

The United Nations World Water Development Report 2023

Partnerships and cooperation for water



Partnerships and cooperation for water

Published in 2023 by the United Nations Educational, Scientific and Cultural Organization,
7, place de Fontenoy, 75352 Paris 07 SP, France

© UNESCO 2023

This report is published by UNESCO on behalf of UN-Water. The list of UN-Water Members and Partners can be found on the following website: www.unwater.org.

ISBN 978-92-3-100576-3



This publication is available in Open Access under the Attribution-ShareAlike 3.0 IGO (CC-BY-SA 3.0 IGO) license (creativecommons.org/licenses/by-sa/3.0/igo/). By using the content of this publication, the users accept to be bound by the terms of use of the UNESCO Open Access Repository (www.unesco.org/open-access/terms-use-ccbysa-en).

The present license applies exclusively to the text content of the publication. For the use of any material not clearly identified as belonging to UNESCO, prior permission shall be requested from the copyright owner.

Section 8.2 by Bo Libert, Iulia Trombitcaia, Elise Zerrath and Diane Guerrier © 2022 United Nations.

Section 8.3 by Silvia Saravia Matus, Marina Gil, Alba Llavona, Laura Martinez Botia, Lisbeth Naranjo and Natalia Saramanto © 2022 United Nations.

Chapter 12 by Helen Laubenstein and Richard Connor © OECD/UNESCO 2023; the opinions expressed and arguments employed herein do not necessarily reflect the official views of the Members of the OECD.

The designations employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Similarly, boundaries and names shown and the designation used on the maps do not imply official endorsement or acceptance by the United Nations. A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

The ideas and opinions expressed in this publication are those of the authors; they are not necessarily those of UNESCO and do not commit the Organization. The contents were contributed by the UN-Water Members and Partners, and others listed on the title pages of the chapters therein. UNESCO and the UNESCO World Water Assessment Programme (WWAP) are not responsible for errors in the content provided or for discrepancies in data and content between contributed chapters. WWAP provided the opportunity for individuals to be listed as authors and contributors or to be acknowledged in this publication. WWAP is not responsible for any omissions in this regard.

Suggested citation:

United Nations, The United Nations World Water Development Report 2023: Partnerships and Cooperation for Water. UNESCO, Paris.

Cover artwork by Davide Bonazzi

Graphic design and layout by Marco Tonsini

Printed by UNESCO, Paris

Printed in France

This publication is printed on 100% recycled, chlorine-free paper.

S H O R T S U M M A R Y

Cooperation is critical to achieving all water-related goals and targets

At current rates, progress towards SDG 6 is off-track. The 2023 edition of the *United Nations World Water Development Report (WWDR)* describes how building partnerships and enhancing cooperation across all dimensions of sustainable development are essential to accelerating progress towards all the targets of SDG 6 and realizing the human rights to water and sanitation.

Partnerships and cooperation take place in almost any water-related endeavour and water resources management has a long history of experience with partnerships, both good and bad. This report reviews this experience, highlighting how enhancing positive and meaningful cooperation amongst the water, sanitation and broader 'development' communities is required to accelerate progress.

This report also addresses how the water and sanitation community can internally collaborate more effectively by maximizing complementarity, as well as reach out to other sectors and realms of decision-making where water plays a critical (but often times misunderstood or ignored) role in meeting their own objectives and amplifying co-benefits.

Safeguarding water, food and energy security through sustainable water management, providing water supply and sanitation services to all, supporting human health and livelihoods, mitigating the impacts of climate change and extreme events, and sustaining and restoring ecosystems and the valuable services they provide, are all pieces of a great and complex puzzle.

Only through partnerships and cooperation can the pieces come together.

And everyone has a role to play.

***Nearly every
water-related
intervention involves
some kind of
cooperation***



"Since wars begin in the minds of men and women it is in the minds of men and women that the defences of peace must be constructed"



Contents

Foreword by António Guterres, <i>Secretary-General of the United Nations</i>	vii
Foreword by Audrey Azoulay, <i>Director-General of UNESCO</i>	viii
Foreword by Gilbert F. Hounbo, <i>Chair of UN-Water and Director-General of ILO</i>	ix
Preface	x
WWDR 2023 Team	xii
Acknowledgements	xiii
Executive summary	1
Prologue Part 1 The state of the world's freshwater resources	11
Water demand	12
Water availability and stress	13
Water quality	16
Water-related ecosystem services	17
Extreme events	18
References	18
Prologue Part 2 Progress towards SDG 6	20
SDG Targets 6.1 and 6.2: Drinking water and sanitation services	21
SDG Target 6.3: Water quality and wastewater	21
SDG Target 6.4: Water use efficiency and water scarcity	23
SDG Target 6.5: Water management and transboundary cooperation	25
SDG Target 6.6: Water-related ecosystems	25
SDG Target 6.a: International cooperation and capacity-building	26
SDG Target 6.b: Community participation	26
References	28
Chapter 1 Introduction	29
1.1 Purpose and scope of this report	30
1.2 Basic concepts	31
References	32
Chapter 2 Food and agriculture	33
2.1 Introduction	34
2.2 Water user associations	34
2.3 Water allocation for agriculture and urban centres	38
2.4 Water–energy–food–ecosystem nexus	43
2.5 Collection and dissemination of water data and information	43
References	46
Chapter 3 Environment	49
3.1 Introduction	50
3.2 Watershed services schemes	51
3.3 Institutional partnerships for policy change and consensus-building	53
3.4 Environmental data and information	55
3.5 Lessons learned	57

Contents

3.6 Conclusions	60
References	61
Chapter 4 Water supply and sanitation for human settlements.....	63
4.1 Introduction.....	64
4.2 Water operators' partnerships	64
4.3 Wastewater management	66
4.4 Multistakeholder partnerships in rural and secondary towns	66
4.5 Water resilience in cities.....	69
4.6 Migrants and refugees.....	70
4.7 Conclusions	71
References	72
Chapter 5 Industry.....	73
5.1 Context	74
5.2 Industrial water use.....	74
5.3 Collective action and industry motivations	75
5.4 Elements of collective action.....	77
5.5 Examples of industry collaboration.....	81
5.6 Energy sector.....	83
5.7 Small and medium enterprises	83
5.8 The way forward.....	84
References	85
Chapter 6 Health	87
6.1 WASH and health linkages.....	88
6.2 Priority WASH and health partnerships	92
6.3 Emerging areas for partnerships for WASH and health	98
6.4 Lessons learned and ways forward.....	100
References	100
Chapter 7 Climate change	103
7.1 Introduction	104
7.2 Water and climate stakeholders	105
7.3 Intra-sectoral approaches	106
7.4 Cross-sectoral approaches	107
7.5 Extra-sectoral approaches	109
7.6 Conclusions	110
References	113
Chapter 8 Regional perspectives	115
8.1 Sub-Saharan Africa	116
8.2 Europe and North America.....	119
8.3 Latin America and the Caribbean	124
8.4 Asia and the Pacific	128
8.5 The Arab region	131
References	137

Contents

Chapter 9 Education and capacity development	141
9.1 Introduction.....	142
9.2 Education and training.....	142
9.3 Knowledge co-creation and communities of practice.....	144
9.4 Life-long learning	145
References	146
Chapter 10 Data, information and monitoring	148
10.1 Introduction.....	149
10.2 Transforming data into information and action	149
10.3 Data generation and sharing.....	150
10.4 Data accessibility and interoperability.....	152
10.5 Trends in monitoring and data accessibility.....	152
10.6 Next steps.....	154
References	155
Chapter 11 Innovation	156
11.1 Introduction	157
11.2 Technological innovations.....	157
11.3 Social innovation	158
11.4 Challenges.....	160
References	161
Chapter 12 Financing.....	162
12.1 Introduction	163
12.2 Cooperation on the demand side of finance	163
12.3 Cooperation on the supply side of finance	164
12.4 Cooperation between the supply and demand side of finance.....	167
12.5 Conclusions	170
References	170
Chapter 13 Governance: A ‘whole-of-society’ approach	172
13.1 Enhanced cooperation over water, food and climate security	173
13.2 Who’s at the table? On meaningful participation	175
13.3 Strategic integration, cross-sectoral coordination and multi-use water systems.....	177
13.4 Regulation and public–private partnerships	178
13.5 Good governance: a whole-of-society partnership approach.....	179
References	180
Chapter 14 Conclusions.....	183
14.1 Guiding principles for successful partnerships and cooperation.....	184
14.2 Aligning roles, including responsibilities and contributions	186
Coda.....	187
References	187
Abbreviations and acronyms.....	188

Boxes, figures and tables

Boxes

Box 1.1	The SDG 6 Global Acceleration Framework	31
Box 2.1	Water reclamation and inter-sectoral water transfer between agriculture and cities: A FAO economic wastewater study	41
Box 2.2	WEFE nexus in Bekaa Valley, Lebanon	45
Box 2.3	Cooperation through water tenure in achieving inclusive water policy and development objectives	46
Box 3.1	Water funds mobilize multiple partnerships to address water security needs	52
Box 3.2	Partnerships for conserving and restoring peatlands for carbon storage, hydrological flows and livelihoods.....	53
Box 3.3	The Ecosystem Services Partnership	55
Box 3.4	The Global Peatlands Initiative	56
Box 3.5	Adopt-a-River in action: UNEP and Four Rotary Clubs partner to clean up the Athi River (Nairobi, Kenya) and plant trees.....	57
Box 3.6	The Ecosystem Service Value Database	59
Box 4.1	The experience of Ghana Water Company Ltd. in pro-poor services: From mentee to mentor.....	65
Box 4.2	Providing water services to indigenous communities in Guatemala through the FESAN–ADECOR water operators’ partnership.....	67
Box 4.3	Smart rainwater management and drought resilience in rural semi-arid communities: A case study of Northeast Brazil.....	68
Box 4.4	Uptime Consortium and Catalyst Facility: A new partnership approach to scaling up sustainable rural water services	69
Box 4.5	Supporting community-based WASH collaboration in displacement settings.....	71
Box 5.1	SDG Ambition	76
Box 5.2	What can industry bring to a collective action?	78
Box 5.3	The CEO Water Mandate’s <i>Guide to Water-Related Collective Action</i>	80
Box 5.4	Partnering to achieve the world’s first Alliance for Water Stewardship Group certification.....	81
Box 5.5	Igniting a CEO-driven initiative: The Water Resilience Coalition	82
Box 5.6	Personal Advancement and Career Enhancement (PACE) programme for women.....	82
Box 5.7	Google’s Flood Forecasting Initiative	83
Box 5.8	Cooperation between a public utility (Hydro-Québec) and the Cree First Nation of Québec, Canada: A sustainable path for the community and the environment	84
Box 7.1	Applying water safety planning for climate resilience in Nepal	107
Box 7.2	Drought-induced collaboration of water managers and service providers in Cape Town.....	108
Box 7.3	Developing a climate financing proposal for water and food security in Zimbabwe.....	109
Box 7.4	Lessons learned on transboundary basin cooperation regarding climate change and energy in the Mekong River	110
Box 7.5	Promoting cooperation on water and climate at the ministerial level.....	111
Box 7.6	Water and climate change cooperation through the ‘Water Tracker’.....	111
Box 7.7	Water and Climate Coalition	112
Box 8.1	AMCOW Pan-African Groundwater Programme: Advancing groundwater for water security and socio-economic transformation in Africa	120
Box 8.2	Santiago Maipo Water Fund.....	127
Box 9.1	H ₂ O Maghreb: A training partnership responding to Morocco’s water challenges.....	145
Box 9.2	Partnering for sustainable water management: The Andean monitoring network iMHEA.....	146
Box 10.1	Joint monitoring of groundwater levels across borders	151
Box 11.1	Citizen science for development.....	160
Box 12.1	Strategic investment pathways in Zambia	165
Box 12.2	Blended finance example: The As Samra wastewater treatment plant expansion in Jordan.....	168
Box 13.1	Public–private partnership on New Cairo Wastewater Treatment Plant.....	179

Figures

Figure P.1	Evolution of global water withdrawals, 1900–2018 (km ³ /year).....	12
Figure P.2	Seasonal variability in water availability.....	13
Figure P.3	Per capita renewable water resources availability by geographic region, 2000, 2012 and 2018 (m ³ /capita).....	14
Figure P.4	Annual baseline water stress.....	15
Figure P.5	Groundwater depletion rates.....	16
Figure P.6	Global risks of poor water quality.....	17
Figure P.7	SDG 6 indicators and tiering system.....	22
Figure P.8	Global coverage of water, sanitation and hygiene (WASH) services, 2015–2020 (%), and acceleration required to meet targets by 2030.....	23
Figure P.9	Change in the level of water stress by region and at the global level, 2008–2018.....	24
Figure P.10	Current data on Indicator 6.b.1: Participation of local communities in water and sanitation management.....	27
Figure 2.1	Schematic of water allocation between agricultural (rural) and urban centres.....	39
Figure 2.2	The FAO approach to the water–energy–food nexus.....	44
Figure 3.1	The World Water Quality Alliance.....	56
Figure 3.2	The SDG Indicator 6.6.1 workflow and monitoring and reporting.....	58
Figure 3.3	Reported barriers to scaling up watershed investments.....	60
Figure 5.1	UNIDO business partnerships typology.....	79
Figure 6.1	Key health sector’s functions in WASH.....	89
Figure 6.2	WASH-related diseases and risks.....	89
Figure 6.3	Partnerships are key to acceleration on WASH (SDG 6) and progress on many health challenges (SDG 3).....	90
Figure 8.1	Complex landscape of water partnerships in Africa.....	119
Figure 8.2	Water stress levels in major river basins in Asia and the Pacific, 2018.....	130
Figure 8.3	The five priority areas of work of the High-Level Joint Committee for Water and Agriculture.....	134
Figure 10.1	Actors involved in improving flood management in West Africa under the FANFAR project.....	154
Figure 12.1	Trend of official development assistance for water and selected sectors.....	165
Figure 12.2	Private finance mobilized through official development finance across sectors (US\$ billion), 2016–2020.....	166
Figure 13.1	What is water security?.....	174
Figure 13.2	The IWRM ‘comb’ for cross-sectoral integration.....	177

Tables

Table 2.1	Factors influencing WUA performance.....	35
Table 2.2	Overview of water allocation mechanisms.....	40
Table 2.3	Challenges and approaches to improve effectiveness of agriculture–urban water reallocation.....	42
Table 3.1	Buyer motivations by sector for user-driven watershed investments.....	54
Table 6.1	WASH-attributable disease burden by health outcome, 2019.....	88
Table 10.1	Examples of how water-related data are transformed into information and action.....	150

Foreword

by **António Guterres**, *Secretary-General of the United Nations*

Water is the lifeblood of humanity. It is vital for survival itself and supports the health, resilience, development and prosperity of people and planet alike.

But humanity is blindly travelling a dangerous path. Vampiric overconsumption and overdevelopment, unsustainable water use, pollution and unchecked global warming are draining humanity's lifeblood, drop by drop.

The effects are all around us – from climate change-driven heatwaves, droughts, floods and violent storms, to the world's supply of fresh water being contaminated by pollutants, chemicals and torrents of salt water from rising seas.

As this year's report reminds us, protecting and preserving this precious resource for future generations depends on partnerships. The smart management and conservation of the world's water resources means bringing together governments, businesses, scientists, civil society and communities – including indigenous communities – to design and deliver concrete solutions.

In particular, the 2023 United Nations Water Conference is a critical moment for collective progress – the first major United Nations meeting on water in nearly half a century, and a significant step towards Sustainable Development Goal 6: clean water and sanitation for all.

The Conference also reminds us that humanity's hopes captured by all of the Sustainable Development Goals – from education and health, to human rights, economic progress and climate action – depend on safeguarding our water resources for the future.

Now is the moment to stand together and invest in the management and governance of the world's water resources and freshwater ecosystems. We must strengthen accountability and equitable water access for all people, and place conservation of this precious resource first across national and global plans and priorities.

The United Nations is proud to stand with you, and to ensure that water continues to sustain our ecosystems, our economies, and the lives, health and future of every person on earth.



António Guterres

Foreword

by **Audrey Azoulay**, *Director-General of UNESCO*

Water is in constant motion. It is part of a cycle – one that ignores all borders created by humans. As such, it is a common good, which requires common management, if this management is to be both effective and relevant. For what happens upstream always has an impact downstream: extracting water from rivers or aquifers directly concerns all the populations that depend on them.

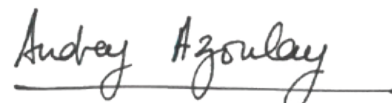
For this reason, water is an essential component of international cooperation. But how can we ensure the success of the partnerships and cooperative arrangements on which its sustainable management depends? That is the question asked by this United Nations World Water Development Report, coordinated by UNESCO on behalf of the UN-Water family.

Successful initiatives often apply a number of principles, which are presented in this report – whether this means the inclusion of all communities, like indigenous peoples and women, or the adoption of an interdisciplinary approach. Pooling expertise and perspectives leads to more relevant and efficient management – as seen in the impressive Climate Risk Informed Decision Analysis tool, which helps identify climate adaptation actions, or in the mapping of the Stampriet Aquifer, shared by Botswana, Namibia and South Africa.

UNESCO seeks to implement these principles on a daily basis, for water is an important area of action for our Organization. Over the past 50 years, we have developed two major programmes: our Intergovernmental Hydrological Programme, with its 169 national committees and 18 flagship initiatives, and our World Water Assessment Programme, both of which have allowed us to develop an impressive network of partners. Not to mention the 29 independent centres operating under the auspices of UNESCO, and the 70 UNESCO chairs working on these topics at universities and research institutions.

This report is a particularly timely way of building on these efforts. I would like to thank all its contributors, as well as the Government of Italy and the Regione Umbria for their ongoing support to UNESCO's World Water Assessment Programme. Indeed, this year, a major event on water is taking place, the United Nations conference on water, which will be an opportunity for the international community to develop a programme of action to ensure water and sanitation for all.

This is an essential objective, for both collective security and human dignity. May this report, the result of the collective intelligence of the entire UN-Water family, contribute to this goal by paving the way for new partnerships and cooperative agreements on this issue.


Audrey Azoulay

Foreword

by **Gilbert F. Hougbo**, *Chair of UN-Water and
Director-General of the International Labour Organization*

Water flows throughout the 2030 Agenda for Sustainable Development. It underpins most of the Sustainable Development Goals (SDGs) that are intended to create a more sustainable future for us all, leaving no one behind.

The essential role of the water cycle in all human activity and in our ecosystems means that if we fail to achieve SDG 6 – to ensure the availability and sustainable management of water and sanitation for all by 2030 – we risk the success of almost all of the other 16 Goals, including those related to food and nutrition, poverty reduction, human health, gender equality, energy, economic growth, sustainable cities, climate change and the environment.

As things stand today we are seriously off-track. The latest data show that if we continue on our current course we will not achieve any of the SDG 6 targets by the 2030 deadline.

But this is not inevitable. We can still achieve SDG 6, and all the related benefits it will bring to other parts of the 2030 Agenda, if we come together and form effective and dynamic partnerships.


This year's edition of the UN World Water Development Report shows what is possible. It presents best-practice examples of water-related partnerships and cooperation. It shows us the potential for expanding and strengthening partnerships and cooperation as a key way to accelerate progress.

It is a landmark publication. I would like to offer sincere thanks to the different UN bodies and partner organizations that make up the UN-Water family, without whose contributions the report would not have been possible. I would also like to recognize the valuable coordination work of UNESCO and its World Water Assessment Programme, as well as the inputs of the many other colleagues who contributed to the diversity and scope of this important study.

The Report is launched as we convene for the UN 2023 Water Conference - the first United Nations Conference on water in almost half a century.

The primary purpose of this Conference is to generate voluntary commitments that will rapidly shift our current course. These will form the Water Action Agenda – a shared endeavour on a critical issue that could make or break the 2030 Agenda for Sustainable Development.

There is much to do and time is not on our side. But this report shows what is possible. We must now come together and accelerate action.



Gilbert F. Hougbo

Preface

by **Michela Miletto**, *UNESCO WWAP Coordinator*
and **Richard Connor**, *Editor-in-Chief*

This year marks the 20th anniversary of the United Nations World Water Development Report (UNWWDR), as well as the 10th anniversary of its annual, thematic version. It also coincides with the first UN conference dedicated to water since 1977, with UNWWDR occupying a critical role as the UN system's principal authoritative report on water.

These milestones provide us the opportunity to both reflect on the successes of the past and, more importantly, take stock and learn from our mistakes as we move forward into the coming decades. The good news is that the resonance of the UNWWDR has been steadily increasing over the years, as evidenced by various indicators ranging from online downloads to media coverage. This in turn has also sparked interest and motivation in contributing to the report.

The concept of this year's edition, *partnerships and cooperation*, underpins the entire archetype of the United Nations. This very report, like all its predecessors, is the result of a tremendous level of *cooperation* between several UN agencies, partners and experts from around the globe. Indeed, the UNWWDR has often been cited as a shining example of the 'UN delivering as one'.¹ The report is all the more relevant in the context of 'accelerating change' – the theme of the 2023 World Water Day – as nearly every water-related intervention that is required to accelerate progress towards SDG 6, the overall objective of the UN 2023 Water Conference, involves some kind of meaningful cooperation.

As messages from this year's report began to emerge, we also came to realize that many of the lessons we've learned developing this report can also apply to this unique collaboration among UN Water members and partners. The first and foremost pertains to the inestimable value of partner dedication and the quality of their contributions. Indeed, the majority of our partners, with several of whom we have been collaborating for several years, continued to be committed and focused on delivering the relevant and insightful content that is the foundation of the report's success.

Another important lesson concerns the importance of data and information, specifically its availability and the best ways to share them among partners. While the theme *partnerships and cooperation* provided opportunities to highlight a vast number of cases and examples, the circumstantial nature of such content does not easily lend itself to detailed empirical analysis. However, covering a broad range of topics and experiences, the data and information provided by various contributors proved to be much more complementary than contradictory, and led to conclusions and response options that can serve the interest of all parties. In other words, the challenges of data limitations can be overcome, at least in part, by working in partnership across different perspectives.

Again this year, we have endeavoured to produce a balanced, fact-based and neutral account of the current state of knowledge, covering the most recent developments. This year's report highlights how enhancing cooperation and partnerships is not only essential to the integrated management of water resources in order to accelerate progress towards every water-related goal, but also critical in addressing the social, environmental and economic challenges that interconnect through water.

¹ 'Delivering as One' refers to a concept at the core of the UN reform process: coordinating different agencies to exploit the benefit of their competitive advantages.

Although primarily targeted at policy- and decision-makers, water resources managers, academics and the broader development community, we hope this report will also be well received by non-water specialists, including those who are engaged in the alleviation of poverty and humanitarian crises, in the pursuit of the human rights to water supply and sanitation, and the advancement of the 2030 Agenda for Sustainable Development.

This latest edition of the UNWWDR is the result of a concerted effort among the Chapter Lead Agencies listed in the acknowledgements. The Report also benefited to a great extent from the inputs and contributions of several other UN-Water members and partners, as well as from numerous universities, research institutions, scientific associations and non-governmental organizations, who all provided a wide range of relevant material.

On behalf of the World Water Assessment Programme Secretariat, we would like to extend our deepest appreciation to the afore-mentioned agencies, members and partners of UN-Water, and to the writers and other contributors for collectively producing this unique and authoritative report. We are profoundly grateful to the Italian Government for funding the Programme and to the Regione Umbria for generously hosting the WWAP Secretariat in Villa La Colombella in Perugia. Their contributions have been instrumental to the production of the UNWWDR.

Our special thanks go to Ms Audrey Azoulay, Director-General of UNESCO, for her ongoing support to WWAP and the production of the UNWWDR, and to Mr Gilbert F. Houngbo, Director-General of the International Labour Organization (ILO) and Chair of UN-Water.

Finally, we extend our most sincere gratitude to all our colleagues at the WWAP Secretariat, whose names are listed in the acknowledgements. The report could not have been completed without their professionalism and dedication.



Michela Miletto



Richard Connor

WWDR 2023 Team

Director of the Publication

Michela Miletto

Editor-in-Chief

Richard Connor

Process Coordinator

Engin Koncagül

Publication Assistant

Valentina Abete

Graphic Designer

Marco Tonsini

Copy Editor

Simon Lobach

UNESCO World Water Assessment Programme (WWAP) Secretariat (2022–2023)

Coordinator: Michela Miletto

Programmes: Richard Connor, Laura Veronica Imburgia, Engin Koncagül and Laurens Thuy

Publications: Valentina Abete, Martina Favilli and Marco Tonsini

Communications: Maria Letícia Carneiro Moderno de Oliveira, Simona Gallese and Eliana Maureen Harrigan

Administration and support: Barbara Bracaglia, Lucia Chiodini and Arturo Frascani

IT and Security: Michele Brensacchi, Tommaso Brugnami and Francesco Gioffredi

Trainees and Interns: Hanouf Alyami Mahdi, David Fabián Chacón-Labrador and Simón Matius Chaves Pacheco

Acknowledgements

This Report is published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), on behalf of UN-Water, and its production is coordinated by the UNESCO World Water Assessment Programme (WWAP). Gratitude goes to UN-Water Members and Partners and other Contributors that made the content preparation of this Report possible.

Chapter Lead Agencies

Food and Agriculture Organization of the United Nations (FAO), International Water Management Institute (IWMI), Organisation for Economic Co-operation and Development (OECD), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), UNESCO (Intergovernmental Hydrological Programme – IHP, Nairobi Office and WWAP), United Nations Human Settlements Programme (UN-Habitat), United Nations Industrial Development Organization (UNIDO), United Nations Regional Commissions (Economic Commission for Europe – UNECE, Economic Commission for Latin America and the Caribbean – UNECLAC, Economic and Social Commission for Asia and the Pacific – UNESCAP, Economic and Social Commission for Western Asia – UNESCWA), World Health Organization (WHO), and World Meteorological Organization (WMO).

Contributors

Alliance for Global Water Adaptation (AGWA), AquaFed, Armenian Women for Health and Healthy Environment, International Capacity Development Network for Sustainable Water Management (Cap-Net), CDP (formerly the Carbon Disclosure Project), CEO Water Mandate, Global Water Partnership (GWP), GWP Mediterranean, International Association of Hydrogeologists (IAH), International Association of Hydrological Sciences (IAHS), International Association for Hydro-Environment Engineering and Research (IAHR), IAHR Experimental Methods and Instrumentation Committee (IAHR-EMI), International Network of Basin Organizations (INBO), International Joint Commission (IJC), International Atomic Energy Agency (IAEA), Institute for Water Education (IHE Delft), International Institute for Applied Systems Analysis (IIASA), International Organization for Migration (IOM), International Union for Conservation of Nature (IUCN), IWMI, OECD, Rural Water Supply Network (RWSN), Stockholm International Water Institute (SIWI), Sanitation and Water for All (SWA), United Nations Convention to Combat Desertification (UNCCD), United Nations Office for Disaster Risk Reduction (UNDRR) Incheon, UNDP, UNECE, UNEP, United Nations University Programme on Comparative Regional Integration Studies (UNU-CRIS), UNU Institute for Environment and Human Security (UNU-EHS), UNU Maastricht Economic and Social Research and Training Centre on Innovation and Technology (UNU-MERIT), Water Committee under the Ministry of Territorial Administration and Infrastructures of Armenia, Water Europe, Water.org, Women for Water Partnership (WfWP), and WHO.

Donors

The development of the Report was financially supported by the Government of Italy and the Regione Umbria. All who have provided in-kind contributions, and their respective donors, are gratefully acknowledged.



Executive summary

The year 2023 marks the first major conference of the United Nations (UN) dedicated to water since 1977. The UN 2023 Water Conference focuses on progress towards water- and sanitation-related goals, coinciding with the mid-term comprehensive review of the International Decade for Action, 'Water for Sustainable Development 2018–2028'.

As the UN system's principal authoritative report on water, the *United Nations World Water Development Report 2023* directly informs the UN conference discussions, describing how building partnerships and enhancing cooperation across all dimensions of sustainable development are essential to accelerating progress towards the Sustainable Development Goal for water and sanitation (SDG 6) and realizing the human rights to water and sanitation.

The world's water: demand, availability and quality

Water use has been increasing globally by roughly 1% per year over the last 40 years and is expected to grow at a similar rate through to 2050, driven by a combination of population growth, socio-economic development and changing consumption patterns. The bulk of this increase is concentrated in middle- and lower-income countries, particularly in emerging economies.

Water scarcity is becoming endemic as a result of the local impact of physical water stress, coupled with the acceleration and spreading of freshwater pollution. As a result of climate change, seasonal water scarcity will increase in regions where it is currently abundant – such as Central Africa, East Asia and parts of South America – and worsen in regions where water is already in short supply – such as the Middle East and the Sahel in Africa. On average, 10% of the global population lives in countries with high or critical water stress.

Low-, middle- and high-income countries all show signs of risks related to water quality. Poor ambient water quality in low-income countries is often related to low levels of wastewater treatment, whereas in higher-income countries runoff from agriculture is a more serious problem. However, water quality data remain sparse, due in large part to weak monitoring and reporting capacity. This is especially true in many of the least developed countries in Asia and Africa.

Progress towards SDG 6 Targets

Half-way through the 2030 Agenda timeline, progress towards SDG 6 targets is only significantly reported for drinking water and sanitation, with some preliminary and rough indications of progress for water stress, water use efficiency, transboundary cooperation and Integrated Water Resources Management (IWRM), leaving 5 of the 11 target indicators without quantified information on progress.

At current rates, progress towards all the targets of SDG 6 is off-track and in some areas the rate of implementation needs to quadruple, or more.

According to the latest figures from 2020, 26% of the world's population (2 billion people) did not have access to safely managed drinking water services (**Target 6.1**), and an estimated 46% (3.6 billion) lacked access to safely managed sanitation (**Target 6.2**).

Approximately 60% of the world's reported water bodies were categorized as having 'good' ambient water quality (**Target 6.3**). However, the poorest 20 countries are grossly under-represented in this global estimate.

Globally, water use efficiency (**Target 6.4**) rose by 9% from 2015 to 2018 (from 17.3 to 18.9 US\$/m³). Progress has been greatest in the industrial sector (15% increase), followed by the water supply and sanitation services and agricultural sectors (8% increase).

• • •
Cooperation improves water governance and decision-making, stimulates innovative solutions, and leverages efficiencies

While most countries have reported some progress, the global rate of progress on IWRM implementation (**Target 6.5**) needs to double to approach the target.

The data required to track changes in the extent of water-related ecosystems over time (**Target 6.6**) are not yet refined enough to reveal discrete trends in recent years. However, available data show an 80% loss in the extent of natural wetland area since the pre-industrial era (1700).

Official development assistance (ODA) committed and disbursed to 'water' in 2020 was estimated at US\$8.7 billion globally, up from US\$2.7 billion in 2002. However, international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes (**Target 6.a**) had not yet been specifically reported at the time of this report's production.

The number of countries with clearly defined procedures in law or policy for participation by users/communities (**Target 6.b**) has increased between 2014 and 2019, but still remains low overall. Levels for both laws/procedures and participation are very low for drinking water in both urban and rural settings compared to the other subsectors.

Diversity of partnerships and collaboration

The currently inadequate rate of progress towards the SDG 6 targets highlights the need to explore opportunities through partnerships and cooperation. Cooperation improves water governance and decision-making, stimulates innovative solutions, and leverages efficiencies. By promoting inclusive engagement, participation and dialogue, and giving voices to those that are otherwise not heard, partnerships can help ensure that no one is left behind and that the human rights to water and sanitation are realized.

Each party invariably comes with its own knowledge, perceptions, interests, positions and objectives, such that disagreements on priorities and strategies are commonplace. While partnerships and cooperation, at all levels, overwhelmingly deliver positive outcomes, in rare occasions, they can institutionalize exclusion, distort resource allocations and encourage fragmentation.

The categorization adopted for the purposes of this report is based on the water-related outcomes that partnerships seek to achieve. The first category involves partners with a **common objective**, such as supplying water and sanitation to local communities or managing shared irrigation systems. The second involves actors with **different** (potentially competing) **water-related objectives**, including cooperation between municipalities and farmers over the allocation of water supplies, or payment for environmental services schemes. The third involves actors from 'outside the water domain', where objectives of some partners are **not primarily water-related**, but where water plays a determining role. These partnerships support water-related interventions that in turn serve objectives related to human health or climate change adaptation and mitigation.

Thematic perspectives

Agriculture

Water user associations (WUAs) are formal organizations through which farmers manage a common irrigation system. Smaller-sized WUAs, in which farmers share similar norms, and have social capital from other local institutions (e.g. village councils or religious groups), long-term involvement of local non-governmental organizations (NGOs), and democratic internal processes (e.g. elected chairpersons and board members) have been most

● ● ●
Water allocation from agriculture to urban centres has become a common strategy to meet freshwater needs in growing cities

successful. Others have underperformed due to poor implementation, unclear roles and responsibilities, lack of women participation, and lack in administrative authority, among other factors. The imposition of central and national directives by governments (e.g. irrigation departments and water ministries), often through mandated scheme by-laws or rules, may limit the effectiveness of WUAs.

While urban water demand is projected to increase by 80% by 2050, water allocation from agriculture to urban centres has become a common strategy to meet freshwater needs in growing cities. The reallocation of water from agriculture has been generally successful in terms of meeting the demands of growing cities. From an agricultural/rural perspective, negative consequences have been observed as less water is available for irrigation, leading to reduced food security and lower farmer livelihood incomes. Compensation, including financial payments or new infrastructure, and benefit-sharing arrangements can help offset these negative impacts.

The water–energy–food–ecosystem (WEFE) nexus provides a systematic approach to understanding WEFE interconnectedness and trade-offs. The WEFE approach integrates across all sectors and provides a holistic vision of sustainability that seeks to balance the different goals, interests and needs of people and the environment.

Environment

Watershed protection or rehabilitation measures are among the oldest of water-related partnerships. Many watershed services schemes address climate change adaptation by building resilience, and their role in mitigation is increasingly recognized.

Co-benefits generated through ecosystem-based approaches provide a strong justification for nature-based solutions. Water utilities are mainly interested in reducing infrastructure risks, ensuring compliance and reducing costs. Climate adaptation benefits, such as flood mitigation, are particularly attractive to rural communities. Additional benefits include biodiversity conservation, and jobs and training opportunities. This diversity and scale of benefits forge strong interests among a broader scope of stakeholders and potential partners.

Water funds, as a means of financing these schemes, support partnerships that bring together downstream users, like cities, businesses and utilities, to collectively invest in upstream habitat protection and land management to improve water quality and/or quantity and generate long-term benefits.

Partnerships involving local communities are increasingly used to improve monitoring of the environment. These are particularly important in order to address the huge gaps in water quality data.

Human settlements

A diversity of actors, including the private sector, NGOs and communities, along with government ministries and departments responsible for water, sanitation and hygiene (WASH), health, housing, agriculture, education, planning and infrastructure, handle various aspects of WASH. Cooperation also opens up space for an even broader range of partners.

WASH initiatives are more likely to meet their objectives if the intended beneficiaries participate in a meaningful way, especially in rural areas and secondary towns. Effective stakeholder involvement in planning and implementation leads to services that are more appropriate to the needs and resources of poor communities, and increases public acceptance and ownership of systems. Stakeholder engagement from the onset also fosters accountability and transparency.

• • •
Many watershed services schemes address climate change adaptation by building resilience, and their role in mitigation is increasingly recognized

Water operators' partnerships (WOPs) connect established, well-functioning utilities with others that need assistance or guidance. The resulting improvements in capacity and performance can facilitate utilities' access to financing for infrastructural investments, supporting further extensions or improvements in services. WOPs can be a valuable instrument to reach underserved populations in both rural and urban contexts.

Forced migration puts an increased strain on local entities (utilities, communities) responsible for providing water supply and services. While states are the primary duty-bearers for fulfilling these human rights, multi-stakeholder partnerships between United Nations agencies, international organizations, NGOs and civil society are needed to respond to the complex dynamics that impact both displaced populations and host communities. Within displacement settings, water user committees can facilitate collaboration with local water authorities as well as promote women's participation.

Industry

Industry turns to collective action when desired outcomes cannot be obtained through internal or unilateral action alone. Industry has the capacity to advance responsible practices and devise market-based solutions to accelerate the SDGs at scale, but this ability can be undermined by governance gaps, market failures, cultural barriers and trust deficits. Collective action, in the form of partnerships and coalitions, is vital to overcoming these impediments.

For collective action to be effective, companies typically have to establish unconventional relationships with non-traditional partners. There must be a commitment to shared goals and a recognition of the potential for trade-offs between company interests and broader public benefits. Collective action requires companies to develop new skills and knowledge, such as greater understanding of community needs and values, and to enhance their ability to connect with government actors and NGOs.

In recent years the increased value of adding environmental, social and governance (ESG) and water stewardship scopes to such arrangements has become very evident – not only in the commercial sense but also in the broader context of overall water sustainability to provide beneficial results for all parties.

Health

Despite interdependences between the WASH and health sectors, gaps in coordination and governance occur because they are led by different ministries, local authorities, international organizations, NGOs and private sector actors. Partnerships aligned at the scientific, strategic and operational levels are therefore necessary to optimize and accelerate positive health outcomes through WASH.

Fully functioning WASH services in health care facilities are essential to the delivery of safe quality care. While the provision of WASH in hospitals, in- and out-patient health centres and clinics is a health sector responsibility, it has until recently been neglected due to health actors either not accepting the role, not knowing how to develop and maintain WASH services, or being overwhelmed with curative tasks. COVID-19 efforts have been increasingly leveraged to strengthen policies, regulations and investments in WASH.

New health risks are emerging from exposure to 'contaminants of emerging concern' in water, such as pharmaceuticals, industrial and household chemicals, personal care products, pesticides, and manufactured nanomaterials. WASH plays an essential role in preventing neglected tropical diseases that are close to elimination from bouncing back. Safe WASH limits the avoidable use of antimicrobials for WASH-preventable infections, thus contributing

● ● ●
Within displacement settings, water user committees can facilitate collaboration with local water authorities

to address the antimicrobial resistance (AMR) crisis. Progress requires cooperation across a wide range of stakeholders, such as policy-makers, engineers and scientists, health care professionals, veterinarians, farmers, donors, NGOs, and private citizens and corporations.

Wastewater disease surveillance can complement diagnostic testing. The global polio eradication programme is a well-established example of a health partnership (with wastewater laboratories) using wastewater as part of a wider surveillance and control approach.

Climate change

The coordination of climate and water agendas is bidirectional. On the one hand, climate policy-makers need to better understand the needs of the water community to adapt to climate change, as well as the role that water resources management and supply and sanitation can play in mitigation. On the other hand, water policy-makers need to proactively reach out to climate stakeholders to better understand how climate-led processes work, and to integrate water-related climate risks into national water policies, strategies and implementation plans.

Accelerating action through partnerships and cooperation between water and climate stakeholders can create additional benefits to freshwater ecosystems and to the most exposed and vulnerable people, reducing disaster risks, delivering cost savings, fostering job creation and generating economic opportunities. The cross-sectoral nature and interdependence of water and climate change with other vital natural resources, such as land or energy, create further opportunities for partnership and cooperation.

In commitments made by Parties to the Paris Agreement, more than 80% of countries have reported freshwater resources as an adaptation priority area. However, mitigation opportunities through water management – ranging from biogas recovery from wastewater treatment systems to geothermal power generation – deserve greater attention from climate planners and should open the door to further collaboration with water stakeholders.

Regional perspectives

Sub-Saharan Africa

Developing water infrastructure, harnessing groundwater resources, addressing climate change effects and investing in science and technology are all needed to drive sustainable water security in Sub-Saharan Africa. However, the coordination, communication and exchange of the generally limited data and information available to African water stakeholders have been very weak due to the lack of appropriate strategies and platforms to enhance dialogue between researchers, decision-makers and community members. Cooperation is particularly critical for ensuring water security in the region's many transboundary basins and aquifers.

Community–public partnerships (CPPs), usually established between a water utility and an elected group within a community, offer win–win arrangements that enable private operators, public utilities and communities to derive benefits through mutual understanding, shared responsibilities, and exchange of knowledge and experiences.

There are currently numerous activities at all levels that require coordination to optimize efforts and resources. Several subregional, regional and continental partnerships could be strengthened. Member states, development partners and other stakeholders should consider reinforcing existing structures, rather than developing new ones.

● ● ●
**Cooperation
is particularly
critical for
ensuring water
security in many
transboundary
basins and
aquifers**

Europe and North America

Water-related partnerships and cooperation initiatives are frequent in Europe and North America. The *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters* and the *Convention on the Protection and Use of Transboundary Watercourses and International Lakes* stress the need for cooperation and involvement of stakeholders, as do several relevant Directives of the European Union. These instruments have facilitated the development of various types of partnerships in the region and are also contributing to stakeholder participation outside the region.

Stakeholder involvement is an objective that has been proactively pursued and, to a large degree, it remains a common challenge in water management, governance and cooperation across the region.

The International Joint Commission (IJC) between Canada and the United States of America has a long history of successful water cooperation, not only across borders but also within countries and between sectors, administrative levels and other stakeholders.

Latin America and the Caribbean

The different types of partnerships and forms of cooperation in the region are mainly water-focused or closely connected to water-dependent sectors, such as agriculture. Evidence points to limited engagement outside the water-based domain, such as water initiatives linked to social justice, gender, education or job creation, or even other environment-related aspects, such as biodiversity.

The most common water-related partnerships at the local level have been established for overseeing drinking water supply and sanitation services, particularly in rural areas. Agricultural producer groups, such as WUAs, are also widespread. One common trait of these associations is that they usually operate independently of urban area regulators, with varying levels of involvement from national-level authorities.

There is a long history of basin management organizations in the region, which mostly focus on data monitoring, research, coordination of actions, regulation, planning, financing, and development and administration, among other aspects. They often face similar challenges related to technical capacity, governance structures and, particularly, funding.

There are additional instances of inter-institutional coordination where public, private and community actors work together with the aim of improving water management. These involve public- and private-sector entities, academia, community and national networks, and national as well as international NGOs.

Asia and the Pacific

Water resources management contributed to the economic and social welfare of the region over the last decade through the provision of basic WASH services, improved food production, industrial development and ecosystem-based services. However, Asia and the Pacific remains far from being on track to meet the targets of SDG 6.

Inequity in terms of water access remains an issue. Women, who are primarily responsible for water collection in local communities, often have limited participation in water management due to traditional norms and practices, such as power imbalances and sociocultural factors. Other critical regional challenges include inadequate sanitation services and pollution, as well as shortcomings in transboundary cooperation.

● ● ●
In many parts of the world, water management is shaped by local knowledge and practices

There is a need to strengthen existing partnerships and networks, to enhance existing platforms for better stakeholder engagement at all levels, and to ensure that all relevant stakeholders are included in water governance. Participative governance approaches at subnational and national levels, across multiple government agencies, would support the mainstreaming and financing of water management and expedite progress across other water-dependent sectors.

The Arab region

The region's surface water scarcity, along with other rising challenges such as climate change, high dependency on transboundary water resources and high usage of water resources by the agricultural sector, requires successful cooperation and partnership initiatives in order to progress towards water security.

Several such arrangements have already been initiated in the Arab region despite the financial and political barriers that might hinder collaboration. These have demonstrated the importance of collaborative efforts, trust-building processes and data exchange for better water management. However, given the immense challenges, increased collaboration is needed, especially to secure additional financing, advance innovation and share information.

Most Arab states largely rely on rivers and/or aquifers shared with neighbouring countries for their water supply. Despite certain inter-state tensions between some neighbouring countries, several examples of cooperation modalities do exist in the region, including transboundary aquifers. These transboundary cooperation arrangements have led to improved water management through iterative trust-building processes that started with targeted data-sharing, information-gathering and scientific research, which then developed into more robust cooperation modalities.

Accelerating change

The following sections align with each of the five 'accelerators' of the SDG 6 Global Acceleration Framework (GAF), in which partnerships and cooperation play a central role. Such partnerships and cooperation transcend boundaries and sectors, making SDG 6 everyone's business.

Education and capacity development

Education and capacity development are crucial to accelerate the development, adoption and institutionalization of more sustainable and equitable water management practices. They involve the sharing of knowledge and skills between teachers, students, institutions, and other providers and recipients of information.

Technological progress is a major driver of such collaborative opportunities. The recent COVID-19 pandemic, in particular, has given a major boost to the development of digital content and the adoption of information and communication technologies (ICT) for teaching and training worldwide.

In many parts of the world, water management is shaped by local knowledge and practices. Often based on natural processes that provide multiple ecosystem services, they can add flexibility and adaptive capacity. Integrating this knowledge requires multidirectional forms of knowledge exchange, such as occurs in communities of practice and professional networks.

● ● ●
Government agencies tasked with resource monitoring and management often lack the capacity to generate all the data needed to address water-related economic and social issues

Maximizing these opportunities poses several challenges. Some of them are technical in nature, such as creating inclusive online platforms and systems that maximize access to disadvantaged groups and communities. But partnerships for more efficient, sustainable and equitable education and capacity development on water can also benefit from a stronger adoption of approaches such as communities of practice, citizen science, open innovation and life-long learning.

Many citizen science projects are cross-disciplinary partnerships that bring together scientists, water professionals and the broader public. These projects often have a strong educational dimension, and are increasingly used to build awareness on local issues, such as water pollution and equitable resource allocation, and to increase transparency and inclusivity.

Data and information

Data and information are essential to water-related decision-making. While the potential breadth and scope of water-relevant data is vast, so too are the data gaps from the local through to the international levels. Additional challenges include insufficient levels of disaggregation and difficulties (or reluctance) in sharing data.

Water-related data are often generated by different users (or 'sectors') and therefore not interoperable for multiple users due to differences in terminology and other factors. While data may be considered to be neutral, the information generated after data analysis may not be. Partnerships can help ensure that relevant data are effectively generated and processed into objective information.

A broader engagement process, involving partners in priority-setting, planning, data collection and joint development of data governance mechanisms, fosters collective ownership. Successful partnerships also require time, transparency and mutual respect. At initial stages, areas of common interest need to be explored, expectations discussed and trust built in order to reach a common understanding of the objectives. Consultation, communication and consensus-building are critical throughout the process.

Open-access global data repositories can be used at national and regional scales, but such data tend to lack the spatial resolution or level of disaggregation required for more targeted interventions. Government agencies tasked with resource monitoring and management, such as agricultural or environmental industries, often lack the capacity to generate all the data needed to address water-related economic and social issues. The problem is compounded further when these agencies fail (or refuse) to share what data they do have between them.

Joint monitoring of transboundary water resources promotes a shared understanding of the system and provides a platform where data can be shared and applied in a timely manner. Transboundary actors such as river basin organizations, national government entities, academic institutions, as well as development organizations, are repositories of data that can be streamlined and shared through these platforms. Harmonizing various databases, within and across borders, requires partnerships between government institutions and private sector actors such as companies and landowners.

● ● ●
**Better coordination
across stakeholders
can generate
additional
funding streams
for water-related
investments**

Innovation

Partnerships can accelerate the development and uptake of innovative technologies through knowledge transfer, entrepreneurship and applied research.

Strengthening and extending South–North and South–South partnerships between universities encourage the transfer of new technologies and innovative skills. Business incubators and accelerators can facilitate partnerships between universities, budding entrepreneurs and venture capital providers. Such incubators should be strengthened and expanded in middle- and low-income countries. Communities of practice for knowledge co-creation and innovation with partners from the North and South could go a long way towards developing technically feasible, economically viable, socially acceptable and locally adaptable solutions.

Novel partnerships across the wider water and sanitation industry are also needed to accelerate the uptake of new technologies for water processing, distribution and treatment. This can be achieved through partnerships between industry and technology providers, such as universities and entrepreneurs.

The introduction of new technologies and innovations, such as ICT, does not favour the participation of those without proper access to internet or mobile phones connections, not to mention electricity. Care should therefore be taken that the introduction of new technologies does not lead to unintended side effects, such as a widening the knowledge and socio-economic divides.

Financing

Achieving equitable access to safe drinking water for all by 2030 could require tripling current investment levels. Evidence suggests that some WASH-related funding may be poorly targeted and even counterproductive in addressing the needs of the poorest people and communities.

Better coordination across stakeholders can generate additional funding streams for water-related investments from various sources. Cooperation mechanisms are key for bringing these beneficiaries together and can facilitate joint financing of relevant projects. Water funds are examples of multi-stakeholder platforms that pool funding from various actors.

Cooperation among the different sources of finance can support and leverage co-financing arrangements. By spreading investment risks among multiple financiers (with differing risk appetites and requirements), public or development finance can be used strategically to improve the risk–return profile of a project and to mobilize additional investment – so-called ‘blended finance’ arrangements.

Better cooperation between the demand and supply sides of finance encompasses improved understanding of (i) the supply and demand side’s respective perceptions, characteristics and requirements; (ii) intermediary institutions and their diverse functions; and (iii) the translation of water-related risks and benefits into expressions relevant and understandable to the financial sector.

Investments for water supply and sanitation facilities at the household level require specific financial products, such as micro-credits for low-income consumers and households, and could attract finance from impact investors.

Governance

A whole-of-society approach embraces both formal and informal institutions in seeking a generalized agreement across society about policy goals and the means to achieve them.

Trust and hope are fundamental building blocks for social cohesion and security. Trust is the ‘lubricant’ needed to ‘grease the wheels’ of the economy, and hope can be the mortar that holds societies together. Addressing corruption has been shown to yield substantial cost savings across the water sector, and also reduce the incidence of cancellations and delays.

Meaningful participation and inclusive stakeholder engagement take time but stand to generate trust and hope. Policy and project processes need to adapt to the concerns and potential contribution of different groups. Strategic integration of cross-sectoral and stakeholder concerns involves developing norms, standards and allocation methods that affect water use efficiency and the protection of resources across sectors.

Public authorities, acting on behalf of the state, in principle determine whether and how to bring private operators in to deliver water and sanitation services. The authorities retain their sovereign duties for ensuring the progressive fulfilment of the human rights to safe drinking water and sanitation. To be successful, public–private partnerships (PPPs) need to build upon cooperation that is beneficial to all stakeholders – they need to serve the public interest while providing a decent return to the service provider. Both private sector and public sector operations are more effective in countries with clear, predictable and stable legislative frameworks, as these allow long-term investment to be supported with confidence and receive a reasonable return.

Coda

Safeguarding water, food and energy security through sustainable water management, providing water supply and sanitation services to all, supporting human health and livelihoods, mitigating the impacts of climate change and extreme events, and sustaining and restoring ecosystems and the valuable services they provide, are all pieces of a great and complex puzzle.

Only through partnerships and cooperation can the pieces come together.

And everyone has a role to play.

Prologue

Part 1

The state of the world's freshwater resources

WWAP

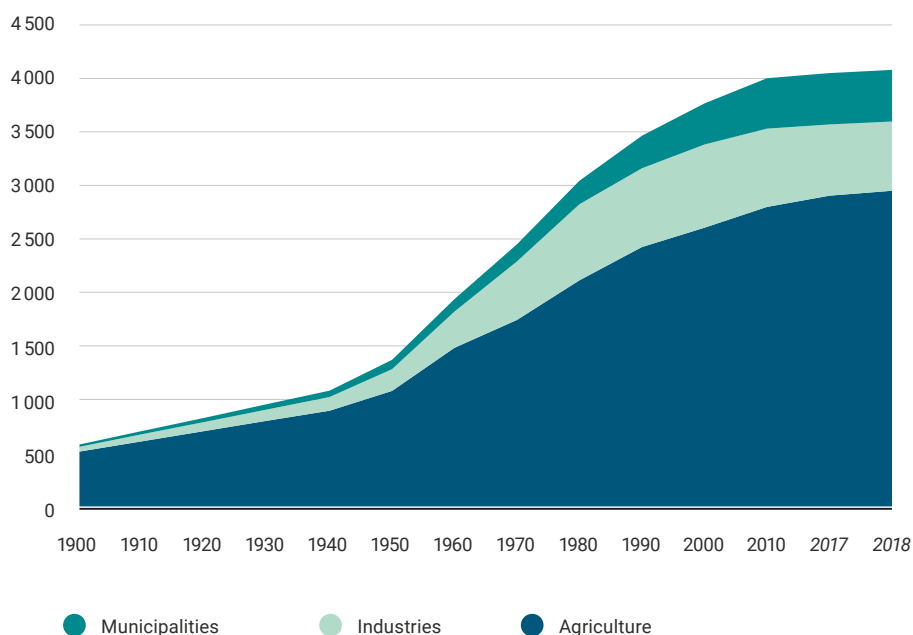
Richard Connor and David Coates

Water demand

Globally, water use has been increasing by roughly 1% per year over the last 40 years (AQUASTAT, n.d.). The bulk of this increase is concentrated in middle- and lower-income countries, particularly in emerging economies (Ritchie and Roser, 2017). This trend has been driven by a combination of population growth, socio-economic development and changing consumption patterns (Figure P.1). Regions with the largest water withdrawals per capita have been Northern America and Central Asia (FAO, 2022). Between 2010 and 2018, municipal withdrawals increased by 3%, whereas agricultural withdrawals increased by 5%, and now represent 72% of total withdrawals. Meanwhile, industrial withdrawals decreased by 12%, mainly due to reductions in withdrawals for thermal power production, as cooling processing has become more water-efficient (FAO, 2022).

Figure P.1

Evolution of global water withdrawals, 1900–2018 (km³/year)



Source: FAO (2022, fig. 1.23, p. 71, based on AQUASTAT).

● ● ●
Growth in water demand will be highly dependent upon whether (or not) measures to improve water use efficiency are implemented across these different sectors

Groundwater provides half of the volume of water withdrawn for domestic uses globally and around 25% of all water withdrawn for irrigation (United Nations, 2022).

Total water withdrawals per capita remained flat or declined from 2000 to 2018, except in Central America and the Caribbean, South America and Southeast Asia. In general, these trends are expected to persist as populations grow, partly due to overall increases in water productivity, including in agriculture, and partly due to the prevalence of water scarcity induced by extended periods of aridity in areas of high population density (FAO, 2022).

