Gulbenkian Think Tank on Water and the Future of Humanity

Water and the Future of Humanity

Revisiting Water Security

CALOUSTE GULBENKIAN FOUNDATION

Springer

Gulbenkian Think Tank on Water and the Future of Humanity

Water and the Future of Humanity

Revisiting Water Security

The Gulbenkian Think Thank on Water and the Future of Humanity

Benedito Braga, Colin Chartres, William J. Cosgrove, Luis Veiga da Cunha, Peter H. Gleick, Pavel Kabat, Mohamed Ait Kadi, Daniel P. Loucks, Jan Lundqvist, Sunita Narain, Jun Xia (in alphabetic order)

CALOUSTE GULBENKIAN FOUNDATION

Springer

Gulbenkian Think Tank on Water
and the Future of Humanity
Calouste Gulbenkian Foundation
Avenida de Berna 45A
1067-001 Lisbon, Portugal

ISBN 978-3-319-01456-2 ISBN 978-3-319-01457-9 (eBook)
DOI 10.1007/978-3-319-01457-9
Springer New York Heidelberg Dordrecht London

Library of Congress Control Number: 2013946034

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

Improved water supply and sanitation contributes to human dignity, health, education, and economic development. It is also increasingly clear that children and adults suffering from diarrhea, as a result of unsafe water and lack of sanitation facilities, cannot fully absorb the nutrients they consume, a condition often referred to as environmental enteropathy. Water has no substitute and the demands for it are increasing. Food and energy production along with industrial activity increasingly compete for the same water to meet the needs of a growing world population. At the same time, we are now seeing the impacts of climate change on water resources management.

This book is the result of 2 years of fruitful discussion about water and the future of humanity among 11 of the world's experts in water resources management under the sponsorship of the Calouste Gulbenkian Foundation. They have examined the major challenges that we face today and that our children will face in the future. They describe the use of water by sector and geographic area, the benefits for humans, and the way in which water use impacts other sectors. They remind us that the source of all our water is precipitation and that water resources are continuously replenished through the hydrological cycle—a cycle driven by energy from the sun. Natural and man-made ecosystems, of which humans are a part, play a vital role in water resources dynamics. The fragility of ecosystems to over-abstraction and pollution is highlighted.

This is a book not only about water management challenges but also about water's value across multiple sectors. We fail to recognize basic facts. The truth is that often water is undervalued in many of the products and services it provides. It is obvious that we must urgently manage our water use more efficiently, even so, under optimistic future scenarios; there could still be millions excluded from access to water and the goods and services that water provides. Wealthy countries and societies can afford expensive technology or purchase what they need on the world market. Countries and people trapped by poverty and suffering as a result of climate change may not have this luxury.

In describing the challenges, the authors send a message of hope. There will almost certainly be advances in technology and know-how in the years to come. They describe technological, economic, and institutional advances already being implemented by decision makers in different settings throughout the world. They

conclude that by replicating and scaling up these advances we can overcome the challenges we face to create a water-secure world. Leadership, vision along with individual and collective action will help secure the future we want.

December 2012

HRH the Prince of Orange, Chair, UN Secretary General's Advisory Board on Water Supply and Sanitation

Prologue

The Calouste Gulbenkian Foundation has a long history of taking an interest in global issues that affect the world today and can, eventually, create serious problems and constraints to the development of humanity. More recently, it has given due consideration to the analysis of environmental problems and processes. The convergence of these two concerns led to the creation of the "Gulbenkian Think Tank on Water and the Future of the Humanity," initiated in 2010, in the context of the former Gulbenkian Environment Program.

One of the purposes of the Think Tank was to reflect on the possibility of future water use creating serious barriers to human development. This possibility has not received sufficient attention so far and, consequently, the issue is not yet a source of adequate public concern.

The Foundation invited 11 highly respected personalities from the science and water management communities to be part of the Think Tank. They have been chosen on the strength of their sound knowledge and experience, as well as their broad vision of freshwater issues and problems. The members of the Think Tank come from different areas of knowledge and different geographic regions. They were all invited on a personal basis, not as representatives of any organizations or institutions they are associated with.

