (Abel 1996)). Given the complexity of the interactions and the centrality of humans in the water environment, more recently interdisciplinary approaches have come to the fore (e.g. Ferrier & Jenkins 2010; Renaud & Kuenzer 2014). The latest of such approaches is what we define in this book as ecosystem services-based approaches. These encompass a range of ways of understanding, assessing, and managing ecosystems at which core is the notion of ecosystem services, understood as the benefits that humans obtain from ecosystems.

The water cycle intimately embraces the ecosystems services paradigm. From regulating to provisioning and cultural services, the water environment provides a unique context through which to express the state of natural capital and flows between different ecosystems and the effects they produce on human wellbeing.

Much has been written about ecosystem services, and approaches using this notion are now being applied to the practical management of ecosystems around the world. Given that ten years have passed since the publication of the Millennium Ecosystem Assessment (2005), it is time to reflect on what has been achieved, what lessons can be learnt, and how we can improve the application of ecosystem services-based approaches for managing water ecosystems in the future.

This book aims to develop a better understanding of water as a service delivered by ecosystems, by furthering the understanding and the potential of ecosystem services-based approaches. This understanding is necessary not only to identify and quantify the critical linkages that regulate the interrelationships of hydrology and biota, but also to elucidate how the control of these linkages contributes to environmental sustainability, human livelihoods, and wellbeing.

In this book, leading academic and non-academic authors, from prestigious research institutions, world global organisations, and international non-governmental organisations, describe the forefront of the application of ecosystem services-based approaches to address global water challenges. Recognising that the challenge is multi-faceted, the authors come from a range of disciplinary backgrounds (from hydrological modelling, to environmental economics, through environmental psychology, international law, and ecological sciences) and 'real world' experiences in conservation, water management, and business. The result is a balance between global and world-regional visions and national and regional case studies from across the world.

The second chapter of the book provides an in-depth history of the notion of ecosystem services and proposes a definition of ecosystem services-based approaches based on four defining core elements (i.e. (1) focusing on the status of ecosystems, and the recognition of its effects on human wellbeing; (2) understanding the biophysical underpinning of ecosystems in terms of service delivery; (3) integrating natural and social sciences and other strands of knowledge for a comprehensive understanding of the service delivery process; and (4) assessing the services provided by ecosystems for its incorporation into decision-making). These core elements articulate discussions on a range

of broad issues on each of the individual chapters, which are organised in four parts:

- Part I looks at how ecosystem services-based approaches can help address major global challenges, such as climate change, food and energy supply, and biodiversity loss at regional and global scales.
- Part II reflects upon whether the notion of ecosystem services is useful in the context of frameworks for water resources management and biodiversity conservation, with a focus on the practicalities of the implementation of the approach.
- Part III provides examples of assessments of ecosystem services through a number of case studies from across the world, showing the latest advances in the integration of the biophysical quantification of water ecosystem service delivery with economic valuation techniques.
- Part IV broadens the perspective, providing innovative insights from less explored areas such as business, cultural ecosystem services, human rights, beliefs, and emotions towards water ecosystem services and the role of community partnerships.

Addressing global challenges and development goals requires a vision for water management beyond protection and restoration. It has to recognise the carrying capacity of ecosystems threatened by increasing human impact and find ways to

enhance the resilience of socio-ecological systems. This book provides a global synthesis of current thinking and applications of ecosystem services-based approaches to inform future water decision-making. The book consolidates current thinking and opens up new perspectives, with contributions from top scholars and practitioners, who take a critical and forward-thinking view aimed at stimulating the debate. The book highlights the potential benefits and challenges of adopting ecosystem services-based approaches and gives an insight on how to shape future strategies for water management and ecosystems conservation.

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