Future trends in demand are difficult to predict accurately. Burek et al. (2016) estimated that overall global demand for water will continue to increase at an annual rate of about 1%, resulting in an increase of between 20 to 30% by 2050, with a margin of error of more than 50%. The evolution of water demand is highly location-specific, reflecting shifting use patterns across the three major water use sectors – municipalities, industries and agriculture. Growth in the municipal sector is mainly driven by the expansion of water supply (and to a lesser extent sanitation) services, and is therefore faster in regions where efforts are being made to address lower levels of existing provision. Industrial water demand is led by water-intensive processes, including various types of manufacturing and energy production.

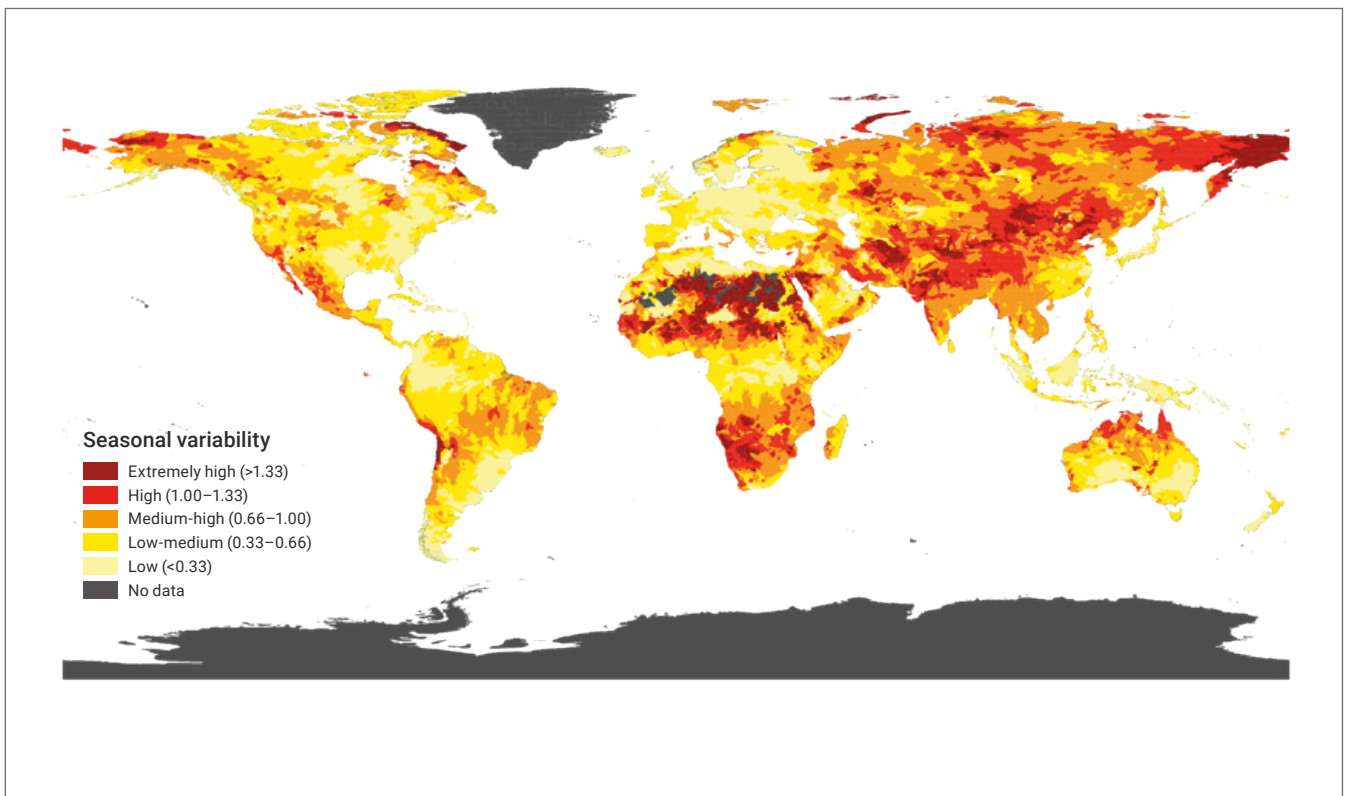
Therefore, increases tend to be associated with escalating industrialization (as is currently the case in many middle-income and emerging economies), but demand can subsequently decrease as industries and (especially) energy production become more water-efficient. Water demand for agriculture is essentially driven by irrigation, where demand will vary as a function of several determining factors, ranging from soil to climatic factors and from crop type to field applications. Agricultural water use is also increasingly determined by competing uses and limits to availability, while food consumption patterns and trade are also important factors (FAO, 2022).

These global figures mask important local and regional differences; for example, in Europe, agriculture withdraws only 30%, municipalities 26% and industry 45%, whereas in South Asia, the respective figures are 91%, 7% and 2% (FAO, 2022). Real growth in water demand will be highly dependent upon whether (or not) measures to improve water use efficiency are implemented across these different sectors.

Water availability and stress

The global volume of renewable freshwater was estimated at around 37,000 km³/year in 2015 (Ritchie and Roser, 2017). Availability varies considerably locally and regionally according to geological and climatic factors. Seasonal variation in water availability (Figure P.2) is also a main driver of water storage needs. It can be as important a factor as total annual availability, or even more important.

Figure P.2 Seasonal variability in water availability

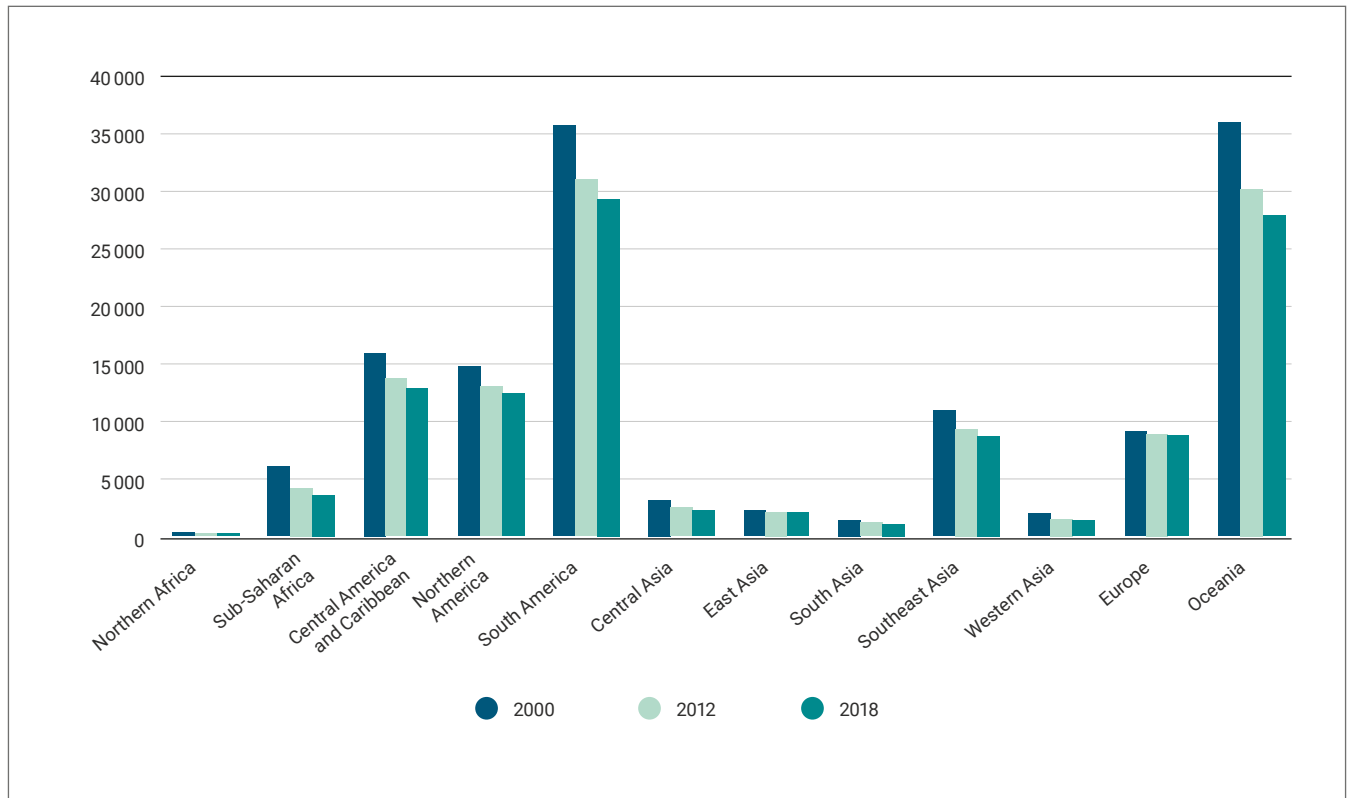


Note: Seasonal variability measures the average within-year variability of available water supply, including both renewable surface and groundwater supplies. Higher values indicate wider variations of available supply within a year.

Source: WRI (2019). Attribution 4.0 International (CC BY 4.0).

Availability per capita is another critical consideration. It varies significantly by region, but has been decreasing in all worldwide as a function of population growth rates (Figure P.3). The decline in global per capita internal renewable water resources (IRWRs) was about 20% between 2000 and 2018; with a greater change in countries with the lowest per capita IRWRs, which are often located in Sub-Saharan Africa (41%), Central Asia (30%), Western Asia (29%) and Northern Africa (26%). Europe was the region showing the smallest decline, with 3% (FAO, 2022).

Figure P.3 Per capita renewable water resources availability by geographic region, 2000, 2012 and 2018 (m³/capita)



Source: FAO (2022, fig. 1.21, p. 69, based on AQUASTAT).

● ● ●
Water scarcity is becoming endemic as a result of the local impact of physical water stress, coupled with the acceleration and spreading of freshwater pollution

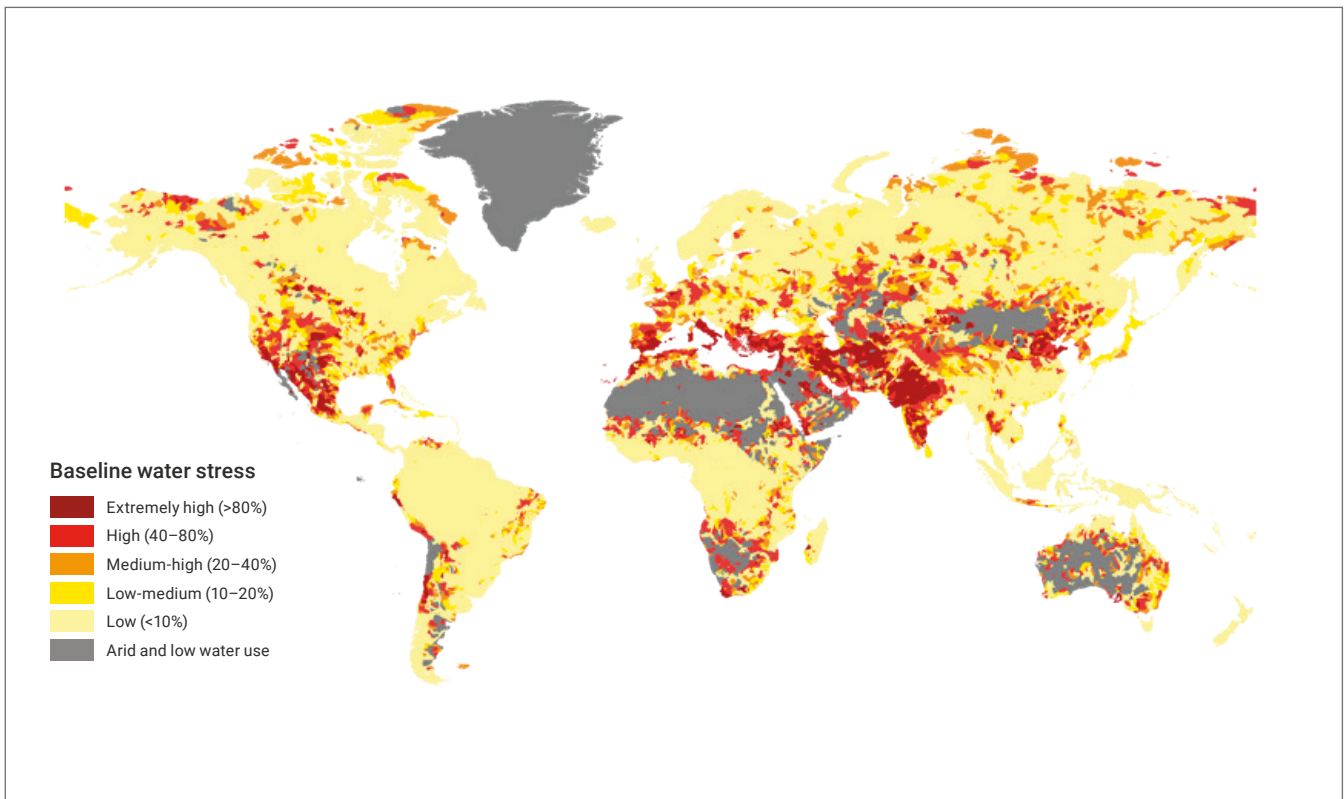
Global freshwater withdrawal was about 3,800 km³/year in 2017 (United Nations, 2021; AQUASTAT n.d.), roughly 10% of renewable water resources availability. But this global statistic is particularly misleading as it hides real problems related to local or regional physical water stress (Figure P.4), a term used to describe water use as a proportion of water availability. Physical water stress is determined by a combination of factors, including surface and/or groundwater availability (which can be greatly influenced by varying climatic conditions), ecological requirements, and human abstractions.

Water scarcity is becoming endemic as a result of the local impact of physical water stress, coupled with the acceleration and spreading of freshwater pollution (FAO, 2022).

The first consequence of scarcity is increasing use and depletion of groundwater. The rate of groundwater storage depletion is estimated to be between 100 and 200 km³/year, accounting for 15 to 25% of all groundwater withdrawals (United Nations, 2022). Hotspots of groundwater depletion are found around the world, most often in areas with intensive groundwater withdrawals for irrigation or to supply large cities (Figure P.5).

While some places experience physical water stress throughout the entire year, others experience water stress during one or more months per year, as a result of seasonal variability in water availability (Figure P.2). Between 2.2 and 3.2 billion people lived under water stress for at least 1 month per year in 2010, corresponding to 32% and 46% of the world's population

Figure P.4 Annual baseline water stress



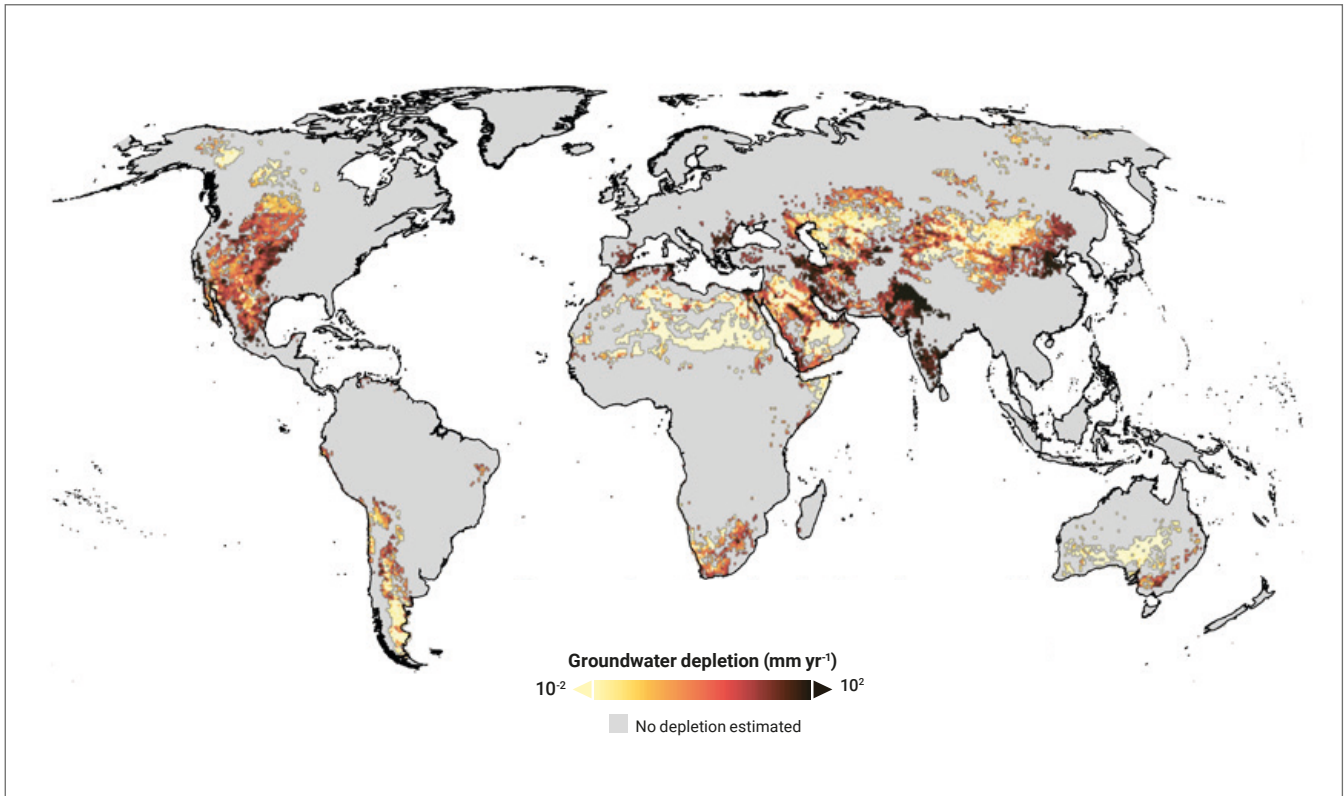
Note: Baseline water stress measures the ratio of total water withdrawals to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: WRI (2019). Attribution 4.0 International (CC BY 4.0).

at the time. Around 80% of people living under water stress lived in Asia; in particular, northeast China, as well as India and Pakistan (Vanham et al., 2021). The global urban population facing water scarcity is projected to increase from 933 million (one third of global urban population) in 2016 to 1.7–2.4 billion people (one third to nearly half of global urban population) in 2050, with India projected to be the most severely affected (He et al., 2021).

Physical scarcity does not adequately account for economic water scarcity, which describes a situation in which there is sufficient water to meet human and environmental needs, but access is limited due to a lack of water infrastructure or poor water resources management. Twenty years ago, an estimated 1.6 billion people lived under conditions of economic water scarcity (Comprehensive Assessment of Water Management in Agriculture, 2007), and it remains unclear whether this number has gone up or down. Currently, about 25% of the global croplands are under agricultural economic water scarcity, where the lack of irrigation is due to limited institutional and economic capacity instead of hydrologic constraints. These lands are mainly located across Sub-Saharan Africa, Central Asia and Eastern Europe (Rosa et al., 2020). However, such calculations rarely consider economic outputs from alternative uses of the same water. Also, dependent on scenario assumptions, major hydrologic basins can experience strongly positive or strongly negative economic impacts due to global trade dynamics and market adaptations to regional water scarcity (Dolan et al., 2021). These observations, among others, highlight the need for a much more systematic approach to assessing both physical and economic water scarcity that will require enhanced partnerships and cooperation between different disciplines and stakeholders.

Figure P.5 Groundwater depletion rates



Source: Adapted from United Nations (2022a, fig 6.3, p. 95).

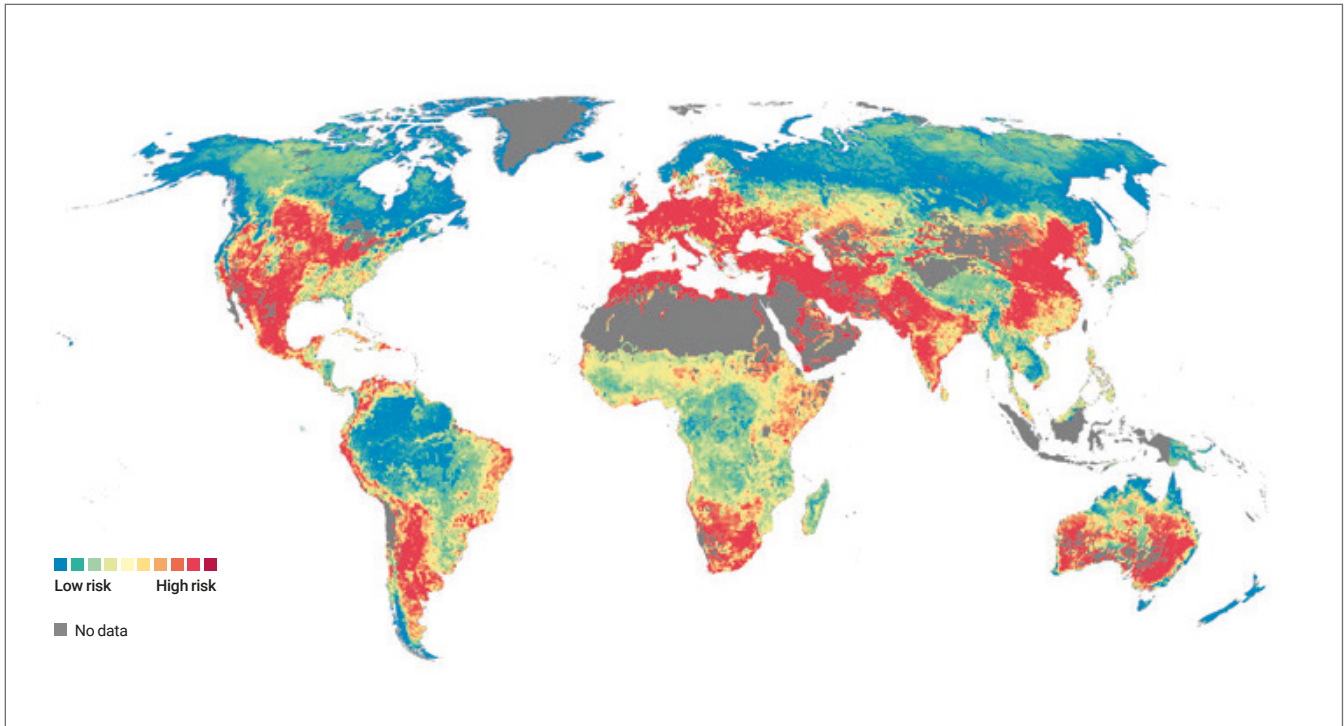
Climate change is likely to increase seasonal variability in, and uncertainty about, water availability, quality and quantity in most regions (UNESCO/UN-Water, 2020). According to World Bank (2016), water scarcity, exacerbated by climate change, could cost some regions up to 6% of their Gross Domestic Product (GDP) by 2050 due to water-related impacts on agriculture, health and incomes, potentially spurring migration and even conflict. The combined effects of growing populations, rising incomes and expanding cities will see an exponential rise in water demand, while supply becomes more erratic and uncertain. Water will become increasingly scarce in regions where it is currently abundant – such as Central Africa, East Asia and parts of South America – and scarcity will greatly worsen in regions where water is already in short supply – such as the Middle East and the Sahel in Africa.

Water quality

Water quality data remain sparse, especially at the global level, due in large part to weak monitoring and reporting capacity. This is especially true in many of the least developed countries in Asia and Africa (United Nations, 2021). Poor water quality remains an impediment to achieving many of the Sustainable Development Goals (SDGs), including regarding public health, productivity, economic prosperity and the environment (Alcamo, 2019).

Low-, middle- and high-income countries all show signs of risks related to water quality (Figure P.6). Poor ambient water quality in low-income countries is often related to low levels of wastewater treatment (WWAP, 2017), whereas in higher-income countries runoff from agriculture is a relatively more serious problem (UNEP, 2021). The release of hazardous chemicals from industry still occurs across all continents, and emerging pollutants, including microplastics and pharmaceuticals, remain a growing concern (WWAP, 2017; United Nations, 2021).

Figure P.6 Global risks of poor water quality



Note: This map shows a water quality index summarizing global prediction for biological oxygen demand, electrical conductivity and nitrogen. Each value is scaled to a common support for comparability and then summed together. Average values for 2000–2010 are displayed. Grey areas have no data for one or more parameters. Details on the construction of the index are presented in the World Bank report's appendix, available at www.worldbank.org/qualityunknown.

Source: Damania et al. (2019, map 1.2, p. 7).

Water-related ecosystem services

● ● ●
The combined effects of growing populations, rising incomes and expanding cities will see an exponential rise in water demand, while supply becomes more erratic and uncertain

Water itself is an ecosystem service and underpins all other ecosystem services. There are specific water-related ecosystem services that have to do with regulating water quality and availability (WWAP/UN-Water, 2018). Terrestrial, freshwater, coastal and marine ecosystems of all types play a role in the global water cycle.

Freshwater ecosystems are among the most threatened in the world (Vári et al., 2022). The most significant pressures on river basin water balances are from freshwater withdrawals and drainage from agricultural land (FAO/IWMI, 2018), which can compromise the hydraulic continuity of downstream wetlands and associated ecosystem services. Impacts are not limited to those from surface water use. Declines of groundwater of less than 1.0 m have been shown to potentially remove high levels of ecological protection (Gleeson and Richter, 2018).

A great majority of indicators of ecosystems and biodiversity have been experiencing rapid deterioration across the globe as a result of multiple human drivers. For example, 75% of the land surface has been significantly altered, with over 85% of natural wetlands area lost. Since 1970, land use change has had the largest relative negative impact on both terrestrial and freshwater ecosystems (IPBES, 2019). *“Areas of the world projected to experience significant negative effects from global changes in climate, biodiversity, ecosystem functions and nature’s contributions to people are also home to large concentrations of indigenous peoples and many of the world’s poorest communities”* (IPBES, 2019, p.15).

Impacts of land use change can also include significant associated greenhouse gas emissions, for example when peatlands are drained and converted to cropland (Crump, 2017).

The loss of environmental services and biodiversity is expected to continue as natural landscapes are lost to cultivated land (UNEP, 2019). How to maintain sustainable levels of production while avoiding further damage to the natural resources and the provision of ecosystem services will remain a central question in global debates on the future of food, water and agriculture (FAO, 2022).

Extreme events

Floods and droughts are among the most devastating disasters due to natural hazards known to humankind. Over the period 2000–2019, floods alone are reported to have caused US\$650 billion in economic losses, affecting 1.65 billion people and resulting in over 100,000 deaths. Over the same period, droughts affected another 1.43 billion people, with recorded estimated losses of nearly US\$130 billion. Combined, floods and droughts accounted for over 75% of all disasters due to natural hazards affecting people (CRED/UNDRR, 2020).

Over the period 1985–2015, flood frequency has increased at both global and latitudinal scales, with floods in the tropics quadrupling since 2000, compared to a 2.5-fold increase in the north mid-latitudes (Najibi and Devineni, 2018). Trends regarding droughts are more difficult to establish, although an increase in intensity or frequency of droughts and ‘heat extremes’ can be expected in most regions as a direct result of climate change (Clarke et al., 2022). According to the Intergovernmental Panel on Climate Change (IPCC) (Hoegh-Guldberg et al., 2018), increases in drought frequency and magnitude are projected to pose substantially larger risks with a temperature rise of 2°C than at 1.5°C, particularly in the Mediterranean region (including southern Europe, northern Africa and the Near East) and southern Africa (medium confidence).

References

- Alcamo, J. 2019. Water quality and its interlinkages with the Sustainable Development Goals. *Current Opinion in Environmental Sustainability*, Vol. 36, pp. 126–140. doi.org/10.1016/j.cosust.2018.11.005.
- AQUASTAT. n.d. *Aquastat: FAO's Global Information System on Water and Agriculture*. Rome, Food and Agriculture Organization of the United Nations (FAO). www.fao.org/aquastat/en/ (Accessed in November 2022).
- Burek, P., Satoh, Y., Fischer, G., Kahil, M. T., Scherzer, A., Tramberend, S., Nava, L. F., Wada, Y., Eisner, S., Flörke, M., Hanasaki, N., Magnuszewski, P., Cosgrove, B. and Wiberg, D. 2016. *Water Futures and Solution: Fast Track Initiative (Final Report)*. IIASA Working Paper. Laxenburg, Austria, International Institute for Applied Systems Analysis (IIASA). pure.iiasa.ac.at/id/eprint/13008/.
- Clarke, B., Otto, F., Stuart-Smith, R. and Harrington, F. 2022. Extreme weather impacts of climate change: An attribution perspective. *Environmental Research Climate*, Vol. 1, Article 012001. doi.org/10.1088/2752-5295/ac6e7d.
- CRED/UNDRR (Centre for Research on the Epidemiology of Disasters/ United Nations Office for Disaster Risk Reduction). 2020. *Human Cost of Disasters: An Overview of the Last 20 years, 2000–2019*. www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019.
- Comprehensive Assessment of Water Management in Agriculture. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*. London/Colombo, Earthscan/International Water Management Institute (IWMI).
- Crump, J. (ed.). 2017. *Smoke on Water – Countering Global Threats from Peatland Loss and Degradation*. A UNEP Rapid Response Assessment. Nairobi/Arendal, Norway, United Nations Environment Programme/ United Nations Human Settlements Programme/GRID-Arendal (UNEP/ UN-Habitat/GRID-Arendal). www.grida.no/publications/355.
- Damania, R., Desbureaux, S., Rodella, A. S., Russ, J. and Zaveri, E. 2019. *Quality Unknown: The Invisible Water Crisis*. Washington, DC, World Bank. https://openknowledge.worldbank.org/handle/10986/32245. License: CC BY 3.0 IGO.
- Dolan, F., Lamontagne, J., Link, R., Hejazi, M., Reed, P. and Edmonds, J. 2021. Evaluating the economic impact of water scarcity in a changing world. *Nature Communications*, Vol. 12, Article 1915. doi.org/10.1038/s41467-021-22194-0.
- FAO (Food and Agriculture Organization of the United Nations). 2022. *The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point*. Main report. Rome, FAO. doi.org/10.4060/cb9910en.

- FAO/IWMI (Food and Agriculture Organization of the United Nations/ International Water Management Institute). 2018. *More People, More Food... Worse Water? A Global Review of Water Pollution from Agriculture*. Rome, FAO. www.fao.org/documents/card/en/c/CA0146EN/.
- Gleeson, T. and Richter, B. 2018. How much groundwater can we pump and protect environmental flows through time? Presumptive standards for conjunctive management of aquifers and rivers. *River Research and Applications*, Vol. 34, No. 1, pp. 83–92. doi.org/10.1002/rra.3185.
- He, C., Liu, Z., Wu, J., Pan, X., Fang, Z., Li, J. and Bryan, B. A. 2021. Future global urban water scarcity and potential solutions. *Nature Communications*. Vol. 12, Article 4667. doi.org/10.1038/s41467-021-25026-3.
- Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bindi, M., Brown, S., Camilloni, I., Diedhiou, A., Djalante, R., Ebi, K. L., Engelbrecht, F., Guiot, J., Hijikata, Y., Mehrotra, S., Payne, A., Seneviratne, S. I., Thomas, A., Warren, R. and Zhou, G. 2018. Impacts of 1.5°C global warming on natural and human systems. V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor and T. Waterfield (eds.), *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Cambridge/New York, UK/USA, Cambridge University Press. pp. 175–312. doi.org/10.1017/9781009157940.005.
- IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). 2019. *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. S. Díaz, J. Settele, E. S. Brondízio, H. T. Ngo, M. Guèze, J. Agard, A. Arneeth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis and C. N. Zayas (eds.). Bonn, Germany, IPBES Secretariat. doi.org/10.5281/zenodo.3553579.
- Najibi, N. and Devineni, N. 2018. Recent trends in the frequency and duration of global floods. *Earth System Dynamics*, Vol. 9, No. 2, pp. 757–783. doi.org/10.5194/esd-9-757-2018.
- Ritchie, H. and Roser, M. 2017. *Water Use and Stress*. OurWorldInData.org. ourworldindata.org/water-use-stress.
- Rosa, L., Chiarelli, D. D., Rulli, M. C., Dell'Angelo, J. and D'Odorico, P. 2020. Global agricultural economic water scarcity. *Science Advances*, Vol. 6, No. 18. doi.org/10.1126/sciadv.aaz6031.
- UNEP (United Nations Environment Programme). 2019. *Global Environment Outlook 6: Healthy Planet, Healthy People*. Nairobi, UNEP. www.unep.org/resources/global-environment-outlook-6.
- _____. 2021. *Progress on Ambient Water Quality: Tracking SDG 6 Series – Global Indicator 6.3.2 Updates and Acceleration Needs*. Nairobi. <https://wedocs.unep.org/20.500.11822/36689>.
- UNESCO/UN-Water (United Nations Educational, Scientific and Cultural Organization/UN-Water). 2020. *The United Nations World Water Development Report 2020: Water and Climate Change*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000372985?posInSet=3&queryId=c45da2c4-7fc7-4be2-be33-5f5a86ee6fca>.
- United Nations. 2021. *The United Nations World Water Development Report 2021: Valuing Water*. Paris, UNESCO. unesdoc.unesco.org/ark:/48223/pf0000375724.
- _____. 2022. *The United Nations World Water Development Report 2022. Groundwater: Making the Invisible Visible*. UNESCO, Paris. <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- Vanham, D., Alfieri, L., Flörke, M., Grimaldi, S., Lorini, V., De Roo, A. and Feyen, L. 2021. The number of people exposed to water stress in relation to how much water is reserved for the environment: A global modelling study. *The Lancet Planet Health*, Vol. 5, No. 11, pp. e766–e774. [doi.org/10.1016/S2542-5196\(21\)00234-5](https://doi.org/10.1016/S2542-5196(21)00234-5).
- Vári, Á., Podschun, S. A., Erős, T., Hein, T., Pataki, B., Iojă, I.-C., Adamescu, C. M., Gerhardt, A., Gruber, T., Dedić, A., Ćirić, M., Gavrilović, B. and Báldi, A. 2021. Freshwater systems and ecosystem services: Challenges and chances for cross-fertilization of disciplines. *Ambio*, Vol. 51, pp. 135–151. doi.org/10.1007/s13280-021-01556-4.
- World Bank. 2016. *High and Dry: Climate Change, Water, and the Economy*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/23665>. License: CC BY 3.0 IGO.
- WRI (World Resources Institute). 2019. WRI Aqueduct website. www.wri.org/aqueduct.
- WWAP/UN-Water (UNESCO World Water Assessment Programme/UN-Water). 2018. *The United Nations World Water Development Report 2018: Nature-Based Solutions for Water*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000261424>.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000247153>.

Prologue

Part 2

Progress towards SDG 6

WWAP

Richard Connor and David Coates

The sixth Sustainable Development Goal (SDG 6) seeks to ensure the availability and sustainable management of water and sanitation for all, focusing on drinking water and sanitation, the sustainable management of water resources, water quality, integrated water resources management (IWRM), water-related ecosystems, and the enabling environment. In the 2030 Agenda for Sustainable Development, countries have committed to engage in systematic follow-up and review of progress towards the SDGs and their targets, using a set of global indicators. The UN-Water Integrated Monitoring Initiative (IMI-SDG6) supports countries' monitoring of, and reporting on, SDGs. A summary of the targets, indicators and custodial agencies are shown in Figure P.7.

Half-way through the 2030 Agenda timeline, progress towards SDG 6 targets is only significantly reported for drinking water and sanitation, with some preliminary and rough indications of progress for water stress, water use efficiency, transboundary cooperation and IWRM, leaving 5 of the 11 target indicators without reported quantified information on progress (United Nations, 2022a). These gaps in monitoring and reporting are largely due to data deficiencies. Without historical data, progress cannot be measured and without multiple waypoints the acceleration required cannot be assessed. The most recent results of the IMI-SDG6 are presented below for each target.

SDG Targets 6.1 and 6.2 Drinking water and sanitation services

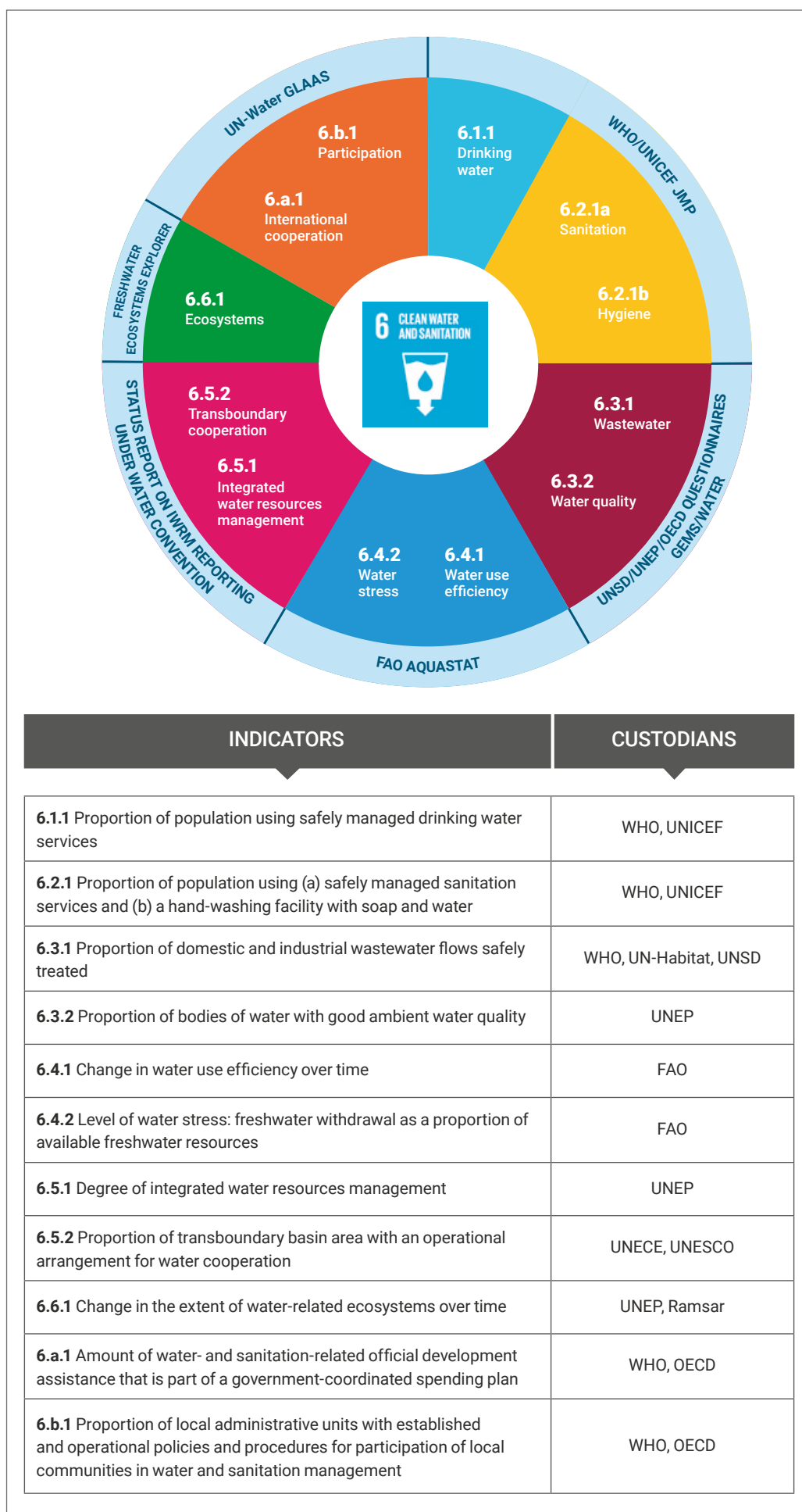
"Five years into the SDGs, the world is not on track to achieve SDG targets 6.1 and 6.2. Achieving universal coverage by 2030 will require a quadrupling of current rates of progress in safely managed drinking water services, safely managed sanitation services, and basic hygiene services. Least developed countries (LDCs) have the furthest to go and it will be especially challenging to accelerate progress in fragile contexts. Many more countries are facing challenges in extending services to rural areas and to poor and vulnerable populations who are most at risk of being left behind" (WHO/UNICEF, 2021, p. 7).

According to the latest figures from 2020 (Figure P.8), 26% of the world's population (2 billion people) did not have access to safely managed drinking water services, including 1.2 billion people with basic services, 282 million with limited services, 367 million using unimproved sources, and 122 million drinking surface water. An estimated 46% (3.6 billion) lacked access to safely managed sanitation, including 1.9 billion people with basic services, 580 million with limited services, 616 million using unimproved facilities, and 494 million practising open defecation. Furthermore, 29% (2.3 billion) lacked basic hygiene services, including 670 million people with no handwashing facilities at all. Over half of these people (374 million) lived in fragile contexts (WHO/UNICEF, 2021).

SDG Target 6.3 Water quality and wastewater

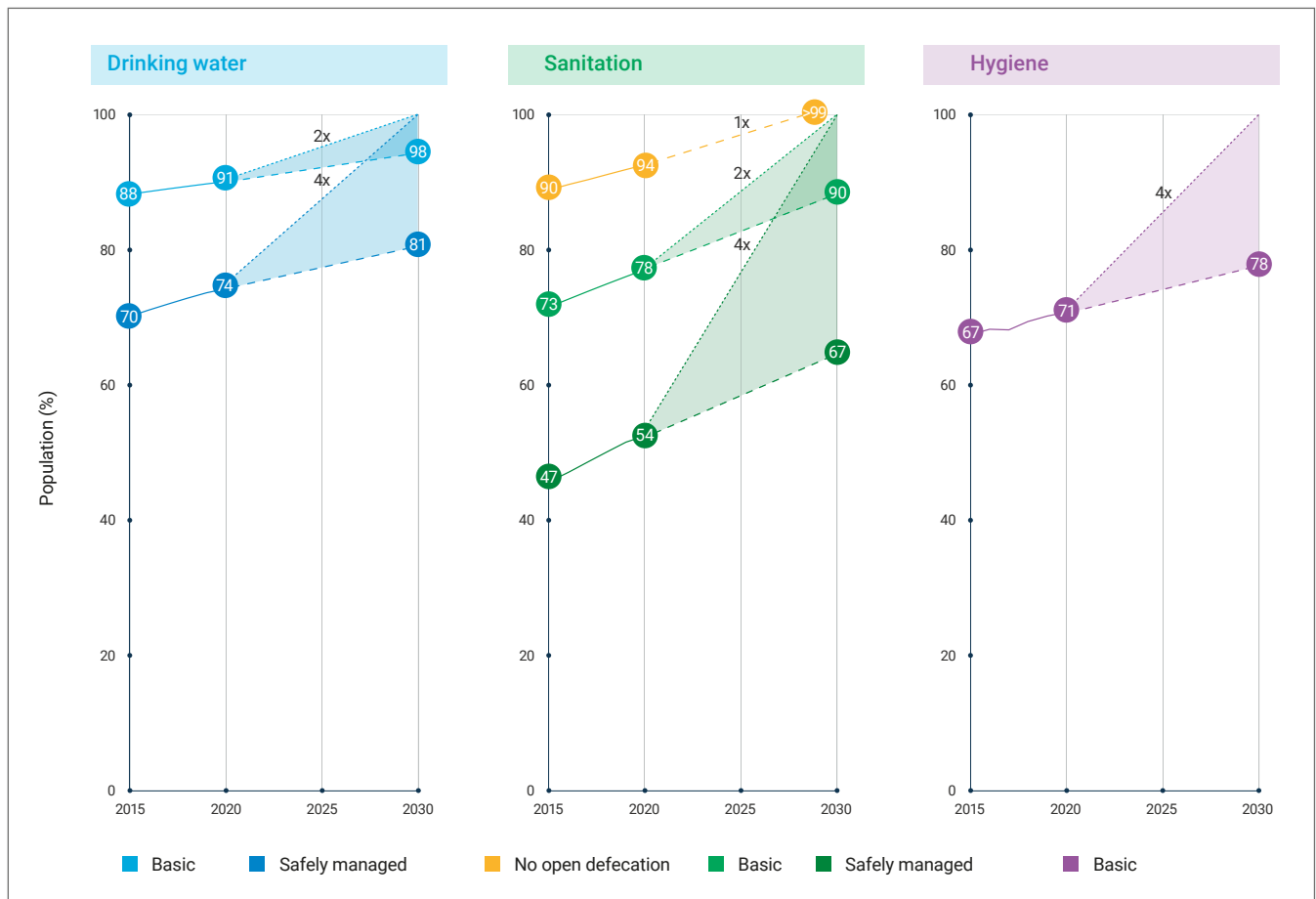
SDG Indicator 6.3.1 tracks the proportion of total, industrial and domestic wastewater flows that are safely treated in compliance with national or local standards, and its status is reported by UN-Habitat/WHO (2021). Globally, an estimated 44% of all domestic wastewater worldwide was not safely treated prior to its release into the environment in 2020. This number was extrapolated from data from 128 countries representing 80% of the global population. Data and reporting coverage are even lower for 'total' and 'industrial' wastewater flows, where figures are available only up to 2015 and remain too sparse to develop global values: only 42 countries (representative of 18% of the global population) reported both generation and treatment of total wastewater flows, with 32% receiving at least some treatment; only 14 countries (representing 4% of the global population) reported the percentage of the industrial wastewater flow that was treated, which averaged only 30%.

Figure P.7
SDG6 indicators and
tiering system



Source: UNEP (2021a).

Figure P.8 Global coverage of water, sanitation and hygiene (WASH) services, 2015–2020 (%), and acceleration required to meet targets by 2030



Source: WHO/UNICEF (2021, fig. 1, p. 7).

SDG Indicator 6.3.2 monitors the proportion of bodies of water with good ambient water quality, as per national and/or subnational water quality standards and based on measurements of five water quality parameters that inform on the most common pressures on water quality at the global level (oxygen, salinity, nitrogen, phosphorus and acidity). The latest status report is provided by the United Nations Environment Programme (UNEP, 2021a). About 60% of the world’s reported water bodies were categorized as having ‘good’ ambient water quality. However, over three-quarters of the over 75,000 water bodies that were reported on in 2020 were in 24 high-GDP countries. The poorest 20 countries reported on just over 1,000 water bodies and are therefore grossly under-represented in this global estimate. Only 59% of the 89 countries reporting included data on groundwater. Some positive trends were reported, with 19 of the 49 countries reporting in both 2017 and 2020 being on track to improve water quality; all were countries with a robust monitoring system in place.

SDG Target 6.4 Water use efficiency and water scarcity

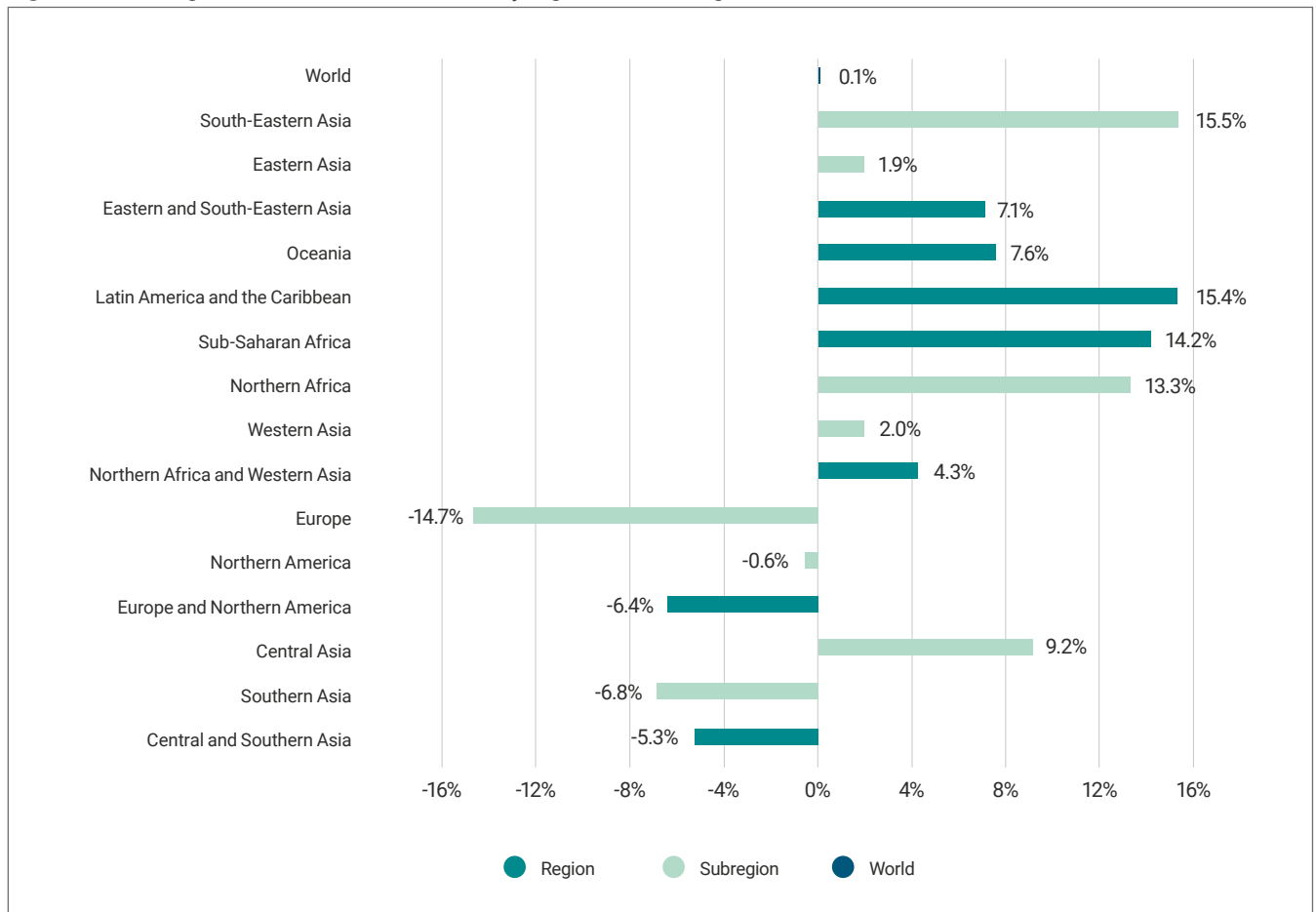
SDG Indicator 6.4.1 monitors the change in water use efficiency over time, measured as the ratio of monetary value added to the volume of water used. The latest status report is available from FAO/UN-Water (2021a). Water use efficiency rose by 9% from 2015 to 2018 (from 17.3 to 18.9 US\$/m³). All economic sectors have seen an increase in their water use efficiency between 2015 and 2018: the industrial sector by 15% (with a water use efficiency equivalent to 32.2 US\$/m³ in 2018), and by 8% in the services sector (112.2 US\$/m³ in 2018) and the agriculture sector (0.60 US\$/m³). Data are available for 86 countries from 2006. The

● ● ●
Globally, an estimated 44% of all domestic wastewater worldwide was not safely treated prior to its release into the environment in 2020

industrial sector has experienced the largest net efficiency gains from 2006 to 2018, likely due to the transformation of thermal cooling for energy production, industrial processes and heating systems. Emerging data on total withdrawals and gross value added (GVA) over the years reveal a potential decoupling of economic growth from water use since 2016. These results are preliminary and remain inconclusive until more data points are forthcoming.

Water use efficiency is closely linked to water scarcity. SDG Indicator 6.4.2 tracks water stress (Figure P.4) as a proxy measure of scarcity, and the most recent status report is provided by FAO/UN-Water (2021b). In 2018, 18.4% of the total global renewable freshwater resources available was being withdrawn.¹ Although this figure may seem safe, there are important large regional, national and subnational variations (Figure P.4). Three out of seven SDG regions had water stress values above 25% in 2018, including Central and Southern Asia with high water stress and Northern Africa with critical water stress. Western Asia and Eastern Asia had medium and low water stress, respectively. The remaining regions and subregions, representing approximately 31% of the global population, were at the 'no stress' level, but important differences in water stress levels were evident at country and major basin level. On average, 10% of the global population lives in countries with high or critical water stress, which significant impacts water access and availability for personal needs.

Figure P.9 Change in the level of water stress by region and at the global level, 2008–2018



Note: To reach Target 6.4, the level of water stress should decrease (i.e. show a negative percentage change over time).

Source: FAO/UN-Water (2021b, fig. 4, p. 19).

¹ This estimate takes account of 'environmental flow requirements' (EFR), which represent, on average, 50% of 'total renewable water resources' (FAO, 2019).

Previous published reports indicate a much lower level of water stress. These differences are attributed largely to improved assessment methodologies. FAO/UN-Water (2021b) recomputed data prior to 2015. This shows that the water stress value has evolved from 2008 to 2018 at the regional and subregional levels (Figure P.9). Note that in order to reach Target 6.4, water stress should not increase at a slower rate, but decrease. Slower growth is evident in Eastern, Western and Central Asia but a moderate to large increase between 2008 and 2018 is evident in South-Eastern Asia, Latin America and the Caribbean, Sub-Saharan Africa, Oceania, and Northern Africa. Southern Asia, Europe and Northern America reduced their water stress level between 2008 and 2018.

SDG Target 6.5 Water management and transboundary cooperation

SDG Indicator 6.5.1 monitors the degree of IWRM² implementation, by assessing the four key dimensions of IWRM: enabling environment, institutions and participation, management instruments, and financing. According to the latest indicator status report (UNEP, 2021b), while most countries have made some progress, the global rate of progress on IWRM implementation needs to double to approach the target. None of the four IWRM dimensions is expected to be fully implemented by all countries by 2030. Management arrangements at the basin level are generally lagging behind at the subnational and national level, and aquifer management is lagging further still. Acceleration is most urgently needed in South and Central America, the Caribbean, Oceania, South Asia, Central Asia, Central Africa, and West Africa, but further effort is still needed in all regions. A total of 107 countries are not on track to achieve SDG Target 6.5. There are signs of progress: between 2017 and 2020, 55 countries made limited or no progress, but 52 countries made moderate progress, 22 countries made substantial progress, and 44 countries are close to the target. Despite this progress, the degree of IWRM implementation remains low, with 87 countries (47%) still reporting 'low' or 'medium-low' levels.