As a result of its activity, the Gulbenkian Think Tank has produced the present book.

The Calouste Gulbenkian Foundation expresses its deep gratitude to the members of the Think Tank for their generous and committed participation in this initiative.

We would also like to thank Luis Veiga da Cunha, coordinator of the group. His vision and expertise on these questions enriched the discussions held on this project since its early stage and were an important element in the Foundation's decision to pursue it.

The mandate of the Think Tank was to clarify the main drivers and issues of an eventual water crisis, in order to identify a realistic vision of a water-secure world in the next few decades and to suggest possible ways to cope with related future water problems.

In the current times of change and uncertainty, global water security is, no doubt, a major concern. Similarly, interactions and feedback effects running through water and other sectors, such as food, energy, urban development, and biodiversity, present major and complex challenges in the globalized world of tomorrow. In this

context, water conveys a potential for crisis and conflict, since it lays at the core of most things which are important for human life. Moreover water, although renewable, is limited and has no substitutes.

We are, thus, convinced that this initiative is a timely effort. We believe that the results of the "Think Tank on Water and the Future of Humanity" represent a valuable contribution for ongoing debates on global sustainable development. In particular, they could be helpful to clarify the need for a global water governance, as a cooperative arrangement to ensure improved living standards for the next generations.

Artur Santos Silva
President, Calouste Gulbenkian Foundation

Preface

The future does not belong to anybody.
There are no precursors, only latecomers.

Jean Cocteau

The Calouste Gulbenkian Foundation in Lisbon, Portugal, decided to create an international Think Tank to analyze noticeable features of the dynamic interactions between freshwater systems and society in the twenty-first century. This book is the result of such an initiative. I was honored by the invitation of the Foundation Board of Trustees to advise on the composition and working rules of this Think Tank and, later, to act as coordinator of the Think Tank activity.

The aim of the Gulbenkian Think Tank was to enhance present knowledge on the role of water in the world. Its reflections addressed water use until 2050, as well as the state of water resources in the planetary environment. The Think Tank has also reflected on the possible creation of serious barriers to development, caused by water-related constraints.

The Think Tank has examined likely trends, regarding water availability and management, comparing them with the growing water demand from various sectors. The Think Tank has also analyzed the main driving forces at play, in order to access the kind of human effort that is feasible and desirable to cope with future situations.

The members of the Gulbenkian Think Tank are (in alphabetical order): Prof. Benedito Braga (*President, World Water Council*; *Professor, Escola Politécnica da Universidade de São Paulo, Brazil*); Dr. Colin Chartres (*Director General, International Water Management Institute—IWMI, Colombo, Sri Lanka*); Dr. William J. Cosgrove (*Honorary President World Water Council, Montreal, Canada*); Prof. Luis Veiga da Cunha (*Professor, Universidade Nova de Lisboa, Lisbon, Portugal*); Dr. Peter Gleick (*President, Pacific Institute, Oakland, USA*); Prof. Pavel Kabat (*Director and CEO, International Institute for Applied Systems Analysis—IIASA, Austria*; *Professor of Earth Systems Science, Wageningen University, the Netherlands*); Dr. Mohamed Ait Kadi (*President, Conseil General du Développement Agricole, Rabat, Morocco*); Prof. Daniel P. Loucks (*Professor, Cornell University, Ithaca, USA*); Prof. Jan Lundqvist (*Senior Scientific Advisor, Stockholm International Water Institute—SIWI, Stockholm, Sweden*); Ms. Sunita

Narain (*Director General, Centre for Science and Environment, New Delhi, India*); and Prof. Jun Xia (*Chair Professor and Dean, Research Institute for Water Security, Wuhan University, China*).

The members of the Gulbenkian Think Tank have assumed collective authorship of the whole book. Obviously, the members agreed to initially distribute the preparation of drafts of the book chapters, which were subsequently discussed in depth by all group members. The book is, thus, a true collective work. The book went through three successive editing processes: first, a scientific editing by Professor Daniel P. Loucks, member of the Think Tank; second, a professional editing by the London firm Scriptoria; and third, the final editing undertaken by the publishers of the book.

