

Shimelis Gebriye Setegn
Maria Concepcion Donoso *Editors*

Sustainability of Integrated Water Resources Management

Water Governance, Climate and
Ecohydrology

 Springer

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Foreword

All around the world, people are feeling enormous pressures from the challenges of managing water resources. Climate change is affecting the global water cycle, leading to irregular rainfall, more floods and more droughts. Water availability has been reduced due to mining of groundwater, pollution and abstraction from upstream water sources. Expanding cities and accelerating economic activity are increasing the demand for energy and food and creating further unsustainable pressures on water resources. Competition for land, water and food is threatening to exacerbate poverty, hunger and environmental deterioration.

Addressing the complex inter-linkages effectively requires an integrated framework that leverages the synergies among access to water and sanitation, education and health, equality and women's empowerment, energy security, food and nutrition, climate, biodiversity and ecosystems, governance and the rule of law. The Millennium Development Goals included the target of halving, by 2015, the proportion of people without sustainable access to safe drinking water and sanitation. Member States of the United Nations in 2010 explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realization of all human rights. Building on the achievements and the lessons learned thus far, the new sustainable development agenda will be adopted in September 2015 to set the world on a path to sustainable development.

The new sustainable development agenda will build on the work of the Open Working Group established after the Rio+20 Conference in 2012. It conducted an unprecedented transparent and inclusive process, open to the participation of all stakeholders, including civil society, businesses, academia, local authorities, parliamentarians and citizens. The outcome of the Open Working Group contains a proposal for the Sustainable Development Goals (SDG), which will be the main basis for the final set of negotiations leading to the world leaders' Summit in September 2015.

The new agenda will be strongly human-development focused while addressing the planetary boundaries, economic growth and social inclusion in an integrated

manner. It will reflect universality, integration and transformative change, backed by accountability supporting the data revolution.

During the deliberations of the Open Working Group, member states acknowledged that water is at the core of sustainable development, as water and sanitation are central to the achievement of many other development goals and play a vital role in economic growth and poverty eradication. The relevance of sustainable management of watersheds and other water-related ecosystems has also been acknowledged. The Integrated Water Resources Management (IWRM) perspective is reflected in the proposal for an SDG on “Ensuring Availability and sustainable management of water and sanitation for all”, with a target to implement IWRM at all levels by 2030.

This book will contribute to providing science-based evidence on the ways of better implementing its goals and targets, monitoring progress through appropriate indicators and data, and the means for implementation. The text addresses some of the theoretical, practical and political issues encompassed by IWRM in a comprehensive and multifaceted way. It includes the households, local, country and regional perspectives on IWRM, linking experiences and evidence with the major global challenges. The book covers a wide range of factors that ultimately influence the effective exercise of the human rights to water and sanitation in a sustainable way, including the links with governance and conflicts.

I believe this publication will help better inform the post-2015 development agenda by bridging the gap between evidence and policy making, between science and programs, between academics, policy makers, civil society, businesses and communities.

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Chapter 1

Introduction: Sustainability of Integrated Water Resources Management (IWRM)

Shimelis Gebriye Setegn

1.1 Overview

Water is essential for life, ecosystems, and social and economic development. We depend on a reliable, clean supply of drinking water to sustain our health. Water is also needed for agriculture, energy production, navigation, recreation, and manufacturing. Its exploitation and use must be well planned and managed in a sustainable manner. Water availability has been reduced due to periodic droughts, overconsumption of surface and groundwater resources, and pollution and climate change. Population increase, fast growth of cities, and accelerating economic activity are increasing the demand for water, energy, and food and creating further pressures on water resources. In many developing countries, the lack of adequate, clean, and safe water, pollution of aquatic environments, and the mismanagement of natural resources are still major causes of environmental health problem and mortality. Irregular rainfall, more floods, and droughts are becoming more frequent events in different parts of the world.

The crucial importance of water to the various aspects of human health, development, and well-being has led to specific objectives concerning water and the support to each of the eight millennium development goals (MDGs), established by the UN in the year 2000. With a human population and water demand that are continuing to grow, the management of water resources will become of vital importance. Moreover, sustainable freshwater resource management will need to be included in future development plans and implementations. The sustainability of integrated water resources management (IWRM) in the face of climate variability and change is an important issue when planning and/or developing policies that

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consider the impact of climate change, ecohydrology, and water governance in the context of a more holistic approach to ensure sustainable management of water resources. Sustainable IWRM is more about processes, and more should be done to articulate the most essential IWRM components that ensure the ongoing IWRM sustainability efforts. Hence this book addresses the importance of integrated water resources management toward achieving water, energy, and food security. It addresses appropriate means of managing the scarce surface and water resources in the face of climate change and increased population pressure and high water demand. The book also addresses the question of how to define and measure the sustainability of IWRM. Main topics covered in this book include global prospective of IWRM; allocation of environmental flows in IWRM; ecohydrology, water resources, and environmental sustainability; climate change and IWRM; IWRM and water governance including social, economic, public health, and cultural aspects; climate change resiliency actions related to water resource management sustainability; and tools in support of sustainability for IWRM.