SDG Indicator 6.5.2 monitors the area of a country within transboundary basins and assesses the extent to which that area is covered by operational³ cooperation arrangements. In total, 153 countries share 286 transboundary river and lake basins and 592 transboundary aquifer systems. As of 2022, an estimated 58% of the world's transboundary basin areas had an operational arrangement for water cooperation. The global average of the aquifer component is 42% (UNECE/UNESCO, 2021). In most cases, transboundary aquifers are part of broader water cooperation arrangements, rather than covered by stand-alone agreements (United Nations, 2022b).

SDG Target 6.6 Water-related ecosystems

SDG Indicator 6.6.1 tracks changes in extent of water-related ecosystems over time. The latest update of the indicator is reported in UNEP (2021c). A primary indicator, the wetlands extent index, tracks natural wetland area since 1700, showing an 80% loss since the pre-industrial era. The data are not yet refined enough to track discrete trends in recent years. The monitoring effort is also compiling data on areas of lakes, rivers, wetlands, mangroves, groundwater and reservoirs. Combined data on these indicators need to be interpreted carefully, but they do confirm, for example, the rapid changes occurring in the global surface water area. An estimated 21% of the world's water basins are experiencing rapid changes, both increases and decreases, in the area covered by surface waters. The disaggregated datasets confirm the continuing shift in surface area from natural wetlands, such as river

² IWRM is "a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP, 2000, p. 22).

³ Arrangements are 'operational' when there is a joint body, meetings between countries take place and information is exchanged at least once per year, and joint or coordinated management plans or objectives for the basin(s) have been set.

floodplains, to artificial water bodies such as reservoirs. An experimental data platform (the 'Freshwater Ecosystems Explorer' – see Section 3.4) is being developed to provide an improved and simplified but accessible overall picture of a complex monitoring area. Datasets also include those for water quality, river flow, IWRM and other management trends. Potential for a 'scorecard' to quantify river basin health, using multiple datasets, to assist in providing a more systematic overview of trends, is being explored. The monitoring for Indicator(s) 6.6.1 does not currently measure mountains or forests or the extent of ecosystem restoration dimensions of Target 6.6.

SDG Target 6.a **International cooperation and capacity-building**

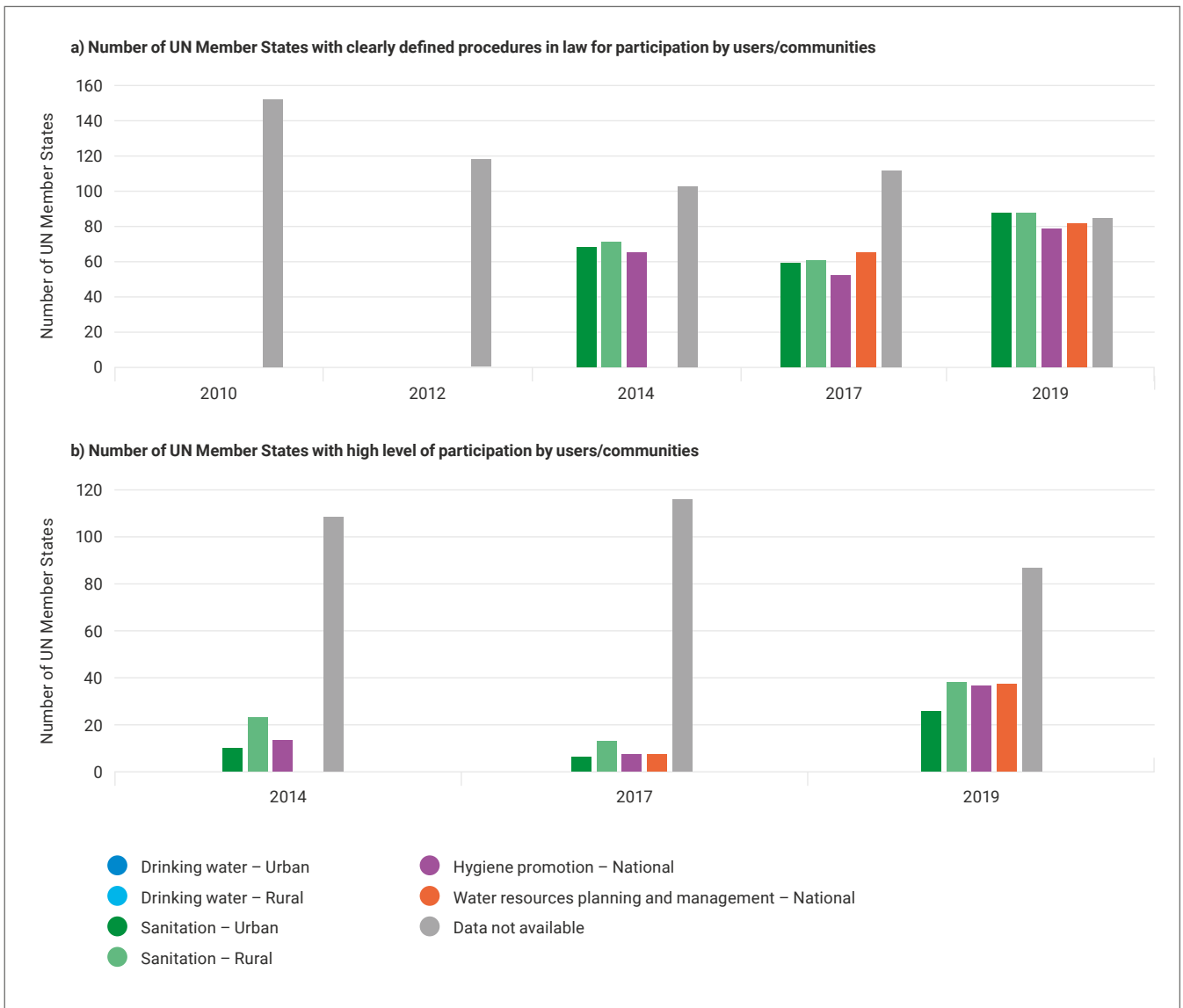
SDG Indicator 6.a.1 tracks the amount of water- and sanitation-related official development assistance (ODA) that is included in a government-coordinated spending plan. According to estimates by the Organisation for Economic Co-operation and Development (OECD), the ODA disbursed and committed to 'water' in 2020 was estimated at US\$8.7 billion globally, up from US\$2.7 billion in 2002 (OECD.stat, n.d.). Investment categories include water supply and sanitation, agricultural water resources, and hydro-electric power plants. The OECD Creditor Reporting System (CRS) currently disaggregates ODA data on water and sanitation among several categories (including sector policy and administration, water resources protection, large and basic water and sanitation systems, river basin infrastructure, waste management, agricultural water resources, and education and training). The UN-Water IMI-SDG6 had not yet reported comprehensively and separately on this indicator at the time of this report's publication, although real-time data are available on the data portal.⁴

SDG Target 6.b **Community participation**

SDG Indicator 6.b.1 measures the proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management. Participation of users and communities helps ensure sustainable solutions for all aspects of SDG 6 and contributes to equality within and among countries, including with regard to gender. The metric in use records the existence, at country level, of procedures in law or policy for participation, as well as the actual level of participation, in the subsectors of urban drinking water, rural drinking water, urban sanitation, rural sanitation, hygiene promotion, and water resources planning and management. Data availability has improved from 2014. The number of countries with clearly defined procedures in law or policy for participation by users/communities has increased between 2014 and 2019. Over the same period, the number of countries reporting high levels of participation has increased more rapidly, but still remains low overall (Figure P.10). Levels for both laws/procedures and participation are very low for drinking water in both urban and rural settings compared to the other subsectors.

⁴ www.sdg6data.org/indicator/6.a.1.

Figure P.10 Current data on Indicator 6.b.1: Participation of local communities in water and sanitation management



Source: UN-Water (n.d.).

References

- FAO (Food and Agriculture Organization of the United Nations). 2019. *Incorporating Environmental Flows into "Water Stress" Indicator 6.4.2 – Guidelines for a Minimum Standard Method for Global Reporting*. Rome. 32 pp. Licence: CC BY-NC-SA 3.0 IGO. www.fao.org/3/CA3097EN/ca3097en.pdf.
- FAO/UN-Water (Food and Agriculture Organization of the United Nations/UN-Water). 2021a. *Progress on Change in Water-Use Efficiency: Global Status and Acceleration Needs for SDG Indicator 6.4.1, 2021*. Rome, FAO. doi.org/10.4060/cb6413en.
- _____. 2021b. *Progress on Level of Water Stress: Global Status and Acceleration Needs for SDG Indicator 6.4.2, 2021*. Rome, FAO. doi.org/10.4060/cb6241en.
- GWP (Global Water Partnership). 2000. *Integrated Water Resources Management*. TAC Background paper No. 4. Stockholm, GWP. www.gwp.org/globalassets/global/toolbox/publications/background-papers/04-integrated-water-resources-management-2000-english.pdf.
- OECD.stat. n.d. *Development. Flows Based on Individual Projects (CRS)*. <https://stats.oecd.org/> (Data extracted on 21 July 2022).
- UNECE/UNESCO (United Nations Economic Commission for Europe/United Nations Educational, Scientific and Cultural Organization). 2021. *Progress on Transboundary Water Cooperation: Global Status of SDG Indicator 6.5.2 and Acceleration Needs*. New York/Paris, United Nations/UNESCO. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_652_Progress-on-Transboundary-Water-Cooperation_2021_EN_UNESCO.pdf.
- UNEP (United Nations Environment Programme). 2021a. *Progress on Ambient Water Quality: Tracking SDG 6 Series – Global Indicator 6.3.2 Updates and Acceleration Needs*. Nairobi. <https://wedocs.unep.org/20.500.11822/36689>.
- _____. 2021b. *Progress on Integrated Water Resources Management: Tracking SDG 6 Series – Global Indicator 6.5.1 Updates and Acceleration Needs*. Nairobi, UNEP. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_651_Progress-on-Integrated-Water-Resources-Management_2021_EN.pdf.
- _____. 2021c. *Progress on Freshwater Ecosystems: Tracking SDG 6 Series – Global Indicator 6.6.1 Updates and Acceleration Needs*. Nairobi. <https://wedocs.unep.org/20.500.11822/36691>.
- UN-Habitat/WHO (United Nations Human Settlements Programme/World Health Organization). 2021. *Progress on Wastewater Treatment – Global Status and Acceleration Needs for SDG Indicator 6.3.1*. Geneva, UN-Habitat/WHO. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_631_Progress-on-Wastewater-Treatment_2021_EN.pdf.
- United Nations. 2022a. *The Sustainable Development Goals Report 2022*. New York, United Nations. <https://unstats.un.org/sdgs/report/2022/>.
- _____. 2022b. *The United Nations World Water Development Report 2022. Groundwater: Making the Invisible Visible*. UNESCO, Paris. <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- UN-Water. n.d. *Progress on Community Participation (SDG Target 6.b)*. UN-Water website. www.sdg6data.org/indicator/6.b.1 (Accessed in August 2022).
- WHO/UNICEF (World Health Organization/United Nations Children's Fund). 2021. *Progress on Household Drinking Water, Sanitation and Hygiene 2000-2020: Five Years into the SDGs*. Geneva, WHO/UNICEF. <https://washdata.org/report/jmp-2021-wash-households>. Licence: CC BY-NC-SA 3.0 IGO.

Chapter 1

Introduction

WWAP

Richard Connor, David Coates, Joshua Newton and Michela Miletto



1.1 Purpose and scope of this report

• • •
**Partnerships
and cooperation,
at all levels,
overwhelmingly
deliver positive
outcomes**

The year 2023 marks the first major United Nations (UN) conference dedicated to water⁵ since 1977. The UN 2023 Water Conference focuses on progress towards water- and sanitation-related goals, coinciding with the mid-term comprehensive review of the International Decade for Action, 'Water for Sustainable Development 2018–2028'. At current rates, progress towards all the targets of the sixth Sustainable Development Goal (SDG 6) is off-track and in some areas the rate of implementation needs to quadruple, or more (see Prologue Part 2). The SDG 6 Global Acceleration Framework (GAF) was designed to accelerate this progress, and partnerships and cooperation are central to it (Box 1.1). Such partnerships and cooperation transcend boundaries and sectors, making SDG 6 everyone's business.

As the UN system's principal authoritative report on water, the *United Nations World Water Development Report 2023* directly informs the UN conference discussions, describing how building partnerships and enhancing cooperation across all dimensions of sustainable development are essential to accelerating progress towards SDG 6 and realizing the human rights to water and sanitation.

The Prologue to this report briefly describes the status and trends concerning global freshwater resources (availability, demand, quality, etc.) and summarizes the current level of progress on each of the SDG 6 targets. Chapters 2–7 showcase experiences and perspectives on partnerships and cooperation from different water-dependent sectors: *Agriculture, Environment, Human Settlements, Industry and Energy, Human Health, and Climate Change*. Regional knowledge and practices are highlighted in Chapter 8. Chapters 9–13 review partnerships and cooperation with regards to each of the five 'accelerators' under the SDG 6 GAF: *Education and Capacity Development, Data and Information, Innovation, Funding, and Governance*. Guiding principles for successful partnerships and cooperation, along with a review of the roles, responsibilities and contributions of partners at various levels, are presented in Chapter 14.

Partnerships and cooperation, at all levels, overwhelmingly deliver positive outcomes. Cooperation improves water governance and decision-making, stimulates innovative solutions, and leverages efficiencies. By promoting inclusive engagement, participation and dialogue, and giving voices to those that are otherwise not heard (e.g. marginalized communities), partnerships can help ensure that no one is left behind and that the human rights to water and sanitation are realized.

However, in rare cases, partnerships and cooperation can institutionalize exclusion, distort resource allocations and encourage fragmentation. Corruption is widespread in the water sector (WIN, 2016; Vos, 2011) and can be based on or influenced by partnerships and cooperation. These negative aspects, even where unintentional, highlight the need to be vigilant that partnerships and cooperation are aligned with societal benefits.

Water resources management has a long history of experience with partnerships, both good and bad. Partnerships and cooperation take place in almost any water-related endeavour. The currently inadequate rate of progress towards the SDG 6 targets (see Prologue Part 2) highlights the need to explore opportunities for new models of partnerships and cooperation, especially because of the intersectoral nature of water, crossing all the social, economic and environmental pillars of sustainable development. This report reviews this experience, highlighting how enhancing positive and meaningful cooperation amongst the water, sanitation and broader 'development' communities is required to accelerate progress.

⁵ For more information, please see: <https://sdgs.un.org/conferences/water2023>.

1.2 Basic concepts

1.2.1 What is a partnership or cooperation?

There is a multitude of definitions and understanding of what constitutes a partnership or cooperation. For the purpose of this report, **partnerships** are considered to be “*voluntary and collaborative relationships between various parties, both public and non-public, in which all participants agree to work together to achieve a common purpose or undertake a specific task and, as mutually agreed, to share risks and responsibilities, resources and benefits*” (UNGA, 2015). Partnerships between different stakeholders at all levels (international, national and local) are emphasized in most contemporary water-related policy approaches, recognizing that solutions to water problems cannot be achieved by one organization or even one segment of society (WWAP, 2003).

Partnerships are often based on some type of formal or informal agreement. **Cooperation** is generally understood to be a less formal practice of “*working together to the same end*” (Dictionary, 2021). ‘Water cooperation’ entails various players and sectors working together towards a common goal to peacefully manage and use freshwater resources at the local, national, regional and international levels (UN Water for Life Decade, 2013). Each of these cooperative arrangements may include more formal partnerships, and each partnership involves cooperation. Consequently, many sections of this report use the two terms flexibly and often interchangeably.

Box 1.1 The SDG 6 Global Acceleration Framework

The SDG 6 Global Acceleration Framework (GAF) is a new, unifying initiative that aims to deliver ‘fast results at an increased scale’. It is part of the UN Secretary-General’s Decade of Action to deliver the SDGs by 2030.

One of the main strategies focuses on partnerships, noting the need to establish or scale up powerful partnerships at the global, regional, community, and river, lake and aquifer basin levels. The objectives of such partnerships include: to generate and sustain political will, to mobilize public and private entities across different sectors for cooperation, to foster innovation and reform, to prevent conflicts, and to promote effective, sustainable and peaceful management of water resources.

Designed to enable entities within the UN system and multi-stakeholder partners to act together to support country progress, the SDG 6 GAF is guided by five accelerators: *Capacity, Funding, Innovation, Data and Information, and Governance*.

Source: UN-Water (2020).

To distinguish them from a loose association among players (e.g. meetings), genuinely successful examples of partnerships and cooperation are those that result in a demonstrable mutual benefit for the parties involved and/or result in a tangible change in their behaviour.

1.2.2 Types of partnerships and cooperation

Partnerships exist at all geographic scales: global, international, basin, regional, national and local. Some are more wide-ranging in terms of the aspects of water that they cover, some are more specific; some focus solely on water, and others link to other subject matters. Examples include multi-stakeholder partnerships, corporate partnerships, academic/research partnerships, public–private partnerships (PPPs), basin organizations that involve multiple countries as partners, water user associations (WUAs), and water operator partnerships, among many others. Examples of cooperation include networks, platforms, transboundary water cooperation, and multi-/cross-/inter-sectoral and interdisciplinary cooperation, technical cooperation, South–South/North–South/triangular cooperation, and development cooperation, among several others. Integrated water resources management (IWRM) can involve both partnerships and cooperation, but not always depending on its level of participation.

Partnerships and cooperation can develop naturally among parties, or need enabling and promoting, but few are without difficulties. Each party comes with its own knowledge, perceptions, interests, positions and objectives, such that disagreements on priorities and strategies are commonplace.

1.2.3 Categorizing partnerships

Spatial scales are a precarious way of categorizing partnership and cooperation over water, as these can occur at different geographic scales and most usually operate across multiple scales. Similarly, categorization by discipline or subsector is problematic because stakeholders themselves often operate across different scales and, most importantly, may or may not necessarily share the same primary water-related objectives.

The novel approach to categorization adopted for the purposes of this report focuses directly on the overall objectives of the partners in relation to the type of water-related outcomes that they are meant to collectively achieve. These are divided into three categories:

- a) **Intra-sectoral** partnerships and cooperation between or among stakeholders with a **common and specific type of water-related use or objective**. The partners may include different types of stakeholders (e.g. governments, non-governmental organizations (NGOs), private sector, financiers, academia, local communities, etc.), but all would share the same general water management objective. Examples include organizations managing a common irrigation system, or coalitions that supply drinking water and sanitation infrastructure to a certain area.
- b) **Cross-sectoral** (or *inter-sectoral*) partnerships and cooperation, involving actors with **different water-related foci and multiple (different or even competing) water-related objectives**. While these can potentially involve several of the actors mentioned above, the difference is that these actors would have different perspectives and, therefore, often different perceptions, intentions and goals requiring conciliation and/or benefit-sharing. Examples include cooperation between municipalities and farmers over the allocation of water supplies, or payment for environmental services schemes.
- c) **Extra-sectoral** partnerships and cooperation, involving actors from 'outside the water domain', where **the primary foci and objectives of some partners are not primarily water-related**, but where water plays a determining role. Such non-water objectives may involve land use, gender equity, urban/rural planning, education, job creation, art and culture, trade, and economic development (among others). Partnerships and cooperation addressing climate change adaptation and mitigation through water-related interventions is one specific example.

References

- Dictionary. 2021. Dictionary website. www.dictionary.com/.
- UNGA (General Assembly of the United Nations). 2015. *Towards Global Partnerships: A Principle-Based Approach to Enhanced Cooperation between the United Nations and all Relevant Partners*. Resolution adopted by the General Assembly on 22 December 2015. Seventieth session. A/RES/70/224. <https://digitallibrary.un.org/record/809811#record-files-collapse-header>.
- UN-Water. 2020. *The Sustainable Development Goal 6 Global Acceleration Framework*. www.unwater.org/app/uploads/2020/07/Global-Acceleration-Framework.pdf.
- UN Water for Life Decade. 2013. *Water Cooperation: Information Brief*. International Annual UN-Water Zaragoza Conference 2012/2013, 8–10 January 2013.
- Vos, J. 2011. *Fighting Corruption in the Water Sector: Methods, Tools and Good Practices*. New York, United Nations Development Programme (UNDP). www.unep.org/publications/fighting-corruption-water-sector.
- WIN (Water Integrity Network). 2016. *Water Integrity Global Outlook 2016*. Berlin, Water Integrity Network. www.waterintegritynetwork.net/wigo/.
- WWAP (World Water Assessment Programme). 2003. *Water for People, Water for Life: The United Nations World Water Development Report*. Paris/New York, UNESCO/Berghahn Books. <https://unesdoc.unesco.org/ark:/48223/pf0000129726>.

Chapter 2

Food and agriculture

FAO

Sasha Koo-Oshima, Matthew England, Maher Salman, Riccardo Biancalani,
Virginie Gillet, Jippe Hoogeveen, Benjamin Kiersch, Patricia Meijas-Moreno,
Livia Peiser and Kamar Khazal



2.1 Introduction

This chapter examines three management responses to explore cooperation and partnership for food and agriculture. Water user associations (WUAs) are chosen as an example of intra-sectoral water partnerships and cooperation; water allocation for agriculture and urban centres to illustrate cross-sectoral interactions; and the water–energy–food–environment (WEFE) nexus as an extra-sectoral case study.

Data and information concerning water use for all sectors is required in order to determine their impacts on water and other water-related systems (e.g. energy). By increasing the availability of high-quality data for evidence-based policy-making, regulations, planning and investments at all levels, the FAO AQUASTAT Database, as well as the UN-Water collaboration and partnerships through the Integrated Monitoring Initiative for the Sustainable Development Goal 6 (IMI-SDG6), are key examples in accelerating the achievement of SDG 6.

The chapter illustrates how the levels of cooperation and performance of a management response is determined by a multitude of hydro-physical, socio-economic, political, institutional and governance parameters. Partnerships and cooperation between actors operate at varying and interdependent sectoral scales, depending on the objectives and scope.

Additional highlights include how the SDG 6 Global Acceleration Framework⁶ accelerators are of critical importance to the performance of management responses, and how partnerships and cooperation can help strengthen them in order to improve water and food security.

2.2 Water user associations

The characteristics of partnerships and cooperation involving WUAs are an important factor when considering their performance. The actors involved in WUAs often include farmers, government agencies, non-governmental organizations (NGOs), academia, bilateral development institutions, development banks, and in some cases the private sector. Capacity, funding and governance issues are also highlighted in relation to WUA performance, linking to the SDG 6 Global Acceleration Framework accelerators. WUAs warrant attention because of their focus on improving the performance of irrigation schemes and smallholder farm systems, enhancing irrigated agricultural productivity and food security for marginalized farmers whose livelihoods are often highly dependent on irrigated agriculture.

WUAs are formal organizations that bring together farmers for the purpose of managing a common irrigation system. The historical development of WUAs at a larger scale originates from the late 1970s. They sought to improve coverage and efficiency in low-performing state-managed irrigation systems (Mollinga et al., 2007; Garces-Restrepo et al., 2007; Turrall, 1995), and to improve small-scale community-based and farmer-led irrigation systems. Decentralization entails transferring management responsibility for all or part of an irrigation scheme from the state to farmers (Aarnoudse et al., 2018; Turrall, 1995). Principal tasks of WUAs include the allocation of water within an irrigation system, operation and maintenance (O&M), and the cost recovery of O&M through the collection of irrigation fees. WUAs are generally small-scale with a limited number of members (usually not exceeding several hundred, dependent on the size of the irrigation system), so that self-management by users is possible (Aarnoudse et al., 2018).

The characterization and development of WUAs differ globally. In South and South-East Asia, as well as North Africa, WUAs are primarily established for the management of large- and medium-scale irrigation systems, rehabilitated or constructed by governments. They are generally managed by state irrigation departments. WUAs in North Africa and Sub-Saharan Africa are also established in small-scale irrigated systems and managed by farmers. In the case of Sub-Saharan Africa, WUAs are often heterogeneous (serving multiple uses and users,

• • •
*Water user
associations
are formal
organizations
that bring
together farmers
for the purpose
of managing a
common irrigation
system*

⁶ The SDG 6 Global Acceleration Framework accelerators include optimizing finance, improved data and information, capacity development, innovation, and governance. For more information, see: www.unwater.org/publications/the-sdg-6-global-acceleration-framework/.

e.g. for irrigated and domestic needs) and often promoted by national governments or donors through development projects addressing smallholder farmers (Aarnoudse et al., 2018).

2.2.1 Factors affecting performance

At the global level, the results of the performance of WUAs are mixed. Some have less-than-satisfactory results, performing below the expectations of governments and donor agencies. Recent reviews of WUA performance based on the analysis of a large number of case studies in Africa and Asia found that, overall, they underperformed due to poor implementation, unclear roles and responsibilities, lack of women participation, and lack in administrative authority, among other factors (Garces-Restrepo et al., 2007; Ghazouani et al., 2012; Mukherji et al., 2009; Senanayake et al., 2011, 2015). This confirms earlier research on implementation challenges of decentralization through Participatory Irrigation Management (Meinzen-Dick et al., 1995; Turral, 1995; Vermillion, 1997; Groenfeldt and Svendsen, 2000; Meinzen-Dick et al., 2002; Uphoff and Wijayarathna, 2000). Factors of WUA underperformance are related to unrealistic cost recovery expectations and lack of inclusive stakeholder participation in irrigation projects (Aarnoudse et al., 2018), characterized by unclear formulation of roles and responsibilities of WUAs (Garces-Restrepo et al., 2007).

Nevertheless, there are also many cases of successful WUA performance and implementation, depending on the local socio-political, economic and hydro-physical context. Generally speaking, context-specific factors positively correlated with effectiveness. Successful experiences have been documented with active farmers' participation in Japan; with small-size systems and rich social capital in Nepal; long-term engagement and involvement of NGOs in Sri Lanka and India; and the provision of correct incentives to irrigation officials and farmers in China (Mukherji et al., 2009).

The multitude of factors influencing WUA performance and levels of cooperation between actors can be categorized into four themes: socio-economic and political settings; water resource systems; governance; and users (Table 2.1) (Meinzen-Dick, 2007). It is beyond the scope of this section to discuss all of these factors. However, a number of partnerships between actors (e.g. farmer user groups, national irrigation agencies) are highlighted as important to the performance and implementation of WUAs, as well as SGD 6 Global Acceleration Framework accelerators, especially in terms of water resources systems (data and information) and finance.

Table 2.1 Factors influencing WUA performance

Socio-economic and political setting	Water resource systems	Governance	Users (farmer groups)
<ul style="list-style-type: none"> • Economic development • Demographic trends • Government water policies • Market incentives • Definition of clear policies and responsibilities for each party involved in water management • Legal framework, low interference from politicians or other groups • High-level political commitment 	<ul style="list-style-type: none"> • Water availability • Climate patterns • Size of the irrigation system • Irrigation infrastructure • Flows in and out of the irrigation system • Predictability of supply • Storage characteristics • Location • Hydrological interaction among irrigation units • Physical infrastructure 	<ul style="list-style-type: none"> • Government organizations • Non-governmental organizations • Local institutions (operational rules, collective-choice rules, constitutional rules, monitoring and sanctioning processes) • Property rights, water tenure • Structure of the user groups (formation, membership, mandate) • Financial performance of user groups • Democratic choice of board members • Adequate staffing levels 	<ul style="list-style-type: none"> • Number of users • Shared norms (social capital) • Socio-economic attributes • Leadership • Location (relative to infrastructure) • History of irrigation • Dependence on irrigation • Knowledge of irrigation • Technology used • Strong social capital, administrative, managerial and accounting skills

Source: Adapted from Meinzen-Dick (2007) and Garces-Restrepo et al. (2007).

● ● ●
Groundwater monitoring is practically non-existent in both Africa and Asia, where diffuse groundwater withdrawals are common

Farmer user groups

The characteristics and internal dynamics of WUA farmer user groups are found to be an important factor in determining the level of participation and cooperation within WUAs. Smaller-sized WUAs are generally more successful, with evidence from Asia indicating that less than 1,000 farmers is optimal (Mukherji et al., 2009). Farmer groups that share similar norms and have social capital from other local institutions, such as village councils or religious groups, are also found to be more successful, as exemplified by the Panchakanya Irrigation System in Nepal (Mukherji et al., 2009). Another influential factor is the presence and long-term involvement of local NGOs within farmer user groups (Meinzen-Dick, 2007). Evidence from Africa also highlights strong and charismatic leadership as an important factor in successive collective action of farmer groups (Meinzen-Dick, 2007; Ghazouani et al., 2012).

Democratic processes within WUAs, such as the election of chairpersons and other board members, are found to enhance farmer participation and cooperation, such as in the Toyogawa Irrigation Project in Japan (Mukherji et al., 2009).

An insightful critique on social dynamics is that WUAs are not necessarily homogeneous groups of water users with predictable relations of trust and a common purpose that would enhance collective action and cooperation (Aarnoudse et al., 2018). It is argued that collective action around irrigation is often embedded in wider systems of patronage and social hierarchies in villages (Mosse, 2006). Government and donor-supported agencies have imposed central and national directives, often through mandated scheme by-laws or rules, which may not reflect local WUA leadership to provide equitable, inclusive member participation in decision-making (Mukherji et al., 2009).

State irrigation authorities

Decentralization of management responsibility from state irrigation departments is a central tenant of WUAs, as pursued through Participatory Irrigation Management from the 1970s onwards. However, irrigation departments and water ministries that do not take farmer-led initiatives into consideration may limit effective farmer participation and cooperation through WUAs. In many countries, such as in India (Nikku, 2006; Mollinga and Bolding, 2004), Indonesia (Suhardiman, 2008), Mexico (Rap et al., 2004; Wester, 2009) and Thailand (Molle and Floch, 2008), state irrigation agencies have gone through decentralization reforms, guiding WUA board member elections, establishing the legal status of WUAs, directing revenue flows, and setting rights and responsibilities through legal documents (Mukherji et al., 2009).

Powerful state irrigation agencies are sometimes inclined to pursue national and regional hydraulic missions, centered upon irrigation control and expansion of large-scale water infrastructure (Molle et al., 2009; Wester, 2009).

Water resource systems

Important water resource system data requirements for WUA management include hydrological data on flows in and out of irrigation systems, water storage requirements, and irrigation infrastructure (Table 2.1). However, particularly in the case of Sub-Saharan Africa, there is little hydrological data collection or monitoring within small-scale irrigation schemes. Government irrigation departments in Sub-Saharan Africa often lack human resource capacity and funds to establish data monitoring, which severely limits benchmark assessment and performance evaluation (Aarnoudse et al., 2018). Greater levels of hydrological data monitoring and evaluation within large and medium-scale irrigation schemes exist in North America, South and South-East Asia, as well as North Africa. Effective hydrological monitoring and evaluation could potentially provide data to identify constraints and opportunities for enhancing WUA performance (Aarnoudse et al., 2018).

Even less is known about groundwater. Groundwater monitoring is practically non-existent in both Africa and Asia, where diffuse groundwater withdrawals are common. Groundwater plays a critical role in conjunctive use with surface water to serve irrigation needs during times of limited surface water availability, such as in times of drought (United Nations, 2022).

Finance

Financial shortfalls to pay for O&M by means of user fees is a commonly cited challenge facing WUA performance and cooperation in Africa and Asia (Aarnoudse et al., 2018; Mukherji et al., 2009). Heterogeneous WUAs are likely to contribute to farmers' disincentives to pay fees, and possibly to the inappropriate use of funds by WUA leadership (Mosse, 2006). The lack of systematic documentation of WUA financial management makes it difficult to estimate the level of fee payment. According to the Independent Evaluation Group (2006), few project evaluation reports provide a clear indication of performance on O&M cost recovery through user fees. Furthermore, donors and public agencies often expect fees to be collected to cover O&M costs and ensure WUA financial independence, but they rarely provide guidance for fee collection. Governments and donor agencies typically expect WUAs to strengthen both user participation and cost recovery aspects of irrigation management. In practice, user participation and cooperation are often equated with assigning O&M tasks to WUAs, while cost recovery concentrates on the collection of water user fees by WUAs (Aarnoudse et al., 2018).

2.2.2 Improving performance

In the past, some WUAs have been challenged in terms of cost recovery for O&M, user participation and cooperation, and hence overall irrigation performance.⁷ The review of case studies and past experiences have shown that socio-economic, political and agricultural conditions are important to shape the ability of WUAs to achieve the expected results and levels of cooperation that would improve irrigation performance. And such enabling conditions cannot be easily created by external institutions and actors.

The actors and partnerships highlighted in this chapter – farmer user groups and government irrigation agencies – illustrate the complex site-specific nature of partnerships for WUA performance. Alignment of the many policies, legislation and fiscal measures that influence water management, service delivery and level of demand, calls for institutional and legal frameworks that can underpin well-defined water rights, provide appropriate incentives for water use, and increase coherence in measures for supply enhancement and demand management (FAO, 2017). The dynamics of these partnerships are influenced by a range of socio-economic, political and agrarian factors as listed in Table 2.1.

A number of alternative management options exists to improve partnerships and cooperation, and hence performance. These include public–private partnerships (PPPs), participatory design, water user platforms, multi-stakeholder and innovation platforms, joint management, multifunctional WUAs, and combined surface water–groundwater WUAs (Aarnoudse et al., 2018; Ghazouani et al., 2012; Mukherji et al., 2009). The appropriate management modality to site-specific WUAs should aim to improve capacity of governments and user groups, increase funding through appropriate user fee collection, and fundamentally, establish hydrological data monitoring and evaluation upon which benchmark assessments can be conducted (Garces-Restrepo et al., 2007).

⁷ Some commentators consider the conceptual weakness of WUAs to be at the root of the problem, with invalid assumptions underpinning the expected functions of WUAs (Mukherji et al., 2009), whereas others consider poor implementation or lack of enabling conditions to be the main challenge (Hodgson, 2007; Vermillion, 1997; Meinzen-Dick, 1997). Meinzen-Dick (2007) proposes to define the most appropriate mix of state control, user management and market mechanisms for irrigation systems based on context-specific conditions.

2.3 Water allocation for agriculture and urban centres

• • •
**Competition
for freshwater
between cities
and agriculture
is projected to
grow due to rapid
urbanization,
for which urban
water demand
is projected to
increase by 80%
by 2050**

Competition for freshwater between cities and agriculture is projected to grow due to rapid urbanization, for which urban water demand is projected to increase by 80% by 2050 (Flörke et al., 2018). Water allocation⁸ from agriculture to urban centres has become a common strategy to meet freshwater needs in growing cities (Garrick et al., 2019; Marston and Cai, 2016; Meinzen-Dick and Ringer, 2008; Molle and Berkoff, 2006). Roughly one-third of the world's cities that are dependent on surface water are facing competition with agriculture, which uses approximately 72% of the global freshwater withdrawals (Garrick et al., 2019).

The Food and Agriculture Organization of the United Nations (FAO) has studied the economics of water transfers from urban reclaimed water to agriculture. The FAO *State of Land and Water Resources for Food and Agriculture (SOLAW) 2021* indicates that rapid growth in urban areas has displaced all types of agricultural land use, while other land use increased by 220 million ha since 2000 (King et al., 2022).

Water allocation is documented at a number of spatial scales and forms. These include schemes related to land use changes or inter-basin transfers, as well as those within river basins or sub-basins, where agriculture is located either upstream or downstream of urban centres (Figure 2.1).

The use of reclaimed water in agriculture is an increasingly viable option in regions experiencing water scarcity, growing urban populations and growing demand for irrigation water. FAO has developed an economic framework for the assessment of the use of reclaimed water from urban to irrigated agriculture as part of a comprehensive planning process in water resource allocation strategies, presenting a more economically efficient and sustainable water utilization (FAO, 2010; Heinz et al., 2011).

2.3.1 Experiences

Different ways of water allocation have produced a range of outcomes for agriculture and urban centres, including win–win, win–lose and lose–lose outcomes.⁹ Results and implications of reallocation evolve over the course of time, with negative impacts on agriculture and urban centres occurring particularly early in the transition process of reallocation (Garrick et al., 2019). Yet comprehensive data on the impacts of reallocation, both positive and negative, are sparse, and evidence about the performance of water reallocation is relatively limited¹⁰ (Garrick et al., 2019; Marston and Cai, 2016; Hooper, 2015; Molle and Berkoff, 2006).

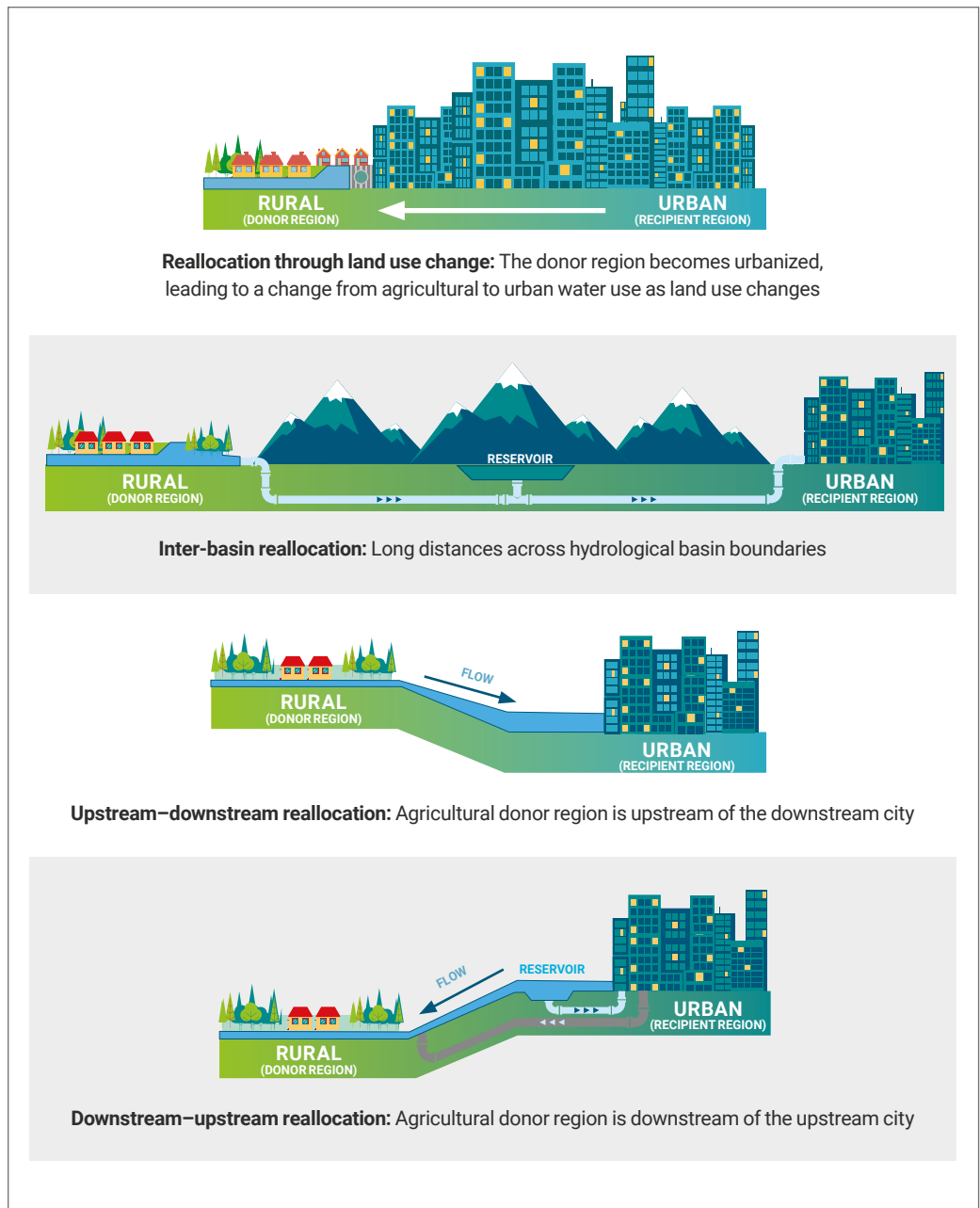
However, based on the case studies that have been conducted, it is possible to draw a few general conclusions. From an urban perspective, the reallocation of water from agriculture has been largely/relatively successful in terms of meeting demands of growing cities as well as improving irrigation efficiency (Molle and Berkoff, 2006).

⁸ Water allocation is the decision-making process to determine the volume or proportion of water available for sectors or individuals. These decisions are based on principles for allocation (Dinar et al., 1997). Water reallocation refers to a change in historical patterns of water use when “the existing allocation is physically impossible, economically inefficient or socially unacceptable” (Marston and Cai, 2016, p. 658). “It is distinct from ‘allocation’ in the sense that reallocation applies to contexts where water is fully committed. Reallocation is a politically more difficult proposition than initial allocation. Nevertheless, the terms reallocation and allocation are often used interchangeably” (Hooper, 2015, p. 23).

⁹ “Reallocation of water out of agriculture follows several modes (gradual or outright, minor or major, surreptitious or open, short-term or permanent, with or without compensation) depending on the hydrological characteristics of the source, the definition of rights/allocation, and the power of the cities/state to reorder this allocation. These different modes shape the impact and the response of society to these reallocations” (Molle and Berkoff, 2006, p. 34).

¹⁰ A recently published review of 97 studies (academic and policy-based) found that owing to data limitations, explicit information on the impacts is available for a third of rural–urban reallocation cases, which constrains efforts to assess the performance. None of the case studies include detailed longitudinal data regarding changing water availability and associated changes in the magnitude and distribution (Garrick et al., 2019).

Figure 2.1
Schematic of water allocation between agricultural (rural) and urban centres



Source: Adapted from Garrick et al. (2019, fig. 1, p. 3).

From an agricultural/rural perspective, numerous negative consequences have been observed as less water is available for irrigation, leading to reduced food security and lower farmer livelihood incomes (Meinzen-Dick and Ringer, 2008). However, ancillary benefits to rural areas and irrigated agriculture have been documented in the form of flood control and improved irrigation efficiency. Furthermore, compensation and benefit-sharing arrangements attempt (with varying success) to offset the negative impacts of water reallocation on the agricultural sector. Compensation can take many forms including financial payments, new infrastructure and, in cases, alternative water supplies (Garrick et al., 2019; Marston and Cai, 2016).

Agricultural water users and irrigators have been seen to adapt to reduced water availability by developing a number of strategies, including demand management. These include farmers and managers increasing irrigation efficiency and productivity at the farm and/or scheme level, or by changing crop patterns. An increased reliance on groundwater as an alternative water source is apparent and widespread, which in cases has led to overwithdrawal, with farmers being driven out of business when groundwater levels sharply declined. Another strategy employed has been the diversion of more water from the same or alternative

surface sources, often with negative implications on the environment. The use of reclaimed wastewater for irrigation in peri-urban areas is also a common response in areas facing water scarcity. For this reason, FAO, the United Nations Environment Programme (UNEP) and the World Health Organization (WHO) have developed guidelines on the safe use of wastewater and greywater for agriculture (WHO, 2006; WWAP, 2017).

2.3.2 Mechanisms of allocation

Mechanisms of water allocation for agriculture and urban settlements are detailed in Table 2.2. These mechanisms shape the nature of interaction and cooperation between agricultural water users and urban centres. Three types are identified: administrative allocation, market allocation, and collective negotiations (Meinzen-Dick and Ringer, 2008; Dinar et al., 1997).

Table 2.2 Overview of water allocation mechanisms

Allocation mechanisms	Definition	Advantages	Disadvantages
Market mechanisms	Water traded between or within sectors.	Seller can increase profitability. Buyer can take advantage of increasing availability.	Conditions for efficient functioning of markets do not often exist, particularly in the Global South.
Administrative mechanism/decision	The state allocates who gets water.	Theoretically equitable.	Prone to corruption and rent-seeking. Implementation challenges.
Collective action/negotiation and demand management	User negotiation and collective action-based demand management, e.g. farmer-managed irrigation.	Efficient and responsible use is possible.	Difficult to apply across large scales (demand management).

Source: Based on Dinar et al. (1997).

Administrative allocation involves the transferring of water by the national, state, or basin entity from one user to another, in this case agriculture to urban, usually under the premise that it is for the benefit of society/water users as a whole (Marston and Cai, 2016). Access to safe water and sanitation for all are fundamental human rights. In 2010, the General Assembly of the United Nations adopted the landmark resolution 64/292, which explicitly recognized these rights (UNGA, 2010). Since then, a number of subsequent resolutions adopted by the Human Rights Council and the General Assembly gave further affirmation and clarified the human rights to water and sanitation.

Collective action and negotiations through multi-stakeholder participation can lead to innovative solutions for water reallocation to agriculture, fisheries and urban water users, which can in cases provide mutually agreeable arrangements and benefits (Box 2.1). Reduced water availability owing to the transfer of water to cities has resulted in agricultural demand management practices, including increased irrigation efficiency and productivity. Negative environmental and water use consequences can also occur, as agricultural water users turn to alternative water supplies, including groundwater (Molle and Berkoff, 2006). Informal collective negotiations are witnessed widely around the world, most prevalent in Asian countries, and particularly in South-East Asian countries, where water scarcity exists but no formal water markets are in place (Marston and Cai, 2016).

Drawing on insights from case studies, it has been found that collective consultation and administrative decisions (when reasonably effective institutional arrangements exist) are the most prevalent form of interaction and cooperation between agriculture and urban centres (Garrick et al., 2019).

Box 2.1 Water reclamation and inter-sectoral water transfer between agriculture and cities: A FAO economic wastewater study

“By means of an illustrative example at Lobregat River basin in Spain, it could be proved that reclaimed water reuse and inter-sectoral water transfer can result in economic and environmental benefits at the watershed level. The agricultural community faces cost savings in water pumping and fertilizing, increases in yields and incomes; the municipality benefits from additional water resources released by farmers. Farmers should be encouraged to participate by implementing adequate economic incentives” (Heinz et al., 2011, p. 1067).

Agriculture benefits from cooperation with the urban sector include:

- Water all year round;
- Nutrients and organic matter;
- Higher yields;
- Location closer to cities;
- More crops/year; and
- Higher incomes.

Cities’ benefits from cooperation with the agricultural sector include:

- Increased food security;
- Additional wastewater treatment; and
- Water exchange with agriculture.

The environmental benefits from urban–agriculture cooperation include:

- Lower pollution; and
- Freshwater conservation.

2.3.3 Methods to improve agriculture–urban water allocation

A number of approaches are highlighted to improve the effectiveness of agriculture–urban water allocation and enhance the level of cooperation and partnerships between the two sectors. These are classified by the ‘accelerators’ of the SDG 6 Global Acceleration Framework: governance, data and information, capacity-building, innovation and finance (Table 2.3).

Accelerating action in addressing water scarcity for agriculture, FAO has fostered the sharing of knowledge and experiences from the private sector, research/academia, water associations, governments, and development banks on the fit-for-purpose use of reclaimed wastewater, desalinated water and rainwater, as well as technologies such as fog and cloud harvesting to augment water for agriculture. Discussions on new mechanisms of collaboration between the public–private sectors and innovative blended financing presented opportunities in scaling up non-conventional water use (FAO, n.d.a).

Water and resource recovery from urban centres represent the greatest opportunity for positive change, but it requires changes in the areas of urban water management and peri-urban irrigated agriculture production. Transitions are needed in implementing the circular economy, enhancing public engagement, integrating utilities, broadening practitioners’ skill sets and creating new jobs. To accelerate the needed transitions in the water and agri-food sector, both public and multi-sectoral stakeholders are needed to be actively engaged.

Table 2.3 Challenges and approaches to improve effectiveness of agriculture–urban water reallocation

SGD 6 Global Acceleration Framework accelerator	Challenge	Social science focus	Natural science and engineering focus	Holistic/integrated approach	Anticipated outcome
Governance	Unsuitable/ ineffective institutional structure and operations.	Identify institutional structures and policies that inhibit equitable reallocation from agriculture to urban.	Improve system operation schemes, provide more reliable hydrologic information, and facilitate communication among actors by novel technologies.	Establish adaptive institution based on scientific and engineering information support and agency collaboration.	Improved institutional support and mitigated institutional barriers.
Governance and capacity	Poorly defined water rights (water tenure).	Establish water rights and improve policies to facilitate equitable reallocation from agriculture to urban.	Quantify environmental flow requirements (monitoring and evaluation).	Link environmental water requirements to urban–agriculture actor outcomes. Create a systems approach to evaluate trade-offs/benefit-sharing between environmental and urban–agriculture water uses.	Balanced water allocation to urban, agriculture and nature needs.
Data and information, innovation, and capacity	Lack of data and information support. Limited agriculture–urban stakeholder involvement in (formal) negotiation processes.	Increase transparency of transfers and clarify actors’ values and beliefs.	Increase hydrological data collection and monitoring; improve information accessibility; monitor environmental effects. Provide insights into urban and agriculture/ irrigation systems through advanced information technology, especially big data tools, remote sensing (e.g. FAO WaPOR).	Incorporate hydrologic data and human responses and values into a coupled urban–agriculture framework.	Reduced uncertainty, lower transaction cost, and enhanced stakeholder support and partnership potential.
Finance; data and information	Third-party effects.	Assess economic and non-economic third-party impacts, as well as methods for compensation for agriculture and urban stakeholders.	Estimate consumptive water use and return flows more accurately and develop more effective monitoring methods; assess impacts of climate and societal change on water.	Co-optimize water benefits based on physical and socio-economic connectedness throughout the system.	Reduced/enhanced negative/positive externalities associated with reallocation.
Finance	Transaction and transition costs.	Comprehensively identify and mitigate social and economic factors that lead to high transaction costs.	Advance physical and cyber infrastructure, novel operation schemes, reliable forecast tools, and robust methods to deal with uncertainty.	Manage transaction costs through an integration of institutional, policy, scientific and technological advances.	Reduced transaction cost and better-informed decision-making.

Source: Based on Marston and Cai (2016).

2.4 Water–energy– food–ecosystem nexus

Over the past decade, the WEFE nexus has risen to prominence as a systematic approach to understanding WEFE interconnectedness and trade-offs. Effective cross-sectoral consultation mechanisms, such as the WEFE framework, are needed at local, national, and global scales to ensure the development of concerted efforts. Understanding and harnessing the potential of the WEFE nexus is key to reconciling often-competing sectoral objectives and attaining sustainable development. WEFE has indeed emerged as a powerful concept to describe and address the complex and interrelated nature of global resource systems needed for humankind to achieve social, economic and environmental goals (Koo-Oshima and Gillet, 2022). The WEFE approach integrates across all sectors and its holistic vision of sustainability aims to attain a balance between the different goals, interests and needs of people and the environment.

Successful partnerships can be built on existing institutions (e.g. river basin organizations, WEFE resource user associations) and their knowledge, capacity, competencies and social capital. It can be challenging to further develop existing structures to fully cover the necessary breadth of the WEFE nexus. Therefore, partnership development must recognize and address thematic and institutional gaps, barriers for change, the wider political economy, social and political contexts, ownership, power relations between actors, and funding, among others. Facilitating an engaging partnership platform for constructive dialogue and participatory design and decision-making can help overcome obstacles to successful partnerships.

As a transformative approach, the WEFE nexus is about restructuring the network of decision-making and partnerships to focus on inclusion and equity among partners. A lack of inclusivity and equity in partnerships can hinder the approach's viability, as the WEFE nexus approach would lack new insights for innovation.

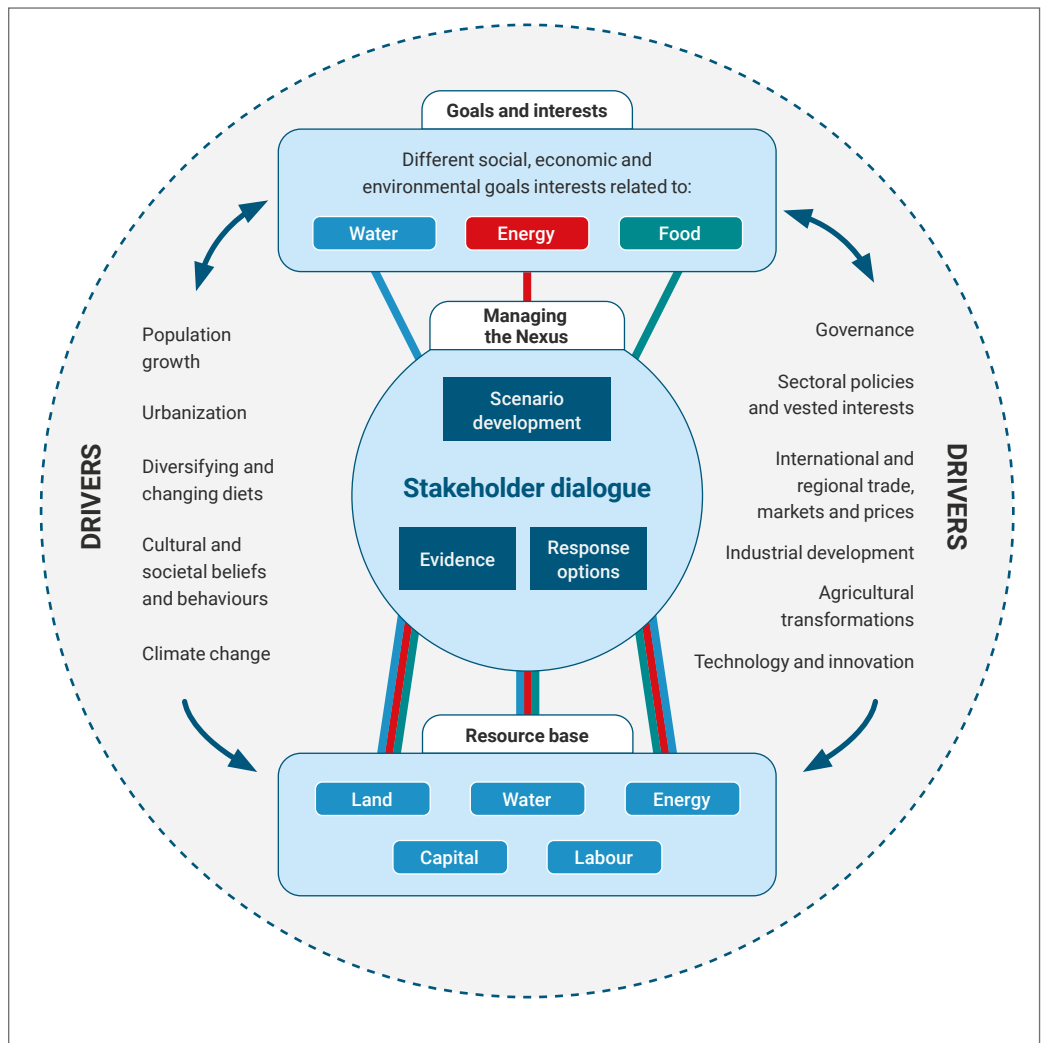
FAO has developed its own conceptual approach to the water–energy–food nexus (Figure 2.2; FAO, 2014). The approach distinguishes between the resource base and the different goals and interests that are to be achieved with the same limited resources. It is about understanding and managing these different resource user goals and interests, while maintaining the integrity of ecosystems. Effective partnerships is key in nexus-based decision-making, with structured stakeholder dialogues in managing the nexus through evidence, scenario development and response options (see Box 2.2).