The global direct and indirect water demand in 2050 was considered, with reference to changes in population and GDP of countries, grouped into seven regions of the world. Global demographic growth, from the current more than seven billion inhabitants of the Earth to more than nine billion by 2050, will be a major driver of changes in water demand. These changes will substantially increase the pressures on water systems towards 2050, with special implications for food, energy, and the environment.

A host of multidimensional drivers is related to an expansion of the so-called *urban culture*, a feature in mushrooming cities. Currently, about half of the world's population lives in urban centers. By 2050, more than 70 % of the world's population will be living in urban areas. The impacts of the corresponding shifts in demand for food, water, and energy will be felt far beyond the boundaries of the urban centers themselves.

Considering increasing demands for water in line with its more uncertain availability, environmental water requirements will become a hot topic. The demand for water has often been considered to be at odds with the need for water to maintain the life of multiple organisms. In addition, human waste, and particularly wastewater, has been discharged into the environment with little concern for its impact on ecosystems. Depriving ecosystems of water, essential to their life, and poisoning them with waste would feedback negatively on human life and development.

The availability of water can become a serious constraint on development. This may happen in a relatively short period. Thus, the danger of insufficient timely awareness is very real. As some have already claimed, a water crisis could negatively affect humanity, even more than the much discussed climate change crisis. However, the public and political concern with global warming is currently stronger than the concern with a global water crisis. The Earth may be quickly approaching critical tipping points related to water, food, and energy security. It is important to recognize that the water and the climate crisis are closely interrelated. Global warming will affect water supply and demand, as well as water quality. At the same time, water is clearly the main mediator of the impacts of climate change in the economy, society, and the environment.

There is a clear need for an interdisciplinary and inter-sectorial reflection on the processes and issues involved in the anticipated global water scarcity and security problems, which may seriously affect the future of humanity.

Concerned with the different aspects referred to above, the Gulbenkian Think Tank has proposed a "Message on Water and the Future of Humanity," which is presented just before the book text.

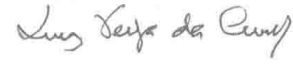
The book consists of nine chapters. The two initial chapters address, in an introductory manner, a number of issues particularly related to future water problems. These include the relationship between development, environment and water, the increasing water crises in the Anthropocene, water and globalization, and water governance (Chap. 1), and also the drivers of water demand, course changes, envisioning the future, projecting water demands and the need for a change of human behavior, involving modified social and environmental concerns (Chap. 2).

The following six chapters deal in detail with a number of critical factors already present but deemed to increase in the future. They relate to water in a variable and changing climate (Chap. 3); water, the environment and ecosystems services (Chap. 4); water in an urbanizing world (Chap. 5); water and food security (Chap. 6); water and energy nexus (Chap. 7); and water projections and scenarios (Chap. 8).

The book concludes by reviewing the main water-related challenges confronting humanity, followed by the consideration of ways to respond to these challenges, emphasizing the role of leadership, commitment, and responsibility (Chap. 9).

The book is intended to present the current knowledge about the challenges, risks, and opportunities present in our path to a future water sustainable world. Water sustainability is something much too serious to leave to politicians, managers, and scientists alone. It is a crucial issue for our emerging globalized world. It concerns everybody and will strongly condition the quality of our lives and even our survival.

The Gulbenkian Think Tank on Water and the Future of Humanity has aimed to offer a scientifically sound book and, at the same time, a readable and motivating one for the public in general. If the business-as-usual approaches, currently adopted to cope with water problems, are not drastically changed then the future of water and, as a consequence, our own welfare may be seriously threatened. We must take care not to be latecomers to the Future, as mentioned by Cocteau in the opening quote of this Preface.



