1 Introduction

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"One role of the sciences should be to provide information to better enable formulation and selection of environment and development policies in the decision-making process. In order to fulfil this requirement, it will be essential to enhance scientific understanding, improve long-term scientific assessments, strengthen scientific capacities in all countries and ensure that the sciences are responsive to emerging needs."

Chapter 35 of Agenda 21, United Nations (1992)

1.1 UNIQUENESS OF HYDROLOGY

The world's water resources and the water environment are under threat as never before. In almost every basin, man's activities have disrupted the natural hydrological and ecological regimes. Consequently, water supplies are no longer secure, the risks of hydrological extremes (floods and droughts) appear to be increasing and aquatic ecosystems are being destroyed or are under threat. The great challenge for the scientific hydrological community is to identify appropriate responses to these threats. Hydrologists should provide the necessary knowledge/understanding of the operation of hydrological processes at all scales, so that, in cooperation with other scientists, solutions can be found to optimize the use of the world's water resources that can then be translated into policy recommendations and actions.

The complexity of water problems requires specialists from many different disciplines, such as biology, atmospheric science, forestry, geology, geography, landscape architecture, engineering, ecology, soil science, and social sciences, to work together to find solutions. Good and bad examples of such solutions can be found in practice. Often the bad examples arise from the fact that the interdisciplinary nature of the problem was underestimated by the planners. Because water resources need to be examined and utilized in a holistic manner, hydrology is a very interdisciplinary science. This must be reflected both in conducting hydrological process research and in the development of strategies for integrated water resources management. Establishing links between disciplines is the prerequisite for providing sustainable water resources solutions. To achieve this requires certain skills, which must be incorporated in science education as "a way of working in a cooperative manner".

As water is the bloodstream of the planet, the uniqueness of hydrology is the integration of expertise from many disciplines to resolve problems in the hydrological cycle.

1.2 WHAT WE FEEL HAS CHANGED SINCE THE HYDROLOGY 2000 GROUP'S REPORT

The water-related challenges of today are more or less of the same character as those that existed when the predecessor of the Hydrology 2020 Working Group, the Hydrology 2000 Working Group, compiled their report in 1987. These challenges range from physical water scarcity to water quality degradation or secondary problems that can in various ways be related to problems associated with water resources or their management, such as a lack of safe drinking water and sanitation, land degradation, decreasing biodiversity, declining agricultural production, political conflicts, reduced economic development, poverty, a lack of infrastructure, global issues including climate change, teleconnection, anthropogenic impacts, and greater competition for resources. However the magnitude and spatial distribution of some problems has changed. In particular, globalisation, trade issues and other, more politically driven processes have forced us to consider water management issues within the framework of an increasingly complex world. International political issues, e.g., The Millennium Development Goals, and information and communication technologies have also drastically altered the way hydrology is done.

1.3 THE AIM AND SCOPE OF THIS BOOK

At its first meeting in Edinburgh, UK, in January 2002, the Hydrology 2020 Working Group developed the following mission statement:

– We will explore how hydrological sciences can evolve into a discipline capable of meeting the world water challenges that are expected to prevail by 2020.

– We will undertake a broad range of tasks, from identifying knowledge gaps and hydrological research priorities to determining ways to improve communication between hydrological scientists and those involved with developing and implementing water policies.

– Our intention is to formulate a vision that will be embraced by practising hydrological scientists and will also persuade younger scientists to become involved in hydrological science research.

The aim of this book is to fulfil our mission statement in summarising the outcomes of our discussions over the past four years. It does not aim to be a hydrology textbook nor to be fully comprehensive, but to present our independent perspectives, as a group and also as individuals currently working in different areas of hydrology, on the future of hydrology. In addition to discussing the current state of the art in hydrological science, the book emphasises societal issues and interdisciplinary work pertinent to hydrology since hydrologists cannot and should not work in isolation from society and other sciences. While there are many excellent contributions to the international water agenda, such as the United Nations (2003) report, "Water for People, Water for Life", our aim in this book is to highlight the contribution of the discipline of hydrology and of hydrologists.