2.5 Collection and dissemination of water data and information

Around the world, countries are grappling to adapt their agriculture and food systems to conditions of water scarcity, climate change and increased competition between users. Better water data and information are indispensable for sustainable and equitable water management. Through close collaboration and engagement with different partners in water quantity and quality data and related information, with additional variables on biomass, crop evapotranspiration, weather and socio-economic data, countries and subnational organizations and stakeholders would be better facilitated in making more effective water management decisions at various levels. It is important to provide tools that improve the coordination, accessibility and usability of water data, particularly made accessible to smallholders as they are the most vulnerable to changes in water access and availability. A strengthened focus on water governance and the related data and supporting informatics for agriculture and food security is therefore crucial to address water management challenges in a changing climate.

AQUASTAT is the FAO's global information system on water resources and agricultural water management. AQUASTAT monitors and reports SDG Indicators 6.4.1 (change in water efficiency over time) and 6.4.2 (water stress level), for which FAO is the

Figure 2.2
The FAO approach to the water–energy–food nexus



Source: FAO (2014, fig. 2, p. 9).

● ● ●
Strengthening the capacities of national institutions, water experts and farmers will require additional support for the generation and dissemination of data and information

responsible UN-Water agency. Country ownership of data is one of the core principles of AQUASTAT, in line with the 2030 Agenda. This requires strong partnerships and continuous dialogue with countries during data collection, analysis and dissemination. To pursue this goal, FAO has established a network of national correspondents at country level responsible for coordinating the collection of water data within their country. In addition to AQUASTAT, FAO has developed a publicly accessible near-real-time WaPOR data portal using satellite data, which allows for the monitoring of agricultural water productivity at different scales. This data portal works with over ten partner countries to build their capacity in the use of WaPOR data for its different applications, and to generate solutions to local challenges linked to water and land productivity as well as water management (FAO, n.d.b).

Whether a farmer or water manager is evaluating the biophysical or societal side of water resource management or water services delivery, water accounting, governance, tenure and the management processes require accurate information and data. Strengthening the capacities of national institutions, water experts and farmers will require additional support for the generation and dissemination of data and information (Box 2.3).

In short, understanding and monitoring the hydrological cycle at the appropriate scale of analysis is necessary to improve water-related decision-making at local, regional and national levels. A better understanding of the hydrological cycle can be obtained

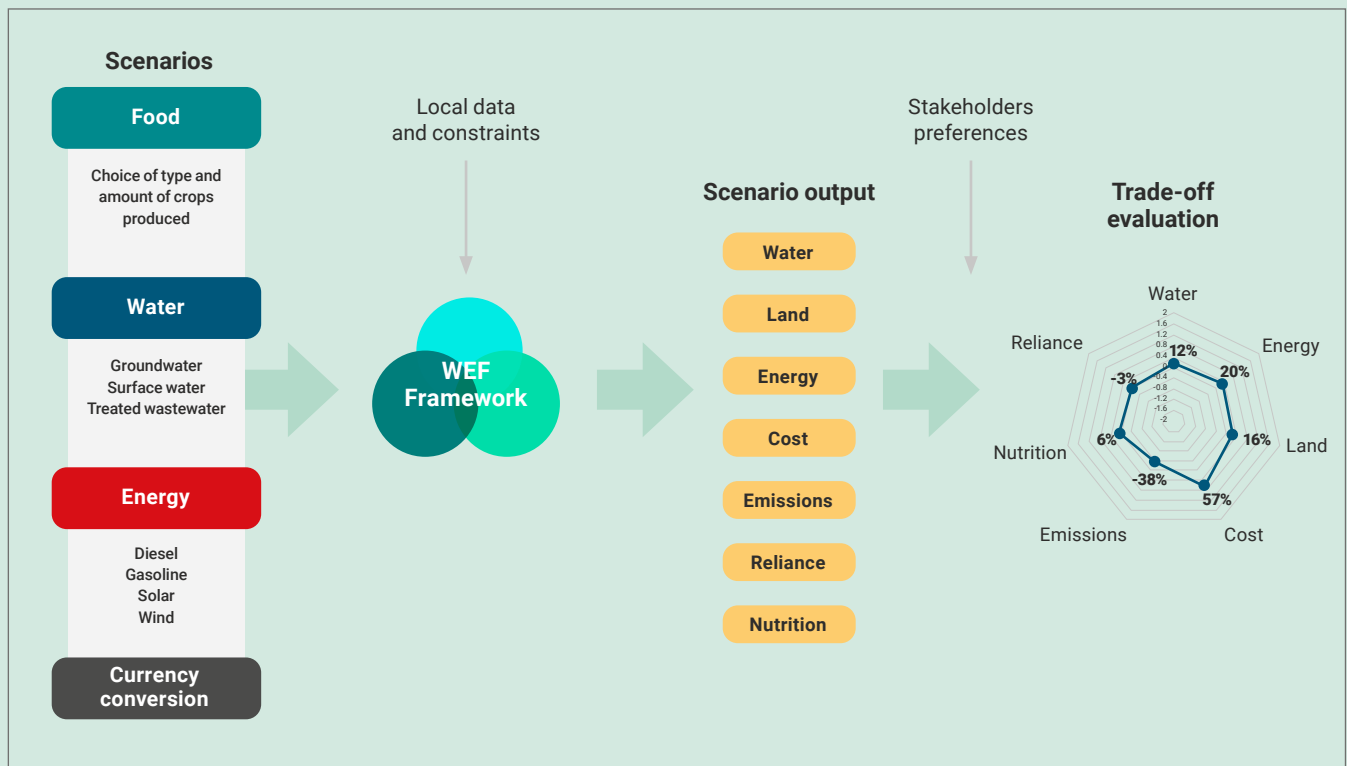
Box 2.2 WEF nexus in Bekaa Valley, Lebanon

A FAO-American University in Beirut study implemented scenario development tools in highlighting the trade-offs associated with different decisions for different food, water, energy and health alternatives and recommended a number of areas to be explored in alternative water resources, land reclamation options and ways to improve higher-yielding nutritious crops. Most importantly, it recommended multi-sectoral stakeholder engagement and cross-government collaborations as requirements in finding optimal solutions to achieve multiple goals (FAO, 2021).

The study concluded that:

- Increasing food security with local production comes at additional requirements in terms of water, energy and land;
- Alternative water resources should be investigated. For example, desalination is expensive whereas wastewater reuse is cheaper and has the additional benefit of solving the problem of wastewater disposal in water bodies;
- Land reclamation, utilization of marginal land, and agroforestry options should be explored;
- Crop yield potential improvements and breeding technologies are needed; and
- Most importantly, stakeholder engagement is key, especially regarding government policy-makers across sectors.

WEFE evaluation framework



Source: FAO (2021, p. 3).

through water accounting. However, such an understanding will not automatically lead to improvements in water governance. Water auditing, which can be defined as “placing trends in water supply, demand, accessibility and use in the broader context of governance, institutions, public and private expenditure, legislation and the wider political economy of water of [sic] specified domains” (Batchelor et al., 2016, p. 9), can help to support improved water policy development. Water accounting and auditing are recommended by FAO and others as being fundamental to initiatives that aim to cope with water scarcity.

Box 2.3 Cooperation through water tenure in achieving inclusive water policy and development objectives

FAO has produced a seminal report on water tenure* and has held water tenure consultations with water experts and country representatives that included the conceptualization of tenure (FAO, 2020). The latter refers to the relationship of customary and statutory water rights and the role of hybrid legal systems for more inclusive water tenure regimes in improving water governance at the national level. This diverse work and the various conceptualizations of water tenure form an important basis for developing international consensus on the core elements, definition and added value of water tenure in order to achieve a diverse array of policy and development goals. The FAO Knowing Water Better project** piloted water resources assessment and different aspects of water tenure in three countries. In Rwanda, several scenarios of water allocation explored the context of increasing competition among water users, using the water tenure approach. In Sri Lanka, the assessment dug into issues such as environmental protection and economic growth and analysed the different strategies to manage water in a more sustainable manner. In Senegal, the project sought to better understand the interlinkages between water and land. All of these projects successfully implemented water tenure consultations and multi-stakeholder engagement across sectors and government line agencies supported by water accounting principles (Batchelor et al., 2016) and water tenure approaches.

Example of participatory approach in water tenure:

- Coordination with village and municipal authorities;
- Establishment of pilot committees on water tenure;
- Community meetings and focus group discussion to define rules and regulations;
- Continuous focus on awareness-raising;
- Capacities of local authorities and members of pilot committees;
- Accompany the follow-up to established conventions; and
- Establishment of water resource user groups/associations.

* Water tenure is the “relationship, whether legally or customarily defined, between people, as individuals or groups, with respect to water resources.” (FAO, 2020, p. 3).

** For more information, please see: www.fao.org/in-action/knowat/en/.

References

- Aarnoudse, E., Closas, A. and Lefore, N. 2018. *Water User Associations: A Review of Approaches and Alternative Management Options for Sub-Saharan Africa*. IWMI Working Paper No. 180. Colombo, International Water Management Institute (IWMI). doi.org/10.5337/2018.210.
- Batchelor, C., Hoogeveen, J., Faurès, J.-M. and Peiser, L. 2016. *Water Accounting and Auditing: A Sourcebook*. FAO Water Reports No. 43. Rome, FAO. www.fao.org/3/i5923e/i5923e.pdf.
- Dinar, A., Rosegrant, M. W. and Meinzen-Dick, R. S. 1997. *Water Allocation Mechanisms: Principles and Examples*. World Bank Policy Research Working Paper Series. Washington, DC, World Bank. doi.org/10.1596/1813-9450-1779.
- FAO (Food and Agriculture Organization of the United Nations). 2010. *The Wealth of Waste: The Economics of Wastewater Use in Agriculture*. FAO Water Reports No. 35. Rome, FAO. www.fao.org/3/i1629e/i1629e00.pdf.
- _____. 2017. *Water for Sustainable Food and Agriculture. A Report Produced for the G20 Presidency of Germany*. Rome, FAO. www.fao.org/3/i7959e/i7959e.pdf.
- _____. 2020. *Unpacking Water Tenure for Improved Food Security and Sustainable Development*. Land and Water Discussion Paper No. 15. Rome, FAO. doi.org/10.4060/cb1230en.
- _____. 2021. *Addressing Food Security Challenges in Lebanon: A Water–Energy–Food–Health Approach*. Policy Brief September 2020. Rome, FAO. www.fao.org/publications/card/en/c/CB4203EN/.
- _____. n.d.a. *Land and Water. Report of the Symposium*. International Symposium of the Use of Non-Conventional Waters to Achieve Food Security, 14-15 November 2019, Madrid. FAO website. www.fao.org/land-water/events/ncwsymposium19/en/.

- _____. n.d.b. *WaPOR, Remote Sensing for Water Productivity*. FAO website. www.fao.org/in-action/remote-sensing-for-water-productivity/en/.
- Flörke, M., Schneider, C. and McDonald, R. I. 2018. Water competition between cities and agriculture driven by climate change and urban growth. *Nature Sustainability*, Vol. 1, pp. 51–58. doi.org/10.1038/s41893-017-0006-8.
- Garces-Restrepo, C., Muñoz, G. and Vermillion, D. L. 2007. *Irrigation Management Transfer: Worldwide Efforts and Results*. FAO Water Reports No. 32. Rome, Food and Agriculture Organization of the United Nations (FAO). www.fao.org/publications/card/en/c/A1520E/.
- Garrick, D., De Stefano, L., Yu, W., Jorgensen, I., O'Donnell, E., Turley, L., Aguilar-Barajas, I., Dai, X., De Souza Leão, R., Punjabi, B., Schreiner, B., Svensson, J. and Wight, C. 2019. Rural water for thirsty cities: A systematic review of water reallocation from rural to urban regions. *Environmental Research Letters*, Vol. 14, No. 043003. doi.org/10.1088/1748-9326/ab0db7.
- Ghazouani, W., Molle, F. and Rap, E. 2012. *Water Users Associations in the NEN Region: IFAD Interventions and Overall Dynamics*. Project report submitted to IFAD by IWMI. Colombo, International Water Management Institute (IWMI). www.un.org/waterforlifedecade/water_cooperation_2013/pdf/water_users_associations_in_nen_region.pdf.
- Groenfeldt, D. and Svendsen, M. (eds.). 2000. *Case Studies in Participatory Irrigation Management*. World Bank Institute (WBI) Learning Resources Series. Washington, DC, World Bank. <https://elibrary.worldbank.org/doi/abs/10.1596/0-8213-4540-0>.
- Heinz, I., Salgot, M. and Koo-Oshima, S. 2011. Water reclamation and intersectoral water transfer between agriculture and cities: A FAO economic wastewater study. *Water Science and Technology*, Vol. 63, No. 5, pp. 1067–1073. doi.org/10.2166/wst.2011.292.
- Hodgson, S. 2007. *Legislation for Sustainable Water User Associations*. FAO Legal Papers Online No. 69. Rome, Food and Agriculture Organization of the United Nations. www.fao.org/documents/card/en/c/dfb3661c-5904-43b2-bbe8-9ad311f7b8ff/.
- Hooper, V. 2015. *The Importance of the 'Urban' in Agricultural-to-Urban Water Transfers: Insights from Comparative Research in India and China*. PhD Thesis. University of East Anglia, School of International Development.
- Independent Evaluation Group. 2006. *Water Management in Agriculture: Ten Years of World Bank Assistance, 1994-2004*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/6890>. License: CC BY 3.0 IGO.
- King, C., Salman, M., Tsegai, D. and Naqvi, M. 2022. *A Rapid Review of Effective Financing for Policy, Implementation and Partnerships Addressing Drought Risks*. Rome, FAO (Food and Agriculture Organization of the United Nations). doi.org/10.4060/cb9971en.
- Koo-Oshima, S. and Gillet, V. 2022. *Integrating Ecosystems in the Water-Food-Energy Nexus for Greater Sustainability*. Open Access Government website. www.openaccessgovernment.org/integrating-ecosystems-in-the-water-food-energy-nexus-for-greater-sustainability/145217/.
- Marston, L. and Cai, X. M. 2016. An overview of water reallocation and the barriers to its implementation. *Wiley Interdisciplinary Review (WIREs) Water*, Vol. 3, No. 5, pp. 658–677. doi.org/10.1002/wat2.1159.
- Meinzen-Dick, R. 1997. Farmer participation in irrigation – 20 years of experience and lessons for the future. *Irrigation and Drainage Systems*, Vol. 11, pp. 103–118. doi.org/10.1023/A:1005739528481.
- _____. 2007. Beyond panaceas in water institutions. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 104, No. 39, pp. 15200–15205. doi.org/10.1073/pnas.0702296104.
- Meinzen-Dick, R. and Ringler, C. 2008. Water reallocation: Drivers, challenges, threats, and solutions for the poor. *Journal of Human Development*, Vol. 9, No. 1, pp. 47–64. doi.org/10.1080/14649880701811393.
- Meinzen-Dick, R., Reidinger, R. and Manzardo, A. 1995. *Participation in the Irrigation Sector*. Social Development Notes No. 3. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/11661>. License: CC BY 3.0 IGO.
- Meinzen-Dick, R., Raju, K. V. and Gulati, A. 2002. What affects organization and collective action for managing resources? Evidence from canal irrigation systems in India. *World Development*, Vol. 30, No. 4, pp. 649–666. doi.org/10.1016/S0305-750X(01)00130-9.
- Molle, F. and Berkoff, J. 2006. *Cities versus Agriculture: Revisiting Intersectoral Water Transfers, Potential Gains and Conflict*. Comprehensive Research Report No. 10. Colombo, International Water Management Institute (IWMI).
- Molle, F. and Floch, P. 2008. Megaprojects and social and environmental changes: The case of the Thai “Water Grid”. *Ambio: A Journal of the Human Environment*, Vol. 37, No. 3, pp. 199–204. doi.org/10.1579/0044-7447(2008)37[199:MASAEC]2.0.CO;2.
- Molle, F., Mollinga, P. P. and Wester, P. 2009. Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives*, Vol. 2, No. 3, pp. 328–349. www.water-alternatives.org/index.php/allabs/65-a2-3-3/file.
- Mollinga, P. P., Meinzen-Dick, R. S., Merrey, D. J. 2007. Politics, plurality and problems: A strategic approach for reform of agricultural water resources management. *Development Policy Review*, Vol. 25, No. 6, pp. 699–719. doi.org/10.1111/j.1467-7679.2007.00393.x.
- Mollinga, P. P. and Bolding, A. (eds.). 2004. *The Politics of Irrigation Reform: Contested Policy Formulation and Implementation in Asia, Africa and Latin America*. Aldershot, UK, Ashgate.
- Mosse, D. 2006. “Collective action, common property, and social capital in South India: An anthropological commentary.” *Economic Development and Cultural Change*, Vol. 54, No. 3, pp. 695–724. doi.org/10.1086/500034.
- Mukherji, A., Fuleki, B., Shah, T., Suhardiman, D., Giordano, M. and Weligamage, P. 2009. *Irrigation Reform in Asia: A Review of 108 Cases of Irrigation Management Transfer*. Final report submitted to the Asian Development Bank by IWMI.
- Nikku, B. R. 2006. *The Politics of Policy. Participatory Irrigation Management in Andhra Pradesh*. PhD thesis. The Netherlands, Wageningen University.
- Rap, E., Wester, P. and Pérez-Prado, L. N. 2004. “The politics of creating commitment: Irrigation reforms and the reconstitution of the hydraulic bureaucracy in Mexico.” P. P. Mollinga and A. Bolding (eds.), *The Politics of Irrigation Reform: Contested Policy Formulation and Implementation in Asia, Africa and Latin America*. Aldershot, UK, Ashgate, pp. 57–94.
- Senanayake, N., Mukherji, A., Suhardiman, D. and De Luca, M. 2011. *Water User's Associations in the Context of Small-Holder Agriculture: A Systematic Review of IFAD Funded Water Users Associations in Asia*. Submitted to International Fund for Agricultural Development (IFAD) by the International Water Management Institute (IWMI). www.ifad.org/documents/38714170/39135645/Water+User+Associations+in+the+context+of+small+holder+agriculture.pdf/87deed7a-4c5f-4ec3-90cc-dfe51d3ac98c?t=1506615933000.
- Senanayake, N., Mukherji, A. and Giordano, M. 2015. Re-visiting what we know about Irrigation Management Transfer: A review of the evidence. *Agricultural Water Management*, Vol. 149, pp. 175–186. doi.org/10.1016/j.agwat.2014.11.004.
- Suhardiman, D. 2008. *Bureaucratic Design: The Paradox of Irrigation Management Transfer in Indonesia*. PhD thesis. <https://library.wur.nl/WebQuery/wurpubs/364279>.
- Turrall, H. 1995. *Devolution of Management in Public Irrigation Systems: Cost Shedding, Empowerment and Performance: A Review*. Working Paper No. 80. London, Overseas Development Institute (ODI). <https://odi.org/en/publications/devolution-of-management-in-public-irrigation-systems-cost-shedding-empowerment-and-performance-a-review/>.

- UNGA (General Assembly of the United Nations). 2010. *The Human Right to Water and Sanitation*. Resolution adopted by the General Assembly on 28 July 2010. Sixty-fourth session. A/RES/64/292. <https://digitallibrary.un.org/record/687002>.
- Uphoff, N. and Wijayaratna, C. M. 2000. Demonstrated benefits from social capital: The productivity of farmer organizations in Gal Oya, Sri Lanka. *World Development*, Vol. 28, No. 11, pp. 1875–1890. doi.org/10.1016/S0305-750X(00)00063-2.
- United Nations. 2022. *The United Nations World Water Development Report 2022: Groundwater: Making the Invisible Visible*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- Vermillion, D. L. 1997. *Impacts of Irrigation Management Transfer: A Review of the Evidence*. Research Report No. 11. Colombo, International Irrigation Management Institute (IIMI). www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/pub011/REPORT11.PDF.
- Wester, P. 2009. Capturing the waters: The hydraulic mission in the Lerma-Chapala Basin, Mexico (1876–1976). *Water History*, Vol. 1, pp. 9–29. doi.org/10.1007/s12685-009-0002-7.
- WHO (World Health Organization). 2006. *WHO Guidelines for the Safe Use of Wastewater Excreta and Greywater. Volume II: Wastewater Use in Agriculture*. Geneva, WHO. www.who.int/publications/i/item/9241546832.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations Development Report 2017. Wastewater: The Untapped Resource*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000247153>.

Chapter 3

Environment

WWAP

David Coates and Richard Connor

UNEP

Lis Bernhardt, Bryce Bray and Carla Friedrich

With contributions from:

Riccardo Zennaro, Avantika Singh, Gavin Reynolds, Dianna Kopansky
and Nina Raasakka (UNEP), and Colin Herron (GWP)



3.1 Introduction

• • •
The continuing rate of loss and degradation of freshwater ecosystems and the loss of freshwater biodiversity remain the highest among all ecosystem types

Ecosystems play a central role in regulating water availability and its quality. Hence, Target 6.6 (“By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes”) was included under Sustainable Development Goal (SDG) 6, as both a descriptor of sustainability and enabler of all the other SDG 6 targets. Different sectors of human activity can change the environment, positively or negatively, through water and land use. Partnerships, therefore, have always been at the heart of meeting environment-related challenges for water. In this regard, inter-sectoral and extra-sectoral partnerships for water and the environment (see Chapter 1) tend to be the norm, with intra-sectoral partnerships being relatively less common.

The three planetary crises of climate change, nature (or biodiversity) loss and pollution are at the centre of the United Nations (UN) systems strategy on the environment (e.g. UNEA, 2021) and articulate the main environmental dimensions of the 2030 Agenda for Sustainable Development. Water is a key dimension of each of the three crises and forges the strongest interdependencies among them.

Water was included in 75% of countries’ climate change National Adaptation Plans (NAPs) (Walton, 2015). Recognition of the role of ecosystems in climate change mitigation and adaptation in the Paris Agreement (United Nations, 2015) allows countries to focus on ecosystem-based mitigation and adaptation strategies in their NAPs and in the intended nationally determined contributions (INDCs) that will determine investment priorities as far as 50 years in the future. The ‘Paris Pact on Water and Climate Change Adaptation’ (UNFCCC, 2015) is clear recognition of the importance of water and ecosystems in the climate change agenda.

The continuing rate of loss and degradation of freshwater ecosystems and the loss of freshwater biodiversity remain the highest among all ecosystem types (Prologue Part 1; UNEP, 2021a). Key drivers include land and water use, and climate change (IPBES, 2019). The proactive use of the nature–water relationship to meet water resources management challenges is the realm of nature-based solutions (NBS), covered in detail in WWAP/UN-Water (2018). The fact that NBS concepts are making their way into high-level policy and decision-making (Bennet and Ruef, 2016) and the rapidly increasing deployment of NBS and attention in the literature (WWAP/UN-Water, 2018) are among the few positive developments in an otherwise usually gloomy outlook for water. Although some commentators remark that the ‘fourth industrial revolution’ is driven by information technology, UNIDO (2019) argues that it is being driven by nature-like and convergent technologies in which partnerships based on NBS play a central role.

Water pollution is a large part of the third crisis (in addition to air and land pollution). Climate change exacerbates water pollution (Seneviratne et al., 2012), as does the loss of nature. The restoration of nature is therefore a leading approach to reducing water pollution (WWAP/UN-Water, 2018). These interdependencies result in water and environment interventions delivering co-benefits across multiple development goals. The water–environment relationship includes a potentially far greater diversity of stakeholders and potential partners than any other water domain.

Partnerships on environment and water, as other areas and interests, operate at multiple levels. These include at the level of policy, between institutions and sectors, and at both national and international levels. The most important are partnerships among or with those stakeholders on the ground, as they can directly implement land and water resources interventions that lead to tangible progress. These are usually individuals and communities that are owners, leaseholders or stewards of land or water or whose activities directly impact these, including their representative bodies. Many are outside the ‘water sector’, according to its narrow definition.

Because of the cross-cutting nature of the three planetary crises, and the ubiquitous nature of partnerships, a comprehensive assessment of these partnerships’ contribution to accelerating change is a complex and challenging task. This chapter focuses on only three areas, among potentially many more: partnerships for watershed services as one of the

most widespread applications of NBS, where partners can be clearly visible on the ground; institutional partnerships for policy change, consensus-building and awareness-raising that may often seem remote but can play an important role in enabling action on the ground; and partnerships on data and knowledge on water and the environment that attempt to rectify gaps in information that hinder the adaptive management essential to achieving transformational change to accelerate progress.

Finally, the chapter attempts to draw some lessons learned from these experiences that can help identify the way forward on accelerating change through partnerships and cooperation, covered in further detail in Chapter 14.

3.2 Watershed services schemes

Watershed services schemes are designed to optimize ecosystem services delivery, often through payments for ecosystem services to incentivize upstream land or water users to maintain or improve the flow of ecosystem services to downstream beneficiaries. Watershed protection or rehabilitation measures are among the oldest of water-related partnerships, with a history that may span millennia. Case studies have been included in previous World Water Development Reports, across multiple themes, and in detail in WWAP/UN-Water (2018). These measures are mostly founded on voluntary partnerships, usually with incentives, and with or without associated supporting regulations.

Green infrastructure payments have protected, rehabilitated, or created new habitats on more than 486 million hectares of land around the world, an area nearly 1.5 times the size of India, with a total investment of US\$25 billion in 2015, mostly going to landowners and local communities and mostly driven by water resources-related objectives (Bennett and Ruef, 2016). However, this is still a meagre 0.37 to 1.1% of the estimated amount of investment required in water infrastructure in the same year (WWC/OECD, 2015). A common means of financing these schemes is through water funds (Box 3.1; see also Box 8.2 and Chapter 12).

Many watershed services schemes address climate change adaptation by building resilience. In recent decades, there has been increasing attention to climate change mitigation measures in watershed services schemes (Box 3.2).



Watershed protection or rehabilitation measures are among the oldest of water-related partnerships

Different partners are likely to have different motivations (Table 3.1). Interestingly, for public sector/government partners, environmental co-benefits rank highest, with mitigating risks ranked second, and meeting compliance/regulations and improving local governance ranked lower. Brand value, maintaining business models and supply chain resilience feature high in private sector partner motives. Both public and private water utility partners are interested mainly in reducing infrastructure risks, ensuring compliance and reducing costs. For non-governmental organizations (NGOs) and donor partners, risks reduction and environmental co-benefits were ranked highest (Bennett and Ruef, 2016). Public subsidy programmes also frequently sought to deliver climate adaptation benefits in rural communities, with high numbers of programmes harnessing watershed protection subsidies to help address challenges amplified by a changing climate, such as increased flooding, forest fires and food insecurity. Many programmes reported monitoring and/or evaluating 'beyond water' benefits, with biodiversity conservation, community benefits, and jobs and training at the top of programme administrators' lists (Bennett and Ruef, 2016). These co-benefits on offer through ecosystem-based approaches should not be underestimated and can provide the strongest justification for NBS interventions (WWAP/UN-Water, 2018). Davidson et al. (2019) estimated the annual value of natural wetlands to be US\$47.4 trillion per year at 2011 values, 43.5% of the global total value of the ecosystem services of all natural biomes, despite wetlands covering less than 3% of land area. Between 32% and 53% of the monetary value of inland wetlands comes from co-benefits such as food, erosion regulation, tourism, and recreation. This diversity and scale of the benefits forge strong interests among stakeholders and potential partners beyond the water sector.

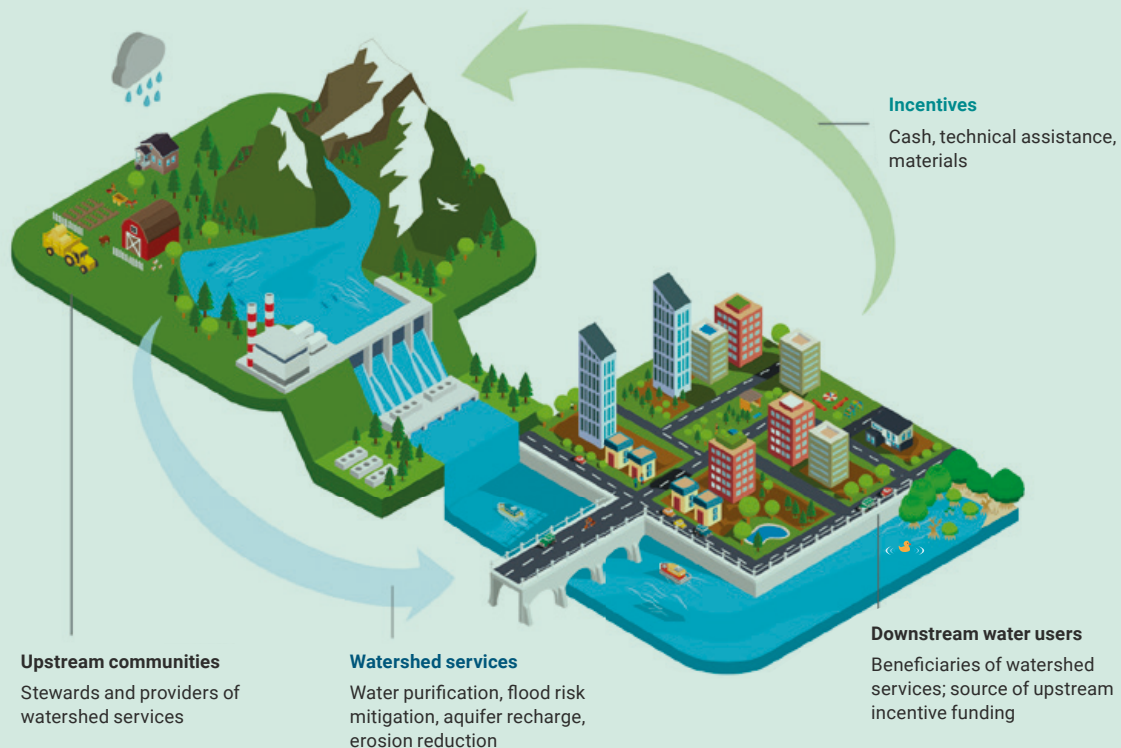
Box 3.1 Water funds mobilize multiple partnerships to address water security needs

Water funds support partnerships that bring together downstream users, like cities, businesses and utilities, to collectively invest in upstream habitat protection and land management to improve water quality and/or quantity and generate long-term benefits for people by addressing climate, nature and pollution. They help to make sense of and manage the complexities associated with water risk and nature-based source water protection (Calvache et al., 2012).

Water fund model

Water funds

Water funds unite public, private and civil society stakeholders around the common goal of contributing to water security through nature-based solutions and sustainable watershed management.



Source: TNC (n.d.).

As an example, *The Monterrey Water Fund* could be cited: an extra-sectoral partnership to protect source water (Abell et al., 2017). The City of Monterrey, Mexico, with a population of 4 million, derives more than 60% of its drinking water from upstream surface water sources, but these are degraded due to a loss of vegetation cover, erosion, forest fires, invasive species and land use change. The region is also prone to intense weather events producing flooding and droughts. Climate change increases the very real risk of future floods exceeding the capacity of the dam built to protect the city. The *Fondo de Agua Metropolitano de Monterrey* (FAMM) was launched in 2013 and became Mexico's first legally established water fund driven by the key objectives to maintain water quality, reduce flooding, improve infiltration, rehabilitate nature, raise awareness and increase resources to support a sustainable watershed. FAMM had over US\$9 million in total investments by 2018. The fund's work is having a significant positive impact on runoff from flooding in the areas of highest sensitivity. Over 40 partners are involved in the FAMM, ranging from federal and local government administrators, scientists, businesses, non-governmental organizations and civil society, through to the farmers, pastoralists and foresters who actually implement the rehabilitation measures (Latin America Water Funds Partnership, n.d.).

Box 3.2 Partnerships for conserving and restoring peatlands for carbon storage, hydrological flows and livelihoods

Peatlands are wetlands that depend on and regulate hydrology. Globally, peatlands store twice as much carbon as all forests, yet they account for less than 3% of the land area. About 5% of anthropogenic greenhouse gas emissions come from degraded peatlands (Crump, 2017). Draining for conversion to agriculture or forestry and livestock grazing are the main drivers of degradation. Attention to peatlands has increased in the last decade due to the recognition of their role in climate change mitigation in the Paris Agreement. Peatlands are able to deliver co-benefits by regulating droughts and floods, preserving biodiversity, supplying food and water, maintaining ecological systems, and improving human livelihoods (UNEA, 2019; Arias et al., 2021). Peatlands contribute to the implementation of multilateral environmental agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), the Convention on Migratory Species (CMS), the Convention on Wetlands and the United Nations Convention to Combat Desertification (UNCCD).

A case study is the restoration of the Ruorgai peatlands on the Tibetan Plateau (Wetlands International, n.d.). These are the largest high-altitude peatlands in the world (490,000 ha), storing 1.9 billion tonnes of carbon. In the past, these percolation peatlands have been drained for crops and fuel and severely damaged by overgrazing. This resulted in land degradation and the encroachment of desert-like conditions due to soil loss. Apart from the significant carbon emissions, it affected the water flows and sediment loads that entered the Yangtze and Yellow rivers, China's two longest rivers. An initial partnership between Wetlands International and the national and local governments and scientific institutions helped to understand the extent and state of the huge peatlands and restoration needs. A critical goal at the implementation stage was to build a good partnership with the nomadic herders who depended on the land for their livelihoods. The trials resulted in sustainable management plans focused on restoration of hydrology and improved grazing management. From 2010 onwards, the government provided financial assistance to sustainably manage and protect the peatlands, largely through direct funding to the herders and local communities to maintain the ecosystem. This led to a rise in eco-tourism and the Ruorgai became a National Nature Reserve and Wetland of International Importance under the Ramsar Convention, boosting the local economy (Wetlands International, n.d.). The restoration approach used in Ruorgai resulted in increased water levels in the canals, up to 26 cm higher than recorded before. Levels in shallow water canals also increased up to 50 cm, which led to an overflow of water and rewetting of the adjacent peatlands, improved water flows and water quality downstream, and restoration of carbon sinks (Zhang et al., 2012).

3.3 Institutional partnerships for policy change and consensus-building

A plethora of partnerships operate at the institutional level to support better environmental outcomes or improved proactive use of ecosystem services with regards to water. Many focus specifically on water while others integrate environment, ecosystems and water into broader agendas. Only a few can be highlighted here.

Over the last few years, ecosystem services have received increasing attention across many forums. This is illustrated by the emergence of the Ecosystem Services Partnership (ESP) in 2008 (Box 3.3). In the ESP, several networks and initiatives work together, including the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the International Association for Landscape Ecology (IALE), the Natural Capital Coalition and the Society for Ecological Restoration (SER). Each of these is also an important partnership relevant to this chapter.

The Global Peatlands Initiative (GPI) is an example of a partnership focused on a priority ecosystem type with regards to the three planetary crises, primarily climate change, but also with an important role in addressing the loss of biodiversity and improving water quality (Box 3.4).

Wastewater, including agricultural runoff, is the leading cause of water pollution. It is intricately linked to human and ecosystem health, with over 80% of global wastewater estimated to enter water bodies untreated (WWAP, 2017). Hosted by the United Nations Environment Programme (UNEP), the *Global Wastewater Initiative* (GW²I) is a multi-stakeholder partnership-based response to improve wastewater management established under the framework of the *Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities* (GPA). It partners

Table 3.1 Buyer motivations by sector for user-driven watershed investments

	Public sector/Government	For-profit/Private sector	Water utility (public or private)	NGO/Donor
Rank of motive	1.			
	2.			
	3.			
	4.			
	5.			

	To mitigate risks to water resources or infrastructure from land use decisions in the basin		To avoid or reduce capital costs of drinking water or wastewater services
	To meet compliance with regulations		To avoid or reduce operational/maintenance costs of drinking water or wastewater services
	Environmental co-benefits, such as biodiversity or carbon, delivered by project		To enhance brand value/demonstrate leadership on water resource challenges
	Social co-benefits, sustainable livelihoods or drinking water access, delivered by project		To ensure supply chain resilience
	To improve local governance of water resources		To mitigate risks to water resources or infrastructure from climate change or natural disasters
	To address physical risks, such as declining water quality or supply disruptions affecting business model		

Source: Bennett and Ruef (2016, table 3, p. 19).

closely with the *Global Partnership on Marine Litter* and the *Global Partnership on Nutrient Management*, also under the GPA. The initiative supports countries through information-sharing, development and adoption of sound policies and guidelines, technical support, and demonstration projects. As such, it acts as a bridge between stakeholders, including the private sector, to leverage additional resources, provide solutions and opportunities for wastewater recovery and reuse, and to help raise awareness and build the necessary capacities. Over time, the initiative has been instrumental in implementing numerous successful projects and activities on wastewater management and sanitation provision. The initiative contributes to SDG 6, implementation of numerous resolutions of the United Nations Environment Assembly, and to UNEP’s *Implementation Plan: Towards a Pollution-Free Planet*.

The *Adopt-a-River for Sustainable Development (Adopt-a-River)* Initiative provides a vehicle for local engagement and action by community members, private enterprise and other stakeholders (Box 3.5).

3.4 Environmental data and information

Box 3.3 The Ecosystem Services Partnership

The *Ecosystem Services Partnership* (ESP) connects over 3,000 ecosystem services scientists, policy-makers and practitioners who work together in more than 40 Working Groups and a growing number of National Networks on all continents. The ESP regularly organizes world and regional conferences and provides many services to further enhance the flow of ecosystem services stemming from nature conservation, ecosystem restoration and sustainable management. The partnership is organized around 20 thematic working groups, 10 biome working groups, and 10 sectoral working groups. It covers all ecosystem services but water-related services (e.g. regulation of water availability and quality, water-related disaster regulation, etc.) are the most prominent. This enables the partnership to operate across sectors (e.g. agriculture, forestry, business and the circular economy) and across biomes (e.g. freshwater systems, forest and woodlands, urban systems, drylands and deserts, etc.). The ESP currently has about 50 sponsors, and this number continues to grow. Sponsors include national governments, aid agencies, intergovernmental and non-governmental organizations and initiatives, and the private sector.

Source: ESP (n.d.).

Environment-related data form one of the most significant gaps in water-related knowledge. Partnerships have always been central to improving this knowledge and many ongoing and recent initiatives are playing a role. The following are only a few illustrations.

The connection between the environment, the three planetary crises (climate change, nature loss, pollution), water, policy and sustainable development is through ecosystem services, or nature's contributions to people.¹¹ Despite this, generating, assessing and monitoring water-related ecosystem services data remain among the weakest areas, particularly for cultural, regulating and supporting services (that is, most services excepting goods). Consequently, there has been a rapid increase in attention to the topic (Aznar-Sánchez et al., 2019). A promising recent development to fill these gaps is the Ecosystem Service Value Database (Box 3.6).

The World Water Quality Alliance (UNEP, n.d.) is a multi-disciplinary partnership, established in 2019, among dozens of contributing organizations worldwide providing a participatory platform for water quality monitoring and assessments and co-design of tailored and demand-driven services and solutions through a multitier, multidisciplinary and networking approach (Figure 3.1). Examples of progress areas include: a baseline water quality assessment (in progress); Africa case studies (Volta Basin, Lake Victoria and Cape Town aquifer system) providing information on achievements and challenges to inform upscaling of approaches; guidelines for the harmonization of methodologies for monitoring plastics in rivers and lakes; capacity-building activities; improvements in spatially explicit data availability and access on nitrogen and phosphorus pollution and toxic stress; and efforts towards a pan-African water quality programme. A snapshot of some of the data provided or made available under the partnership is included in UNEP (2021b). However, the scale of the challenge is illustrated in the latest national SDG 6 indicator data on water quality (UNEP, 2021b), which shows the absence of reported data for the whole of South Asia (including India), China, South-East Asia and large parts of Africa and the Middle East, among other areas, possibly representing the bulk of the world population.

Truly integrated water resources management (IWRM) involves all the sectors and dimensions of water resources management. While the environment has been a driver of its development and application, it has also been one of the main casualties of its absence. The *SDG 6 IWRM Support Programme* is an example of a multi-level partnership under the guidance of UNEP and coordinated by the Global Water Partnership (GWP) in collaboration with UNEP-DHI and the International Capacity Development Network for Sustainable Water Management (UNDP Cap-Net). The goal is to support country and regional responses to SDG Target 6.5 (on IWRM) as an entry point to accelerate implementation of SDG 6 and other water-related goals. While the Support Programme is, in itself, a partnership, it in turn fosters other partnerships across SDG targets at the global and regional levels, and with regional commissions, banks and support agencies, through the production of regional analyses based on the SDG Indicator 6.5.1 reporting exercise, including the identification of actions required. Although still in its infancy, the partnership has already delivered results from the first round of monitoring (UNEP, 2021c).

¹¹ 'Nature's contributions to people' is a term reflecting 'ecosystem services' but sensitive to differing world views on the relationships of people with the planet, or Mother Earth (IPBES, 2019).

Box 3.4 The Global Peatlands Initiative

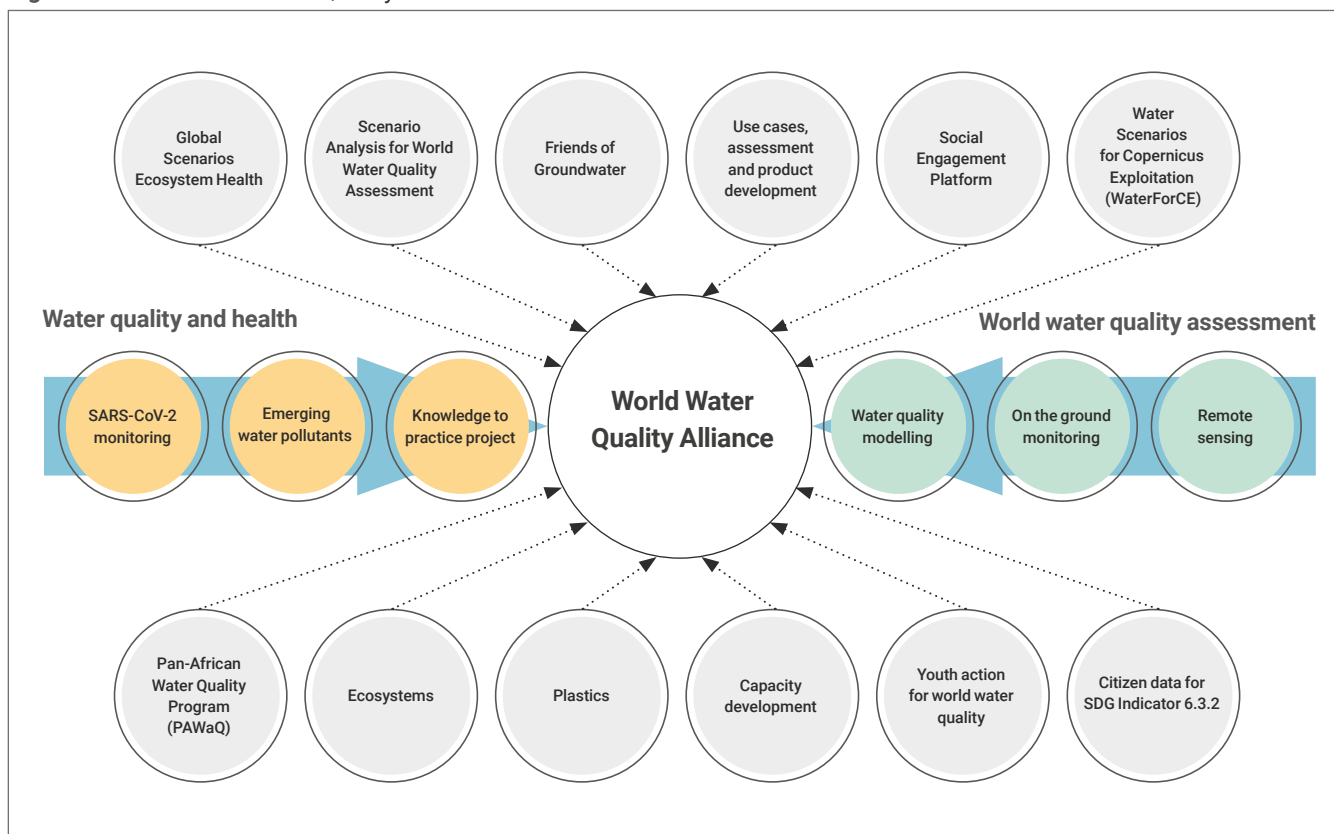
The Global Peatlands Initiative (GPI) was launched at the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Marrakech, Morocco in 2016. The partnership’s goal is to protect and conserve peatlands as the world’s largest terrestrial organic carbon stock, and to prevent the carbon stocked in them from being emitted into the atmosphere. The initiative has now 49 partners committed to working together to improve the conservation, restoration and sustainable management of peatlands. By bringing together the best available science, the GPI informs policies, decisions and actions to protect peatlands all around the world, with four peat-rich tropical countries (the Democratic Republic of the Congo, Indonesia, Peru and the Republic of the Congo) serving as pilots.

South–South and triangular cooperation are the primary delivery mechanisms of the GPI. This approach has facilitated the identification, collection and sharing of good practices, enabled exchanges, improved methodologies, and promoted more sustainable approaches to peatland management. The GPI has communicated and disseminated results widely to upscale peatlands transformation and inspire evidence-based action based on their contribution to climate, people and the planet, in line with global climate and biodiversity targets. It has been instrumental in raising awareness of peatlands and mobilizing funding in the context of climate change, biodiversity and water resources management at national and international national levels.

Source: GPI (n.d.).

SDG Indicator 6.6.1 uses changes in water-related ecosystem extent (area) as a proxy for ecosystem service delivery (see Section ‘SDG Target 6.6: Water-related ecosystems’ in the Prologue Part 2). UNEP and the Ramsar Convention secretariat are custodians of the indicator. The Ramsar Convention secretariat, with its extensive list of international and national partners, lead on providing data on wetlands, including mangroves, in partnership with the Global Mangrove Watch, itself a consortium of partners. The scope of the indicator effort has now expanded to include monitoring water quality and IWRM

Figure 3.1 The World Water Quality Alliance



Source: UNEP (n.d.).

Box 3.5 Adopt-a-River in action: UNEP and Four Rotary Clubs partner to clean up the Athi River (Nairobi, Kenya) and plant trees

Following the signing of an agreement between the United Nations Environment Programme (UNEP) and Rotary International, local Rotary clubs embarked on a project to remove all solid waste along the Athi River. Following a waste assessment, the first phase focused on removing solid waste, installing traps at points where storm water carrying solid waste gets into the rivers and planting trees along the river to reduce surface erosion. The clubs collaborated with members of the community to provide labour. The next phase will include providing recycling bins in partnership with waste collection service providers. Industries releasing their effluent to the river through various channels will also be brought on board as part of efforts to improve upstream biological treatment of industrial waste.

Source: Ombok (2021).

implementation. Partners involved in compiling and disseminating statistics include national water and environment institutions, statistics agencies and the United Nations Statistics Division, together with partners that convey results and messages to Member States collectively, including the High-Level Political Forum on Sustainable Development and the Inter-Agency and Expert Group on Sustainable Development (Figure 3.2).

The *Freshwater Ecosystems Explorer* (UNEP, 2021d) is an open-access data platform developed by UNEP in partnership with the European Commission's Joint Research Centre, Google, the UNEP-DHI Centre on Water and Environment, Global Mangrove Watch and the EU Copernicus Earth Observation Programme. The data portal aims to provide accurate, up-to-date, high-resolution geospatial data depicting the extent of freshwater ecosystems change over time in order to support decision-making and track progress towards the achievement of SDG Target 6.6. Again, although still in their infancy, these partnerships have already made progress in data and information availability, which is summarized in UNEP (2021d).

Partnerships involving local communities ('citizen science'; see Section 11.3) are increasingly used to improve monitoring of the environment. This is particularly so for water quality monitoring, in order to address the huge gaps in data availability. Concentrations of nitrate and phosphate and total suspended solids measured by citizen scientists at Lake Tanganyika matched those established by professional scientists, showing considerable potential to upscale to other African Great Lakes (Moshi et al., 2022). Engaging youth and women in data-scarce least developed countries is gaining attention, engendering personal empowerment and ownership, particularly for hydrological data (Rigler et al., 2022). At least 19 water-related citizen science projects emerged in China since 2005, most of which are dedicated to improving water quality, with a few focusing on biodiversity monitoring (Wu et al., 2022). Multiple stakeholders, including NGOs, academic institutions, governments and companies participate in these activities.

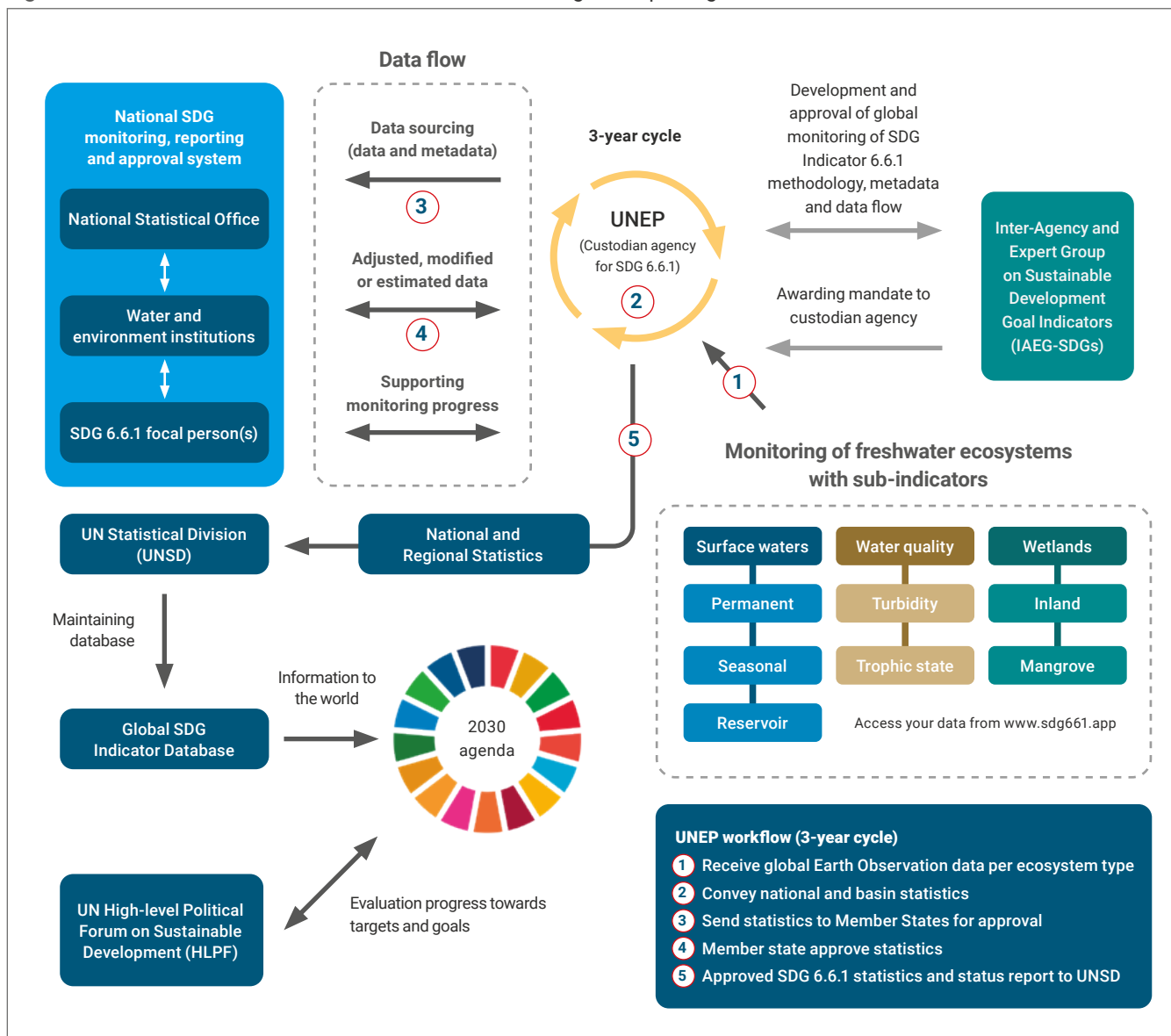
'Debris Tracker'¹² is an example of open-access citizen science that operates globally to track the status of plastic debris from upstream catchments down through to oceans.

3.5 Lessons learned

Better and impartial critical assessments of project and partnership performance are required. Although there is a plethora of case studies on partnerships on water and environment, far too few include critical assessments of quantified costs, outcomes and challenges. In particular, a reliance on discretionary donor financing leads many institutions to showcase the positive and avoid any negative messaging of their projects. Improved and more systematic attention to impartial evaluations of performance, and open access to them, would improve our ability to tease out ways and means by which partnerships for water and the environment can be scaled up to accelerate progress towards SDG 6.

¹² debristracker.org

Figure 3.2 The SDG Indicator 6.6.1 workflow and monitoring and reporting



Source: UNEP (2021d, fig. 3, p. 16).