Luis Veiga da Cunha
Coordinator of the Gulbenkian Think Tank
on Water and the Future of Humanity

Acknowledgments

The book has benefited significantly from contributions and advice from scholars outside the Gulbenkian Think Tank on Water and the Future of Humanity. This was done by so many, and in so many ways, that we cannot thank them all personally, but we particularly want to acknowledge the following:

Dr. David Wiberg, International Institute for Applied Systems Analysis (IIASA), together with Fulco Ludwig, Wageningen University, for extensive contributions to the water and climate change topic; Dr. Aditya Sood, International Water Management Institute (IWMI), for re-implementing the WATERSIM model and for providing scenarios of water demand and water availability for the period 2010–2050; Morgan Levy, University of California, Berkeley, for her work at the Pacific Institute researching and writing on the history and practice of water scenarios and projections; Camelia Dewan, Stockholm International Water Institute (SIWI), and Dr. Gerald C Nelson, International Food Policy Research Institute (IFPRI), for providing data on estimated GDP growth for the period 2010–2050; Dr. Dieter Gerten and Holger Hoff, Institute for Climatic Research (PIK), for providing global hydrological data as an input for the WATERSIM model; Dr. Mark Smith, International Union For Conservation of Nature (IUCN), and Dr. Karin Krchnak, The Nature Conservancy, for their contributions to water and the environment; and Ms. Debra Perrone, Vanderbilt University, for her advice on water and energy issues.

We would like to acknowledge SCRIPTORIA (London) and TVM DESIGNERS (Lisbon), respectively for their professional editing of the book and for redrawing the figures and tables to improve their uniformity in style and quality. Finally we also want to acknowledge with thanks the intellectual and logistic support we received from IIASA, IWMI, and SIWI during the preparation of this book.

Country borders or names shown on maps in this book do not necessarily reflect the position of the Calouste Gulbenkian Foundation or any of the members of the Gulbenkian Think Tank on Water and the Future of Humanity concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

A Message on Water and the Future of Humanity

A combination of demographic, technological, and economic trends has accelerated the ability of humans to modify their built and natural habitats. Growth in the world's economic sectors—including agriculture—and urban centers is changing the landscapes of our Earth and multiplying the flow of goods and services derived from water and other natural resources. The human potential to develop and manage natural resources for the individual and common good has increased exponentially during recent decades. Unfortunately, many of our past governance and piecemeal decisions concerning the management and use of natural resources have resulted in real and possible threats. These threats take the form of disruption of river flow regimes and water quality, the lowering of ground water tables, and the deterioration of natural ecosystems and of the services they provide, including those related to water quality. In addition, global warming, including climate change and variability, speeds up many of the processes in the hydrological cycle with increased unpredictability in the spatial and temporal availability of water. Geographically, as well as economically and socially, there will be winners and losers if these trends continue unabated.

Being the dominant and most dynamic species on Earth, humans have an opportunity to willfully reflect on the consequences of their collective behavior. We can use our visionary abilities, technologies, and economic resources for increased human well-being and the sound stewardship of our resources. Or we can allow a business-as-usual trend to continue, with its inherent risk for undesirable disruptions on planet Earth and, in particular, for our water resources. Piecemeal and post-damage control of undesirable disruptions in life support systems are not enough in the environment we find ourselves in today; an environment where humans can indeed control the fate of this planet. In this Anthropocene epoch, humans are the only species with the capacity to reflect on their behavior and change it as needed to achieve the goals of humanity in harmony with the dynamics of water and the other natural resources essential for our health and economic and social well-being.

The writers of this book seek to determine a path to a desirable, sustainable future for humans in a world with immense opportunities, but also with limits, boundaries, and vulnerabilities. We believe essential components of human well-being can be enhanced without a corresponding increase in resource exploitation and its associated detrimental environmental side effects. Inefficiencies in the use of

water and other resources are still low when compared to the inefficiencies in the use of our productive potential. There are a number of obstacles to overcome. Providing healthy lives and meaningful livelihoods for humankind require a number of changes in the way that the necessary water, food, energy, and other goods and services are provided and beneficially consumed. Changes are also required in the ways in which by-products are recycled or disposed of. Progress has to be envisioned against a background of the present consumption habits of the most affluent, the inequitable distribution of the benefits of the planet's water and other resources, and a climate that is changing because of, among other reasons, human activity.

We have examined in a systematic manner the major development challenges and the linkages between them and their dependence and effects on water and other resources. From this examination we have identified several positive trends and technological, economic, political, and social measures that, if adopted, would set the course to the achievement of a desirable future.

The Gulbenkian Think Tank on Water and the Future of Humanity

Contents