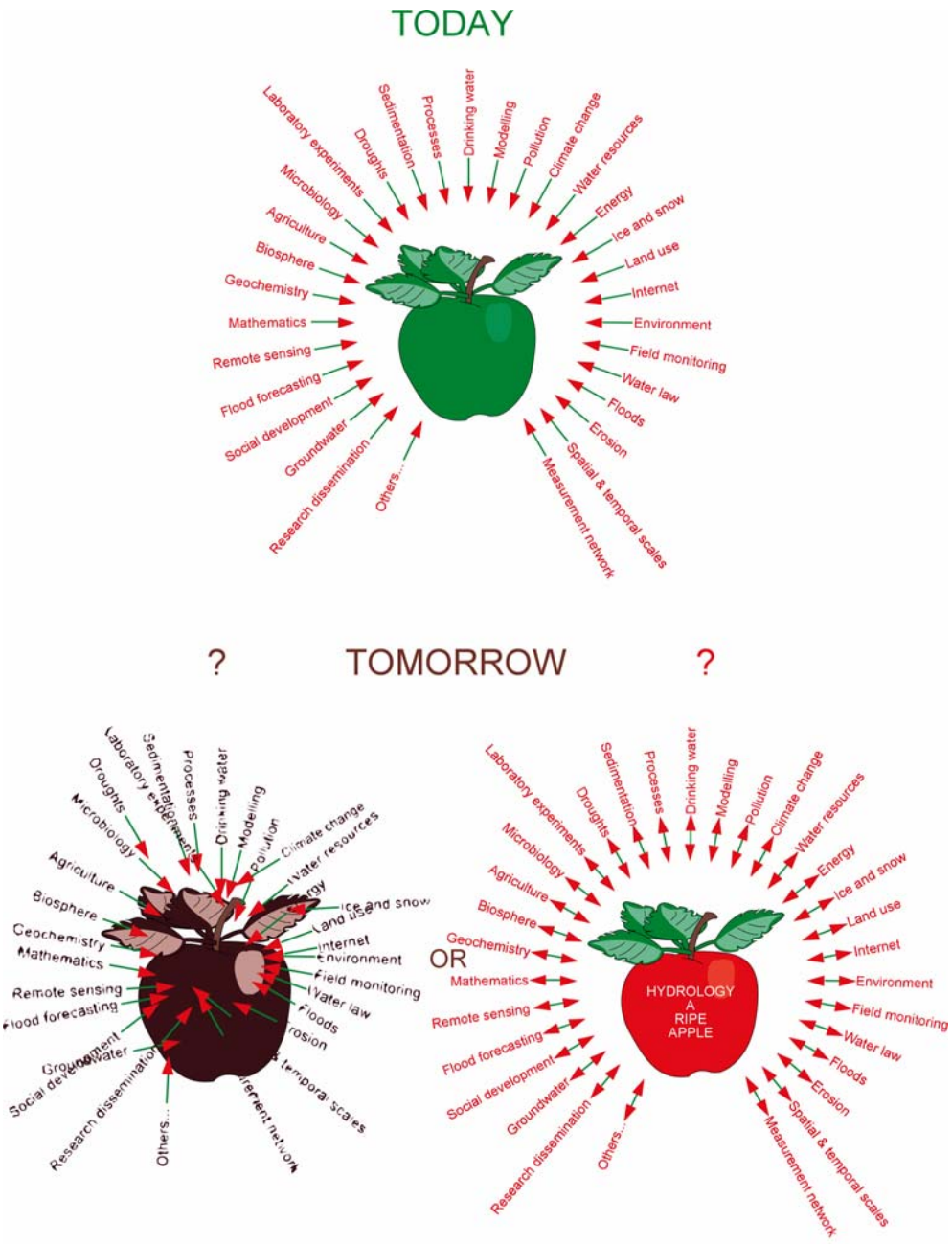

Fig. 1.1 *Alternative hydrological futures. The current situation is conceptualized as an unripe apple, characterized by limited and compartmentalized interaction between hydrology and other disciplines. Two alternative hydrological futures are presented. The bottom left figure depicts a "rotten" apple in which hydrology disintegrates. The ideal future shown in the bottom right is an interdisciplinary "ripe" apple in which a strong core of hydrological knowledge interacts with other disciplines.*

1.4 THE STRUCTURE OF THIS BOOK

The book is divided into eight chapters. Chapter 2 presents an assessment of the current and future global water resources availability and starts to consider how hydrology can contribute to water resources management from a more practical point of view. Chapter 3 identifies societal issues that we feel are closely related to water issues, thereby providing the rationale for hydrology and hydrological research. Chapter 4 discusses key issues in the measurement of water quantity and quality fluxes, because mensuration influences our understanding of hydrological processes and theory, as well as our ability to model and make predictions. Chapter 5 describes current issues and the future of modelling and prediction. Chapter 6 discusses the interdisciplinary nature of hydrology through selected examples of hydrology integrated with other disciplines. Chapter 7 presents the gaps, obstacles and bottlenecks facing hydrology as we perceive them today. The discussion is structured around three categories: scientific, technological/practical and organizational capacity. From this analysis, possible paths are identified that the hydrological community can take to overcome the identified gaps, obstacles and bottlenecks. Finally, Chapter 8 contains our conclusions and key messages, and presents some key recommendations for actions by different actors.

All the drafts of each chapter were first developed by the lead author(s) and extensively revised and edited by the whole group. Therefore all the contents and opinions presented in this book are largely the consensus of the members. It was an innovative and cooperative endeavour, supported by the latest information and communication technology. In conjunction with the description of the current status of each area of hydrological science, projections looking forward to the future are provided.

All the working group members hope that readers will enjoy and hopefully be inspired by the contents of the report. The future of hydrology is in your hands. The hydrological community itself will determine whether the discipline of hydrology will change from an “unripe” apple to a “rotten” or a “ripe” apple (as illustrated in Fig. 1.1). Together we can act to ensure that hydrology matures from its current state, in which there are many disparate interactions with other sciences, to become an inter-disciplinary science, with a strong core of hydrological knowledge.