Barriers to further uptake of partnerships need to be better understood. A useful example of improved approaches is the assessment of barriers to further uptake of partnerships through watershed services schemes by Bennett and Ruef (2016). This study ranked ongoing challenges with relationships with stakeholders or local partners second-highest after future regulatory uncertainty (Figure 3.3), confirming that partnerships are not a panacea. Unfortunately, inadequate information was provided on the nature of the challenges and means to overcome them. Interestingly, scientific and technical challenges were not ranked high, and conflicts with basin planning and securing demand (buyers of the watershed services) were ranked unexpectedly low. Surprisingly, lack of support from policy/decision-makers was ranked as the least serious challenge, signalling a positive trend in recognition of the potential of such partnerships. Further lessons here include: (1) policy support tends to be enabling, but governments could likely accelerate uptake by addressing regulatory constraints, (2) more attention is required to understand relationships between stakeholders and ways to manage them better to accelerate progress, (3) social sciences are likely to identify means to accelerate progress towards SDG 6 rather than natural sciences and technology, and (4) at least with regards to the environment and water, it is not necessary for partners to have the same motivations (Figure 3.3), as long as they reach agreement regarding what needs to be done.

Box 3.6 The Ecosystem Service Value Database

The Ecosystem Service Value Database (ESVD) was developed under a voluntary partnership based on open access with the mission to gather and standardize information on monetary values of ecosystem services to reflect their 'true' value. It covers all ecosystem services, but since all depend on water and the water-related services are among the most highly valued, the database is broadly relevant to water. The ultimate purpose is for these values to be internalized in everyday economic decision-making. The ESVD organizes its value estimates and corresponding data in 106 columns with information on among others: bibliographic details, study site, biome, ecosystem service, valuation method, valuation result in original units, standardized value and review status. It also promotes standardized classifications of ecosystem services, biomes and ecosystems. The initiative involves partnerships with several international governmental and non-government organizations, research and academia, governments, financial institutions including private banks, business and consultancy, and other partners in the Ecosystem Services Partnership (Box 3.3). The involvement of partners from outside 'the water (or ecosystems) box' is particularly pertinent to enable uptake of the results into economic decision-making. Although still in its infancy, the partnership has already created the largest publicly available database and tool with standardized monetary values for all ecosystem services and all biomes on all continents. All the information in the ESVD comes from over 30 years of peer-reviewed academic research and official reports on monetary valuation of ecosystem services.

Source: ESVD (n.d.).

Better cost–benefit analyses are required. For example, many ecosystem restoration projects are being carried out without clear cost analyses (Puspitaloka et al., 2021). From a partnership perspective, the indirect costs of addressing social challenges, such as expenses to engage local communities, were often left out of assessments and these can add up to half of the total cost of restoration projects.

Better understanding of challenges and drawbacks of citizen science is needed. For example, the factors that drive the success of citizen science activities around water and environment remain unclear (San Llorente Capdevila et al., 2020). Despite the obvious potential of partnerships with women to accelerate progress, there can be significant exclusion of women in citizen science on the topic of water and environment, which can also curtail their role in governance and leadership (Nigussie et al., 2018).

The World Water Quality Alliance (UNEP, n.d.) notes several lessons learned, including:

- *There can be issues with data/information-sharing due to institutional or government sensitivities;*
- *Fragmented institutional landscapes across neighbouring countries constrain partnerships for transboundary water bodies; and*
- *Stakeholder networks should be expanded to include a broader range of sectors and include more local contacts of alliance partners.*

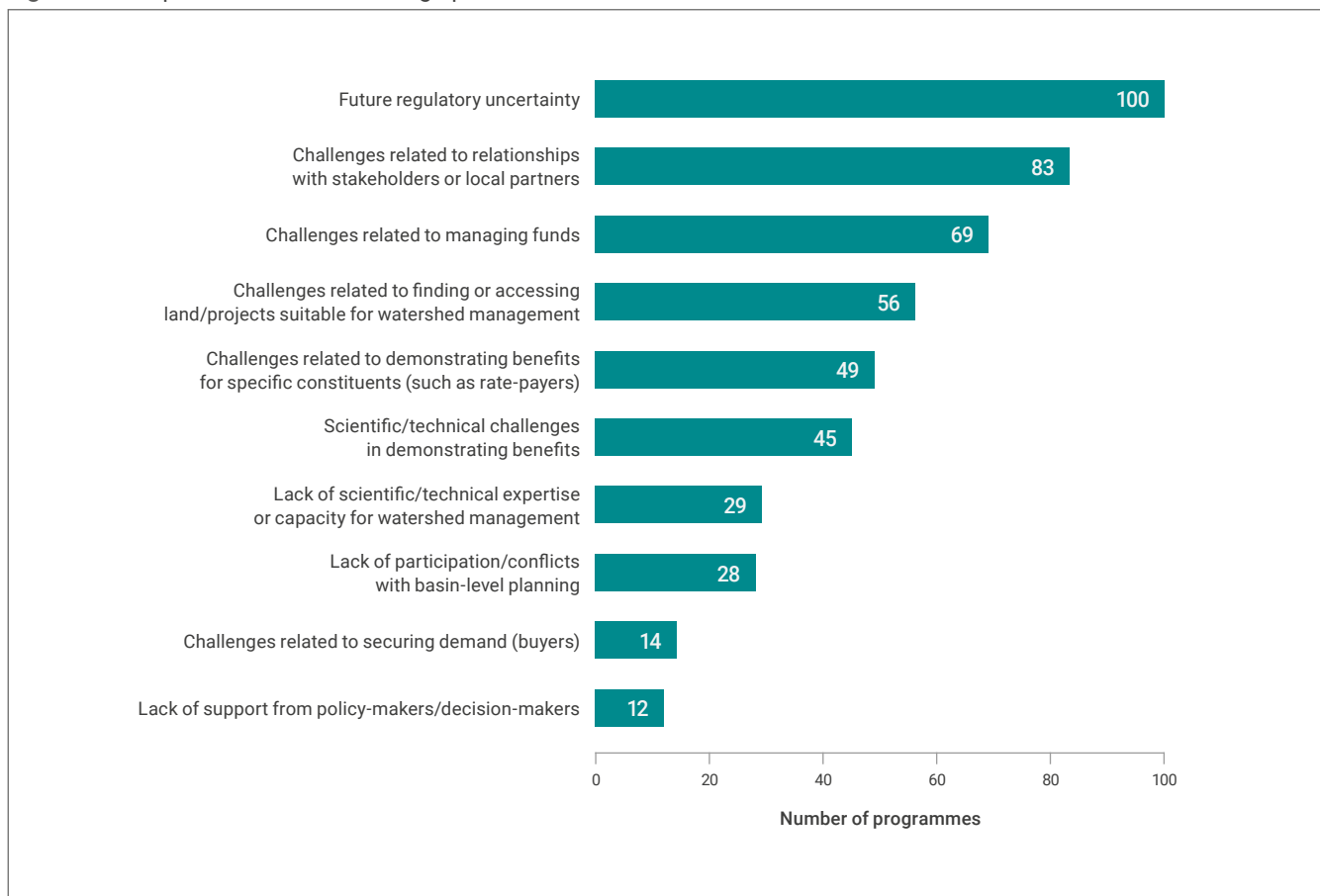
Experiences from payments for watershed services schemes also reveal a number of important lessons, including:

Watershed services schemes can also lead to new problems that need to be understood. Chan et al. (2017) note that payments for ecosystem services schemes have revealed concerns including: (1) the creation of new externalities; (2) misplacement of rights and responsibilities; (3) crowding out of existing motivations; (4) efficiency–equity trade-offs; (5) monitoring costs; (6) limited applicability; and (7) top–down prescription/alienating agencies. To overcome such problems, the authors suggest supplementing monetary value-based decisions with approaches that recognize rights and responsibilities conducive to sustainability and build sustainable relationships with nature.

Governance approaches can have a major bearing on outcomes.

For example, Lin (2014) compared the New York watershed partnership (the Catskills programme) with a partnership that was set up in Beijing. The former was regarded as comparatively more successful, mainly due to its bottom–up, as opposed to top–down, evolution that creates stronger and more effective partnerships as well as more realistic financial incentives that better reflect true values. Importantly though, both case studies show that positive incentives prove more pragmatic and effective than negative ones, suggesting that voluntary incentive-based partnerships have the potential to accelerate progress more than regulatory approaches (although the two are not mutually exclusive).

Figure 3.3 Reported barriers to scaling up watershed investments



Source: Bennett and Ruef (2016, fig. 20, p. 49).

3.6 Conclusions

There would be few, if any, initiatives operating in the environment–water arena that do not involve partnerships. This brief introduction confirms their predominantly inter-sectoral nature. A conspicuous feature of environment–water partnerships is engagement with partners outside the water ‘box’, or beyond the water and sanitation sector. This is illustrated, for example, by partnerships on data where initiatives include attempts to integrate the information into broader planning tools and forums, or involve investors from beyond the water sector. This is an essential ingredient of progress since many of those that influence the environment are beyond the water domain and many that benefit most from it are unable to manage it alone.

But this report is tasked with exploring the potential to scale up partnerships to accelerate progress towards SDG 6. The chasm between the current state of the environment regarding water and the progress required (see Prologue Part 2) and the ubiquitous nature of partnerships for water and the environment suggest they will continue to play a significant role in future progress. The evident increasing attention paid to the environment–water relationship, through, for example, NBS, gives some reason for optimism that more progress will be made, and faster. Environment–water stakeholders must collectively be more critical of their partnerships and generate pragmatic information on what works, what doesn’t, and why, and how to overcome constraints, if the presumed substantial opportunities for partnerships to accelerate progress are to be realized.

References

- Abell, R., Asquith, N., Boccaletti, G., Bremer, L., Chapin, E., Erickson-Quiroz, A., Higgins, J., Johnson, J., Kang, S., Karres, N., Lehner, B., McDonald, R., Raeppele, J., Shemie, D., Simmons, E., Sridhar, A., Vigerstøl, K., Vogl, A. and Wood, S. 2017. *Beyond the Source: The Environmental, Economic and Community Benefits of Source Water*. Arlington, Va., The Nature Conservancy. www.nature.org/content/dam/tnc/nature/en/documents/Beyond_The_Source_Full_Report_FinalV4.pdf.
- Arias, P. A., Bellouin, N., Coppola, E., Jones, R. G., Krinner, G., Marotzke, J., Naik, V., Palmer, M. D., Plattner, G.-K., Rogelj, J., Rojas, M., Sillmann, J., Storelvmo, T., Thorne, P. W. and Trewin, B. 2021. *Climate Change 2021: The Physical Science Basis*. Technical Summary. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK/New York, Cambridge University Press, pp. 33–144. www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf.
- Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., Belmonte-Ureña, L. J. and Manzano-Agugliaro, F. 2019. The worldwide research trends on water ecosystem services. *Ecological Indicators*, Vol. 99, pp. 310–323. doi.org/10.1016/j.ecolind.2018.12.045.
- Bennett, G. and Ruef, F. 2016. *Alliances for Green Infrastructure: State of Watershed Investment 2016*. Washington, DC, Forest Trends' Ecosystem Marketplace. www.forest-trends.org/wp-content/uploads/2017/03/2016SOWIReport121416.pdf.
- Chan, K. M. A., Anderson, E., Chapman, M., Jespersen, K. and Olmsted, P. 2017. Payments for ecosystem services: Rife with problems and potential – for transformation towards sustainability. *Ecological Economics*, Vol. 140, pp. 110–122. doi.org/10.1016/j.ecolecon.2017.04.029.
- Calvache, A., Benítez, S. and Ramos, A. 2012. *Water Funds: Conserving Green Infrastructure – A Guide for Design, Creation and Operation*. Bogotá, Latin America Water Funds Partnership/The Nature Conservancy/Fundación FEMSA/Inter-American Development Bank (IDB). www.nature.org/media/freshwater/latin-america-water-funds.pdf.
- Crump, J. (ed.). 2017. *Smoke on Water: Countering Global Threats from Peatland Loss and Degradation. A Rapid Response Assessment*. Nairobi/Arendal, Norway, United Nations Environment Programme (UNEP)/GRID-Arendal. gridarendal-website-live.s3.amazonaws.com/production/documents/s_document/376/original/RRApeatland_revised_jan.pdf?1515398975.
- Davidson, N. C., Van Dam, A. A., Finlayson, C. M. and McInnes, R. J. 2019. Worth of wetlands: Revised global monetary values of coastal and inland wetland ecosystem services. *Marine and Freshwater Research*, Vol. 70, No. 8, pp. 1189–1194. doi.org/10.1071/MF18391.
- ESP (Ecosystem Services Partnership). n.d. ESP website. www.es-partnership.org.
- ESVD (Ecosystem Services Value Database). n.d. ESVD website. www.esvd.info/home.
- GPI (Global Peatlands Initiative). n.d. GPI website. www.globalpeatlands.org.
- IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). 2019. *The Global Assessment Report on Biodiversity and Ecosystem Services*. Summary for policymakers. Bonn, Germany, IPBES. doi.org/10.5281/zenodo.3553579.
- Latin America Water Funds Partnership. n.d. *Monterrey Metropolitan Water Fund (FAMM), City of Monterrey, Nuevo Leon*. www.fondosdeagua.org/content/dam/tnc/nature/en/documents/latin-america/Monterreye.pdf.
- Lin, F. 2014. A comparative study on payment schemes for watershed services in New York City and Beijing. *Consilience*, Vol. 11, No. 1, pp. 27–40. doi.org/10.7916/D8Q81CSJ.
- Moshi, H. A., Kimirei, I., Shilla, D., O'Reilly, C., Wehrli, B., Ehrenfels, B. and Loisel, S. 2022. Citizen scientist monitoring accurately reveals nutrient pollution dynamics in Lake Tanganyika coastal waters. *Environmental Monitoring and Assessment*, Vol. 19, Article 689. doi.org/10.1007/s10661-022-10354-8.
- Nigussie, L., Barron, J., Haile, A. T., Lefore, N. and Gowing, J. 2018. *Gender Dimensions of Community-Based Groundwater Governance in Ethiopia: Using Citizen Science as an Entry Point*. IWMI Working Paper 184. Colombo, International Water Management Institute (IWMI). doi.org/10.5337/2018.222.
- Ombok, E. 2021. UNEP, Four Rotary clubs team up to clean up Athi River, plant trees. *The Timeline* website, 1 October 2021. timeline.rotary9212.org/unep-four-rotary-clubs-team-up-to-clean-up-athi-river-plant-trees.
- Puspitaloka, D., Kim, Y.-S., Purnomo, H. and Fulé, P. Z. 2021. Analysis of challenges, costs, and governance alternative for peatland restoration in Central Kalimantan, Indonesia. *Trees, Forests and People*, Vol. 6, Article 100131. doi.org/10.1016/j.tfp.2021.100131.
- Rigler, G., Dokou, Z., Khadim, F. K., Sinshaw, B. G., Eshete, D. G., Aseres, M., Amara, W., Zhou, W., Wang, X., Moges, M., Azage, M., Li, B., Holzer, E., Tilahun, S., Bagtzoglou, A. and Anagnostou, E. 2022. Citizen science and the Sustainable Development Goals: Building social and technical capacity through data collection in the Upper Blue Nile basin, Ethiopia. *Sustainability*, Vol. 14, Article 3647. doi.org/10.3390/su14063647.
- San Llorente Capdevila, A., Kokimova, A., Ray, S. S., Avellán, T., Kim, J. and Kirschke, S. 2020. Success factors for citizen science projects in water quality monitoring. *Science of The Total Environment*, Vol. 728, Article 137843. doi.org/10.1016/j.scitotenv.2020.137843.
- Seneviratne, S. I., Nicholls, N., Easterling, D., Goodess, C. M., Kanae, S., Kossin, J., Luo, Y., Marengo, J., McInnes, K., Rahimi, M., Reichstein, M., Sorteberg, A., Vera, C. and Zhang, X. 2012. Changes in climate extremes and their impacts on the natural physical environment. C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and P. M. Midgley (eds.), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Special Report of the Intergovernmental Panel on Climate Change. Cambridge, UK/New York, Cambridge University Press, pp. 109–230. www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap3_FINAL-1.pdf.
- TNC (The Nature Conservancy). n.d. *What is a Water Fund?* TNC website. waterfundstoolbox.org/getting-started/what-is-a-water-fund.
- UNEA (United Nations Environment Assembly). 2019. *Conservation and Sustainable Management of Peatlands*. Fourth session. Nairobi, 11–15 March 2019. UNEP/EA.4/Res.16. <https://wedocs.unep.org/handle/20.500.11822/30675?show=full>.
- _____. 2021. *For People and Planet: The United Nations Environment Programme Strategy for 2022–2025 to Tackle Climate Change, Loss of Nature and Pollution*. Fifth session. Nairobi, 22–26 February 2021. UNEP/EA.5/3/Rev.1. <https://wedocs.unep.org/bitstream/handle/20.500.11822/34776/K2002827%20-%20UNEP-EA.5-3-Add.1%20-%20Advance.pdf?sequence=1&isAllowed=y>.
- UNEP (United Nations Environment Programme). 2021a. *Progress on Freshwater Ecosystems: Global Indicator 6.6.1 Updates and Acceleration Needs*. Tracking SDG 6 Series. Nairobi. wedocs.unep.org/bitstream/handle/20.500.11822/36691/PFE6.6.1.pdf?sequence=3&isAllowed=y.

- _____. 2021b. *Progress on Ambient Water Quality: Global Indicator 6.3.2 Updates and Acceleration Needs*. Tracking SDG 6 Series. Nairobi. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_632_Progress-on-Ambient-Water-Quality_2021_EN.pdf.
- _____. 2021c. *Progress on Integrated Water Resources Management: Tracking SDG 6 Series – Global Indicator 6.5.1 Updates and Acceleration Needs*. Nairobi, UNEP. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_651_Progress-on-Integrated-Water-Resources-Management_2021_EN.pdf.
- _____. 2021d. *Progress on Freshwater Ecosystems: Global Indicator 6.6.1 Updates and Acceleration Needs*. Tracking SDG 6 Series. Nairobi. www.unwater.org/app/uploads/2021/09/SDG6_Indicator_Report_661_Progress-on-Water-related-Ecosystems_2021_EN.pdf.
- _____. n.d. *The World Water Quality Alliance – A Partnership Effort*. UNEP website. www.unep.org/explore-topics/water/what-we-do/improving-and-assessing-world-water-quality-partnership-effort.
- UNFCCC (United Nations Framework Convention on Climate Change). 2015. *Press Release LPAA Resilience 1: Paris Pact on Water and Climate Change Adaptation Announced*. UNFCCC website, 2 December 2015. unfccc.int/news/press-release-lpaa-resilience-1-paris-pact-on-water-and-climate-change-adaptation-announced#:~:text=Paris%2C%20%20December%202015%20%E2%80%93%20A,development%20%2D%20more%20resilient%20to%20climate.
- UNIDO (United Nations Industrial Development Organization). 2019. *Nature-Like and Convergent Technologies Driving the Fourth Industrial Revolution*. Vienna, UNIDO. www.unido.org/sites/default/files/files/2020-01/Convergent%20technologies.pdf.
- United Nations. 2015. *Paris Agreement*. United Nations. unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.
- Walton, B. 2015. Water gained stature at Paris climate talks. Circle of Blue website, 15 December 2015. www.circleofblue.org/2015/world/water-gained-stature-at-paris-climate-talks.
- Wetlands International. n.d. *Restoring the World's Largest High Altitude Peatlands*. Wetlands International website. peatlands.wetlands.org/restoring-the-worlds-largest-high-altitude-peatlands.
- Wu, Y., Washbourne, C. and Haklay, M. 2022. Citizen science in China's water resources monitoring: Current status and future prospects. *International Journal of Sustainable Development & World Ecology*, Vol. 29, No. 3, pp. 277–290. doi.org/10.1080/13504509.2021.2013973.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000247153?posInSet=1&queryId=719a7c03-6247-4548-801c-218d5ff430ab>.
- WWAP/UN-Water. 2018. *The United Nations World Water Development Report 2018: Nature-Based Solutions for Water*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000261424?posInSet=3&queryId=141006a4-a5ed-43c6-b560-607801ee45db>.
- WWC/OECD (World Water Council/Organisation for Economic Co-operation and Development). 2015. *Water: Fit to Finance? Catalyzing National Growth through Investment in Water Security*. Report of the High Level Panel on Financing Infrastructure for a Water-Secure World. Marseille, France, World Water Council. www.worldwatercouncil.org/sites/default/files/Thematics/WWC_OECD_Water_fit_to_finance_Report.pdf.
- Zhang, X., Liu, H., Baker, C. and Graham, S. 2012. Restoration approaches used for degraded peatlands in Ruoergai (Zoige), Tibetan Plateau, China, for sustainable land management. *Ecological Engineering*, Vol. 38, No. 1, pp. 86–92. doi.org/10.1016/j.ecoleng.2011.09.004.

Chapter 4

Water supply and sanitation for human settlements

UN-Habitat

Hezekiah Pireh and Giuliana Ferrero

With contributions from:

Nidhi Nagabhatla (UNU-CRIS), Gemma Arthurson and Yasmine Zaki Abdelaziz (IOM),
Sanjaya Bhatia (UNDRR Incheon), Sean Furey (RWSN), and Carlos de Oliveira Galvão (IAHR)



4.1 Introduction

• • •
The magnitude of the WASH challenges in formal and informal human settlements is such that no one country or institution alone can overcome the growing demand for these services

The need for partnerships and cooperation on water supply, sanitation and hygiene (WASH) in human settlements, regardless whether they are formal or informal, is driven by three main factors.

First, the cross-sectoral nature of WASH creates the need for partnerships. Various actors, including the private sector, non-governmental organizations (NGOs) and communities, along with government ministries and departments responsible for WASH, health, housing, agriculture, education, planning and infrastructure, among others, are all handling various aspects of the water supply and sanitation sector. Partnerships and cooperation open up space for additional actors relevant to – but not always considered to be part of – the WASH sector.

Second, the magnitude of the WASH challenges in formal and informal human settlements is such that no one country or institution alone can overcome the growing demand for these services (WHO/UNICEF, 2021). Pollution, climate change impacts and environmental degradation of freshwater resources, combined with the huge infrastructure gap in a world of scarce financial resources, explains the multitude of state and non-state actors involved in water supply and sanitation service provision.

Third, there is consensus that WASH initiatives are much more likely to meet their objectives if the intended beneficiaries participate in a meaningful way in multistakeholder partnerships and cooperation, especially in rural areas and secondary towns (UN-Habitat, 2008). Evidence suggests that effective stakeholder involvement in the decision-making process and in planning and implementation leads to services that are more appropriate to the needs and resources of poor communities, and increases public acceptance and ownership of systems (Jones, 2003). Stakeholder engagement also ensures from the onset that accountability and transparency are built into the programme (Evans et al., 2005).

This chapter presents an analysis of a number of examples of WASH-related partnerships and cooperation in formal and informal settlements that address specific objectives, including: those aimed at strengthening the capacity of operators through peer-to-peer support; those aimed at addressing wastewater management; those aimed at ensuring that interventions are informed by and respond to the needs of local stakeholders; those aimed at building resilience to climate change; and those aimed at improving access to services in refugee and migrant settlements.

4.2 Water operators' partnerships

Water supply and sanitation service provision in human settlements is affected by a plethora of governance and operational challenges. In the last decades, service providers across the globe have been turning to peer-to-peer partnerships to enhance their capacity and performance while striving to provide affordable quality services for all. These not-for-profit partnerships are referred to as *water operators' partnerships* (WOPs). They work by connecting established, well-functioning utilities with other utilities that need assistance or guidance. Building on peers' shared understanding of professional demands and challenges, partners conduct joint diagnoses to assess challenges and design solutions. WOPs are non-commercial partnerships that rely on trust and open exchange of information and expertise.

The United Nations Secretary-General's Advisory Board on Water and Sanitation first called on development actors to support these partnerships in 2006 and requested the United Nations Human Settlements Programme (UN-Habitat) to host the Global Water Operators' Partnerships Alliance (GWOPA)¹³ to support water operators through WOPs. WOPs are implemented in a variety of settings that include cities and small towns in low- and middle-income countries and fragile states. In the global WOPs database maintained by

¹³ <https://gwopa.org/>

Box 4.1 The experience of Ghana Water Company Ltd. in pro-poor services: From mentee to mentor

About half of the 17 million urban residents in Ghana live in low-income urban communities (LIUCs).

While Ghana Water Company Limited (GWCL) is responsible for potable water supply to all urban communities in Ghana, only a fraction of the LIUC's residents have direct access to GWCL's piped network.

Over the last 15 years, GWCL has been the beneficiary of a series of WOPs, first supported by Dutch and South African public companies, to improve operational performance and attract additional investments. GWCL then received mentorship and funding from the Dutch WaterWorX Programme and the Dutch Water for Life Foundation to extend service delivery to LIUCs by providing direct access to water services to over 750,000 people. This process led to the creation of a specialized Low-Income Customer Support Unit, making service delivery to the underserved poor a viable market.

The impact associated to this success story grew further in 2021 when GWCL embarked on a new WOP, this time as a mentor, together with VEI Dutch water operators, to support the development of pro-poor activities at the Guma Valley Water Company in Sierra Leone.

Source: GWOPA (2021).

GWOPA, out of the 425 WOPs documented, the majority (50%) involves two utilities from the Global South; and 38% are partnerships between a northern and a southern utility. The remaining are triangular partnerships¹⁴ (10%) and partnerships among utilities from the Global North (2%).

WOPs can vary in terms of duration, objectives, and the number and nature of partners involved. Some WOPs focus on a single technical issue and last less than a year; others cover several aspects of service delivery and organizational functioning, and last for some years. In general, WOPs make their impact by helping utilities acquire and apply knowledge, establish new practices and implement improved approaches. The areas tackled through mentorship encompass the management, financial and technical levels. Utilities may want to increase efficiency, take up new mandates, such as providing services in low-income areas, expanding sanitation service coverage, enhancing environmental performance, facilitating access to finance, and/or rebuilding human resource capacity following a restructuring. The resulting capacity and performance improvements can facilitate utilities' access to financing for infrastructural investments, supporting further extensions or improvements in services. WOPs have been gaining importance on the global development agenda, as demonstrated by the EU-WOP programme launched by GWOPA in 2021. The EU-WOP programme is a €9 million initiative funded by the European Commission; it involves 22 WOPs created among utilities from African, Arab, Asian, European and Latin American countries.¹⁵

WOPs can be a valuable instrument to reach underserved populations in urban contexts, and implementing WOPs can have a ripple effect because the beneficiary or mentee utility, after having enhanced its capacities and acquired new competences, can go on and use this expertise to help other utilities (Box 4.1).

Moreover, many countries are still facing challenges in extending services to rural areas, where coverage of safely managed drinking water services (60%) is lower than in urban areas (86%) (WHO/UNICEF, 2021). However, the WOP model has proven effective in rural areas of Latin America. For example, the National Federation for Sanitation Services Cooperatives (FESAN) in Chile supported the Rural Community Development Association (ADECOR) in Guatemala to provide water services to indigenous communities (Box 4.2). A long-lasting impact on rural water providers can be achieved by partnerships that tap into local knowledge in a participatory manner.

The positive outcomes generated by WOPs include organizational changes related to improvements in staff knowledge, skills, awareness and attitude, in addition to a deeper understanding of the organization's needs and strategies on how to address them (Pascual-Sanz et al., 2018). This translated in an estimated number of 63.7 million indirect beneficiaries (UN-Habitat, n.d.). However, from a practical standpoint, some challenges still persist. For example, the performance indicators normally used to monitor how capacity development takes place in WOPs provide little insight into the intangible elements of capacity development and the effectiveness of the partnership (Pascual-Sanz et al., 2013). Other aspects to be carefully considered while implementing a WOP are the context in which it takes place, including language, cultural norms and governance structures (Tutusaus and Schwartz, 2016). Lastly, questions of power dynamics should be more openly discussed within the WOP community, as operators and donors have various interests at stake (Beck, 2021).

¹⁴ Triangular cooperation normally involves a traditional donor from the ranks of the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD), an emerging donor in the South, and a beneficiary country in the South (Ashoff, 2010).

¹⁵ <https://gwopa.org/eu-wops/>.

4.3 Wastewater management

• • •
**Water operators’
partnerships work
by connecting
established,
well-functioning
utilities with other
utilities that need
assistance or
guidance**

Increases in rural and urban populations, rapid economic development and expanding agricultural production have increased the volume of water consumed and discharged as wastewater. Lack of adequate infrastructure and resources to treat wastewater in cities and towns in a number of developing countries results in a large proportion of wastewater being discharged directly into drainage channels, rivers, lakes and oceans. It is estimated that well over 80% of the world’s wastewater flows back into the environment without being treated or reused (WWAP, 2017). As a result, at least 2 billion people (globally) use a drinking water source contaminated with faeces, putting them at risk of contracting cholera, dysentery, typhoid and polio (WHO/UNICEF, 2021).

Over the years, a number of partnerships have been created at global, regional and country levels to address wastewater management in an efficient and sustainable way. At the global level, the Global Wastewater Initiative (GW²), a global multiple stakeholder platform, was launched in 2013. It brings together United Nations agencies, NGOs, academia, the private sector, development banks and others, to step up efforts against wastewater pollution worldwide, and to change the paradigm of how wastewater is commonly seen, from simple waste to a valuable and rich resource.

At the regional level, findings from two regional case studies in Israel, the ‘Karmiel Region Union of Towns for Sewage Treatment’ and the ‘Treatment and Reuse of Wastewater in the area of the Hadera Stream, Ltd.’, suggest that *“regional cooperation can be an efficient tool in promoting advanced wastewater treatment, and has several advantages: an efficient use of limited resources (financial and land); balancing disparities between municipalities (size, socio-economic features, consciousness and ability of local leaders); and reducing spillover effects”* (Hophmayer-Tokich and Kliot, 2008, p. 554).

At the national level, the United States Environmental Protection Agency (US EPA) and 20 partner organizations involved in managing decentralized wastewater systems entered into a Memorandum of Understanding to work collaboratively to encourage proper management of decentralized wastewater systems and increase collaboration among US EPA, state and local governments, and decentralized system practitioners and providers. It aims to encourage proper decentralized wastewater system management and protect the nation’s public health and water resources with an emphasis on small, rural and suburban communities. The partnership was initiated in 2005 with eight public and private sector organizations, and had expanded to 20 partners in 2020 (US EPA, n.d.).

4.4 Multistakeholder partnerships in rural and secondary towns

In the Lake Victoria region in East Africa, multistakeholder forums were created by UN-Habitat in 2005 to enhance local ownership of WASH interventions in secondary towns around the lake. It is generally acknowledged that giving stakeholders a voice and choice in the basic service delivery process, and building their capacity to manage and maintain them, leads to services that are more appropriate to the needs and resources of poor communities, and increases public acceptance and ownership of systems (WWAP/UN-Water, 2019). Stakeholder engagement also ensures that accountability and transparency are built in to programmes from the onset.

The Lake Victoria Water and Sanitation Initiative (LVWATSAN), initially supported by the Government of the Netherlands in 2005 and later by the African Development Bank (AfDB) in 2011, involved a group of diverse stakeholders representing a range of knowledge and expertise and attributed with specific responsibilities:

Box 4.2 Providing water services to indigenous communities in Guatemala through the FESAN–ADECOR water operators’ partnership

In 2017–2018, the National Federation for Sanitary Services Cooperatives (FESAN) from Chile supported the Rural Community Development Association (ADECOR) to expand inclusive and sustainable access to safe drinking water for people living in rural areas of Guatemala, to support women in conditions of extreme poverty, and to increase women’s participation in the sphere of water.

This water operators’ partnership (WOP), financed by the Inter-American Development Bank, was characterized by the participation of water professionals and local leaders. A needs assessment was conducted that highlighted issues with water access, systems functionality and environmental hazards. Then, FESAN went on to share their rich experience about technical and administrative capacity-building. As a result, the Municipality of San Martín Jilotepeque in Guatemala decided to establish an independent drinking water service unit, aligned with the culture and identity of the Kaqchikel ethnic group. The final phase of the WOP focused on training women and men from Maya indigenous communities on sustainable management models for rural drinking water supply, which allowed them to expand career opportunities.

As a result of this WOP, local communities and rural water operators of the district of San Martín Jilotepeque were able to supply drinking water to indigenous populations. Considering the local culture in a participatory manner is fundamental to make a long-lasting impact in rural water suppliers, impact workers and help them take ownerships of the solutions.

Source: GWOPA (2019).

- i. **Respective ministries of water** – responsible for ensuring that the objectives, roles and responsibilities of the national governments are aligned. The ministries also coordinated activities falling under other ministries, such as environment, local government and public works.
- ii. **Municipal authorities** – responsible for providing guidance on urban planning, especially in solid waste, drainage and on-site sanitation. The authorities participated at all stages of the project to ensure that LVWATSAN was properly integrated into the local urban system.
- iii. **NGOs and community groups** – responsible for community mobilization and implementation of community water and sanitation schemes. NGOs and community-based organizations (CBOs) were also responsible for community awareness-raising, training and education activities. Partnership building with local authorities created opportunities for contracting NGOs and CBOs for service provision.
- iv. **Regional water service boards** – key organization in the sector reforms and are looking at LVWATSAN as a way to operationalize water sector reforms at the local level. They were also responsible for setting pro-poor policies, such as adjusting tariff structures. The Initiative assisted in building the capacity of the Boards in the areas of regulation and management of local service providers.
- v. **Local water and sanitation service providers** – large utilities and small-scale providers are managers of assets and any assistance in infrastructure or capacity-building has a direct impact on the management of their operations. The Initiative improved on their assets and management capacity, for sustainability of the project. It also assisted in building the capacity of local service providers in the areas of business plan development, financial management (including tariff-setting), technical management (including operations and maintenance), and demand management.
- vi. **Local private sector** – town-wide improvements in water supply, sanitation, drainage and solid waste management attract further investments and increase local economic activities in the participating towns. The local private sector was, therefore, a direct beneficiary of the programme.
- vii. **Local water vendor associations** – responsible for most of the service provision to the poor communities in the participating towns. The Initiative supported them in establishing and supporting the formation of associations of small-scale service providers; providing access to finance and supporting development of entrepreneurship skills; regulating prices and monitoring quality of water supplied to consumers; and establishing linkages with utilities (through franchising etc.) to ensure vertical integration and synergy.
- viii. **Local media** – responsible for raising levels of awareness about water, sanitation, waste management and drainage issues in the Lake Victoria region in general, and in the participating towns, in particular, among political leaders, policy-makers, development partners and beneficiary communities.

In selecting membership, consideration was given to the diverse

Box 4.3 Smart rainwater management and drought resilience in rural semi-arid communities: A case study of Northeast Brazil

The smart rainwater management in Northeast Brazil was triggered by a drought between 1979 and 1983, which killed nearly one million people. Since the late 1970s, the Governmental Agricultural Research Center for the Semi-arid Region (EMBRAPA Semi-Arid) conducts research on rainwater harvesting systems. In 1990, the Regional Institute of Small Appropriate Agriculture and Animal Husbandry (IRPAA) and other non-governmental organizations started undertaking research and dissemination of rainwater harvesting technologies, as part of the model 'Living in Harmony with the Semi-Arid Climate'. Over the course of the 1990s, it became necessary to create the institutional basis to implement larger programmes, so the government funded the Brazilian Rainwater Catchment and Management Association in July 1999, bringing together researchers and users of rainwater technologies.

In the same year, non-governmental organizations founded the Semi-Arid Network (ASA), which brought together more than 2000 grassroots organizations, including non-governmental organizations, farmers' unions, cooperatives, associations and church communities. The ASA launched the campaign under the slogan 'No family without safe drinking water' and proposed the One Million Cisterns Programme (P1MC), to be implemented by civil society in a decentralized way (at the community, municipal, micro-regional, state and semi-arid regional levels). The P1MC was complemented by the Programme One Piece of Land and Two Types of Waters (P1+2), calling for every rural family to have: (1) a piece of land large enough to produce food, raise livestock, and ensure a sustainable life; and (2) two types of water storage, one for drinking and another for agricultural production.

The rainwater management programmes, executed principally by ASA with governmental financing, are a success story. The community went from 1 million dead people to 1 million cisterns. In the drought of 1979 to 1983, about 1 million people in the Northeast died of starvation, that is, hunger or thirst. In the drought that lasted from 2012 to 2017, there were no records of deaths by starvation, no large migrations, no emergencies and much less looting in the cities of the hinterland.

The One Million Cisterns Programme received the Future Policy Award 2017 during the 13th Conference of the Parties of the UN Convention to Combat Desertification in Ordos, China, because it "is a participative, bottom-up way to provide water for consumption, for producing food and raising livestock in Brazil's drought-prone semi-arid region using simple rainwater collection technology. It empowers millions of the region's poorest people to be in control of their own needs, to generate income and enhance their food security".

Source: Text excerpted and adapted from Gleason Espíndola et al. (2020, pp. 210–211, 215–216).

stakeholder interests and the need for a balanced geographical and gender distribution. Identifying credible individuals who can represent the issues and concerns of a particular stakeholder group is an efficient way to obtain active engagement.

To document this engagement experience in the Lake Victoria region, the multistakeholder engagement guide *How to Set Up and Manage a Town-Level Multistakeholder Forum: A Step-by-Step Guide* (UN-Habitat, 2008) has been used to set up a number of town-level multistakeholder platforms for citizen feedback and oversight in the provision of urban water and sanitation services in Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda. The multistakeholder platforms have also been used in these countries to involve residents in city-wide issues, including

Box 4.4 Uptime Consortium and Catalyst Facility: A new partnership approach to scaling up sustainable rural water services

Rural water supply in low- and middle-income countries, particularly in Sub-Saharan Africa, is typified by a mix of community-based management and self-supply (Carter, 2021). While decentralizing to the community and household level has advantages, there are also marked disadvantages when it comes to uneven and unreliable sustainability and equity (Whaley et al., 2020; Sutton and Butterworth, 2021). Thorough analysis and action research by the University of Oxford and partners in Kenya revealed that, if repair times for waterpoints are brought down from weeks to 1–3 days, willingness to pay goes up and cost recovery improves (Foster et al., 2022). Professionalized operators can maximize ‘uptime’ of rural water services if incentivized to do so through performance-based contracts and blended finance (McNicholl et al., 2019). With this insight, the Uptime Catalyst Facility was created in 2020, initially comprising five non-governmental organizations (NGOs) and private sector operators in Burkina Faso, the Central African Republic, Kenya and Uganda, serving over a million people. This has now expanded to seven countries and 1.6 million people served (uptimewater.org, n.d.), but the goal is to scale up to 100 million people by 2030. For this, partnerships are essential, and a first step was collaboration with the Rural Water Supply Network (RWSN) to find operators and governments that could adopt this approach.

the improvement of municipal governance. Institutionalized citizen engagement within the local governments in turn enhanced public accountability, performance and customer responsiveness in water and sanitation service provision.

A similar multistakeholder engagement initiative in Northern Brazil is summarized in Box 4.3.

In remote rural areas, where water supply is often provided through a combination of community engagement and household self-supply, participatory approaches through partnerships can lead to improvements in maintenance and cost recovery (Box 4.4).

4.5 **Water resilience** **in cities**

Making Cities Resilient 2030 (MCR2030)¹⁶ is a multi-stakeholder initiative for improving local resilience, including reducing disaster and climate risks, through advocacy, sharing knowledge and experiences, establishing mutually reinforcing city-to-city learning networks, injecting technical expertise, connecting multiple layers of government, and building partnerships. Through delivering a clear roadmap to urban resilience, providing tools, access to knowledge and monitoring and reporting tools, MCR2030 is supporting cities on their journey to reduce risk and build resilience. The founding partners are the World Council for City Data, the United Nations Development Programme (UNDP), the United Nations Office for Project Services (UNOPS), UN-Habitat, the World Bank, United Cities and Local Governments (UCLG), Local Governments for Sustainability (ICLEI), R-Cities, the United Nations Office for Disaster Risk Reduction (UNDRR), C40 Cities, the Japan International Cooperation Agency (JICA) and the International Federation of Red Cross and Red Crescent Societies (IFRC). In addition, there are over 280 other partners that provide services to cities.

MCR2030 strives to ensure cities become inclusive, safe, resilient and sustainable by 2030, contributing directly to the achievement of Sustainable Development Goal (SDG) 11 and other global frameworks (Sendai Framework, Paris Agreement, New Urban Agenda).

¹⁶ The information in this section is based upon: www.unisdr.org/campaign/resilientcities/assets/home/documents/MCR2030in%20English.pdf.

MCR2030 tools promote a better understanding of the role of water in the development of an urban settlement. The tools promote diagnostics of risks to human settlements, including from excess or scarcity of water, an analytical approach to address the challenges posed by this situation, and an action plan to handle risks, including water-related risks. For example, the tools emphasize that deforestation may increase the potential for flash flooding, and green areas may help in flood and stormwater management. As such, the Disaster Resilience Scorecard for Cities encourages cities to examine the “‘Water/sanitation loss factor’. If: $a = \text{estimated \# of days to restore regular service area-wide}$ and $b = \% \text{ of user accounts affected... then water/sanitation loss factor} = a \times b$ ” (UNDRR, 2017, p. 66). This kind of calculations helps to understand the customer service days at risk, so that city planners are better equipped to analyse vulnerabilities in the WASH sector.

4.6 Migrants and refugees

• • •
*Over the years,
a number of
partnerships have
been created at
global, regional
and country
levels to address
wastewater
management in
an efficient and
sustainable way*

At the end of 2020, the number of forcibly displaced people was estimated to be 82.4 million, with 48 million of these internally displaced (UNHCR, 2022). International human rights law requires that states guarantee everyone the right to an adequate supply of safe water for personal and domestic use. However, forced migration puts an increased strain on water resources and more importantly, on the local entities (utilities, communities) responsible for providing water supply and sanitation services. While states are the primary duty-bearers for these rights, multi-stakeholder partnerships between United Nations agencies, international organizations, NGOs and civil society are required to respond to the complexity of contemporary displacement dynamics, impacts and drivers, which affect both displaced populations and host communities.

The Global Compact for Safe, Orderly and Regular Migration (GCM)¹⁷ commits states to provide evidence- and human rights-based policy-making and public discourse on migration. Water governance and effective policy responses are required to consider the full spectrum of human mobility under a human rights framework, with consideration for the relationship between migration and water – that is, how water insecurity drives migration, and how pressure on water resources is also an impact of migration (Global High-Level Panel of Water and Peace, 2017).

In addition to high-level water governance, intra-sectoral partnerships for crisis management are formulated through the Global WASH Cluster to ensure coordination and response quality and capacity for WASH assistance to people affected by emergencies (e.g. operational support to national WASH coordination boards, enhancing emergency preparedness of WASH participants; liability and learning to enable WASH actions and promotion for WASH as an essential part of the humanitarian response in both emergency and development settings). This is specific to emergencies when for example a human settlement displacement camp is being set up. WASH actors need to collaborate under the National WASH Cluster, which is the main coordination mechanism for partnerships and cooperation in emergencies.¹⁸

Within displacement settings, water user committees can facilitate collaboration with local water authorities as well as promote women’s participation (Box 4.5).

¹⁷ For more information, please see: www.ohchr.org/en/migration/global-compact-safe-orderly-and-regular-migration-gcm.

¹⁸ For more information, please see: <https://washcluster.net/>.

Box 4.5 Supporting community-based WASH collaboration in displacement settings

The International Organization for Migration (IOM) has worked to improve access to safe drinking water and sanitation in the Gedo Region of Somalia. A crucial element for ensuring water sustainability has been the establishment of several water user committees, which own and manage the water infrastructure and services. Their members are elected by the community and entrusted with responsibility for the operation and maintenance of the waterpoints on the site, in order to ensure their long-term sustainability. Water committees can also take on other roles, such as promoting positive hygiene behaviour change such as safe storage and collection of water, and safe food and hand hygiene.

It is key for women to be active participants of the committees, given that they are primarily responsible for domestic water collection, and are the main water decision-makers at the household level. Water committees can also work to mitigate disputes over water, promoting cooperation and conflict resolution.

Women's participation and inclusion in labour (work) activities form also a challenge in northeast Nigeria, where the role of women is largely limited to domestic chores, with little or no opportunity to participate in activities that bring them out into the public domain. The IOM encourages women to be fully involved at every stage of programme development, for example selecting where to drill boreholes and place sanitation infrastructure. Further, the IOM has engaged Hygiene Promotion and Community Engagement Volunteers, 80% of whom are women, who are actively involved in mass campaigns and risk communication and community engagement, leading a large transformation in attitude towards, and access to, these types of roles.

Contributed by IOM.

4.7 Conclusions

Experiences on WASH-related partnerships and cooperation in human settlements highlighted in this chapter are driven by the need to accelerate change, create greater impact and achieve sustainable results by sharing knowledge, resources and technical expertise. WOPs, for example, are a valuable tool to enhance the performance of water and sanitation service providers by connecting a strong utility with another utility that needs assistance or guidance.

At the project management level, multistakeholder partnerships involving local community groups and local governments illustrate the value of partnerships in ensuring community ownership and engagement in the management of water and sanitation facilities.

Partnerships and cooperation at global, regional and national levels are equally instrumental in advocating for better performance in wastewater management in diverse human settlements. Strengthening city-to-city learning networks is an equally unique partnership opportunity for improving local resilience. Partnerships on water and sanitation in migrant and refugee contexts also demonstrate the impact of cooperation to ensure supply of these essential services to displaced populations.

References

- Ashoff, G. 2010. *Triangular Cooperation: Opportunities, Risks, and Conditions for Effectiveness*. Development Outreach. World Bank. <https://openknowledge.worldbank.org/handle/10986/6081>. License: CC BY 3.0 IGO.
- Beck, A. 2021. *Water Operator Partnerships after 15 Years: Re-Politicising the Debate*. EADI blog. www.developmentresearch.eu/?p=1029.
- Carter, R. 2021. *Rural Community Water Supply: Sustainable Services for All*. Rugby, UK, Practical Action Publishing. doi.org/10.3362/9781788531689.
- Evans, B., Joe McMahon, J. and Caplan, K. 2005. *The Partnership Paperchase: Structuring Partnership Agreements in Water and Sanitation in Low-Income Communities*. London, Building Partnerships for Development in Water and Sanitation.
- Foster, T., Hope, R., Nyaga, C., Koehler, J., Katuva, J., Thomson, K., and Gladstone N. 2022. *Investing in Professionalized Maintenance to Increase Social and Economic Returns from Drinking Water Infrastructure in Rural Kenya*. Policy Brief. Oxford, UK, Smith School of Enterprise and the Environment, School of Geography and the Environment, University of Oxford. www.smithschool.ox.ac.uk/sites/default/files/2022-02/Kitui-maintenance-policy-brief_0.pdf.
- Gleason Espíndola, J. A., Casiano Flores, C. A., Pacheco-Vega, R. and Pacheco Montes, M. R. (eds.). 2020. *International Rainwater Catchment Systems Experiences: Towards Water Security*. London, IWA Publishing.
- Global High-Level Panel of Water and Peace. 2017. *A Matter of Survival: Report of the Global High-Level Panel on Water and Peace*. Geneva, Geneva Water Hub. www.genevawaterhub.org/resource/matter-survival.
- GWOPA (Global Water Operators' Partnerships Alliance). 2019. *Access to Drinking Water in Guatemala thanks to Local Water Committees*. GWOPA website. <https://old.gwopa.org/en/gwopa-news/access-to-drinking-water-in-guatemala-thanks-to-local-water-committees-3-2>.
- _____. 2021. *The Impact of a WOPA in Serving Low-Income Urban Communities in Ghana*. GWOPA website. <https://gwopa.org/the-impact-of-a-wop-in-serving-low-income-urban-communities-in-ghana/>.
- Hophmayer-Tokich, S. and Klot, N. 2008. Inter-municipal cooperation for wastewater treatment: Case studies from Israel. *Journal of Environmental Management*, Vol. 86, No. 3, pp. 554–565. doi.org/10.1016/j.jenvman.2006.12.015.
- McNicholl, D., Hope, R., Money, A., Lane, A., Armstrong, A., Van der Wilk, N., Dupuis, M., Harvey, A., Nyaga, C., Womble, S., Favre, D., Allen, J., Katuva, J., Barbotte, T., Buhungiro, E., Thomson, P. and Koehler, J. 2019 *Performance-Based Funding for Reliable Rural Water Services in Africa*. Uptime Consortium Working Paper, Vol. 1, Oxford, UK, Smith School of Enterprise and the Environment, University of Oxford. <https://static1.squarespace.com/static/5d5fc19961d87c00011689d2/t/5f02887c0e31a70a9c5fc990/1594001552517/Performance-based+funding+for+reliable+rural+water+services.pdf>.
- Pascual-Sanz, M., Perkins, J., Kiyenje, J., Wright-Contreras, L. 2018. Water operators' partnerships for universal and sustainable access to water services. A. M. Badia Martín and L. Huici Sancho (eds.), *Agua, recurso natural limitado: Entre el desarrollo sostenible y la seguridad internacional* [Water, limited natural resource: Between sustainable development and international security]. Madrid, Marcial Pons. (In Spanish.)
- Pascual-Sanz, M., Veenstra, S., Wehn de Montalvo, U., Van Tulder, R. and Alaerts, G. 2013. What counts as 'results' in capacity development partnerships between water operators? A multi-path approach toward accountability, adaptation and learning. *Water Policy*, Vol. 15, No. S2, pp. 242–266. doi.org/10.2166/wp.2013.022.
- Sutton, S. and Butterworth, J. 2021. *Self Supply: Filling the Gaps in Public Water Supply Provision*. Rugby, UK, Practical Action Publishing. <https://practicalactionpublishing.com/book/2530/download?type=download>.
- Tutusaus, M. and Schwartz, K. 2016. National Water Operators' Partnerships: A promising instrument for capacity development? *Journal of Water, Sanitation and Hygiene for Development*, Vol. 6, No. 3, pp. 500–506. doi.org/10.2166/washdev.2016.040.
- UNDRR (United Nations Office for Disaster Risk Reduction). 2017. *Disaster Resilience Scorecard for Cities. Detailed Level Assessment*. UNDRR. <https://mcr2030.undrr.org/disaster-resilience-scorecard-cities>.
- UN-Habitat (United Nations Human Settlements Programme). 2008. *Stakeholder Engagement and Partnership Building in the Lake Victoria Region Water and Sanitation Initiative. How to Set Up and Manage a Town-Level Multistakeholder Forum: A Step-by-Step Guide*. Nairobi, UN-Habitat. <https://unhabitat.org/how-to-set-up-and-manage-a-town-level-multistakeholder-forum-a-step-by-step-guide>.
- _____. n.d. WOPs Database. <https://gwopa.org/resources/wops-database/> (Accessed on 19 April 2022).
- UNHCR (Office of the United Nations High Commissioner for Refugees). 2022. *Global Trends Report: Forced Displacement in 2021*. Geneva, UNHCR. www.unhcr.org/62a9d1494/global-trends-report-2021.
- Uptimewater.com. n.d. *Global Dashboard*. www.uptimewater.com/global-dashboard (Accessed on 15 November 2022).
- US EPA (United States Environmental Protection Agency). n.d. *EPA's Decentralized Wastewater Partnership*. US EPA website. www.epa.gov/septic/epas-decentralized-wastewater-partnership.
- Whaley, L., Cleaver, F. and Mwachungu, E. 2021. Flesh and bones: Working with the grain to improve community management of water. *World Development*, Vol. 138, Article 105286. doi.org/10.1016/j.worlddev.2020.105286.
- WHO/UNICEF (World Health Organization/United Nations Children's Fund). 2021. *Progress on Household Drinking Water, Sanitation and Hygiene 2000–2020: Five Years into the SDGs*. Geneva, WHO/UNICEF. www.who.int/publications/i/item/9789240030848. Licence: CC BY-NC-SA 3.0 IGO.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000247153>.
- WWAP (UNESCO World Water Assessment Programme)/UN-Water. 2019. *The United Nations World Water Development Report 2019: Leaving No One Behind*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000367306>.

Chapter 5

Industry

UNIDO

Taylor Henshaw and John Payne

With contributions from:

Mai-Lan Ha (CEO Water Mandate)



5.1 Context

Industry has the capacity to advance responsible practices and devise market-based solutions to accelerate the Sustainable Development Goals (SDGs) at scale, but this ability can be undermined by governance gaps, market failures, cultural barriers and trust deficits. Collective action, in the form of partnerships and coalitions, is vital to overcoming these impediments (Nelson, 2017). The phrase “*collective action*”, which is gaining prominence in the business community, refers to “*coordinated engagement among interested parties within an agreed-upon process in support of common objectives*” (CEO Water Mandate, 2013, p. 3). Industry turns to collective action when desired outcomes cannot be obtained through internal or unilateral action alone.

Industry is in a unique position to lead on the collective action front, being very familiar with strategic partnerships and cooperation and their ability to produce win-win outcomes in core business areas. In recent years the increased value of adding environmental, social and governance (ESG) and water stewardship scopes to such arrangements has become very evident – not only in the commercial sense but also in the broader context of overall water sustainability to provide beneficial results for all parties.

Although industry is no stranger to collective action, there is a need to increase the scale and also the “*effectiveness, efficiency and legitimacy*” of such efforts (Nelson, 2017). To that end, this chapter looks at industry motivations to enter into collective action, canvasses key elements of collective action involving industry, and explores some examples of practical collective action and trends where industry is taking the lead, and where it can therefore engage in partnerships and cooperation to accelerate SDG 6.

5.2 Industrial water use

A frequently cited statistic is that industry and energy together use approximately 19% of the world’s freshwater withdrawals (Ritchie and Roser, 2017).¹⁹ Energy uses approximately 10% of the world’s withdrawals (IEA, 2016a). While this is much less than the 70% attributed to agricultural use (Ritchie and Roser, 2017), it is nonetheless a considerable amount of water that requires careful stewardship in the watersheds that industry and energy share with so many other users. On the other hand, these data do not provide a complete picture, as it has been estimated that two-thirds of all water consumption is involved in corporate supply chains (TNC, n.d.). Supporting this estimate, companies in seven major sectors – food, textile, energy, manufacturing, chemicals, pharmaceuticals and mining – are affecting more than 70% of the world’s freshwater use and pollution (CDP, 2018).