This book will be of interest to researchers, practitioners, water resource managers, policy- and decision-makers, donors, international institutions, governmental and nongovernmental organizations, educators, as well as graduate and undergraduate students. It is a useful reference for integrated water resources management (IWRM), ecohydrology, climate change impact and adaptations, water governance, environmental flows, geographic information system and modeling tools, water and energy nexus, and related topics.

1.2 Integrated Water Resources Management: Global Perspective

IWRM, as the Global Water Partnership defined, is the process of promoting the coordinated development and management of water, land, and related resources, to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. IWRM aims to support countries in their efforts to tackle specific water challenges, e.g., water scarcity, water-borne diseases, floods, droughts, and access to water and sanitation, and thus sustain their development to achieve the goals such as poverty alleviation, food security, economic growth, and ecological conservation. IWRM is a comprehensive, participatory planning and implementation tool for managing and developing water resources, ensuring the protection of ecosystems for future generations.

Efforts to achieve the millennium development goals involve planning and action in water resource development, management, and use. Better management and development of water resources through IWRM approach has been recognized in 2002 during the Johannesburg World Summit on Sustainable Development with the Summit urging all countries “to develop IWRM and water efficiency plans by 2005.” IWRM is a constantly evolving subject, and its development and application

have received intense attention and contributions from many parties, including national authorities, international and intergovernmental bodies, and academic and nongovernmental organizations.

In this book we have addressed several issues of IWRM with special emphasis to African, Latin American, and global perspective of IWRM.

1.3 Ecohydrology, Water Resources, and Environmental Sustainability

A defining characteristic of integrated water resources management (IWRM) is its commitment to balance socioeconomic development of water resources with environmental sustainability. This is articulated in the definition of IWRM by the Global Water Partnership (GWP 2000) and is being adopted in new water policies and legislation worldwide (UNEP 2012). A major component of environmental sustainability in water resource development is the explicit allocation of water to meet ecosystem needs. This environmental water allocation is commonly referred to as an environmental flow. The most widely accepted definition of environmental flows is “the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems” (Brisbane Declaration 2007). Ecosystem services, or the beneficial roles that forests and wetlands have on water availability and quality, are being increasingly recognized worldwide. Forests and wetlands store water during the rains, promote groundwater recharge, and feed streams and springs in the dry season. Harnessing this inherent capacity of ecosystems to maintain water quality and to regulate hydrology is then the logical way to manage water resources sustainably and affordably. Understanding the links between different ecosystems in a catchment and local/regional hydrology enables restoration and maintenance of the ecosystems along with the services they provide.

This book consists of different issues on how environmental flow and ecohydrology play significant roles for sustainable management of water resources. The main topics addressed in this issue include allocation of environmental flows in IWRM, understanding and maintaining ecosystem services for IWRM, and application of ecohydrology in IWRM.

1.4 Climate Change and Integrated Water Resources Management (IWRM)

A reliable and clean supply of drinking water is necessary to sustain human health. Water is also needed for agriculture, energy production, navigation, recreation, and manufacturing. These demands place pressures on water resources that are likely to

be exacerbated by climate change. In many areas, climate change is likely to reduce surface and groundwater resources, accompanied by increasing water demand. A major effect of climate change is likely to be alterations in hydrologic cycles and changes in water availability. Increased evaporation, combined with changes in precipitation, has the potential to affect runoff, the frequency and intensity of floods and droughts, soil moisture, and available water for irrigation and hydroelectric generation.

The Intergovernmental Panel on Climate Change (IPCC 2007) findings suggest that developing countries will be more vulnerable to climate change due to their economic, climatic, and geographic settings. According to IPCC (2007) report, the population at risk of increased water stress in Africa is projected to be between 75 and 250 and 350 and 600 million people by the 2020s and 2050s, respectively. Moreover, yields from rain-fed agriculture could be reduced by up to 50 %, in countries which depend mainly on rain-fed agriculture.

In some areas, climate change increases runoff, flooding, or sea level rise. Changes in the amount of rainfall during storms provide evidence that the water cycle is already changing. Setegn et al. (2011) investigated how changes in temperature and precipitation might translate into changes in stream flows and other hydrological components using downscaled outputs from four climate models.

This book consists of topics on sustainability of water resources in tropical regions in the face of climate change, sustainable development and integrated water resources management, water resources variability due to climate change in Mexico, and sustainable management of floods and extreme events.

1.5 IWRM and Water Governance

Meeting the millennium development goals for water and sanitation in the next decade will require substantial economic resources, sustainable technological solutions, and courageous political will. The challenge is to mobilize the political will to implement water resource development programs which cater in an equitable manner for the various demands on water. A great number of governments and international organizations have launched water-related programs and interventions all over the world as an effective way to improve people's health and welfare. But the challenges to overcome the impacts will be very high. An integrated approach should be designed to decrease the alarming impact of water quality, chemical impurities, and other water pollutions.

IWRM is not just about managing physical resources; it also requires and promotes the positive changes in water governance regarding the enabling environment, institutional roles, and management instruments. IWRM systems should, therefore, not only be responsive to changes among its development process, for example, between projected goals and decision-makers' willingness, but also be capable of adapting to new economic, social, and environmental conditions and to changing human values over a long-term implementation.