A regional distribution shows that industrial water withdrawal averages 17% of total water use in high-income countries but only 2% in low-income countries. The average for industrial use hides a huge range, from 49–96% in the European Union (with the highest level in Estonia) to 0–5% in many countries of various income levels in other regions. Such percentages correspond in reverse to the use of water for agriculture, particularly in poorer economies. However, areas in the Middle East and North Africa with high levels of water stress are only using about 4% of their water for industry, while South Asia is experiencing high industrial use (47%) and high water stress simultaneously (Ritchie and Roser, 2017).

The perspective changes when the quantity of industrial water use is taken into account. The two largest users, Asia and North America, are very similar at 229 km³/year and 249 km³/year respectively, yet Asia is by far the world’s largest user for all sectors at 2505 km³/year, which is considerably more than runner-up North America at 602 km³/year (United Nations, 2022, Figure 3, p. 15). By contrast, the total use (agriculture, domestic and industry) for each of the

¹⁹ The backstop for industrial water use statistics is the AQUASTAT database by the Food and Agriculture Organization of the United Nations (FAO), which provides the amount of self-supplied water used, including thermoelectric and nuclear cooling water, but excluding hydropower. Publicly supplied water to industry is usually included in municipal water withdrawal, so the total amount of industrial water use is unknown but will be more than the AQUASTAT data.

● ● ●
Industry turns to collective action when desired outcomes cannot be obtained through internal or unilateral action alone

other continents – Africa, Europe and South America – is close to the industrial use of Asia and North America (United Nations, 2022. Figure 3, p. 15). Globally, energy uses a relatively small total of 338 km³/year (IEA, n.d.).

Estimates for future water demand in industry and energy are not widely available. In 2012, globally, a 400% increase for manufacturing and a 140% increase for thermal power generation between 2000 and 2050 was projected (OECD, 2012). A report in 2009 had forecast that by 2030 industrial water withdrawals globally would increase to 22% (2030 Water Resources Group, 2009). A later study suggests a 24% increase in industry and energy's water demand by 2050 in a 'middle of the road' scenario (Burek et al., 2016). More recently, the CDP (formerly the Carbon Disclosure Project) reported that about two-thirds of the companies that responded to its survey are reducing or maintaining their withdrawals (CDP, 2021). Water withdrawal for energy by 2030 is expected to remain much the same for the scenarios considered by the International Energy Agency (IEA), except for the Sustainable Development Scenario,²⁰ which forecasts an increase in consumption of about 75 km³/year (from 50 km³/year) in 2016, but a reduction in overall use of about 275 km³/year. (IEA, 2018).

According to the CDP, issues of water quality have largely been overlooked, with only 59% of the responding companies monitoring their wastewater quality, only 12% setting pollution targets and only 4.4% making progress against them (CDP, 2021).

Progress can be made in reducing water stress by decoupling water use from industrial and energy growth, controlling supply chains, and maintaining the quality and accessibility to water for those in need – which are all best achieved by collective action.

5.3 Collective action and industry motivations

Companies within industries that rely heavily on water for their core business – such as manufacturing of goods or production of inputs and raw materials – have become increasingly attuned to water stress and the risks²¹ it poses to business interests. As a result, many companies are exploring and testing ways to reduce or mitigate water risks across their business and supply chains (CEO Water Mandate, 2013).

The UN Global Compact's SDG Ambition (Box 5.1), launched at Davos in 2020, "aims to enable the world's leading companies to set ambitious goals and targets in the areas that will have the greatest business impact on the SDGs, and integrate sustainable development into enterprise management processes and systems" (UN Global Compact, 2020, p. 2).

Companies that make the strategic decision to manage water-related risks or seek water stewardship initiatives (WSIs)²² often do so to ensure business viability, retain their legal or social license to operate, assure investors, and uphold corporate values and commitments. "Collective action is desirable (and likely necessary) when the ability to produce these outcomes is not possible through internal or unilateral action" (CEO Water Mandate, 2013, p. 5).

²⁰ The Sustainable Development Scenario uses the objectives from the SDGs 7, 3 and 13 and "assesses what combination of actions would deliver them." The SDG Targets 6.1–6.3 are not embedded in this Scenario, however the analysis "provides a what if case to assess what the additional energy needs of achieving these targets might be under the framework of the Sustainable Development Scenario." (IEA, 2018).

²¹ The CEO Water Mandate defines water risk as "the possibility of an entity experiencing a water-related challenge (e.g., water scarcity, water stress, flooding, infrastructure decay, drought). The extent of risk is a function of the likelihood of a specific challenge occurring and the severity of the challenge's impact. The severity of impact itself depends on the intensity of the challenge, as well as the vulnerability of the actor" (CEO Water Mandate, 2014, p. 4).

²² "Water stewardship initiatives typically involve structured collective action and joint decision making and implementation to ensure use of water that is socially equitable, environmentally sustainable, and economically beneficial" (CEO Water Mandate/WIN, 2015, p. 11).

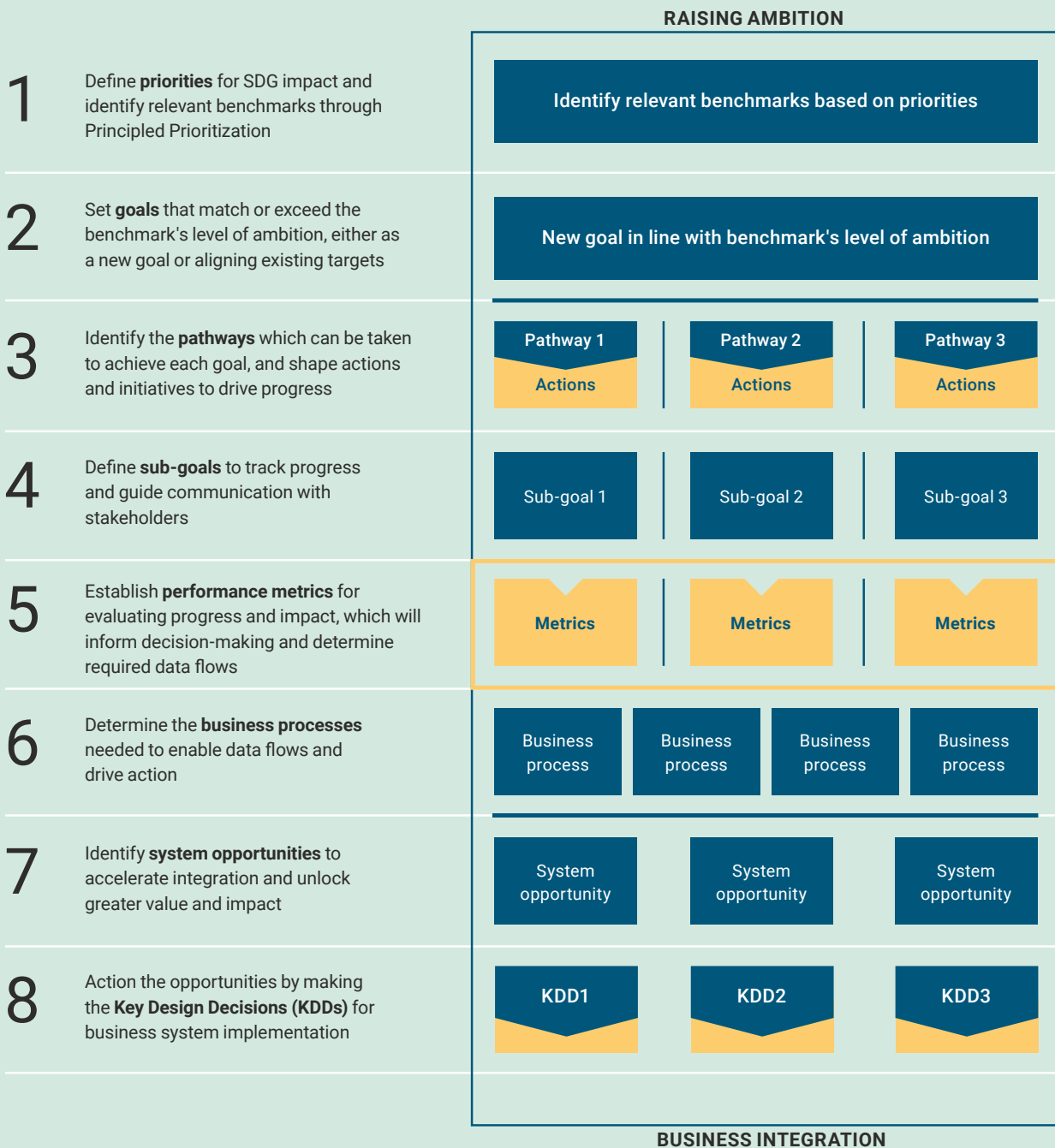
Box 5.1 SDG Ambition

SDG Ambition, launched at Davos in 2020, establishes the level of ambition that is required by business to deliver on the Sustainable Development Goals (SDGs) by 2030.

The SDG 6 Benchmark is *Net-Positive Water Impact in Water-Stressed Basins*, which helps businesses assess their water use and deliver net-positive water impacts,* especially in highly water-stressed areas (defined by the World Resources Institute as an area where 40% or more of the available supply of water is withdrawn each year (Hofste et al., 2019)). This benchmark enables businesses to assess their impact across freshwater's availability, quality and accessibility, and advocates moving beyond operational to measurable improvements of watersheds in proportion to their local water use and economic impact. Companies must set targets for direct operations' water use in the short term, supporting a pathway to 50% fulfillment by 2030 and 100% fulfillment of net-positive water by 2050 (CEO Water Mandate, n.d.b).

There are eight strategic steps to operationalize the SDG Ambition benchmarks (Figure).

Strategic steps to operationalize the SDG Ambition benchmarks



Source: UN Global Compact (2020, fig. B, p. 17).

* A net-positive water impact "contributes toward reducing water stress in its three dimensions: availability (quantity), quality, and access[ibility]. It ensures the company's contributions [continually] exceed impacts on water stress in the same region" (CEO Water Mandate, n.d.a).

• • •
Companies within industries that rely heavily on water for their core business have become increasingly attuned to water stress and the risks it poses to business interests

Nestlé, the world's largest food and beverage company, explains that industrial trends are *"shifting from an isolationist mindset to a more collective approach. ... This change reflects a growing realization taking place globally that water is not a confined commodity, rather a shared resource, and unless collective action is taken, the positive impact on water resources will remain minimal. For business water users this means looking at your water risks not just within your fence line, but at a catchment level"* (AWS, 2020, p. 5).

In practice, the motivating factors behind any company's participation in collective action vary (Enright et al., 2018). According to the CEO Water Mandate's analysis (2013) and research by Nelson (2017), industry will typically embrace collective action with interested parties for:

- Coherent articulation of the problem, shared ownership of solutions, and clarity of joint purpose;
- Better-informed decision-making by all parties to the effort;
- A larger pool of expertise and increased capacity to focus on fostering change;
- Access to partner assets (new networks, technical support and complementary skills; new technologies; data and information);
- Lasting outcomes, due to support from the engaged parties;
- Credibility, legitimacy and visibility among key interested parties, bolstering its legal and social license to operate;
- Stronger, more sustainable governance as a result of the engagement of multiple stakeholders;
- Involvement in larger and more significant projects;
- The ability to leverage financial resources, including access to donor funding and pooling of resources that can be mobilized and optimized toward a common purpose;
- Opportunities to shape industry standards, influence and garner political support, and encourage behavioural change; and
- Fresh ideas and perspectives for solving a problem.

5.4 Elements of collective action

Collective action for industry can take many forms, ranging from a relatively informal exchange of perspectives to highly structured processes of joint decision-making, implementation and accountability (CEO Water Mandate, 2013). Box 5.2 shows some of the contributions industry can bring to a collective action for sustainable development. Given the long-term nature of partnership building and system change, most collective actions remain at an early stage. Rigorous analysis of their impacts, and of what works or not, is therefore not readily available (Nelson, 2017).

Typically, interested parties must have a shared sense of risk, responsibility and benefit for collective action to be successful. The potential advantages of acting with others to manage water-related risks or capture opportunities for WSIs must be weighed against the potential challenges and complexities of consulting other parties, sharing information, making joint decisions or commitments, and sharing responsibility for implementation. According to the CEO Water Mandate, *"Companies engaging in collective action can face a host of vulnerabilities, including additional public scrutiny, unrealistic expectations and skepticism about motives. Done poorly, collective action can undermine a company's reputation, tarnish product brands and exacerbate existing problems"* (CEO Water Mandate, 2013, p. 2). For collective action to

Box 5.2 What can industry bring to a collective action?

- Cutting-edge experience/ know-how in specific industry sectors
- Products, services and technology
- Brand power
- Access to markets and value chains/distribution networks to take a solution to scale
- Leveraging of scarce public funding and mobilization of private capital
- Infrastructure and logistics
- Managerial and operational experience
- Policy influence
- Risk management and appetite for risk
- Intervention sustainability (extended investment horizons beyond short-term project cycles)
- Solutions mindset and focus on results
- Access to customers, employees, suppliers, peer companies, investors and training providers

Sources: UNIDO (2013) and Stibbe and Prescott (2020).

be effective, companies typically have to establish unconventional relationships with non-traditional partners. There must be a commitment to shared goals and a recognition of the potential for trade-offs between company interests and broader public benefits. Collective action (Box 5.3) requires companies to develop new skills and knowledge, such as greater understanding of community needs and values, and enhance their ability to connect with government actors and non-governmental organizations (NGOs) (CEO Water Mandate, 2013).

The CEO Water Mandate (2013) proposes the following collective action engagement levels:

- *Informative*: coordinating the sharing of information for expanded knowledge and increased transparency, familiarity and trust;
- *Consultative*: convening specific interested parties to exchange ideas and expertise, and to create a shared understanding of needs, interests and challenges to enable informed, independent decisions;
- *Collaborative*: bringing interested parties closer together to find common ground and objectives, and increasing individual and collective effectiveness by sharing implementation responsibilities; and
- *Integrative*: a formal joint structure when an alignment of interests, resources, decision-making and coordinated actions to meet water-related challenges or opportunities is needed.

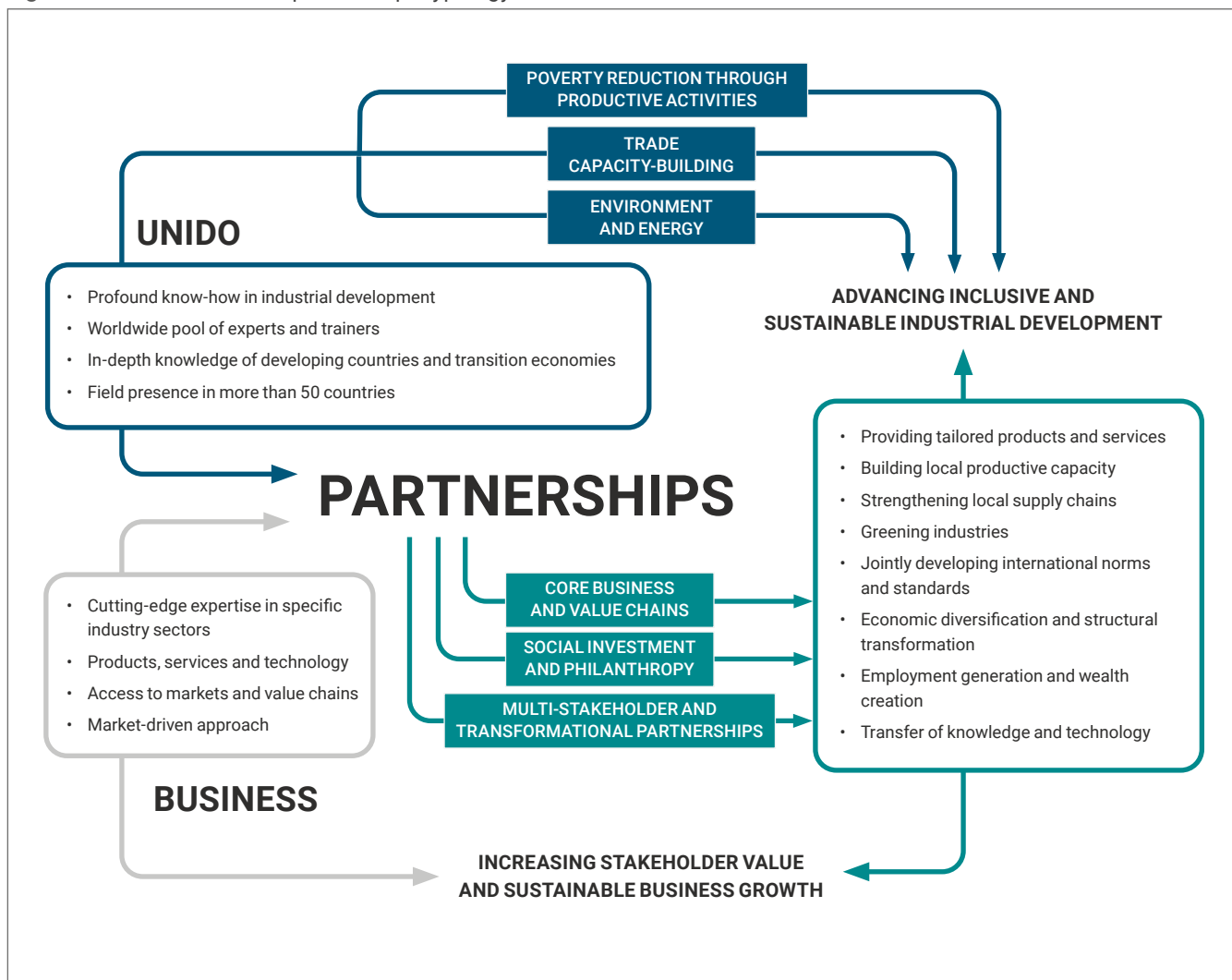
With a long history of working with industry, the United Nations Industrial Development Organization (UNIDO) has developed a classification (Figure 5.1) of three collective action scenarios (upon which this chapter builds further, using a framework presented by the UN Global Compact for collaboration between the United Nations and the private sector) that can be considered from the perspective of SDG 6, as follows:

(1) Core business and value chain partnerships

These partnerships harness the core strengths of industry and/or change the way industry operates to be more in line with development goals (UNIDO, 2013). The aim is to “[create] *positive shared value for host countries and communities by mobilizing the innovative technologies, processes, products and skills of industry to help achieve international goals [such as SDG 6] through what are increasingly called ‘inclusive business models,’ ‘base of the pyramid models,’ or ‘creative capitalism’*” (UN Global Compact, 2008).

These alliances “*can be commercially viable from the outset, or they may require various forms of seed or venture financing, or hybrid approaches that include ongoing public, donor or philanthropic support*” (UN Global Compact, 2008). Key development multipliers from core business operations can include producing safe and affordable products and services; generating income and investment; creating jobs; developing human resources; fostering entrepreneurship (including women empowerment) and building local businesses and business linkages; spreading responsible

Figure 5.1 UNIDO business partnerships typology



Source: Adapted from UNIDO (2013).

business standards and practices; supporting technology development and transfer; establishing physical and institutional infrastructure; and participating in collective platforms (UN Global Compact, 2008). For large companies with operations and subsidiaries in numerous countries, or a sizable market share and influence in their industries, cooperating more systematically with business partners along their value chains can have a substantial scaling impact (Nelson, 2017).

(2) Social investment and philanthropy partnerships

These partnerships provide different types of non-commercial financial support, including traditional philanthropy, social venture funds, hybrid or blended-value financing mechanisms, or employee volunteers. They can also contribute core industry expertise, products or services to the public cause (UNIDO, 2013). Activities can include: building the capacity of community leaders and social entrepreneurs; training local technical specialists; enhancing the governance capacity and voice of local civil society groups and media organizations; supporting multicultural education and awareness programmes; establishing and supporting micro-credit programmes and small business initiatives (UN Global Compact, 2008); and promoting gender equality and providing opportunities for marginalized groups.

Box 5.3 The CEO Water Mandate's *Guide to Water-Related Collective Action*

The CEO Water Mandate, an initiative of the UN Global Compact in partnership with the Pacific Institute, is an umbrella programme that encourages individual corporations to join its network, use its resources to address water issues, and advance corporate water stewardship. It provides opportunities for collective action at many levels and its *Guide to Water-Related Collective Action* introduces the idea that success in responsible engagement is critically tied to effective collective action among all parties with a stake in sustainable water management at the relevant scale – local, regional, national or international. The Guide provides a five-element process to approaching collective action:

1. Scoping the water challenges and action areas;
2. Identifying and characterizing the interested parties;
3. Engaging all interested parties in the challenges and action areas at a level of involvement to deliver the results and benefits;
4. Designing the collective action engagement; and
5. Structuring and managing the collective action.

The CEO Water Mandate also provides an online platform, the Water Action Hub, which has a mapping function and assists organizations in identifying potential collaborators, such as businesses, relevant governments, non-governmental organizations (NGOs) and local communities, to improve water management in watersheds of critical strategic interest.

Source: CEO Water Mandate (2013).

(3) Multi-stakeholder and transformational partnerships

These partnerships enable dynamic processes for issue-focused consultation and scalable operations among numerous private and public parties, and help to include industry representatives in governance structures (UNIDO, 2013). Such partnerships allow “*individual companies or business associations engaging in advocacy, public policy dialogue, joint regulation, and efforts to build or strengthen public institutions and administrative capacity in order to bridge governance gaps, improve the enabling environment, and support more systemic change at the local, national or global level*” (UN Global Compact, 2008, p. 4). Activities can include supporting local and national governments to protect human rights, making public administration and service delivery more efficient, and improving the fairness and transparency of regulation; engaging in global dialogue on water issues; and advocating for increased quantity and quality of donor aid to developing countries (UN Global Compact, 2008).

Because businesses generally do not publish their unsuccessful attempts or failures at collective action, explicit lessons from collective actions are not easily drawn. Collective actions for WSIs involving industry are also still relatively new. “*As such the evidence regarding their efficacy is still limited and much work has been through a process of trial and error. And many still question whether corporate engagement is anathema to sustainable and equitable water management arguing, for instance, that it can lead to policy and resource capture [undue influence on decision-making, skewing of public policy priorities, or privileged access to water resources] or provide companies with increased access to decision-makers and information*” (CEO Water Mandate/WIN, 2015, p. 5).

The CEO Water Mandate and Water Integrity Network (WIN) recognized that WSIs, which require a lot of collective action, would be subject to many pitfalls and so produced a document titled *Guide for Managing Water Integrity in Water Stewardship Initiatives: A Framework for Improving Effectiveness and Transparency* to support existing and future WSIs in creating tangible benefits for society by ensuring high levels of integrity and transparency. The document notes that

“WSIs with integrity ideally have: (1) Clear objectives and demonstrable outcomes that advance sustainable water management; (2) Trustworthy, credible and accountable participants; [and] (3) Inclusive, transparent and responsive processes and governance that lead to informed and balanced decision making” (CEO Water Mandate/WIN, 2015, p. 13). WSIs that fail often do not have one or more of these dimensions.

5.5 Examples of industry collaboration

The format of collective actions in industry is demonstrated in three major ways: intra-, multi- and extra-sectoral partnerships and cooperation, as defined previously in the report (Chapter 1). These are illustrated by examples in the four boxes (5.4, 5.5, 5.6 and 5.7) that follow.

Box 5.4 Partnering to achieve the world’s first Alliance for Water Stewardship Group certification

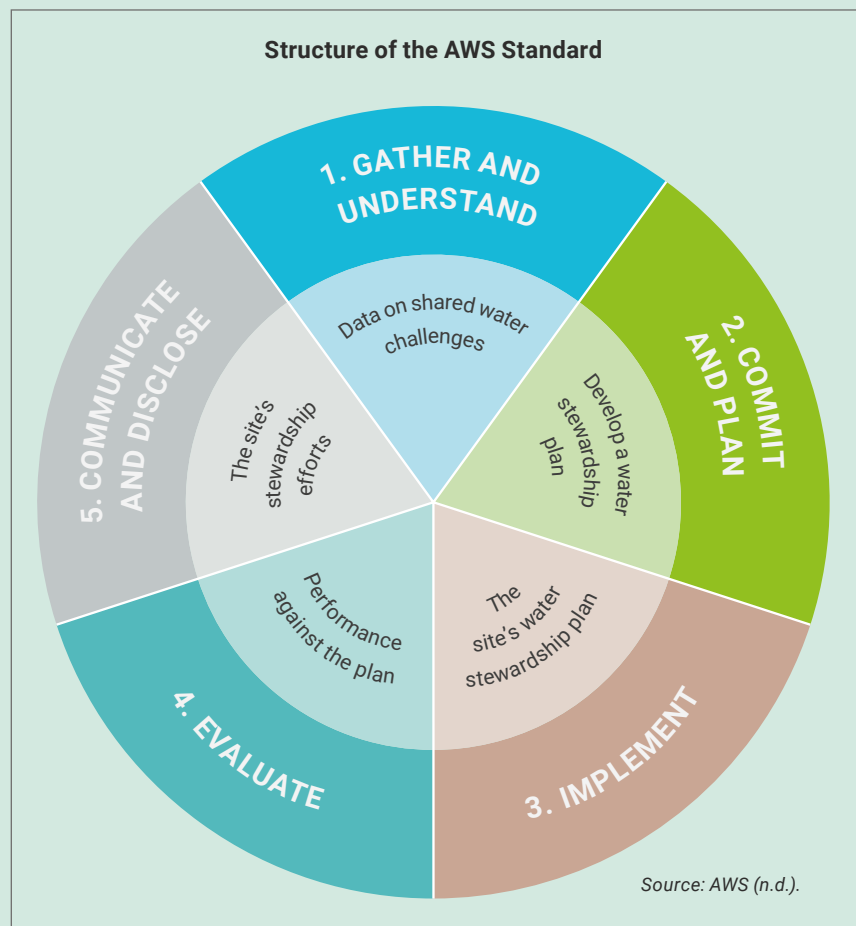
The Alliance for Water Stewardship (AWS) Standard is a framework for major water users in a catchment area to understand their own water use and impacts, and to work collaboratively and transparently with others towards sustainable water management – driving social, environmental and economic benefits. Implementing the AWS Standard can help industry understand water dependencies and impacts; mitigate operational and supply chain water risks; ensure that responsible water procedures are in place; build relationships with local water-related stakeholders; and address challenges shared with others in a catchment.

The food retailer Edeka has partnered with the World Wildlife Fund for Nature (WWF) to apply the AWS Standard to drive good water stewardship practices in its supply chain. The partners worked with Dole Food Co., one of the largest producers of fruit and vegetables in the world and a key supplier to Edeka, to implement the AWS Standard on eleven privately owned banana farms in Colombia.

The farms are located in the Frío-Río Sevilla catchment, where high water demand from agriculture is causing pressure on water resources, especially during the three months of the dry season.

The eleven banana farms worked together to achieve the first AWS Standard Group Certification in the world (2020), which was drawn up through dialogues between various actors, such as banana producers, local communities, parish governments and producers from other agricultural sectors in the area. It has helped the banana producers understand their water risks; identify and implement clear activities toward collective action to minimize them – thereby improving their operational, regulatory and reputational performance and minimizing unaccounted expenses; and become a driver of positive change that delivers long-lasting benefits beyond the farm level.

Source: Adapted from AWS (n.d.) and Vatter et al. (2021).



Box 5.5 Igniting a CEO-driven initiative: The Water Resilience Coalition

The CEO Water Mandate has partnered with a number of leading global companies from the beverage, technology and garment manufacturing sectors, among others, that use water in their own operations or in their value chains (including AB InBev, Diageo, Dow Chemical Co., Ecolab, Gap Inc., Microsoft and PVH Corp.) to launch an industry-driven, CEO-led initiative: the Water Resilience Coalition. Founded in 2020, the Coalition, through collective action, will ground its work in building the resilience of water-stressed basins around the world – prioritizing those that pose the greatest risk to local communities and economies, industry, and long-term economic prosperity.

Companies that join the Water Resilience Coalition sign a pledge to make the needed investments in their own operations, and work together through collective action, to meet three overarching commitments by 2050:

- **Net-positive water impact:** Deliver measurable net positive impact in water-stressed basins, defined as contributing more to the availability, quality and accessibility of a basin's freshwater resources than what is taken from it;
- **Water-resilient value chain:** Develop, implement and enable strategies to support leading impact-based water resilience practices across the global value chain; and
- **Global leadership:** Raise the ambition of water resilience through public and corporate outreach, and inspire other industry leaders to join the Coalition.

Coalition members are expected to work together, share their knowledge and participate in collective action projects in water-stressed basins to achieve their pledge commitments. By 2030, the expectation is that members will enable water resilience actions and outcomes in the parts of their value chain with the largest water dependencies and impacts. By 2050, coalition members will be working with all value chain partners with significant water use/impacts to encourage net-positive water impact. More than 25 companies have joined the Coalition as of July 2022.

Source: CEO Water Mandate (n.d.c).

Box 5.6 Personal Advancement and Career Enhancement (PACE) programme for women

According to UN-Water *“Effective planning, implementation and monitoring of water and sanitation depends on engaging with the whole of society, especially the involvement of women and young people and the integration of gender equality considerations. [Therefore, to accelerate SDG 6] Opportunities, such as engaging women to build skills for maintenance of water provision systems with water operators, must be expanded.”* (UN-Water, 2020, p. 7). Industry is uniquely positioned to accelerate gender equality in the water domain, may it be individually or in partnership with other entities.

Worldwide, women comprise approximately 80% of garment workers in the apparel industry, which is *“also responsible for roughly one-fifth of [global] freshwater pollution. For example, manufacturing processes such as dyeing and finishing garments are sometimes poorly regulated and can result in impacts to surrounding community water resources. Many of the countries where apparel production is based also face underlying challenges in meeting the health, economic, and natural resource management needs of their populations. A significant factor that contributes to women’s disadvantages in many of these countries is the disproportionate burden that women bear for household responsibilities, particularly related to water, sanitation, and hygiene (WASH). Women and girls collectively spend more than 150 million hours collecting water and face serious health risks due to inadequate access to safe drinking water and sanitation facilities, and poor understanding of healthy hygiene practices. Addressing these issues provides an opportunity to strengthen women’s lives”* (USAID, n.d.).

Gap Inc. launched its Personal Advancement & Career Enhancement (PACE) programme for women in vendor facilities in 2007, to support their professional and personal growth through education and skills training. A WASH curriculum was added in 2014 (Nanda et al., 2014). In 2017, Gap Inc. in partnership with the United States Agency for International Development (USAID) expanded its efforts to the watershed level with the Women + Water (W+W) Alliance, a five-year programme aimed at improving the health and well-being of women and communities touched by the apparel industry through improved WASH services. To help build community water resilience, W+W Alliance partners the Cooperative for Assistance and Relief Everywhere (CARE), water.org, WaterAid and the Institute for Sustainable Communities work to help build women’s self-efficacy with trainings and resources to advocate for their water needs, to improve awareness and access to water and sanitation, and to train cotton farmers to incorporate water stewardship into their farming practices (Gap Inc., 2021).

For the 2017 through January 2022 period, the Alliance empowered more than 1.5 million people to improve their access to clean water and sanitation. The initiative has also led to the following impacts: 162,174 women enrolled in PACE self-efficacy training; 2,198 Village Action Plans developed for local water access; 10,244 women and youths trained on water quality testing; 66,100 affordable loans made; US\$12.8 million in financing catalysed for water and sanitation; 4,140 farmers trained on good operating practices for sustainable cotton cultivation; and 260 women entrepreneurs supported to sell farmers bio-based fertilizer and pesticides (USAID, n.d.).

Box 5.7 Google's flood forecasting initiative

As part of a crisis response programme that aims to provide trusted information and resources in critical moments, Google began a flood forecasting initiative in 2018, with the goal of preventing catastrophic damage by equipping those in harm's way with accurate and detailed alerts. Working in partnership with the Indian Central Water Commission and the Bangladesh Water Development Board, it initially covered areas of India and Bangladesh with a population of 220 million, to send out 40 million potentially life-saving alerts. Previous global flood alerts provided only information on how much rivers would rise, which was not always meaningful to the people who were at risk. Google's flood alerts visualize this critical information by overlaying the extent and depth of potential flooding right on Google Maps.

In 2021, the initiative expanded to cover an area with over 360 million people and send more than 115 million alerts, using more advanced flood prediction technology. The company has also partnered with local aid organizations such as the International Federation of Red Cross and Red Crescent Societies, the Indian Red Cross Society, the Bangladesh Red Crescent Society, and Yuganter to help reach people without smartphones or internet access. Google worked closely with these organizations to provide training in local villages on how to read the alerts and flood maps, as well as how to act and notify others once an alert is issued. The flood forecasting system is now live throughout India and Bangladesh, and Google is working to expand to other countries in South Asia and South America.

Source: Matis (2021).

5.6 Energy sector

The energy sector, particularly power generation, conventionally uses much water and its efforts to decarbonize have an impact on water in countries of all income levels. The effects of drought and water scarcity have large repercussions on cooling water for thermal generation and on reservoirs for hydropower (see UNESCO/UN-Water, 2020, Table 7.2). Decarbonization, particularly through renewables, is reflected through the SDG 6 targets concerning water quality, water use efficiency, integrated water resources management and water-related ecosystems. However, in low-income countries and water-stressed areas, there is an added dimension of safe drinking water and sanitation, where poor water availability or poor access can be mitigated by providing increased access to electricity. This means water can be pumped and moved more efficiently, thus improving the lives of people – particularly benefiting women who would otherwise spend much time and effort obtaining water. This shows that the energy sector does not work in a vacuum, as collective action in water basins can be beneficial to all (Box 5.8).

5.7 Small and medium enterprises

There are approximately 400 million small and medium enterprises (SMEs)²³ globally, representing about 95% of companies and providing 60% to 70% of employment (National Action Plans on Business and Human Rights, n.d.). The International Finance Corporation (IFC) estimates that there are 9.34 million registered women-owned SMEs in over 140 assessed countries in the non-agricultural sector (IFC, 2014).

SME Connect, a network of SMEs in the European Union, has an SDG 6 working group, which aims, among other things, to “*build networks of knowledge and support better water policy/regulations in Europe and worldwide*” (SME Connect, n.d.). This includes finding solutions for challenges related to industrial wastewater.

²³ Small enterprises have less than 50 employees; medium enterprises less than 250 (National Action Plans on Business and Human Rights, n.d.).

Box 5.8 Cooperation between a public utility (Hydro-Québec) and the Cree First Nation of Québec, Canada: A sustainable path for the community and the environment

Hydro-Québec launched the Eastmain-1-A/Sarcelle/Rupert project to partially divert the Rupert River's flow northward. The goal was to increase generating capacity and build two new powerhouses while preserving the surrounding environment and respecting the host communities. From the design stage, Eastmain-1-A/Sarcelle/Rupert incorporated many environmental protection measures, reflecting the traditional knowledge of the Cree community members consulted. The Cree Nation of Québec were involved in all stages of the project, ensuring they had a voice in how their land would be impacted. A combination of dykes and canals was necessary to improve the water flow, which ensured that the project, which diverts 71% of the river, flooded the smallest possible land area. Hydro-Québec also incorporated a substantial ecological in-stream flow and a series of weirs in the river to protect biological diversity, preserve the landscape, and maintain navigation and other activities in the area. Hydro-Québec also signed an unprecedented water management agreement with the Cree to ensure that the modulation of the ecological in-stream flow was managed in a cooperative manner. Throughout construction, which began in 2007, more than US\$700 million in contracts were awarded to Cree companies. In 2002, the Boumhounan Agreement put in place an extensive participation programme built around information and consultation with Cree stakeholders. In 2014, after project completion, the Reappropriation Agreement was signed, giving Cree land users the necessary support to maintain their traditional activities as long as the Rupert River diversion continues in operation.

Source: Adapted from WaterPower Canada (2015).

The World Wildlife Fund for Nature (WWF) is involved in collective action with SMEs to implement water stewardship in China, India and Pakistan, as well as several lower-income countries. In China, the textile and dyeing industry was prioritized, particularly in industrial parks (a form of collaboration in themselves). With the help of an international clothing company, a pilot project was established in one industrial park. One objective was to *“improve the water stewardship performance of SMEs individually and collectively”*. A local dyeing association of 23 companies has been engaging with local government. The *Industrial Park Water Stewardship Guidance* has been developed and, by the end of 2016, a total of 346 SMEs had been engaged. WWF also convened a multi-stakeholder water stewardship platform of various levels of government, international companies, SMEs, NGOs and academia (WWF, 2017).

5.8 The way forward

Achieving SDG 6 is an ambitious vision. As more and more businesses choose that vision as their roadmap to growth, general confidence in reaching the SDGs will grow, creating powerful incentives for companies, governments and other stakeholders to plan and invest accordingly (Business and Sustainable Development Commission, 2017). But while leadership by individual companies is necessary to accelerate action toward SDG 6, it is not sufficient to drive requisite transformational and systemic change to achieve this goal. Collective action, while not a panacea, is *“needed among companies themselves, working together along global supply chains and on a precompetitive basis in specific industry sectors, issues and locations. It will also be needed on a cross-sector basis among companies, governments and civil society organizations”* (Nelson, 2017, p. 5). Businesses anticipating that future in the strategic choices they make today are more likely to thrive and unlock the opportunities that a more environmentally stable and socially inclusive planet can bring.

References

- 2030 Water Resources Group. 2009. *Charting Our Water Future: Economic Frameworks to Inform Decision-Making*. Executive Summary. 2030 Water Resources Group. <https://2030wrg.org/charting-our-water-future-economic-frameworks-inform-decision-making/>.
- AWS (Alliance for Water Stewardship). 2020. *Case Study: Implementing the AWS Standard. Nestlé Sheikhpura, Pakistan South Asia*. AWS. <https://a4ws.org/download/implementing-the-aws-standard-nestle-sheikhpura-pakistan/>.
- _____. n.d. *The AWS International Water Stewardship Standard*. <https://a4ws.org/the-aws-standard-2-0/>.
- Burek, P., Satoh, Y., Fischer, G., Kahil, M. T., Scherzer, A., Tramberend, S., Nava, L. F., Wada, Y., Eisner, S., Flörke, M., Hanasaki, N., Magnuszewski, P., Cosgrove, B. and Wiberg, D. 2016. *Water Futures and Solution: Fast Track Initiative (Final Report)*. IIASA Working Paper. Laxenburg, Austria, International Institute for Applied Systems Analysis (IIASA). <http://pure.iiasa.ac.at/id/eprint/13008/1/WP-16-006.pdf>.
- Business and Sustainable Development Commission. 2017. *Better Business Better World. The report of the Business and Sustainable Development Commission*. London, Business and Sustainable Development Commission. <https://sustainabledevelopment.un.org/content/documents/2399BetterBusinessBetterWorld.pdf>.
- CDP. 2018. *Treading Water: Corporate Responses to Rising Water Challenges*. CDP Global Water Report 2018. London, CDP Worldwide. www.cdp.net/en/research/global-reports/global-water-report-2018.
- _____. 2021. *A Wave of Change: The Role of Companies in Building a Water-Secure World*. CDP Global Water Report 2020. London, CDP Worldwide. www.cdp.net/en/research/global-reports/global-water-report-2020.
- CEO Water Mandate. 2013. *Guide to Water-Related Collective Action*. The CEO Water Mandate. https://ceowatermandate.org/wp-content/uploads/2019/07/Water_Guide_Collective_Action.pdf.
- _____. n.d.a. *NPWI (Net Positive Water Impact)*. <https://ceowatermandate.org/resilience/net-positive-water-impact/>.
- _____. n.d.b. *Net-Positive Water Impact in Water-Stressed Basins*. https://ceowatermandate.org/resilience/wp-content/uploads/sites/37/2022/03/SDG_Ambition_Water_200923.pdf.
- _____. n.d.c. *Water Resilience Coalition*. Launch Announcement. <https://ceowatermandate.org/resilience/launch-announcement/>.
- CEO Water Mandate/WIN (Water Integrity Network). 2015. *Guide for Managing Integrity in Water Stewardship Initiatives: A Framework for Improving Effectiveness and Transparency*. The CEO Water Mandate/WIN. <https://ceowatermandate.org/files/integrity.pdf>.
- Enright, S., Oger, C., Pruzan Jorgensen, P. M. and Farrag-Thibault, A. 2018. *Private Sector Collaboration for Sustainable Development*. Research Report. San Francisco, Calif., BSR. www.bsr.org/en/our-insights/report-view/private-sector-collaboration-for-sustainable-development.
- Gap Inc. 2021. *1 Million People Have Improved Access to Water Through The USAID Gap Inc. Women+Water Alliance*. www.gapinc.com/en-us/articles/2021/11/1-million-people-have-improved-access-to-water-thr.
- Hofste, R. W., Reig, P. and Schleifer, L. 2019. *17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress*. World Resources Institute (WRI) website. www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress.
- IFC (International Finance Corporation). 2014. *Women-Owned SMEs: A Business Opportunity for Financial Institutions. A Market and Credit Gap Assessment and IFC's Portfolio Gender Baseline*. Washington, DC, IFC. www.ifc.org/wps/wcm/connect/44b004b2-ed46-48fc-8ade-aa0f485069a1/WomenOwnedSMes+Report-Final.pdf?MOD=AJPERES&CVID=kiiZZDZ.
- IEA (International Energy Agency). 2016. *Water-Energy Nexus, Excerpt from the World Energy Outlook 2016*. Paris, OECD/IEA. www.iea.org/reports/water-energy-nexus.
- _____. 2018. *World Energy Outlook 2018*. Paris, OECD/IEA. www.iea.org/reports/world-energy-outlook-2018.
- _____. n.d. *Energy and Water. Exploring the Interdependence of Two Critical Resources*. IEA website. www.iea.org/topics/energy-and-water.
- Matis, Y. 2021. *Expanding Our ML-Based Flood Forecasting*. Google. <https://blog.google/technology/ai/expanding-our-ml-based-flood-forecasting/>.
- Nanda, P., Mishra, A., Walia, S., Sharma, S., Weiss, E. and Abrahamson, J. 2013. *Advancing Women, Changing Lives: An Evaluation of Gap Inc.'s P.A.C.E. Program*. Washington, DC, International Center for Research on Women (ICRW). www.icrw.org/publications/advancing-women-changing-lives/.
- National Action Plans on Business and Human Rights. n.d. *Small and Medium-Sized Enterprises*. National Action Plans on Business and Human Rights website. <https://globalnaps.org/issue/small-medium-enterprises-smes/>.
- Nelson, J. 2017. *Partnerships for Sustainable Development: Collective Action by Business, Governments and Civil Society to Achieve Scale and Transform Markets*. London/Cambridge, USA, Business and Sustainable Development Commission/Harvard Kennedy School. www.hks.harvard.edu/centers/mrcbg/programs/crri/research/reports/report73.
- OECD (Organisation for Economic Co-operation and Development). 2012. *OECD Environmental Outlook to 2050: The Consequences of Inaction*. Paris, OECD Publishing. doi.org/10.1787/9789264122246-en.
- Ritchie, H., and Roser, M. 2017. *Water Use and Stress*. Our World in Data. <https://ourworldindata.org/water-use-stress#licence>.
- SME Connect. n.d. *Working Group SDG6*. SME Connect website. www.smeconnect.eu/working-groups/sdg6/.
- Stibbe, D. and Prescott, D. 2020. *The SDG Partnership Guidebook: A Practical Guide to Building High-Impact Multi-Stakeholder Partnerships for the Sustainable Development Goals*. New York, The Partnering Initiative/United Nations Department of Economic and Social Affairs (UNDESA). https://sustainabledevelopment.un.org/content/documents/26627SDG_Partnership_Guidebook_0.95_web.pdf.
- TNC (The Nature Conservancy). n.d. *Corporate Water Use*. Conservation Gateway. www.conservationgateway.org/ConservationPractices/Freshwater/CorporateWaterUse/Pages/corporate-water-use.aspx.

- United Nations. 2022. *The United Nations World Water Development Report 2022: Groundwater: Making the Invisible Visible*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- UNESCO (United Nations Educational, Scientific and Cultural Organization)/UN-Water. 2020. *The United Nations World Water Development Report 2020: Water and Climate Change*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000372985.locale=en>.
- UN Global Compact. 2008. *The United Nations and the Private Sector: A Framework for Collaboration*. New York, United Nations. www.un.org/millenniumgoals/2008highlevel/pdf/background/UN_Business%20Framework.pdf.
- _____. 2020. *SDG Ambition: Ambition Guide: Setting Goals for the Decade of Action*. New York, United Nations. <https://unglobalcompact.org/library/5791>.
- UNIDO (United Nations Industrial Development Organization). 2013. *UNIDO Business Partnerships. Partnership and Prosperity*. Vienna, UNIDO. www.unido.org/sites/default/files/2014-01/UNIDO_BPP_English_2013_0.pdf.
- USAID (United States Agency for International Development). n.d. *Women + Water Alliance*. Globalwaters.org. www.globalwaters.org/Women-Water-Alliance.
- UN-Water. 2020. *The Sustainable Development Goal 6 Global Acceleration Framework*. UN-Water. www.unwater.org/app/uploads/2020/07/Global-Acceleration-Framework.pdf.
- Vatter, J., Laporte-Bisquit, A., Camargo, R. and Morgan, A. 2021. *Tackling Growing Water Risks in the Food Sector: How Scenario Analysis can Help Food Retailers Understand Future Risk and Build Resilience*. Water Risk Filer Research Series Volume 2. Berlin, WWF Germany. https://wwfint.awsassets.panda.org/downloads/tackling_growing_water_risks_to_food_sector__wwf_edeka_.pdf.
- WaterPower Canada. 2015. *Paths Forward: Hydropower and Aboriginal Relationships across Canada*. <https://waterpowercanada.ca/wp-content/uploads/2019/06/CHA-PathsForward-en-web-v6.pdf>.
- WWF (World Wildlife Fund for Nature). 2017. *Collective Action for Better Governance: Implementing Water Stewardship with Micro, Small and Medium Enterprises in China, India & Pakistan*. WWF-Pakistan, India & China/WWF Freshwater Practice. WWF. www.wwf.org.uk/sites/default/files/2017-06/170605_SMEs-WS_CS_Final.pdf.

Chapter 6

Health

WHO

Kate Medicott, Betsy Engebretson, Bruce Gordon, Maggie Montgomery,
Joanna Esteves-Mills, Jennifer De France, Rick Johnston and Sophie Boisson

With contributions from:

Xavier Leflaive, Marijn Korndewal and Helen Laubenstein (OECD),
Sanae Okamoto (UNU-MERIT), and Nidhi Nagabhatla (UNU-CRIS)



6.1 WASH and health linkages

Water, sanitation and hygiene (WASH) is crucial for human health and well-being. Global data show that on average, progress needs to be four times faster to meet the promise on safely managed WASH for all by 2030 (WHO/UNICEF, 2020a; 2021a; WHO/UNICEF/World Bank, 2022). WASH and health partnerships are needed to accelerate progress on WASH, and in turn accelerate progress on WASH-related health goals. While there is interdependence between the WASH and health sectors, there are also gaps in coordination and governance stemming from the fact that these sectors are led by different ministries, local authorities, international organizations, non-governmental organizations (NGOs) and private sector actors at all levels. Both areas comprise different disciplines, practitioners, funding streams and institutional arrangements. Therefore, partnerships between WASH and health stakeholders, particularly those that work at the key intersection points as elaborated below, are necessary to optimize and accelerate positive health outcomes, especially among the most vulnerable. As shown in Table 6.1, in 2019, 1.4 million deaths and 74 million disability-adjusted life years (DALYs) were attributable to inadequate WASH globally.

Historically, many health programmes have focused on curative strategies for disease control, such as medication and surgery. However, sustained and cost-effective disease control has proved difficult or impossible without addressing the root causes of disease transmission by preventing, rather than treating, diseases through better WASH services. Partnerships among WASH actors for health outcomes, and between WASH and health programmes, have proven to be an important tool to drive and hold WASH-related diseases down.

Table 6.1 WASH-attributable disease burden by health outcome, 2019

Health outcome	PAF (95% CI)	Deaths (95% CI)	DALYs (in 1000s) (95% CI)
Diarrhoea	69% (65–72%)	1 035 170 (929 178–1 159 750)	54 590 (50 033–59 562)
Acute respiratory infections	14% (13–17%)	355 533 (319 625–404 826)	16 578 (14 257–19 481)
Undernutrition	10% (9–10%)	7 853 (7 171–8 656)	825 (755–905)
Soil-transmitted helminthiasis*	100%**	2 149 (1 897–2 602)	1 942 (1 862–2 028)
Trachoma	100%**	--	194 (175–219)

Note: PAF (population attributable fraction); CI (confidence interval); DALYs (Disability-Adjusted Life Years).

* *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms, ** Assumes 100% of soil-transmitted helminthiasis and trachoma are linked to inadequate WASH.

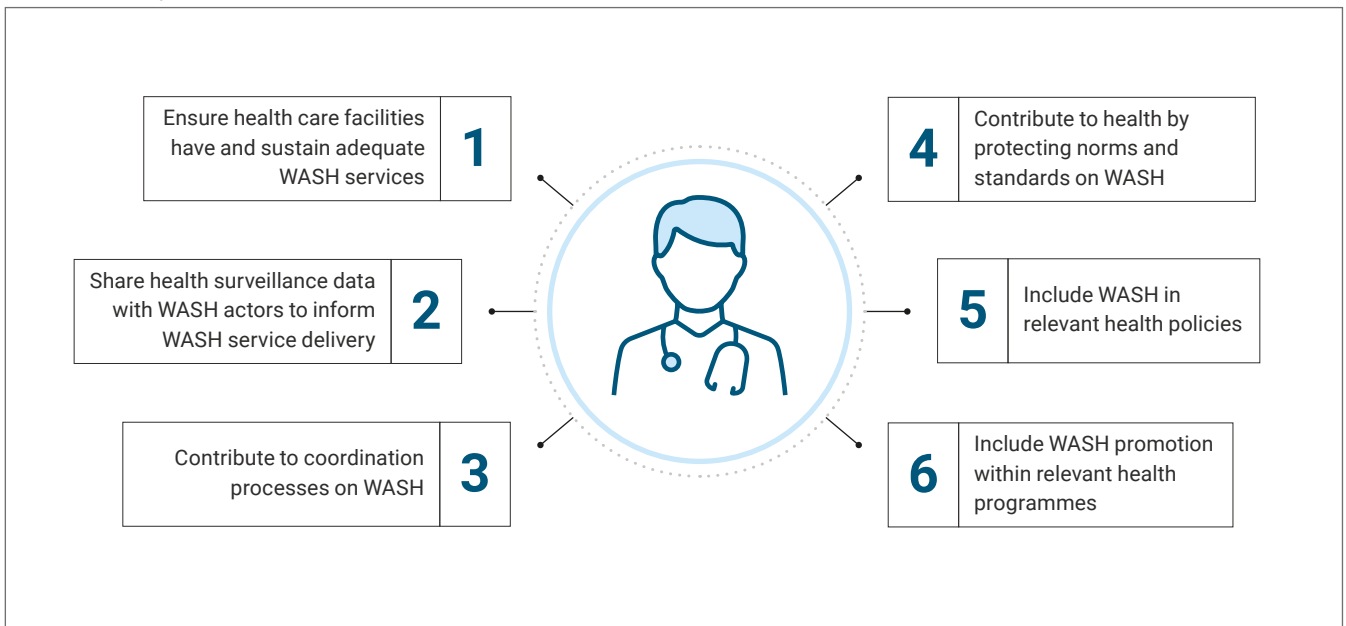
Source: WHO (n.d.).

For WASH–health partnerships to be successful, they need alignment at the scientific and strategic level, and efficiencies at the operational level to allow for focus and meaningful collaboration. Figure 6.1 outlines core functions of the health section in WASH.

Similarly, health sector stakeholders concerned with issues in Figure 6.2 have reasons to engage and partner with WASH.

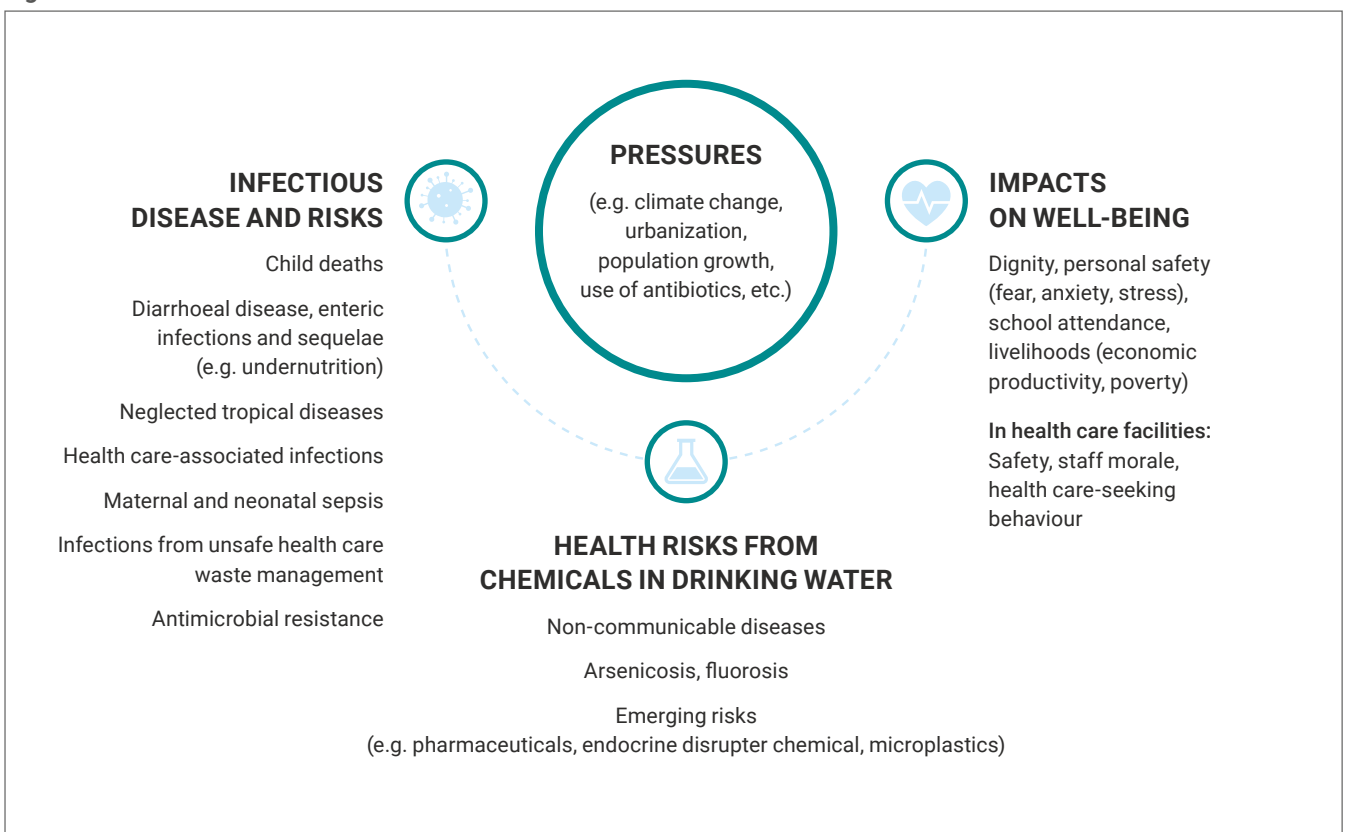
The definition of health extends beyond the absence of disease to also encompass human well-being, which WASH impacts as well. As shown in Figure 6.3, WASH affects antimicrobial resistance (AMR), safety and mental health, food safety and decent work. Working with the health sector is key for achieving the Sustainable Development Goal (SDG) 3 on health. New health risks are emerging from exposure to contaminants of emerging concern (CECs) in water, such as pharmaceuticals, industrial and household chemicals, personal care products, pesticides and manufactured nanomaterials.

Figure 6.1 Key health sector's functions in WASH



Source: WHO (2019, fig. 2, p. 22).

Figure 6.2 WASH-related diseases and risks



Source: WHO (2019, fig. 1, p. 2).

Figure 6.3 Partnerships are key to acceleration on WASH (SDG 6) and progress on many health challenges (SDG 3)

ACCELERATION

CHILD SURVIVAL

More children survive and grow up to be healthy adults.

CHOLERA

Elimination of cholera in 20 countries with recurrent outbreaks and no more uncontrolled outbreaks in fragile settings.

INTESTINAL WORMS

Achievement of global targets for control of neglected tropical diseases stands a greater chance of being met. Infections are less likely to rebound if drug administration is scaled back.

HEALTH SERVICES

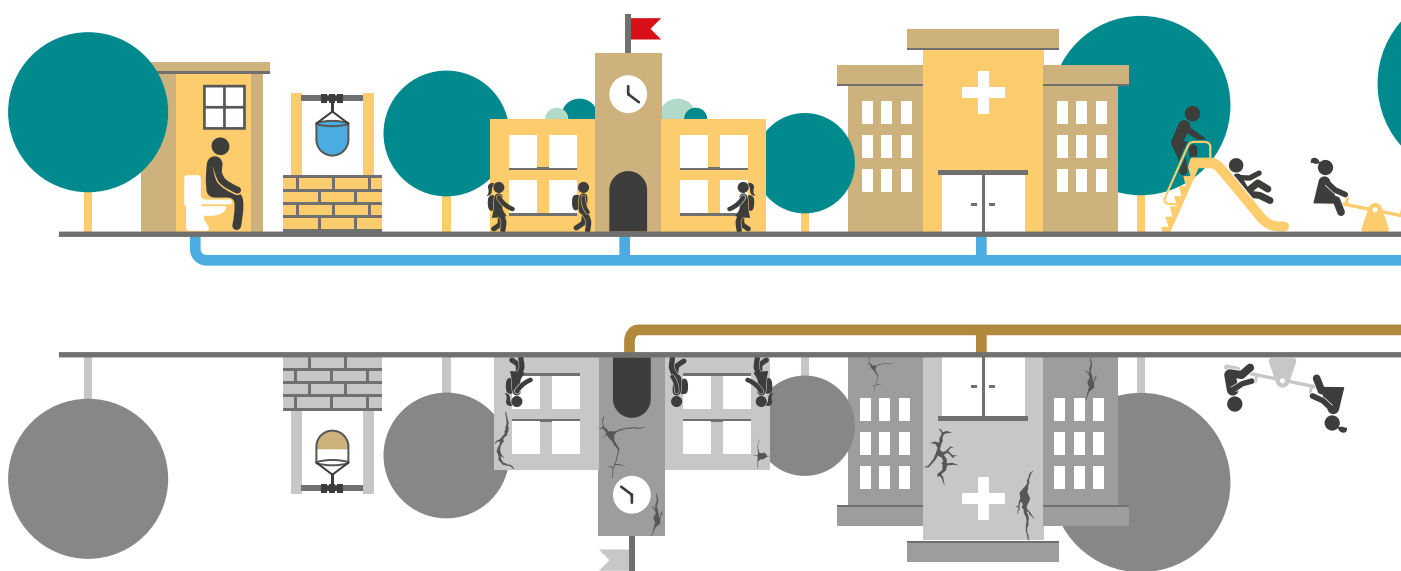
Less stress on health systems.
Higher utilization of health services, particularly among women, due to better facilities. Fewer health care-acquired infections.

POLIO

Polio could become the second human disease in history to be eradicated, freeing humanity from a debilitating virus.

NUTRITION

Children can realize the full benefits of investment in better nutrition, are less stunted, and learn and achieve more at school.



CHILD SURVIVAL

Every year 273,000 children will die from preventable diarrhoeal diseases (WHO, n.d.).

CHOLERA

Outbreaks will continue in hotspots with poor water supply and sanitation. Precious funds will be spent on outbreak response that could be more sustainably spent on safe water and sanitation to fix the underlying cause.

INTESTINAL WORMS

Regular drug administration will keep infections at bay, but people will continue to be reinfected where open defecation and use of untreated wastewater for irrigation are practiced.

HEALTH SERVICES

Health services in communities with poor WASH will be burdened with treating preventable infections. Where health centres lack water supply and sanitation and basic hygiene, women will choose not to give birth there and there will be more infections among patients.

POLIO

The goal of global eradication may remain just out of reach due to re-emergence in areas with poor sanitation.

NUTRITION

Repeated diarrhoea, caused by unsafe WASH, resulting in poor gut function, will prevent people, especially children, from absorbing the nutrients in food needed to grow and thrive.

BUSINESS AS USUAL

Source: Adapted from WHO/UNICEF (2020a, pp. 22–23).

ANTIMICROBIAL RESISTANCE (AMR)

Less antimicrobial use for preventable infections, extending the useful life of the last line of defence antimicrobials. Fewer untreatable WASH-related infections such as drug-resistant typhoid.

SAFETY AND MENTAL HEALTH

Human dignity and safety will be increased and stress levels reduced, contributing to greater social and economic opportunity and a more equal world.

FOOD SAFETY

Safe use of wastewater and sludge in agriculture, horticulture and aquaculture can support nutrition and the circular economy and also reduce use of chemical fertilizers and recover some of the cost of sanitation services.

ENVIRONMENTAL JUSTICE

Communities – particularly those with lower incomes – have a cleaner water environment and healthier neighbourhoods.

CLIMATE CHANGE

Resilient water and sanitation services protect investments in essential WASH services and ensure systems are better prepared to cope with future shocks.

DECENT WORK

Millions of new formalized jobs are created that will sustain sanitation services, contribute to the green economy and protect public health.

RECREATION

Improved WASH services will lead to more opportunities for healthy recreational exercise and well-being, fewer gastrointestinal illnesses, and a cleaner environment with better tourism and greater economic potential.



ANTIMICROBIAL RESISTANCE (AMR)

Hundreds of millions of doses of antimicrobials will be used each year for infections that could have been prevented with better WASH. Wastewater laden with resistant bacteria will continue to spread AMR.

SAFETY AND MENTAL HEALTH

Without safe water and sanitation at home, schools and workplaces, people (especially women and girls) will continue to suffer of anxiety, shame and fear while collecting water or trying to find a safe place to urinate, defecate and manage menstrual hygiene.

RECREATION

Beaches polluted with wastewater will continue to deter or sicken swimmers and damage economies in places that rely on clean water bodies for tourism and sports events.

FOOD SAFETY

Increasing water scarcity and urbanization will increase demand from peri-urban farms for water and nutrients. Unsafe use of wastewater and sludge will cause outbreaks and an increase in chronic foodborne diseases.

ENVIRONMENTAL JUSTICE

Poor and marginalized groups, particularly in low-lying areas, will continue to be disproportionately affected by other people's unmanaged faecal sludge and sewage in their water supplies and communities.

CLIMATE CHANGE

Sanitation systems will become more vulnerable to flooding from storms and sea level rise or may have less water for flushing and conveying sewage. Climate change is also impacting the quantity and quality of source water for drinking water supplies, while extreme events can lead to infrastructure and service disruptions. Even small losses will affect the health of whole communities.

DECENT WORK

Sanitation workers, especially in the informal sector, will continue to suffer indignity and disease and even death though poor working conditions.

6.2 Priority WASH and health partnerships

• • •
For WASH–health partnerships to be successful, they need alignment at the scientific and strategic level, and efficiencies at the operational level to allow for focus and meaningful collaboration

Partnerships addressing WASH and health can be found among actors within the WASH sector, as well as among actors working in other sectors. This section highlights some priority WASH partnerships with health actors, focusing on the nature of the partnership and some of the main guiding strategies and tools, complemented with examples of challenges and successes of the partnerships in accelerating change and driving down diseases. All examples given cover major partnerships with collaboration at global, regional and local scales among international organizations, governments, NGOs, private sector actors and citizens, all with strong local leadership.

6.2.1 WASH in health care facilities

Fully functioning WASH services in health care facilities (encompassing facilities of all sizes, such as hospitals, in- and out-patient health centres, and clinics) are critical to delivery of safe quality care and for effectively responding to outbreaks and pandemics, including COVID-19. Such services are also essential for creating an environment that supports dignity, equity and human rights, especially for mothers, newborns, children and care providers. Shockingly, major gaps in basic WASH still exist, with 1.8 billion people using health care facilities that lack basic water services and 780 million using facilities with no toilets globally in 2021 (WHO/UNICEF, 2022). The COVID-19 pandemic has exposed gaps in these basic services but also drew attention to the need for greater support for WASH in all settings. A recent price-tag analysis led by the World Health Organization (WHO) also found that costs required to ensure universal access to WASH in health care facilities in least developed countries is modest (US\$6.5–9.6 billion over 10 years) compared to existing government health and WASH spending (Chaitkin et al., 2022).

The provision of WASH in health care facilities is a health sector responsibility. However, until recently it was neglected due to health actors either not accepting the role, not knowing how to develop and maintain WASH services, or being overwhelmed with curative tasks. Partnership with WASH was needed to accelerate and guide progress.

WHO and the United Nations Children’s Fund (UNICEF) lead global efforts with global national and local health and WASH partners on WASH and health care facilities, and are working to improve the situation through three main pillars of work: (i) Global leadership, advocacy and knowledge exchange;²⁴ (ii) Technical support, tools²⁵ and country capacity-building; and (iii) Monitoring and accountability of country actions²⁶ in line with commitments made in the 2019 World Health Assembly Resolution on WASH in health care facilities. In addition, the WHO/UNICEF Joint Monitoring Programme (JMP) provides robust data on WASH services in health care facilities²⁷ through their data portal and regular reports.

In 2022, a particular focus was given to supporting national WASH and health system actors to unlock key bottlenecks particularly relating to budgets and financing. Focus was also given to further integrate WASH into health systems and quality of care efforts through the Global WASH in Health Care Facility Taskforce and an updated Water and Sanitation for Health Facility Improvement Tool (WASH FIT) package.²⁸ Over 40 countries are already using WASH FIT and the new, state-of-the-art package will support existing and new facility improvement efforts to address climate resilience, environmental sustainability, gender and equity as part of incremental, risk-based WASH and waste improvements.

²⁴ For more information, please see: www.washinhcf.org/.

²⁵ For more information, please see: <https://washinhcf.org/wash-fit/>.

²⁶ For more information, please see: <https://washinhcf.org/country-progress-tracker/>.

²⁷ For more information, please see: <https://washdata.org/data/healthcare#!/>.

²⁸ For more information, please see: <https://washinhcf.org/wash-fit/>.

While there has been success in conducting situational analyses, updating standards and setting baselines, with more than 60% of countries reporting progress on these actions, development and implementation of costed country roadmaps and integration of WASH into health systems monitoring and budgeting is still far from optimal (less than 30% of countries) (WHO/UNICEF, 2020b; 2022). Countries like Ghana, Indonesia and the Philippines provide important examples of how developing and implementing national roadmaps, rolling out WASH FIT nationally, and integrating and regularly monitoring WASH in health care facilities as part of wider universal health coverage efforts can be done (WHO/UNICEF, 2020b). Further examples and continued advocacy and leadership at every level are needed to support more widespread and sustainable uptake of this work by the health sector.

6.2.2 Neglected tropical diseases

WASH is critical in the prevention and management of many neglected tropical diseases (NTDs) scheduled for intensified control, elimination or eradication by 2030 under the global NTD roadmap. Sanitation in particular plays a key role in preventing diseases such as soil-transmitted helminth infections, schistosomiasis or trachoma, while safe water and hygienic conditions in health facilities and in homes are essential for the management and care of many NTDs (WHO, 2020). Partnerships on WASH are essential to prevent NTDs that are close to elimination from bouncing back when treatment interventions, such as mass drug administration, are eventually scaled back.

The WASH and NTDs partnership includes WHO and its Member States, academia, donors, NGOs (spearheaded by the NGO Network on NTDs (NNN)²⁹) and pharmaceutical companies donating medications for treatment of some NTDs. In 2015, the partnership was strengthened with the WASH and NTD Strategy 2015–2020 to guide cross-sectoral collaboration, and for the first time the new 2021–2030 NTD roadmap included specific WASH-related targets to incentivize collaborative action along with an updated WASH and NTD strategy (WHO, 2021a; Boisson et al., 2021). Translating a will to collaborate into concrete action requires tools and sustained effort. The *WASH and Health Working Together* toolkit developed by the NNN with WHO provides tools and a forum to support sustained collaboration (NNN/WHO, 2019).

Phenomenal global progress has been made on the elimination of Guinea worm (or dracunculiasis). Dracunculiasis decreased from an estimated 3.5 million cases in 20 countries in the mid-1980s to just 15 human cases in 2021, driven largely by WASH interventions (WHO, 2022a). Sustained partnerships over this period with health surveillance authorities and clinics enabled targeted support for safe drinking water, using filters to remove worm larvae. Follow-up and care were provided to infected people to ensure wounds would not recontaminate water bodies.

Similarly, the number of people living in districts in which trachoma is a public health problem dropped from 1,517 million in 2002 to 125 million in June 2022 (WHO, 2021b) under the SAFE strategy³⁰ in which the 'F' and 'E' components cover facial cleanliness and an excreta-free environment (specifically improved access to water and sanitation).

²⁹ A global forum for non-governmental organizations working together on NTDs. For more information, please see: www.ntd-ngonetwork.org.

³⁰ SAFE: Surgery for advanced disease, Antibiotics to clear *C. trachomatis* infection, Facial cleanliness and Environmental improvement to reduce transmission.

● ● ●
**WASH is critical
in the prevention
and management
of many neglected
tropical diseases
(NTDs)**

6.2.3 Cholera

In 2015, it was estimated that annually there are 1.3 to 4.0 million cholera cases, affecting 69 countries across the globe (Ali et al., 2015). Cholera continues to disproportionately affect the world's poorest and most vulnerable communities, often occurring in 'hotspots' where access to safely managed water and sanitation is limited. The Global Taskforce on Cholera Control³¹ is a collaboration of over 30 WASH and health organizations that seeks to end cholera through a multisectoral approach that includes vaccination, WASH and cholera treatment delivered via coordinated leadership and community engagement. There are a number of tools that guide this work, including frameworks for developing national cholera prevention and control plans, WASH and infection and prevention control standards for cholera in health care facilities, and outbreak response manuals. A number of working groups are developing technical products to support the vaccination, WASH and treatment elements of the partnership, and documenting their implementation.

While cholera deaths have reduced from a peak of almost 1 in 20 cases in the mid-1990s to less than 1 in 500 in 2020, global case numbers have risen dramatically in the past 5–10 years, indicating that global treatment responses are improving while preventive measures are not (WHO, 2021c). This trend indicates that the goals of the global cholera roadmap³² to eliminate cholera by 2030 in up to 20 countries will be difficult to reach without substantial improvements in WASH services. Vaccination has been used effectively in hotspot locations, but without sustained WASH improvements the disease can easily return as immunity wanes over time. Success in eliminating cholera will require sustained and concerted national efforts to extend and prioritize WASH services to those most in need, in order to address the root causes of outbreaks – and in doing so, such efforts also address key issues around equity, human rights and prevention of other waterborne diseases.

6.2.4 Antimicrobial resistance

The world is facing a crisis of AMR, meaning that infections that have been easily treatable since the scientific discovery of antibiotics less than 100 years ago could once again kill. The pipeline of new antimicrobials has all but dried up, and urgent solutions to tackle AMR are needed from a wide range of stakeholders such as policy-makers, engineers and scientists, health care professionals, veterinarians, farmers, donors, NGOs, and private citizens and corporations. Everyone has a role to play (FAO/OIE/WHO, 2020).

Wastewater effluent from all sources including communities, health facilities, plant and animal production, and antimicrobial manufacturing are increasingly recognized as critical components in the fight against AMR. Safe WASH limits the avoidable use of antimicrobials for WASH-preventable infections. Treatment of wastewater from all sectors limits the emergence and spread of AMR in water and soil that has been polluted with untreated wastewater and sludge (FAO/OIE/WHO, 2020; UNEP, 2022).

The response to the AMR crisis has been spearheaded through the One-Health global action plan on antimicrobial resistance (WHO, 2015), developed by WHO in a close tripartite collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE). This global action plan was formally endorsed by the General Assembly of the United Nations in 2016 and the United Nations Environment Programme (UNEP) joined in 2022 to more fully embrace the One-Health approach encompassing human, animal and ecological health. A central task of the quadripartite is to support the development and implementation of national policies and actions plans (NAPs) that mobilize national and local-level governments, industry and private sector partners around investments to combat AMR in all sectors.

³¹ For more information, please see: www.gtfcc.org/about-cholera/.

³² Roadmap 2030 – Global Task Force on Cholera Control (www.gtfcc.org).

Key elements to coordinate and mobilize the partnership are the Inter-Agency Coordination Group (Secretary-General of the United Nations, 2017) and a One-Health global leaders' group on antimicrobial resistance (UNEP, n.d.). Collectively, with world antimicrobial awareness weeks, they have succeeded in raising the profile of environmental dimensions of AMR and the role of the water and waste management across sectors. However, a key challenge remains that the role of WASH and wastewater management are not well understood or well represented in NAPs – the important roles of WASH and wastewater management are often not addressed, or the proposed actions do not align with the major AMR risks within national contexts.

6.2.5 Nutrition

The three principal underlying causes of undernutrition are unsuitable or insufficient food intake, poor care practices and disease. These are directly or indirectly related to inadequate access to WASH. Partnerships between WASH and nutrition actors can deliver significant synergies. For example, WASH programmes, often implemented at scale, can enhance the coverage and effectiveness of nutrition interventions to reduce the malnutrition and stunting that affect 22% or 149 million children under the age of five years globally according to estimates for 2020 (WHO, 2021d).

One important global partnership between WASH and nutrition is that between the Scale Up Nutrition (SUN) Movement³³ and Sanitation and Water for All (SWA).³⁴ This partnership was created in response to recommendations for cross-sectoral collaboration on new analyses, tools, evidence, funding and commitments from the landmark 2015 international Bonn WASH Nutrition Forum.³⁵ SUN and SWA collaboration focuses on three thematic areas, namely joint advocacy, good practices and research, encapsulated in the joint WASH–nutrition narrative (SWA/SUN, n.d.).

While there is no question about the critical role played by environmental health in shaping children's nutritional outcomes, difficulties in quantifying the impact of WASH on nutrition have sometimes challenged cross-sectoral programmatic collaboration. Most significantly, a series of studies published in 2018–2019 investigating this relationship showed little or no impact of selected WASH interventions on reducing childhood diarrhoea or stunting (Null et al., 2018; Luby et al., 2018; Humphrey et al., 2019; Cumming et al., 2019). The implications of these studies were not always clearly articulated, prompting doubt among some practitioners, researchers and funders on the value of WASH investment for improved nutrition. Strong partnerships and constructive interaction across sectors play a vital role in ensuring the evidence base and its limitations are well understood, creating dialogue on the myriad benefits of co-programming beyond health impacts, and ensuring that co-programming becomes more effective (WHO/UNICEF, 2019).

6.2.6 Food safety

Safe water for irrigation, food processing and food hygiene in homes and restaurants is an essential part of protecting human health in food systems, along with risk reduction measures at the farm (e.g. selection of high-growing crops³⁶ or crops eaten cooked).

³³ For more information, please see: <https://scalingupnutrition.org/about/what-we-do/priorities/integrating-wash-and-nutrition-actions>.

³⁴ For more information, please see: <http://sanitationandwaterforall.org/>.

³⁵ For more information, please see: <https://scalingupnutrition.org/news/wash-nutrition-forum-features-mirror-sessions-inspire-further-collaboration-between-two>.

³⁶ Refers to crops where the edible portion is high enough on the plant so that it does not come into contact with irrigation water.

● ● ●
**Safe WASH limits
the avoidable use
of antimicrobials
for WASH-
preventable
infections**

Studies looking at multiple pathways of exposure to water- and sanitation-related pathogens have consistently shown uncooked produce as the leading exposure pathway in low and middle-income countries.³⁷

The FAO/WHO Codex Alimentarium³⁸ is the primary international partnership on food safety. Codex fosters consumer trust in the safety and quality of food products by developing international food standards, guidelines and codes of practice for the safety, quality and fairness of food trade. Common risk assessments underpinning global guideline values for chemicals in food and drinking water, including bottled water, form an important aspect of the partnership between the drinking water quality guideline developers, the WASH sector and Codex (WHO, 2022b). Codex and wider partnerships with the agricultural sector also exist for irrigation and food processing water quality.

However, developing partnerships to ensure the safe use of wastewater (both formal and informal use) in agriculture and aquaculture continues to be a significant challenge, due to the highly multisectoral nature of the topic and the gaps in institutional responsibilities, particularly for informal reuse (WHO, 2006; 2016). Stronger collaboration is needed between the water, agricultural and health sectors to develop coherent policy, standards and implementation approaches as demand for wastewater use grows with demands for fresh produce near expanding urban centres, while water scarcity increases due to climate change.

6.2.7 Pandemics and public health emergencies

Experiences with recent and ongoing public health emergencies, including COVID-19, Ebola, Zika and cholera outbreaks, highlight the centrality of WASH in preparedness, readiness, response and recovery efforts. WASH services are needed to help prevent infections of health care workers and patients within health care settings, to allow schools and workplaces to operate more safely, and to help protect communities and families from infections.

While the role of WASH in preventing COVID-19 (including hand hygiene, water supply to enable hand hygiene, and essential water and sanitation services to enable stay-at-home and distancing measures) is indisputable, WHO Strategic Preparedness and Response Plans did not comprehensively address or monitor WASH, and initial investments went disproportionately to other pillars of the response.

Increasingly, though, COVID-19 efforts are being leveraged to strengthen policies, regulations and investments in WASH. The recently established WASH in Public Health Emergency Working Group, co-led by WHO and UNICEF, working with a wide range of WASH and health emergency partners, seeks to consolidate guidance, to strategically address gaps and to engage with health actors. Furthermore, guidance on key WASH interventions for COVID-19 (WHO/UNICEF, 2020c) and more recently on environmental surveillance of SARS-CoV-2 in wastewater (WHO, 2022c) provide evidence-based frameworks from which to take action. COVID-19 exposed the particular lack of investment and services around safe health care waste management (WHO, 2022d). This work can no longer just focus on segregation and safe treatment, but must address the entire waste management chain, including reducing procurement of non-essential personal protective equipment (PPE), seeking products with less and biobased packaging and components, and supporting safe reusable PPE as well as recycling and reverse logistics. Such efforts also align with the new framework that is being put in place to

³⁷ For more information, please see: www.sanipath.net/results-dashboard.

³⁸ For more information, please see: www.fao.org/fao-who-codexalimentarius/about-codex/en/.

● ● ●
Safe water for irrigation, food processing and food hygiene in homes and restaurants is an essential part of protecting human health in food systems

support countries in implementing the commitments on low-carbon and sustainable health systems that were established at the 26th Conference of the Parties (COP 26) to the United Nations Framework Convention on Climate Change (UNFCCC).

Many countries leveraged COVID-19 financing and attention to improve WASH. For example, in Lao PDR, since 2020, the Ministry of Health has mobilized over US\$2 million nationally to implement national green and climate-resilient WASH and energy standards in 62 health care facilities (WASH in Health Care Facilities, n.d.). Funds supported procuring autoclaves, water tanks, hand hygiene stations and other infrastructure as well as to run WASH FIT trainings and deliver ongoing supportive supervision. During a 2021 cholera outbreak in Niger, where increasing terrorist threats and growing food insecurity threatened many households, the work on emergency WASH focused on health care facilities. In response, a national taskforce was established led by the Ministry of Health and involving key WASH and health partners. The WASH FIT roll-out began nationally and efforts focused on cholera hotspots and engaged local community leadership and women's groups to support best hygiene practices and to sustain WASH improvements in health care facilities.

The number of individuals affected by emergencies, encompassing both disasters caused by natural hazards and conflict, is unlikely to decrease in the foreseeable future. Thus, there will be a continued need to implement WASH interventions that are sustainable, that result in health and well-being benefits, and for which there is strong local engagement, understanding and leadership.

6.2.8 Hygiene for disease prevention

Hand hygiene is critical to preventing the transmission of infectious diseases. The COVID-19 pandemic highlighted insufficient global coverage of hand hygiene in low- and middle-income countries, persistent lack of political prioritization and chronic underinvestment. Against this backdrop, and given the cross-sectoral nature of the challenge, new collaborative initiatives emerged, including the Hand Hygiene for All global initiative (HH4A) (WHO/UNICEF, 2020d). Launched in June 2020, HH4A aims to work with diverse actors to embed and elevate hand hygiene within existing policies, plans and budgets across relevant sectors, and to support their implementation. It is jointly led by UNICEF and WHO in partnership with international partners, national governments, public and private sectors, and civil society. Core partners include the World Bank, SWA, the International Federation of the Red Cross and the Red Crescent Societies (IFRC), the International Labour Organization (ILO), the London School of Hygiene and Tropical Medicine/Hygiene Hub, the Office of the United Nations High Commissioner for Refugees (UNHCR), the Global Handwashing Partnership and WaterAid.

Other important partnerships include:

- The Hand Hygiene Behaviour Change Coalition (HBCC),³⁹
- The Hand Hygiene Market Accelerator (HHMA),⁴⁰ and
- The longstanding Global Handwashing Partnership (GHP).⁴¹

Successes of these partnerships can be seen from the country to the global level. Over 60 national governments have been supported by HH4A partners to develop fully costed roadmaps for universal hygiene coverage. Notable regional efforts include a hygiene

³⁹ For more information, please see: <https://worldhealthpartners.org/hbcc.php>.

⁴⁰ For more information, please see: <https://fr.weforum.org/projects/mobilizing-hand-hygiene-for-all-initiative>.

⁴¹ For more information, please see: <https://globalhandwashing.org/>.

strategy for Southern Africa (SADC, 2021) led by the Southern African Development Community (SADC), and the 'Hand Hygiene for South Asia'⁴² partnership (Klaesener-Metzner and Cavill, 2022). At the global level, partnerships facilitate co-developed tools to support country action, such as for example a country costing tool (WHO/UNICEF, 2021b), as well as advocacy efforts of unprecedented scale. A successful example of this is Global Handwashing Day,⁴³ coordinated each year by GHP. In 2020, the HH4A partnership brought together the individual efforts of veteran hand hygiene champions to equal more than the sum of their parts, securing high-level political commitment⁴⁴ and more than doubling the social media reach of 2019.

6.2.9 Wastewater monitoring for disease surveillance

Wastewater surveillance can play an important complementary role to diagnostic testing by providing additional evidence to inform disease surveillance and management. An important benefit is that samples from wastewater generate population level data on disease trends that are not susceptible to biases inherent in diagnostic testing. These data can provide valuable insights to public health decision-makers, such as: early warning of increasing cases (including asymptomatic cases); hotspots where testing services and behaviour change interventions should be targeted; vulnerable or isolated communities and events; and known and novel disease variants, among others.

The global polio eradication programme is a well-established form of a health partnership (with wastewater laboratories) using wastewater surveillance as part of a wider surveillance and control approach. Wastewater is monitored for early detection of an outbreak and confirmation of the absence of circulation of wild-type and vaccine-derived poliovirus in a population (WHO, 2003). It is also used in typhoid surveillance (WHO, 2018), at pilot scale for monitoring antimicrobial resistance (WHO, 2021e) and for monitoring illicit drug use, and has also been rapidly scaled up in many settings for COVID-19 (WHO, 2022c).

6.3 Emerging areas for partnerships for WASH and health

In addition to the partnerships for WASH and health previously described, working together is also crucial for the following areas.

6.3.1 Climate Change

Climate change is leading to shifting WASH-related health risks – particularly for mosquito-borne diseases where larvae breed in water containers and uncontained wastewater. Collaboration between and within institutions needs to be strengthened to integrate disaster and climate risk management into national policies and practices. This would include the clear identification of climate-related risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by planners, engineers and other decision-makers. Protection of human health often depends on efforts by other sectors, such as food and agriculture, energy and urban planning. The active involvement of these sectors in National Adaptation Plans would make them more effective. Another reason for stronger inter-sector collaboration concerns the implementation of climate-resilient water and sanitation safety plans, as many teams from the health sector lack the necessary climate and hydrological experience to access climate data and expertise.

⁴² For more information, please see: <https://sanitationlearninghub.org/2022/01/10/hand-hygiene-for-south-asia/>.

⁴³ For more information, please see: <https://globalhandwashing.org/global-handwashing-day/>.

⁴⁴ For more information, please see: <https://globalhandwashing.org/resources/global-handwashing-day-leader-commitments/>.

● ● ●
Wastewater surveillance can play an important complementary role to diagnostic testing by providing additional evidence to inform disease surveillance and management

Climate change has already started influencing the transmission and spread of vector-borne diseases, and its impacts are likely to worsen (Rocklöv and Dubrow, 2020). In response to mosquito/vector-borne disease, new partnerships with climate specialists are needed to better understand how the spatial distribution of vectors (e.g. warmer climates, which are wetter further north and south of the equator) is evolving, and to update WASH strategies for vector control amid this new reality.

6.3.2 Contaminants of emerging concern

Chemical pollution in freshwater and drinking water is a threat to human health across the globe (Fuller et al., 2022). CECs are drivers of AMR and several diseases induced by endocrine disruption (Kahn et al., 2020). Partnerships across policy domains that address the life cycle of harmful products and substances are essential to reduce water pollution in order to safeguard human health and aquatic ecosystems. This includes promoting policies on chemical safety, public health, agriculture and food, environment, industry, trade, and waste management (including pharmaceutical disposal) (OECD, 2019; forthcoming). The scientific community has an important role to play in partnerships by developing and promoting state-of-the-art knowledge on the complexities of chemical pollution impacts and potential responses (Brack et al., 2022). Partnerships and coordination between pharmaceutical companies, consumers (patients and agriculture), health care actors (doctors, hospitals, pharmacies) and governments across the life cycle of pharmaceuticals are the most effective approach (OECD, 2019).

Partnerships between the public sector and industry are increasingly established to minimize pollution at source or to finance mitigation measures (OECD, 2022). For example, Extended Producer Responsibility (EPR) schemes transfer the responsibility of environmental impacts of harmful products to the manufacturer. The manufacturer can respond by switching to a less harmful product design, or by financially contributing to, for example, wastewater treatment infrastructure that is needed to break down harmful substances.

6.3.3 Mental health and well-being

While the connections between WASH and physical health are well established, the relationship between water and mental health is considerably less well known, and causal relationships between water and mental ill health are difficult to empirically confirm (Wutich et al., 2020). This knowledge gap could be addressed through productive collaboration between the WASH sector and the mental health care community. One option would be to build upon the research and experiences concerning 'ecological grief' and 'climate anxiety' (Nagabhatla et al., 2021; Okamoto and Nagabhatla, 2022).

6.3.4 Labour

Workers in the water sector around the world provide an essential public service. Yet, these services all too often come at the cost of the health, safety and dignity of workers, particularly in sanitation – as workers doing toilet cleaning (predominantly women), faecal sludge management and sewer cleaning (predominantly men) are among the most vulnerable workers (World Bank/ILO/WaterAid/WHO, 2019). Their jobs often exist in an informal economy without basic labour protection or rights, and many are consigned to this work through religion or class and face stigma. Many more workers are needed to achieve SDG 6. Partnerships with labour movements are needed to ensure that workers' rights are recognized, and that their working conditions are improved and progressively formalized to safeguard health and decent working conditions, as called for by SDG 8.

6.4 Lessons learned and ways forward

Partnerships for WASH and health are diverse and address a wide range of topics. While there have been some successes, collaboration also comes with challenges. It is known that safe WASH is a prerequisite to health, but the health sector often neglects prevention and instead focuses on clinical diagnosis and care, vaccines and medicines. On the other hand, the WASH sector faces pressures and timescales of achieving and sustaining safe water and sanitation services for all, which will ultimately deliver health benefits, but it may not prioritize health objectives directly in planning and delivery of services.

NTD efforts failed to sustainably eliminate disease in unsanitary environments, despite cheap and effective mass drug administration. Cholera, rotavirus, polio and typhoid all have vaccines, but are often lacking the WASH component to effectively sustain disease control and prevent reemergence of outbreaks. Attempts at partnership have clearly been made, but often actors have struggled to organize themselves to optimum effect, in part due to entrenched structures of funding, competing incentives, as well as varied implementation structures and institutional arrangements.

The world is facing serious, emerging challenges such as AMR, increases in zoonotic diseases, pollution by CECs and magnified climate risks. To address these challenges, continued and new partnership among the WASH and health sector will be critical to accelerate progress in existing areas of collaboration and to effectively face new challenges. Moreover, emerging challenges are in need of bold partnerships extending to other sectors, including environment, chemical safety, agriculture, industry, food safety and trade.

References

- Ali, M., Nelson, A. R., Lopez, A. L. and Sack, D. A. 2015. Updated global burden of cholera in endemic countries. *PLoS Neglected Tropical Diseases*, Vol. 9, No. 6, Article e0003832. doi.org/10.1371/journal.pntd.0003832.
- Boisson, S., Wohlgemuth, L., Yajima, A., Peralta, G., Obiageli, N., Matendehero, S., Baayenda, G., Seife, F., Hamilton, H., Chase, C., Barry, F. B. M., Solomon, A. W. and Velleman, Y. 2021. Building on a decade of progress in water, sanitation and hygiene to control, eliminate and eradicate neglected tropical diseases. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, Vol. 115, No. 2, pp. 185–187. doi.org/10.1093/trstmh/trab001.
- Brack, W., Barcelo Culleres, D., Boxall, A. B. A., Budzinski, H., Castiglioni, S., Covaci, A., Dulio, V., Escher, B. I., Fantke, P., Kandie, F., Fatta-Kassinos, D., Hernández, F. J., Hilscherová, K., Hollender, J., Hollert, H., Jahnke, A., Kasprzyk-Hordern, B., Khan, S. J., Kortenkamp, A., Kümmerer, K., Lalonde, B., Lamoree, M. H., Levi, Y., Lara Martín, P. A., Montagner, C. C., Mougin, C., Msagati, T., Oehlmann, J., Posthuma, L., Reid, M., Reinhard, M., Richardson, S. D., Rostkowski, P., Schymanski, E., Schneider, F., Slobodnik, J., Shibata, Y., Snyder, S. A., Sodr , F. F., Teodorovic, I., Thomas, K. V., Umbuzeiro, G. A., Viet, P. H., Yew-Hoong, K. G., Zhang, X. and Zuccato, E. 2022. One planet: one health. A call to support the initiative on a global science–policy body on chemicals and waste. *Environmental Sciences Europe*, Vol. 34, Article 21. doi.org/10.1186/s12302-022-00602-6.
- Chaitkin, M., McCormick, S., Alvarez-Sala Torrealano, J., Amongin, I., Gaya, S., Hanssen, O. N., Johnston, R., Slaymaker, T., Chase, C., Hutton, G. and Montgomery, M. 2022. Estimating the cost of achieving basic water, sanitation, hygiene, and waste management services in public health-care facilities in the 46 UN designated least-developed countries: A modelling study. *The Lancet Global Health*, Vol. 10, No. 6, pp. e840–e849. doi.org/10.1016/S2214-109X(22)00099-7.
- Cumming, O., Arnold, B. F., Ban, R., Clasen, T., Esteves Mills, J., Freeman, M. C., Gordon, B., Guiteras, R., Howard, G., Hunter, P. R. and Johnston, R. B., Pickering, A. J., Prendergast, A. J., Pr uss-Ust n, A., Rosenboom, J. W., Spears, D., Sundberg, S., Wolf, J., Null, C., Luby, S. P., Humphrey, J. H. and Colford, J. M. Jr. 2019. The implications of three major new trials for the effect of water, sanitation and hygiene on childhood diarrhea and stunting: A consensus statement. *BMC Medicine*, Vol. 17, No. 1, pp. 1–9. doi.org/10.1186/s12916-019-1410-x.
- FAO/OIE/WHO (Food and Agriculture Organization of the United Nations/ World Organization for Animal Health/World Health Organization). 2020. *Technical Brief on Water, Sanitation, Hygiene and Wastewater Management to Prevent Infections and Reduce the Spread of Antimicrobial Resistance*. WHO/OIE/FAO. www.who.int/publications/i/item/9789240006416.

- Fuller, R., Landrigan, P. J., Balakrishnan, K., Bathan, G., Bose-O'Reilly, S., Brauer, M., Caravanos, J., Chiles, T., Cohen, A., Corra, L., Cropper, M., Ferraro, G., Hanna, J., Hanrahan, D., Hu, H., Hunter, D., Janata, G., Kupka, R., Lanphear, B., Lichtveld, M., Martin, K., Mustapha, A., Sanchez-Triana, E., Sandilya, K., Schaeffli, L., Shaw, J., Seddon, J., Suk, W., María Téllez-Rojo, M. and Yan, C. 2022. Pollution and health: A progress update. *The Lancet Planetary Health*, Vol. 6, No. 6, pp. E535–E547. doi.org/10.1016/S2542-5196(22)00090-0.
- Humphrey, J. H., Mbuya, M. N. N., Ntozini, R., Moulton, L. H., Stoltzfus, R. J., Tavengwa, N. V., Mutasa, K., Majo, F., Mutasa, B., Mangwadu, G., Chasokela, C. M., Chigumira, A., Chasekwa, B., Smith, L. E., Tielsch, J. M., Jones, A. D., Manges, A. R., Maluccio, J. A. and Prendergast, A. J. 2019. Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: A cluster-randomised trial. *The Lancet Global Health*, Vol. 7, No. 1, pp. e132–e147. doi.org/10.1016/S2214-109X(18)30374-7.
- Kahn, L., Philippat, C., Nakayama, S. F., Slama, R. and Trasande, L. 2020. Endocrine-disrupting chemicals: Implications for human health. *The Lancet Diabetes and Endocrinology*, Vol. 8, No. 8, pp. 703–708. doi.org/10.1016/S2213-8587(20)30129-7.
- Klaesener-Metzner, N. and Cavill, S. 2022. *Hand Hygiene for South Asia*. The sanitation learning hub. <https://sanitationlearninghub.org/2022/01/10/hand-hygiene-for-south-asia/>.
- Luby, S. P., Rahman, M., Arnold, B. F., Unicomb, L., Ashraf, S., Winch, P. J., Stewart, C. P., Begum, F., Hussain, F., Benjamin-Chung, J., Leontsini, E., Naser, A. M., Parvez, S. M., Hubbard, A. E., Lin, A., Nizame, F. A., Jannat, K., Ercumen, A., Ram, P. K., Das, K. K., Abedin, J., Clasen, T. F., Dewey, K. G., Fernald, L. C., Null, C., Ahmed, T. and Colford, J. M. Jr. 2018. Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Bangladesh: a cluster randomized controlled trial. *The Lancet Global Health*, Vol. 6, No. 3, pp. e302–e315. doi.org/10.1016/S2214-109X(17)30490-4.
- Nagabhatla, N., Okamoto, S. and Bhandari, S. 2021. *The New Normal of 'Climate Grief': Why Mental Health must Feature in Adaptation and Resilience Planning*. United Nations University Institute on Comparative Regional Integration Studies (UNU-CRIS). <https://cris.unu.edu/new-normal-%E2%80%98climate-grief%E2%80%99-why-mental-health-must-feature-adaptation-and-resilience-planning>.
- NNN/WHO (Neglected Tropical Disease NGO Network/World Health Organization). 2019. *WASH and Health Working Together: A 'How-To' Guide for Neglected Tropical Disease Programmes*. Geneva, WHO. www.who.int/publications/i/item/9789241515009.
- Null, C., Stewart, C. P., Pickering, A. J., Dentz, H. N., Arnold, B. F., Arnold, C. D., Benjamin-Chung, J., Clasen, T., Dewey, K. G., Fernald, L. C. H., Hubbard, A. E., Kariger, P., Lin, A., Luby, S. P., Mertens, A., Njenga, S. M., Nyambane, G., Ram, P. K. and Colford, J. M. 2018. Effects of water quality, sanitation, handwashing, and nutritional interventions on diarrhoea and child growth in rural Kenya: A cluster randomized controlled trial. *The Lancet Global Health*, Vol. 6, No. 3, pp. e316–e329. doi.org/10.1016/S2214-109X(18)30005-6.
- Okamoto, S. and Nagabhatla, N. 2022. *Climate Change's Impact on Mental Health is Overlooked and Misunderstood – Here's what can be done*. The Conversation, 8 November 2022. <https://theconversation.com/climate-changes-impact-on-mental-health-is-overlooked-and-misunderstood-heres-what-can-be-done-194128>.
- OECD (Organisation for Economic Co-operation and Development). 2019. *Pharmaceutical Residues in Freshwater: Hazards and Policy Responses*. OECD Studies on Water. Paris, OECD Publishing. doi.org/10.1787/c936f42d-en.
- _____. 2022. *Background Note: The Implementation of the Polluter Pays Principle*. www.oecd.org/water/dg-env-economics-of-wfd.htm (Accessed on 4 July 2022).
- _____. Forthcoming. *Endocrine Disruption in Freshwater*. OECD Studies on Water. Paris, OECD Publishing.
- Rocklöv, J. and Dubrow, R. 2020. Climate change: An enduring challenge for vector-borne disease prevention and control. *Nature Immunology*, Vol. 21, pp. 479–483. doi.org/10.1038/s41590-020-0648-y.
- SADC (Southern African Development Community). 2021. *SADC Hygiene Strategy 2021–2025*. Gaborone, SADC. <https://globalhandwashing.org/wp-content/uploads/2022/01/SADC-Hygiene-Strategy.pdf>.
- Secretary-General of the United Nations. 2017. *Interagency Coordination Group on Antimicrobial Resistance*. 17 March 2017, New York. www.un.org/sg/en/content/sg/personnel-appointments/2017-03-17/interagency-coordination-group-antimicrobial-resistance.
- SWA/SUN (Sanitation and Water for All/Scale Up Nutrition Movement). n.d. *WASH-Nutrition Linkages: A Joint Narrative between Sanitation and Water for All and the Scaling Up Nutrition (SUN) Movement*. <https://scalingupnutrition.org/wp-content/uploads/2017/10/WASH-Nutrition-Narrative.pdf>.
- UNEP (United Nations Environment Programme). 2022. *Environmental Dimensions of Antimicrobial Resistance: Summary for Policymakers*. UNEP. www.unep.org/resources/report/summary-policymakers-environmental-dimensions-antimicrobial-resistance.
- _____. n.d. *One Health Global Leaders Group on Antimicrobial Resistance*. UNEP website. www.unep.org/one-health-global-leaders-group-antimicrobial-resistance.
- WASH in Health Care Facilities. n.d. *Country Progress Tracker*. www.washinhealth.org/country-progress-tracker/#country-progress-tracker.
- WHO (World Health Organization). 2003. *Guidelines for Environmental Surveillance of Poliovirus Circulation*. Geneva, WHO. <https://apps.who.int/iris/handle/10665/67854>.
- _____. 2006. *WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume I Policy and Regulatory Aspects*. Geneva, WHO. www.who.int/publications/i/item/9241546824.
- _____. 2015. *Global Action Plan on Antimicrobial Resistance*. Geneva, WHO. www.who.int/publications/i/item/9789241509763.
- _____. 2016. *Sanitation Safety Planning: Manual for Safe Use and Disposal of Wastewater, Greywater and Excreta*. Geneva, WHO. www.who.int/publications/i/item/9789241549240.
- _____. 2018. *Typhoid: Vaccine Preventable Diseases Surveillance Standards*. Geneva, WHO. www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-typhoid.
- _____. 2019. *Water, Sanitation, Hygiene and Health: A Primer for Health Professionals*. Geneva, WHO. www.who.int/publications/i/item/WHO-CED-PHE-WSH-19.149.
- _____. 2020. *Ending the Neglect to Attain the Sustainable Development Goals: A Road Map for Neglected Tropical Diseases 2021–2030*. Geneva, WHO. www.who.int/publications/i/item/9789240010352. Licence: CC BY-NC-SA 3.0 IGO.
- _____. 2021a. *Ending the Neglect to Attain the Sustainable Development Goals: A Global Strategy on Water, Sanitation and Hygiene to Combat Neglected Tropical Diseases, 2021–2030*. Geneva, WHO. <https://apps.who.int/iris/handle/10665/340240>. Licence: CC BY-NC-SA 3.0 IGO.
- _____. 2021b. WHO Alliance for the Global Elimination of Trachoma: Progress report on elimination of trachoma, 2021. *Weekly Epidemiological Record*, Vol. 97, No. 31, pp. 353–364. <https://apps.who.int/iris/handle/10665/361290>.
- _____. 2021c. Cholera, 2020. *Weekly Epidemiological Record*, Vol. 96, No. 37, pp. 445–460.

- _____. 2021d. *Levels and trends in child malnutrition: key findings of the 2021 edition of the joint child malnutrition estimates*. Geneva, United Nations Children's Fund (UNICEF)/WHO/World Bank. www.who.int/publications/i/item/9789240025257.
- _____. 2021e. *WHO Integrated Global Surveillance on ESBL-Producing E. coli using a "One Health" Approach: Implementation and Opportunities*. Geneva, WHO. www.who.int/publications/i/item/who-integrated-global-surveillance-on-esbl-producing-e-coli-using-a-one-health-approach. Licence: CC BY-NC-SA 3.0 IGO.
- _____. 2022a. *Dracunculiasis (Guinea-Worm Disease)*. www.who.int/data/gho/data/themes/topics/dracunculiasis-guinea-worm-disease.
- _____. 2022b. *Guidelines for Drinking-Water Quality: Fourth Edition Incorporating the First and Second Addenda*. Geneva, WHO. www.who.int/publications/i/item/9789240045064. Licence: CC BY-NC-SA 3.0 IGO.
- _____. 2022c. *Environmental Surveillance for SARS-COV-2 to Complement Public Health Surveillance – Interim Guidance*. WHO. www.who.int/publications/i/item/WHO-HEP-ECH-WSH-2022.1.
- _____. 2022d. *Global Analysis of Healthcare Waste in the Context of COVID-19: Status, Impacts and Recommendations*. Geneva, WHO. www.who.int/publications/i/item/9789240039612. Licence: CC BY-NC-SA 3.0 IGO.
- _____. n.d. The Global Health Observatory. *Water, sanitation and hygiene: burden of disease*. WHO website. www.who.int/data/gho/data/themes/topics/topic-details/GHO/water-sanitation-and-hygiene-burden-of-disease. (Accessed on 28 November 2022)
- WHO/UNICEF (World Health Organization/United Nations Children's Fund). 2019. *Implications of Recent WASH and Nutrition Studies for WASH Policy and Practice*. Position Paper. www.who.int/publications/m/item/implications-of-recent-wash-and-nutrition-studies-for-wash-policy-and-practice.
- _____. 2020a. *State of the World's Sanitation: An Urgent Call to Transform Sanitation for Better Health, Environments, Economies and Societies*. New York, UNICEF/WHO. www.who.int/publications/i/item/9789240014473.
- _____. 2020b. *Global Progress Report on Water, Sanitation and Hygiene in Health Care Facilities: Fundamentals First*. Geneva, WHO. www.who.int/publications/i/item/9789240017542.
- _____. 2020c. *Water, Sanitation, Hygiene, and Waste Management for SARS-CoV-2, the Virus that causes COVID-19 – Interim Guidance*. WHO/UNICEF. www.who.int/publications/i/item/WHO-2019-nCoV-IPC-WASH-2020.4.
- _____. 2020d. *Hand Hygiene for All*. WHO/UNICEF. www.unicef.org/reports/hand-hygiene-for-all-2020#:~:text=The%20Hand%20Hygiene%20for%20All,protect%20their%20health%20and%20environment.
- _____. 2021a. *State of the World's Hand Hygiene: A Global Call to Action to Make Hand Hygiene a Priority in Policy and Practice*. New York, UNICEF. www.who.int/publications/i/item/9789240036444.
- _____. 2021b. *Costing Tool for Estimating the Cost of Interventions to Improve Hand Hygiene in Domestic Settings*. Technical document. WHO. www.who.int/publications/i/item/WHO-HEP-ECH-WSH-2021.3.
- _____. 2022. *Progress on WASH in Health Care Facilities 2000–2021: Special Focus on WASH and Infection Prevention and Control (IPC)*. Geneva, WHO/UNICEF. [www.who.int/publications/i/item/progress-on-wash-in-health-care-facilities-2000-2021--special-focus-on-wash-and-infection-prevention-and-control-\(ipc\)](http://www.who.int/publications/i/item/progress-on-wash-in-health-care-facilities-2000-2021--special-focus-on-wash-and-infection-prevention-and-control-(ipc)). Licence: CC BY-NC-SA 3.0 IGO.
- WHO/UNICEF/World Bank (World Health Organization/United Nations Children's Fund/World Bank). 2022. *State of the World's Drinking-Water: An Urgent Call to Action to Accelerate Progress on Ensuring Safe Drinking Water for All*. Geneva, WHO. Licence: CC BY-NC-SA 3.0 IGO.
- World Bank/ILO/WaterAid/WHO. 2019. *Health, Safety and Dignity of Sanitation Workers: An Initial Assessment*. Washington DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/32640>. Licence: CC BY 3.0 IGO.
- Wutich, A., Brewis, A. and Tsai, A. 2020. Water and mental health. *WIREs Water*, Vol. 7, No. 5, e1461. doi.org/10.1002/wat2.1461.

Chapter 7

Climate change

UN-Water Expert Group on Climate Change

Sonja Koeppel and Veronica Girardi (UNECE); Wouter Bouyteart, Anil Mishra and Koen Verbist (UNESCO-IHP); and Jose Gestí Canuto, Nicolas Franke and Stefan Uhlenbrook (WMO)

With contributions from:

Ingrid Timboe (AGWA), Vania Paccagnan (CDP), Danielle Gaillard-Picher (GWP), Christophe Cudennec (IAHS), Edouard Boinet (INBO), Jennifer Jun (SIWI), Daniel Tsegai (UNCCD), Marianne Kjellén (UNDP) and Jennifer de France (WHO)



7.1 Introduction

• • •
Mitigation derived from water and sanitation management are not on the radar of countries when they make commitments to reduce the emissions of greenhouse gases

To advance on sustainable development and climate action, a number of global frameworks have been adopted. These include the 2030 Agenda for Sustainable Development and its specific Sustainable Development Goals (SDGs) 6 and 13, to ensure availability and sustainable management of water and sanitation for all, and to take urgent action to combat climate change and its impacts, respectively. The Paris Agreement on climate change and the Sendai Framework for Disaster Risk Reduction 2015–2030 have also set ambitious climate-related goals and targets. These agreements can, in many ways, be considered as a ‘partnership’ among countries.

While those distinct frameworks exist, recent analysis shows how governments increasingly recognize that action to address climate change is inseparable from delivering the SDGs to eradicate poverty and hunger and reduce inequality (UNDP/UNFCCC, 2019). The same analysis concludes also that through those frameworks the private sector, cities, regions, investors, civil society and other stakeholders have all become more involved in cross-sectoral solutions to climate change.

Water has been recognized as the ‘climate connector’ that allows for greater collaboration and coordination across the majority of targets of the 2030 Agenda, the Paris Agreement and the Sendai Framework (UNESCO/UN-Water, 2020). Recently, the first global stocktake of commitments made by Parties to the Paris Agreement (UNFCCC, 2022) indicates that more than 80% of countries are reporting freshwater resources as an adaptation priority area. In relation to mitigation, the stocktake reveals that opportunities derived from water and sanitation management are not comprehensively on the radar of countries when they make commitments to reduce the emissions of greenhouse gases, signaling an area where stronger cooperation and partnerships between the climate and water communities is needed.

However, in order to begin to strengthen such cooperation, it is essential to develop a clear understanding of *who* makes up these ‘communities’ and *how* they differ from one another. For example, water is a manageable, ecosystem-based resource that ultimately provides services to humankind. Its stakeholders are largely comprised of users and practitioners, working under various water-related institutions and governance structures, whose objective is to maximize these services whilst protecting the resource for future generations. Climate change, on the other hand, is a process or a phenomenon (many might say, a ‘crisis’). Its stakeholders are heavily science-oriented, primarily concerned with either addressing the causes of climate change (mitigation) or dealing with its impacts (adaptation).

Despite such broad distinctions, the two domains also share several commonalities. For example, water and climate change both directly impact upon, and are impacted by, agricultural practices and food security, energy production, ecosystems, industry, and a plethora of other ‘sectors’, such that both are implicitly ‘cross-sectoral’ in nature. Furthermore, given the all-too-often different political frameworks through which they are managed and/or addressed (UNESCO/UN-Water, 2020), it can become quite difficult, if not impossible, to clearly define exactly which stakeholders belong to which discrete community.

While cross-sectoral climate change policies and plans, led by climate stakeholders such as ministries of environment, and centred on national priorities, have the potential to unleash investment into low-carbon and climate-resilient development, the institutional, political and economic environment for implementing these policies and plans is complex (Cooke et al., 2018). Key identified bottlenecks for implementation of agreed climate priorities include lack of: integration with existing national development policy and planning (sector-driven); access to reliable information and data; clear financing plans; and political will (UNDP/UNFCCC, 2019).

7.2 Water and climate stakeholders

Water governance adds a complexity layer to the effective implementation of climate-related water priorities, as it is characterized by a wide diversity of policy areas and stakeholders, decentralized water policy-making, a sectoral fragmentation of water-related tasks across ministries and public agencies, a diversity of actors involved in water policy-making, and policy-makers facing conflicting objectives (OECD, 2011). Addressing those bottlenecks through effective climate and water partnership and collaboration represents an opportunity to safeguard sustainable and climate-resilient development. While good examples start to emerge, surely there is need and scope for stronger partnerships and cooperation between the climate and water stakeholders.

Everyone is a climate change stakeholder. Climate change touches upon all aspects of society. Yet, distinct frameworks exist for climate and sustainable development planning, and distinct stakeholders manage climate and water-driven policy and strategy. For example, at the country level, ministries of environment and climate change departments are responsible for climate planning and for reporting commitments made as part of the United Nations Framework Convention on Climate Change (UNFCCC), while departments of water resources services, oftentimes part of different ministries, look after water development policies and strategies.

Accelerating action through partnerships and cooperation between water and climate stakeholders can create additional benefits to freshwater ecosystems and to the most exposed and vulnerable people, reducing disaster risks, delivering cost savings, job creation and economic opportunities.

This requires improving existing partnerships and in some cases forging new ones at all levels, from local, national, basin to global, and is usually best accomplished through multi-stakeholder processes (OECD, 2015). Research and learning institutions, the private sector, and civil society, including youth, women and marginalized groups, play a key role and support efforts to underpin effective government leadership and action. Working together on water resource management, water and sanitation service delivery, as well as health, inclusion, food and energy, can broaden benefits from climate mitigation and adaptation efforts. Such an approach also presents opportunities to further engage and align commitments, with a view to strengthening mutual accountability. The five ‘accelerators’ of capacity, financing, innovation, data/information, and governance under the SDG6 Global Acceleration Framework (UN-Water, 2020) each have a critical role to play in water–climate partnerships and cooperation, and have the potential to contribute to progress across the 2030 Agenda and towards the climate resilience of communities, ecosystems and production systems.

While climate change and water partnerships are de facto ‘extra-sectorial’, the following three subsections highlight examples of water and climate partnerships and collaboration at different working levels, engaging different stakeholders, and progressing through different ‘accelerators’.

The sections on the ‘intra-sectoral’ and ‘cross-sectoral’ dimensions of partnerships and collaboration focus on how climate action is a trigger to foster and strengthen collaboration, first within the water community, and then within water and other natural resources management areas. After that, the section on ‘extra-sectoral’ collaboration highlights instead the opportunities that water brings to climate-led processes and therefore to partnerships and collaborations from this other angle.

7.3 Intra-sectoral approaches

● ● ●
The opportunities that the water (and sanitation) sector represent for emission reductions deserve greater attention from climate planners and should open the door to further collaboration with water stakeholders

The Intergovernmental Panel on Climate Change's (IPCC) most updated reports released in 2021 and 2022 (IPCC, 2021; 2022) confirm that climate change has already altered freshwater ecosystems, leading to diverse adverse impacts on human systems. This highlights, from a water intra-sectoral perspective and a climate angle, the connection and interdependence between water resources management (WRM) and the provision of basic services such as water, sanitation and hygiene (WASH).

While such interconnection is clear, *"enabling effective and adaptive collaboration between water resources and WASH actors is challenged by conflicting mandates, differences in management scales, financial constraints, and the lack of engagement platforms"* (Mahayni et. al., 2021, p. 2).

Climate planning processes and disaster management can facilitate such engagement and collaboration. Indeed, ensuring continuity of WASH services during climate-related shocks requires the assessment, design, construction and operation of drinking water and sanitation services that have factored in potential changes in water resources quantity and quality caused by climate hazards and stresses, such as drought or flooding. This includes considering the direct impacts they may have on service disruption through infrastructural damage (e.g. caused by flooding) and also the impact that climate hazards (e.g. drought) may have in terms of rendering the service temporarily or permanently non-functional. In fact, ensuring continuity of WASH services to withstand climate stresses goes beyond just structural measures and involves joint WRM–WASH cooperation (UNDP/SIWI/UNICEF, forthcoming).⁴⁵ The following three approaches can create opportunities where climate action can strengthen collaborations and partnerships between water resource managers and water/sanitation service providers:

1. Bottom-up water resilience approaches

The Climate Risk Informed Decision Analysis (CRIDA) uses stakeholder engagements at each step of the process to identify multidisciplinary challenges in a target area, and to identify those adaptation actions that provide co-benefits for other sectors simultaneously. This allows, for example, prioritizing nature-based solutions (NBS) when addressing challenges to water security, by focusing not only on the direct impact of water resources, but also on the environmental secondary impacts of proposed solutions. The active engagement of stakeholders and partnerships throughout the process steers the multidisciplinary decision-making and ensures that positive impacts are achieved across sectors and interest groups (UNESCO/ICIWaRM, 2018).

2. Water safety planning for climate resilience

As availability of freshwater is under increasing threat from climate change, water safety planning is one risk management-based approach for managing both water availability and water quality risks to safe drinking water services. Integration of climate risks and water resources in a water safety plan (WSP) starts with ensuring that the team established to lead the development and ongoing implementation of the plan has sought additional expertise from water resources and climate experts, in addition to WASH experts. Subsequently, some of the key steps where WRM–WASH cooperation should occur in the development and implementation of the WSP include: (1) adding water resources characteristics (past, present, future) when describing the water supply system and factoring in competing demands of other water resources user groups; (2) considering the strategic risks posed by source water scarcity and quality as part of the climate hazard and risk assessment; and (3) identify and jointly implement WRM-related control measures to mitigate climate risks (WHO, 2017).

⁴⁵ This report was commissioned by UNDP and UNICEF through the 'Accountability for Sustainability' partnership between UNICEF, UNDP and SIWI.

3. City Water Resilience Approach

“Urban water issues are complex, involving overlapping and interconnected systems and diverse sets of actors. Water services are shaped by financial and political considerations, affected by urban growth, land use planning and environmental management. Given the nature of these relationships, planning for water resilience is neither simple nor straightforward. The City Water Resilience Approach helps cities build the capacity of urban water systems to endure, adapt and transform in the face of new challenges for the benefit of all city residents. It has been developed to [bring together and] guide decisions by a range of stakeholders including government, private sector, academic and civil society actors. Ultimately, the approach will inform how water programmes and projects are planned, designed, delivered and operated to improve outcomes” (ARUP, 2019, p. 8).

The Boxes 7.1 and 7.2 provide examples of climate adaptation triggering WRM–WASH Cooperation.

7.4 Cross-sectoral approaches

The cross-sectoral nature and interdependence of water and climate change with other vital natural resources, such as land or energy, creates further opportunities for partnership and cooperation. For example, food security is affected by the impacts of climate change on water, including food production, transportation, processing, access, use and price stability (Porter et al., 2014). Furthermore, water management is critical for the necessary transformation of food systems (Uhlenbrook et al., 2022). Water is also required for nearly all production and conversion processes in the energy sector, including fuel extraction and processing (fossil and nuclear fuels as well as biofuels) and electricity generation (thermoelectric, hydropower and renewable technologies) (WWAP, 2014).

Box 7.1 Applying water safety planning for climate resilience in Nepal

Climate change-related hazardous events in Nepal include increased precipitation intensity and variability and decreased water flows, both of which have an impact on the availability and quality of water supply. Over the last few years, climate-resilient water safety plans (WSPs) have been piloted in five water supply systems. Some modification to the WSP process has been introduced, whereby a climate change expert (or person with knowledge of climate change) is included in WSP teams. The hazard identification and risk assessment now include consideration of climatic hazards and control measures that are sensitive to climate change and extreme weather events at the basin level. WSP teams are encouraged to tap into the opportunities available in their local areas for engagement with other stakeholders, including health officers and local experts. For example, the climate-resilient WSP in Barchour Ranipani (Tanahun) initially had the usual control measure of a diversion channel above the intake to protect against contamination of the source water through the upstream irrigation channel during the rainy season. However, considering climate risks such as landslides and floods related to extreme weather conditions, and strengthening collaboration with water resource managers at basin level, major control measures now include catchment protection to control soil erosion and divert floodwater during rainfall events; improved wellhead protection; installation of deep-set tube wells; and water conservation and protection of local or alternative sources, including awareness campaigns to conserve, reuse and recycle water.

Source: Text excerpted and adapted from WHO (2017, pp. 71–73).

These dependencies result in increasing competition of resources and challenge their management. Transformative action is thus required to accelerate progress towards achieving SDG 6 in connection with all other SDGs, including on climate action. This cannot happen without urgently strengthening broader cooperation between water, land, food and energy actors.

Several approaches have been proposed, including integrated water resources management (IWRM), and more recently, the water–energy–food (WEF) security nexus (Liu et al., 2017; Heal et al., 2021). While these approaches should be drivers for cross-sectoral partnerships, there are challenges related to putting into place the necessary governance structures needed for an integrated management of resources. There are also operational problems in enacting the various management instruments required, leading to investments in water, energy and food infrastructure being made separately, sacrificing

Box 7.2 Drought-induced collaboration of water managers and service providers in Cape Town

Cape Town's dominant water crisis over the last years has caused the extreme multi-year drought that confronted the city and its people. It is a remarkable achievement that a city of over four million was able to reduce its collective consumption by approximately 50% in a short period of time, in order to avoid 'Day Zero'.

The City Water Resilience Approach (CWRA) responds to a demand for innovative processes and tools as a response to climate change. Through its application in Cape Town in 2019, two assessment workshops engaged experts from government, academia, civil society and the private sector in round-table discussions focusing on the city's resilience to various water challenges. Key recommendations were made to ensure sustainable management of water resources and water and sanitation services.

It was highlighted that improved collaboration between the municipal, regional and national spheres of government will be critical in overcoming ongoing water shortages and preventing future crises. While relationships between government, the private sector and civil society have improved since the height of the drought crisis at the beginning of 2018, efforts to sustain and improve coordination must be maintained post-crisis. A key first step agreed through the CWRA application is to improve coordination around collecting, managing and sharing data, including between government agencies, and between the scientific community and government. More needs to be done as well to improve engagement with local communities, to identify local partners and to ensure that opportunities exist for residents to provide meaningful input into decision-making around water issues. It was highlighted that initiatives that improve community engagement can help inform decisions that account for the holistic social, environmental and economic costs and benefits of water programmes and projects. Moving forward, the city will need to extend its focus beyond water supply and extend collaboration with stakeholders managing wastewater, drainage and sanitation.

Source: Adapted from ARUP (2020).

efficiencies and risking counterproductivity (McDonnell, 2008). In relation to this, the *UN-Water Policy Brief on Climate Change and Water* recommended that, when targeting multilateral, bilateral and other sources of climate financing, stakeholders should ensure that proposals bring together multiple water considerations, including sanitation (and wastewater) and hygiene, health, agriculture, energy and industry, and ecosystems (UN-Water, 2019). Engaging climate stakeholders in the process of managing natural resources creates opportunities for synergistic partnerships and collaboration aimed at financing resilient water, food and energy security interventions.

As both water and climate change know no borders, joint adaptation to climate change and cooperation across administrative boundaries (in domestic or transboundary) river basins and aquifers represent two great opportunities for cross-sector and cross-country collaboration in order to enable the sharing of the costs and benefits of adaptation measures, to ensure their optimal location in a river basin, and to avoid the possible negative effects of unilateral adaptation or management measures. Transboundary cooperation on adaptation and mitigation of climate change can also bring additional benefits in terms of conflict prevention, socio-economic development and human well-being, and can even motivate transboundary cooperation in other domains (UNECE/INBO, 2015).

A focus on climate adaptation can make transboundary cooperation more effective and efficient, through increased data-sharing, joint planning and the locating of measures where they have the optimum effect (UNECE/INBO, 2015). Examples include the International Commission for the Danube River Basin that developed and later updated a basin-wide adaptation strategy that has supported basin countries in their own adaptation planning (UNECE, 2022). The Niger Basin authority has secured the first transboundary adaptation programme from the Green Climate Fund, which includes also implementation of national and local adaptation measures (Green Climate Fund, n.d.). There is now a rich and specialized literature providing other examples of best practices, tools and methodologies for cooperation between water and climate stakeholders at basin scale (Rieu-Clarke et al., 2015; UNECE/INBO, 2015; World Bank, 2019). The Task Force on Water and Climate under the Convention on the Protection and Use of Transboundary Rivers and International Lakes and the global network of basins managed jointly with the International Network of Basin Organizations (INBO) enable sharing of experiences and lessons learned between transboundary basins.

The following case studies described in Boxes 7.3 and 7.4 focus on strengthening collaborations and partnerships between water resource and service managers on the one, and land, food and energy actors on the other hand.

7.5 Extra-sectoral approaches

Box 7.3 Developing a climate financing proposal for water and food security in Zimbabwe

In Zimbabwe, climate change has over the last decades contributed to a decline in crop diversity, production and productivity across the country. This has caused decreasing food availability to households, leading to malnutrition. However, malnutrition is not only related to decreased food availability; as it has been estimated that roughly 50% of all malnutrition is associated with inadequate water, sanitation and hygiene (WASH) services (Prüss-Üstün et al., 2008).

While numerous actions have been taken by the government and other entities to address these challenges, many of these have been implemented using isolated and centralized approaches. To address this, the Government of Zimbabwe, with support of development partners, is drafting a climate financing proposal, using a consultative approach with multiple national and subnational stakeholders, in close collaboration between the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development and the climate financing-designated authorities to the Green Climate Fund.

The overall objective of the proposal is to strengthen the food and water security of vulnerable communities under changing climate conditions through an integrated water resources management (IWRM) approach. This will be achieved by simultaneously enhancing agricultural production through climate-smart agriculture, and maximizing the impacts of healthier food and improved health practices and behaviours through resilient WASH services.

This section highlights the opportunities that water brings to climate-led processes in terms of partnerships and collaborations. An important point of departure is that water is not explicitly mentioned in the Paris Agreement on climate change. However, closer analysis reveals to what extent the achievement of the Paris Agreement goals is dependent on water. The Sendai Framework for Disaster Risk Reduction 2015–2030 includes a call to strengthen and implement global mechanisms on hydrometeorological issues, and to raise awareness and improve understanding of water-related disaster risks and their impact on society (UN-Water, 2019).

Given water's inherent centrality to achieve both climate and sustainable development goals, stronger partnerships and collaboration between the climate and water communities can help to reinforce and strengthen state commitments to climate change adaptation, mitigation, disaster risks reduction, as well as strategies to address poverty and inequality.

In relation to mitigation, countries are expected to periodically revisit and strengthen their nationally determined contributions (NDCs) to align them with global temperature goals. The opportunities that the water (and sanitation) sector represent for emission reductions – ranging from biogas recovery from wastewater treatment systems to geothermal power generation (UNESCO/UN-Water, 2020) – deserve greater attention from climate planners and should open the door to further collaboration with water stakeholders. For example, wastewater treatment and discharge directly account for 11.8% and 4.2% of global CH₄ and N₂O emissions, respectively (Crippa et al., 2019). In addition, drinking water and wastewater management are responsible for approximately 4% of global electricity consumption in 2014, often associated with indirect carbon emissions (IEA, 2017).

Parties to the Paris Agreement are also expected to assess progress towards the Global Goal on Adaptation (GGA) and enable its implementation. To advance on those fronts, countries have been urged to complete their National Adaptation Plans (NAPs).

Only through greater cooperation between climate and water stakeholders can it be ensured that the untapped water- and sanitation-related opportunities for mitigation are prioritized in NDCs, that the adaptation needs of the water and sanitation sector are included in NAPs, and that climate financing is directed to support the implementation of these priorities.

Examples of existing platforms to foster such collaboration include the Water and Climate Coalition, the Adaptation Action Coalition, the Marrakesh Partnership, the COP Water Pavilion, as well as the COP27 Flagship initiative Action for Water Adaptation and Resilience (AWARE).

Boxes 7.5, 7.6 and 7.7 describe specific cases where water and climate actors work together towards stronger climate planning processes.

Box 7.4 Lessons learned on transboundary basin cooperation regarding climate change and energy in the Mekong River

The regional aspects of water resource management and energy production, particularly hydropower development – a renewable source of electricity – lends itself very favourably to partnerships and cooperation on water and climate change. This is highlighted in the Siem Reap Declaration adopted by Prime Ministers of the Mekong River Commission (MRC) Member Countries on 5 April 2018: “[...] *The increasing development in the mainstream and tributaries highlight the need for the sustainable and coordinated operational management of tributary and mainstream water resources development projects.*” Due to the intensity of hydropower development in the Mekong Basin mainstream and tributaries, enhanced information-sharing and coordination of operations across cascades of projects (with potentially different owners) is critical, and led to the development of a Mekong climate change adaptation strategy and action plan later in 2018. This was important to optimize power production, but also essential for the coordination of flood and drought mitigation and management, sediment transmission during flushing operations, navigation, and riparian community safety. National priorities for cascade operation may be linked to electricity market requirements. However, the consequences of this form of operation may have commercial as well as environmental and community safety implications, therefore extending the need for collaboration with environmental and civil protection stakeholders. This is of particular concern in the transboundary context, where cross-border collaboration in the form of early warning systems and operational events (e.g. spillway gate operations) are needed. These are issues that are already familiar to MRC Member Countries based on past experience. Flood warning protocols are already well established but need to be strengthened to include dam operations and related emergency response planning. Cooperation mechanisms for information-sharing and a clear attribution of roles and responsibilities among the participating projects and Member Countries are required. Proposals for a coordination and monitoring centre have already been studied in Lao PDR. These concepts will need to be further expanded to ensure basin-scale management and transboundary communication.

Source: Adapted from MRC (2022).

7.6 Conclusions

Climate and water are intrinsically linked and so are the climate change and sustainable water development agendas. For these agendas to materialize, the water and climate communities need to collaborate and strengthen partnerships. Furthermore, it would be necessary to facilitate, demonstrate and scale up science-based joint solutions and innovation, including open science, citizen science, women and youth-led initiatives, as well as traditional and indigenous knowledge to achieve more effective and climate-resilient water and sanitation management. This has to be in line with national priorities and circumstances.

This chapter has argued how the coordination of climate and water agendas is bidirectional. On the one hand, climate policy-makers need to better understand the role that water and sanitation can play in mitigation, and importantly, also the needs of the water community to adapt to climate change. It is through strong partnerships and collaboration between climate and water stakeholders that water and sanitation can feature more prominently in nationally determined contributions (NDC) and National Adaptation Plans, contributing to national commitments made to the Paris Climate Agreement.

Box 7.5 Promoting cooperation on water and climate at the ministerial level

The triple climate, health and economic crisis has highlighted the crucial role of water, sanitation and hygiene (WASH) in building resilient communities and achieving sustainable development, including meeting environmental goals.

For the first time since its inception, the Sanitation and Water for All (SWA) Partnership convened in May 2022 a High-Level Sector Ministers' Meeting on WASH with ministers of environment, climate, health and economy* to discuss joint solutions for climate change resiliency, pandemic prevention and increased economic development. The overall theme for discussion was *Building Forward Better for Recovery and Resilience*.

During the event, ministers of environment and climate had the opportunity to collaborate with WASH ministers so that agreements could be forged to make sure that water adaptation needs, as well as mitigation opportunities, are introduced in national climate plans. The meeting also served to discuss how to ensure that climate priorities are integrated into national COVID-19 recovery plans.

The 2022 Sector Ministers' Meeting was preceded by a six-month-long preparatory process, composed of multi-stakeholder discussions at national and regional levels. During those discussions, water and climate stakeholders jointly analysed national progress on identified bottlenecks and successes regarding water and sanitation, and agreed on joint action.

As a result of this WASH and climate collaboration, a set of 25 commitments by country governments and other constituencies were formulated. An example is the commitment made by the Ministry of Water and Sanitation of Malawi to increase alignment to sector strategies, such as the nationally determined contributions (NDCs) and the National Water Policy, by closely working with climate stakeholders. The outcomes of the meeting were followed up through national-level processes, contributing to the preparatory process of the 27th Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change (UNFCCC), the 2023 UN Water Conference, and the Sanitation and Water for All 2023 Finance Ministers' Meeting.

* For more information, please see: www.sanitationandwaterforall.org/2022-sector-ministers-meeting.

Box 7.6 Water and climate change cooperation through the 'Water Tracker'

Understanding the explicit and implicit water requirements of climate-sensitive development plans is critical for ensuring that countries are not only able to meet Paris Agreement targets, but are also able to design, finance and implement effective projects that contribute to social, economic and ecological resilience through the careful consideration of water.

The Water Tracker for National Climate Planning* is a tool and diagnostic guide to help countries self-assess and enhance water resilience in their national climate plans. Working in collaboration, climate and water actors use the Water Tracker to guide water resilience thinking within national climate plans so that they can be monitored, enhanced, implemented and refined over time.

The Water Tracker acknowledges that national climate plans, including nationally determined contributions (NDCs) and National Adaptation Plans (NAPs), need to be progressive over time, demonstrating increases in ambition and commitment. It facilitates the achievement of reporting requirements for countries by establishing a baseline to grow from, revealing existing gaps in national climate plans and providing concrete tools and frameworks for addressing those gaps, and enhancing national climate plans.

In 2021, Costa Rica was the first country to implement the Water Tracker, triggering and fostering engagement between different governmental institutions with an aim to improve water resilience and its reflection in climate planning. Online workshops were held with representatives from across various ministries and levels of government, as well as academia, non-governmental organizations (NGOs) and international organizations. Existing synergies and gaps in climate planning were identified. The Water Tracker analysis is helping to improve and align the different climate plans in Costa Rica, develop bankable climate-resilient water projects, and provide overall support to the country's Paris Agreement commitments (AGWA, 2022).

* For more information, please see: www.alliance4water.org/water-tracker-for-national-climate-planning.

Box 7.7 Water and Climate Coalition

The Water and Climate Coalition was founded by ten United Nations entities and the Global Water Partnership (GWP) as a response to the call by the Secretary-General of the United Nations for a Decade of Action to accelerate the implementation of the Sustainable Development Goals (SDGs). As an initiative in support of the SDG 6 Global Acceleration Framework, the main objectives of the Coalition are to provide:

- Guidance for high-level policy development through its group of water and climate leaders.
- A platform for its Members to partner in the implementation of solutions that address the gaps of operational water and climate challenges. The Coalition's aims will focus on catalysing tangible action and activities for water and climate.

The Water and Climate Leaders provide guidance for high-level policy development. They include current and former heads of state, prime ministers and ministers, as well as representatives of intergovernmental organizations, the private sector, research institutions and youth organizations. The Leaders have formulated an action plan that defines their activities over the next years. It spells out the impact they would like to make, such as being a catalyst for a step change in the ways in which water and climate are reflected in national and regional planning and in the implementation of adaptation and mitigation strategies.

Coalition Members have joined forces and resources to design and implement activities that show that current shortcomings (silos, short span of commitment, regional scope not being considered, etc.) can be overcome, and that co-benefits can be leveraged if we adhere to an integrated water and climate approach in project and systems planning and implementation. The Water and Climate Coalition is open for a wide range of stakeholders from scientific organizations, the private sector, non-governmental organizations (NGOs), UN organizations, member states and civil society. Being a member of the coalition is on a voluntary basis, it is a non-bureaucratic community of like-minded individuals and organizations, and aims to create a movement rather than to function as a structure or an organization. The coalition is set to create action through positive motivation. The objective is to engage and align different players to generate trust and momentum through implementing activities on a national, regional and global scale.

For more information, please see: www.water-climate-coalition.org/.

On the other hand, water and sanitation policy-makers also need to proactively reach out to climate stakeholders and seek partnerships to better understand how climate-led processes work, and to integrate water-related climate risks into national water policies, strategies and implementation plans. Indeed, partnering with climate stakeholders and working on climate action is a great opportunity for the water community to help bridge water resource management and water and sanitation service priorities and objectives. Working together, the climate and water stakeholders can ensure the implementation of agreed climate and water–energy–food priorities in countries.

To do that, climate and water stakeholders need to collaborate at the most adequate level – from local, national, basin, to global – and this is best accomplished through multi-stakeholder processes.

The five 'accelerators' of financing, data and information, capacity development, innovation and governance under the SDG 6 Global Acceleration Framework can serve as an umbrella for water and climate partnerships and cooperation, and contribute to progress across the 2030 Agenda and to the climate resilience of communities, ecosystems and production systems.

These accelerators are the following:

- Climate and water stakeholders must join efforts to **secure the adequate financial resources** to overcome barriers to the implementation of national and subnational climate–water established commitments.
- **Climate (risk) data and water management information, such as data on water use and discharge, and on impacts on the environment, people and businesses,** need to be transparently shared within national jurisdictions and across borders to effectively inform decision-making processes by supra-national/national/subnational governments, environmental agencies and the private sector (among other stakeholders). Further joint efforts are needed to generate data and evidence on savings in terms of avoided greenhouse gases emissions as a result of improved water resources management, and supply and sanitation operations.
- Joint operational technical teams, forums and platforms, representing both the climate and the water community, represent an opportunity for **bi-directional capacity development**, with climate stakeholders understanding better how the water community operates and vice versa.
- Collaboration between water and climate stakeholders is needed to further develop and test **innovative tools and approaches that bridge climate planning and early warning with regard to water policy making.**
- Further collaboration among water and climate stakeholders is needed to streamline and clarify respective responsibilities and to take ownership of their specific roles, recognizing climate–water interlinkages, building on complementarities, and ensuring that **institutions, policy frameworks and enabling environments are effective.**

Finally, given the fact that climate change essentially exacerbates water-related challenges, making them both more challenging and urgent, climate change should in and of itself be an accelerator for action on water.

References

- AGWA (Alliance for Global Water Adaptation). 2022. *The Water Tracker in Action: Workshops in Costa Rica and Malawi*. www.alliance4water.org/blog-posts/the-water-tracker-in-action-workshops-in-costa-rica-and-malawi.
- Arup. 2019. *The City Water Resilience Approach*. www.arup.com/perspectives/city-water-resilience-approach.
- _____. 2020. *City Water Resilience Assessment Cape Town: Water Resilience Profile*. Arup.
- Cooke, K., Gogoi, E. and Petrarulo, L. 2018. *Overcoming the NDC Implementation Gap: Lessons from Experience*. Policy brief. Oxford, UK, Oxford Policy Management (OPM). www.opml.co.uk/files/Publications/8617-action-on-climate-today-act/ndc-gap.pdf?noredirect=1.
- Crippa, M., Oreggioni, G., Guizzardi, D., Muntean, M., Schaaf, E., Lo Vullo, E., Solazzo, E., Monforti-Ferrario, F., Olivier, J. G. J. and Vignati, E. 2019. *Fossil CO₂ and GHG Emissions of All World Countries*. Luxembourg, Publication Office of the European Union. doi.org/10.2760/655913.
- Green Climate Fund. n.d. *FP092: Programme for Integrated Development and Adaptation to Climate Change in the Niger Basin (PIDACC/NB)*. Green Climate Fund. www.greenclimate.fund/project/fp092.
- IEA (International Energy Agency). 2017. *Water–Energy Nexus*. Paris, IEA. <https://www.iea.org/reports/water-energy-nexus>. License: CC BY 4.0.
- IPCC (Intergovernmental Panel on Climate Change). 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge, UK/New York, Cambridge University Press. www.ipcc.ch/report/sixth-assessment-report-working-group-i/.
- _____. 2022. *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge, UK/New York, Cambridge University Press. www.ipcc.ch/report/ar6/wg2/.

- Liu, J., Yang, H., Cudennec, C., Gain, A. K., Hoff, H., Lawford, R., Qi, J., De Strasser, L., Yillia, P. T. and Zheng C. 2017. Challenges in operationalizing the water–energy–food nexus. *Hydrological Sciences Journal*, Vol. 62, No. 11, pp. 1714–1720. doi.org/10.1080/02626667.2017.1353695.
- Heal, K. V., Bartosova, A., Hipsey, M. R., Chen, X., Buytaert, W., Li, H.-Y., McGrane, S. J., Gupta, A. B. and Cudennec, C. 2021. Water quality: The missing dimension of water in the water–energy–food nexus? *Hydrological Sciences Journal*, Vol. 66, No. 5, pp. 745–758. doi.org/10.1080/02626667.2020.1859114.
- Mahayni, B., Goldstein, J., Latham, K., Lemme, K., Gammie, G., Harawa, K., Kanweri, G. and Serrano, A. 2021. *The Case for Source Water Protection in WASH Systems: Entry Points and Opportunities*. USAID Sustainable Water Partnership/Tetra Tech/Winrock International/Water For People/The Nature Conservancy/Forest Trends. <https://winrock.org/wp-content/uploads/2022/03/The-Case-for-Source-Water-Protection-in-WASH-Systems-Entry-Points-and-Opportunities.pdf>.
- McDonnell, R. A. 2008. Challenges for Integrated Water Resources Management: How do we provide the knowledge to support truly integrated thinking? *International Journal of Water Resources Development*, Vol. 24, No. 1, pp. 131–143. doi.org/10.1080/07900620701723240.
- MRC (Mekong River Commission). 2022. *Sustainable Hydropower Development Strategy: A Basin-Wide Strategy for a Changing Mekong River Basin*. Vientiane, MRC Secretariat. doi.org/10.52107/mrc.ajutpe.
- OECD (Organisation for Economic Co-operation and Development). 2011. *Water Governance in OECD Countries: A Multi-Level Approach*. OECD Studies on Water. Paris, OECD Publishing. doi.org/10.1787/9789264119284-en.
- _____. 2015. *Stakeholder Engagement for Inclusive Water Governance*. OECD Studies on Water. Paris, OECD Publishing. doi.org/10.1787/9789264231122-en.
- Porter, J. R., Xie, L., Challinor, A. J., Cochrane, K., Howden, S. M., Iqbal, M. M., Lobell, D. B. and Travasso, M. I. 2014. Food security and food production systems. IPCC (Intergovernmental Panel on Climate Change), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK/New York, University Press, Cambridge, pp. 485–533. www.ipcc.ch/report/ar5/wg2/.
- Prüss-Üstün, A., Bos, R., Gore, F. and Bartram, J. 2008. *Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health*. Geneva, World Health Organization (WHO). apps.who.int/iris/handle/10665/43840.
- Rieu-Clarke, A., Moynihan, A. and Magsig, B.-O. 2015. *Transboundary Water Governance and Climate Change Adaptation: International Law, Policy Guidelines and Best Practice Application*. WWAP. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000235678?poslnSet=1&queryId=c3fbaec9-d2b3-4ef1-981e-444d5d3ef716>.
- Uhlenbrook, S., Yu, W., Schmitter, P. and Smith, D. M. 2022. Optimizing the water we eat – rethinking policy to enhance productive and sustainable use of water in agri-food systems across scales. *The Lancet Planetary Health*, Vol. 6, No. 1, pp. 59–65. doi.org/10.1016/S2542-5196(21)00264-3.
- UNDP/SIWI/UNICEF (United Nations Development Programme/Stockholm International Water Institute/United Nations Children's Fund). Forthcoming. *Cooperation Opportunities for Improved Integration Across SDG6*.
- UNDP/UNFCCC (United Nations Development Programme/United Nations Framework Convention on Climate Change). 2019. *The Heat is On: Taking Stock of Global Climate Ambition*. New York, UNDP/UNFCCC. <https://unfccc.int/sites/default/files/resource/NDC%20Outlook.pdf>.
- UNECE (United Nations Economic Commission for Europe). 2022. *Convention of the Protection and Use of Transboundary Watercourses and International Lakes: Sixth Meeting of the Global Network of Basins Working on Climate Change Adaptation, Monday 25th April 2022*. https://unece.org/sites/default/files/2022-06/Global_network_overview_pilot%20projects_progress_Apr2022_final_ENGL_update%2028.6.2022.pdf.
- UNECE/INBO (United Nations Economic Commission for Europe/International Network of Basin Organizations). 2015. *Water and Climate Change Adaptation in Transboundary Basins: Lessons Learned and Good Practices*. New York, United Nations. <https://unece.org/environment-policy/publications/water-and-climate-change-adaptation-transboundary-basins-lessons>.
- UNESCO/ICIWaRM (United Nations Educational, Scientific and Cultural Organization/International Centre for Integrated Water Resources Management). 2018. *Climate Risk Informed Decision Analysis (CRIDA). Collaborative Water Resources Planning for an Uncertain Future*. Paris/Alexandria, Va., UNESCO/ICIWaRM Press. <https://unesdoc.unesco.org/ark:/48223/pf0000265895>.
- UNESCO/UN-Water (United Nations Educational, Scientific and Cultural Organization). 2020. *The United Nations World Water Development Report 2020: Water and Climate Change*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000372985?poslnSet=3&queryId=07a6f542-7e2c-40e6-a73e-7556bc850bc1>.
- UNFCCC (United Nations Framework Convention on Climate Change). 2022. *Synthesis Report for the Technical Assessment Component of the First Global Stocktake. Synthesis Report on the Overall Effect of Parties' NDCs and Overall Progress Made by Parties towards the Implementation of their NDCs, including the Information Referred to in Article 13, Paragraph 7(b), of the Paris Agreement*. Prepared by the Secretariat under the Guidance of the Co-Facilitators of the Technical Dialogue of the First Global Stocktake. UNFCCC. https://unfccc.int/sites/default/files/resource/GST_SR_23c_30Mar.pdf.
- UN-Water. 2019. *Water and Climate Change – UN-Water Policy Brief*. Geneva, UN-Water. www.unwater.org/publications/un-water-policy-brief-climate-change-and-water.
- _____. 2020. *The Sustainable Development Goal 6 Global Acceleration Framework*. Geneva, UN-Water. www.unwater.org/publications/sdg-6-global-acceleration-framework.
- WWAP (World Water Assessment Programme). 2014. *The United Nations World Water Development Report 2014: Water and Energy*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000225741?poslnSet=1&queryId=4882f682-e944-4ba9-8690-5be76e7c4525>.
- WHO (World Health Organization). 2017. *Climate-Resilient Water Safety Plans: Managing Health Risks Associated with Climate Variability and Change*. Geneva, WHO. <https://apps.who.int/iris/handle/10665/258722>. License: CC BY-NC-SA 3.0 IGO.
- World Bank. 2019. *Financing Climate Change Adaptation in Transboundary Basins: Preparing Bankable Projects*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/31224>. License: CC BY 3.0 IGO.

Chapter 8

Regional perspectives

8.1 UNESCO

Alexandros Makarigakis and Samuel Partey

With contributions from:

Nidhi Nagabhatla and Philippe De Lombaerde (UNU CRIS)

8.2 UNECE

Bo Libert, Iulia Trombitcaia, Elise Zerrath and Diane Guerrier

With contributions from:

Dimitris Faloutsos (GWP Mediterranean), Durk Krol (Water Europe), Edward Virden (International Joint Commission), Armine Arushanyan (Water Committee under the Ministry of Territorial Administration and Infrastructures of Armenia), and Emma Anakhasyan (Armenian Women for Health and Healthy Environment)

8.3 UNECLAC

Silvia Saravia Matus, Marina Gil, Alba Llavona, Laura Martínez Botia, Lisbeth Naranjo and Natalia Sarmanto

8.4 UNESCAP

Solene Le Doze, Katinka Weinberger and Rochelle Lerios

With contributions from:

Nidhi Nagabhatla and Sisir Bhandari (UNU-CRIS), Danielle Gaillard-Picher (GWP), Stefan Uhlenbrook (IWMI), and Umaya Doss Sarvana Kumar (IAEA)

8.5 UNESCWA

Ziad Khayat and Tracy Zaarour



8.1 Sub-Saharan Africa

•••
The coordination, communication and exchange of the generally limited data and information available to African water stakeholders has been very weak due to the lack of appropriate strategies and platforms to establish a fruitful dialogue between researchers, decision-makers and community members

Of the 771 million people still lacking even a basic drinking water service in 2020, half lived in Sub-Saharan Africa (WHO/UNICEF, 2021). There is a widening gap in water supply between urban and rural dwellers (Adams et al., 2019; Grasham et al., 2019; Niva et al., 2019) where governments have not been able to expand the necessary infrastructure to meet growing demand.

Developing water infrastructure, harnessing ground water resources, addressing climate change effects and investing in science and technology under an enabling political and institutional environment are key areas needed to drive sustainable water security. Given the multifaceted nature and the magnitude of water challenges in the region, strategic collaboration among stakeholder groups is deemed crucial and a necessity for reaching solutions. However, even though some efforts have been made recently to mitigate this problem, the coordination, communication and exchange of the generally limited data and information available to African water stakeholders has been very weak due to the lack of appropriate strategies and platforms to establish a fruitful dialogue between researchers, decision-makers and community members (see Chapter 10).

This chapter presents a few cases of strategic partnerships on water development in Sub-Saharan Africa, ranging from community-based to regional and international levels.

8.1.1 Community–public partnerships

Community–public partnerships (CPPs) offer win–win arrangements that enable private operators, utilities and communities to derive benefits through mutual understanding, shared responsibilities, and exchange of knowledge and experiences (Adams et al., 2019). CPPs are usually established between a water utility and an elected group within a community. Adams et al. (2019) examined the role of CPPs for water supply in Ghana, Malawi, Tanzania and Zambia. In Malawi, a CPP between water boards and community-elected water user associations (WUAs) in informal settlements, facilitated by local non-governmental organizations (NGOs), community leaders and city councils, led to significant improvements in water supply (Adams and Zulu, 2015; Adams et al., 2019). In Tanzania, the CPP between community-based organizations (CBO) and public utilities in Dar es Salaam enabled the construction and maintenance of secondary pipes which permitted water connections to households (Adams et al., 2019; Dill, 2010).

CPPs have also been linked to the resolution of water-related conflicts. In Ghana, a partnership between the Ghana Water Company, private operators and community water boards enabled a successful mediation of water tariff conflicts by showcasing broader communal benefits (Galaa and Bukari, 2014). In Zambia, the CPP in the city of Ndola showed how a partnership between informal water supply systems and the formal sector was critical in ensuring safe water quality (Liddle et al., 2016).

8.1.2 Regional and international water development partnerships

Alliance for Water Stewardship Africa

The need to hold businesses and water users accountable and ensure adoption of sustainability practices for the management of water resources has inspired water stewardship worldwide. In 2011, the International Water Stewardship Programme (IWaSP) was initiated to foster collaboration among different water actors. Inspired by IWaSP, the Alliance for Water Stewardship (AWS) was born as a global collaboration membership comprising businesses, NGOs and the public sector. AWS members contribute to the sustainability of local water resources through their adoption and promotion of the AWS Standard, a universal framework that recognizes and rewards good water stewards through third-party certification. AWS Africa is the regional partner of AWS, driving and

guiding implementation of the AWS Standard across the continent. In 2018, 26 regional stakeholders from eight countries joined to agree on a strategy to guide and champion the AWS Standard in Africa (AWS Africa, n.d.).

In Kenya, AWS Standards were tested at flower and vegetable farms and a coffee processing enterprise to examine their suitability in delivering better water management in the challenging context of an African river basin (Hepworth et al., 2011). The study, carried out in the Lake Naivasha basin, showed that application of AWS Standards improved water use efficiency and quality, and resulted in long-term investments and management commitments to improving basin governance by WUAs through research and partnership projects (Hepworth et al., 2011; Isundwa and Mourad, 2019).

As Isundwa and Mourad (2019) have noted, there are several other African examples of successful water partnerships under the AWS. A stewardship partnership resulted in secured groundwater supply for residents and businesses in Lusaka (IWaSP, n.d.a). In Uganda, more than 500 hectares of wetland areas were reportedly restored through a partnership between companies and local industries operating in the Ruwizi River catchment area (IWaSP, n.d.b). In Tanzania, a stewardship partnership comprising development partners resulted in successful restoration of the Mlalakua River and safeguarded it from pollution (IWaSP, n.d.c).

Transboundary water partnerships

Cooperation is crucial for ensuring water security in the region's many transboundary basins and aquifers.

In the Stampriet Transboundary Aquifer shared by Botswana, Namibia and South Africa, a joint assessment of the water system required the harmonization of data across the countries. In partnership with UNESCO's Intergovernmental Hydrological Programme (IHP) and the International Groundwater Resources Assessment Centre (IGRAC), the project has generated more than 40 thematic maps, which have been uploaded to the project's Information Management System.⁴⁶ The coordination mechanism supports science-based decision-making on water allocation and sound management at the basin level.

Cooperation in International Waters in Africa (CIWA), managed by the World Bank, invests in water infrastructure development and offers technical support and analyses to foster a better understanding of transboundary water issues. It provides governments, river basin organizations (RBOs) and other stakeholders with the sound evidence required to make informed decisions. Since 2011, the CIWA partnership has supported riparian governments in Sub-Saharan Africa by addressing constraints to cooperative management and development of transboundary waters in order to advance sustainable, inclusive and climate-resilient growth. CIWA's activities are cross-sectoral, involving climate resilience, biodiversity conservation, data initiatives, energy, agriculture, social issues, the environment, as well as Gender and Social Inclusion (GESI), and Fragility, Conflict, and Violence (FCV). The partnership works to protect people and property from water-related shocks and use the valuable resource sustainably. CIWA has strengthened cooperative and sustainable management and development in the Niger River basin and is seeking to unlock growth opportunities through transboundary cooperation in the Zambezi River basin (World Bank, 2022).

W12+ Programs

W12+ Programs is a partnership-based initiative jointly run by the Institute for Ecological Civilization (EcoCiv) and a registered charity based in South Africa (SOS NPO⁴⁷), born out of the crisis experienced by Cape Town as it approached Day Zero (See Box 7.2). W12+'s mandate is to connect, catalyse and incubate water solutions, particularly in urban contexts

⁴⁶ For more information, please see: www.un-igrac.org/case-study/stampriet-aquifer.

⁴⁷ For more information, please see: <https://soscpt.org/water-delivery/>.

• • •
**Cooperation
is crucial
for ensuring
water security
in the many
transboundary
basins and aquifers
of Sub-Saharan
Africa**

facing the dual crisis of climate change and rapid urbanization. W12+ Programs addresses the obstacles to water security through a two-pronged approach: supporting local leaders who are working to solve their own communities' water security challenges via hubs; and connecting these leaders or decision-makers to global resources and knowledge via the Blueprint's network and other W12+ events such as the 'W12+ Drive-In'.

W12+ has three African 'hub' locations: in Wau (South Sudan) with Water for South Sudan (WfSS); in Minya (Egypt) with Life from Water; and in Johannesburg (South Africa) with the National Business Initiative. Via a participatory process, these hubs each identified key priority interventions to transition towards a water-secure future. W12+ then provided a supportive, capacity development partnership to design, implement and evaluate these interventions, ultimately sharing them widely with the W12+ network broadly to prompt global adaptation and uptake, scaling the impact of each W12+ Hub. The W12+ Blueprint currently houses over 35 case studies representing adaptable and replicable water solutions from over 30 countries globally. W12+ also organizes informational and networking events for local leaders, activists, policy-makers and government leaders, including W12+ Drive Ins and W12+ Congresses.

Continental Africa Water Investment Programme

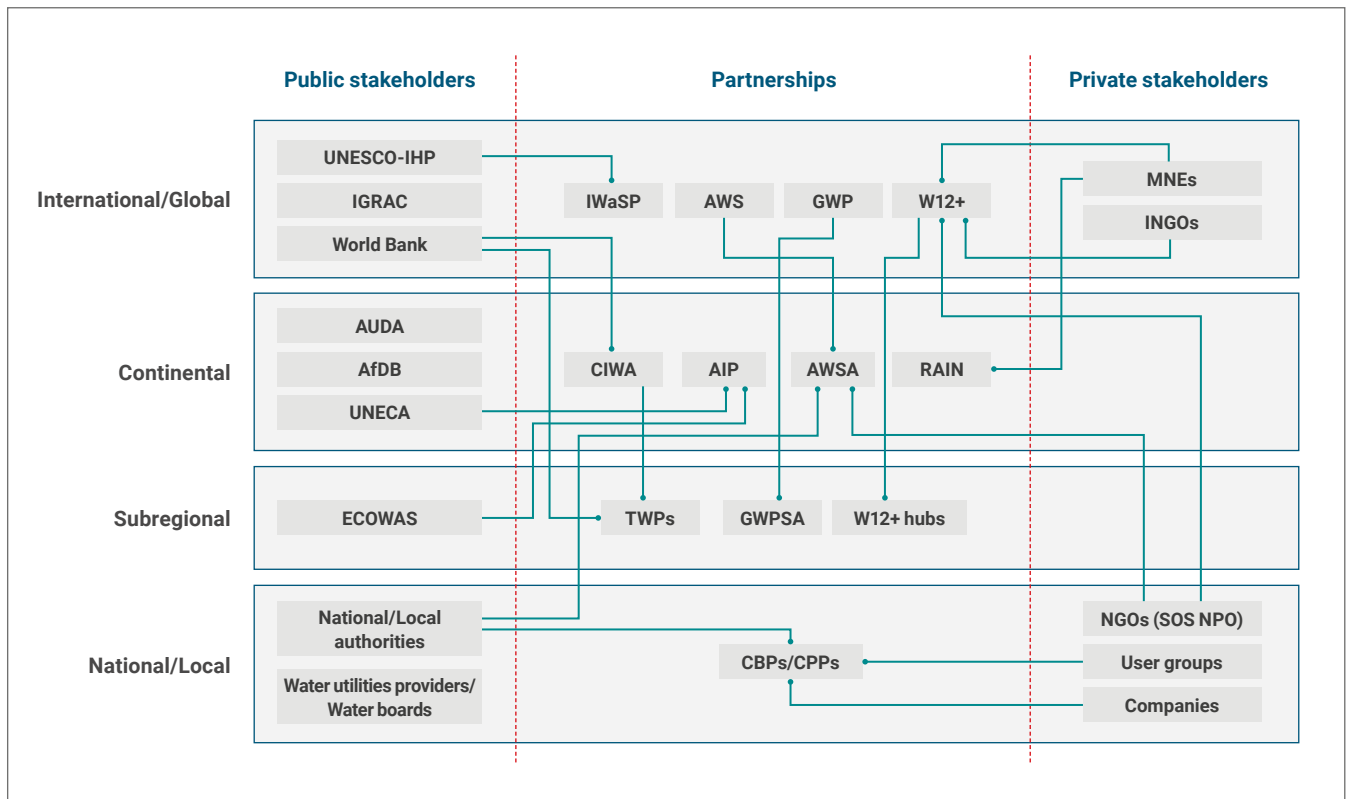
The Continental Africa Water Investment Programme (AIP), part of the second phase of the Programme for Infrastructure Development in Africa – Priority Action Plan (PIDA – PAP 2) of the African Union Development Agency's New Partnership for Africa's Development (AUDA-NEPAD), is an emerging partnership between regional and global agencies such as AUDA-NEPAD, the African Development Bank (AfDB) and the United Nations Economic Commission for Africa (UNECA). AIP supports a collective 'call for action' for meeting the 2025 Africa Water Vision of Water Security by addressing investment gaps and supporting water infrastructure projects. The new agenda targets five pilot countries (Benin, Cameroon, Tunisia, Uganda and Zambia) and five transboundary basins: the North-West Sahara aquifer system, the Volta River basin, the Lake Chad basin, the Kagera/Lake Victoria basin and the Zambezi River basin. In August 2018, AUDA-NEPAD, the AfDB, the African Ministers' Council on Water (AMCOW), the Infrastructure Consortium for Africa, and the Global Water Partnership (GWP) signed a joint communiqué to make investment in water security and sustainable sanitation a key goal for AIP (AUDA-NEPAD/AfDB/AMCOW/ICA/GWP, n.d.). The Economic Community of West African States (ECOWAS), a political and economic union of 15 countries in West Africa adopted AIP to accelerate regional cooperation on transboundary water investments. While the partnership aligns with the targets of the 17th Sustainable Development Goal (SDG 17 – in particular 17.17) and encourages and promotes public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships data, monitoring and accountability, success depends on how participatory these partnerships emerge (Nagabhatla et al., 2021).

8.1.3 Conclusions

Figure 8.1, below, provides a schematic representation of the complex landscape of water partnerships in Africa.

There are currently numerous activities at all levels that require coordination to optimize efforts and resources. The value of CPPs is worth examining further, and CPPs should potentially be scaled up. Several subregional, regional and continental partnerships could be strengthened. A knowledge management tool and a campaign to avoid duplication and ensure complementarity are required. At the continental level, the role of such coordination is being taken up by AMCOW (Box 8.1). Development partners and other stakeholders should consider reinforcing existing structures, rather than developing new ones. It is only then that the growing complexity of partnerships involved in Africa's water governance can be fully addressed.

Figure 8.1 Complex landscape of water partnerships in Africa



Note: Public stakeholders: IHP (Intergovernmental Hydrological Programme), IGRAC (International Groundwater Resources Assessment Centre), AUDA (African Union Development Agency), AfDB (African Development Bank), UNECA (United Nations Economic Commission for Africa), ECOWAS (Economic Community of West African States); partnerships: IWaSP (International Water Stewardship Programme), AWS (Alliance for Water Stewardship), GWP (Global Water Partnership), CIWA (Cooperation in International Waters in Africa), AIP (Continental Africa Water Investment Programme), AWSA (African Water and Sanitation Academy), RAIN (Replenish Africa Initiative), TWPs (Transboundary Water Partnerships), GWPSA (Global Water Partnership Southern Africa), CBPs (community-based partnerships), CPPs (community–public partnerships); private stakeholders: MNEs (multinational enterprises), INGOs (International Non-Governmental Organizations), NGOs (Non-Governmental Organizations).

Source: Own elaboration.

8.2 Europe and North America

The case studies below illustrate partnerships and cooperation initiatives that are frequent in the Europe and North American region. The *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters* (Aarhus Convention – UNECE, 1998) and the *Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (Water Convention – UNECE, 1992) stress the need for cooperation and involvement of stakeholders, as do several relevant Directives of the European Union (EU). These instruments have facilitated the development of various types of partnerships in the region and are also contributing to stakeholder participation outside the region.

While stakeholder involvement is an objective that has been proactively pursued and, to a large degree, successfully achieved in the outlined case studies, it remains a common challenge in water management, governance and cooperation across the region.

8.2.1 Cooperation in the Drin basin

The transboundary Drin River basin includes two rivers (Drin and Buna/Bojana) and three lakes (Prespa, Ohrid and Skadar/Shkoder). Four State Parties to the Water Convention - Albania, Greece, Montenegro, North Macedonia - and Kosovo (within the framework of the United Nations Security Council Resolution 1244, dated 1999), share the basin. It provides water resources for drinking, energy, fishing, agriculture, biodiversity, tourism and industry.

Box 8.1 AMCOW Pan-African Groundwater Programme: Advancing groundwater for water security and socio-economic transformation in Africa

The African Ministers’ Council on Water (AMCOW) identified groundwater as a priority intervention area in its Strategic Plan 2018–2030, launching the Pan-African Groundwater Program (APAGroP) in Kampala in February 2020. Through APAGroP, AMCOW has engaged groundwater networks and institutions such as the German Federal Institute for Geosciences and Natural Resources (BGR), the British Geological Survey (BGS), the International Water Management institute (IWMI) and UNESCO’s Intergovernmental Hydrological Programme (IHP), working across three main thematic pillars (see Table).



Source: Adapted from Tijani (n.d.).

Arising from this collaboration, several joint activities were accomplished, including the development of a groundwater country support tool (the Namibia case study), a groundwater financing framework (the Uganda pilot study) and the development of the Pan-Africa Water Quality Programme in collaboration with the IWMI.

With the support of GWP Mediterranean (GWP-Med) and the Water Convention Secretariat of the United Nations Economic Commission for Europe (UNECE), multi-stakeholder consultations at the national and basin level led to the signing by riparians of a *Memorandum of Understanding (MoU) for the Management of the Extended Transboundary Drin Basin*⁴⁸ in 2011. The MoU established an institutional framework for cooperation: the Meeting of the Parties, a Drin Core Group and three Expert Working Groups. Objectives of the MoU include increased accessibility to comprehensive data and adequate information, minimization of flooding, pollution control, and reduction of damage from hydro-morphological changes (UNECE, 2022).

⁴⁸ The full text can be found here: https://unece.org/DAM/oes/MOU/MOU_Drin_Strategic_Shared_vision_Final.pdf.

● ● ●
**Partnerships
and cooperation
initiatives are
frequent in the
Europe and North
American region**

With the support of the Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and GWP-Med, joint activities under the MoU included a transboundary diagnostic analysis that provides the basis for collaborative work. Outcomes included:

- Consensus among riparians on key transboundary concerns and drivers of change, including climate change and variability, reached through joint fact-finding;
- Commitment of riparians and donors to sustain joint cooperation mechanisms and to undertake priority reforms and investments; and
- Benefits demonstrated in the field by environmentally sound approaches and technologies new to the region (such as River Basin Management Plans, wastewater treatment technologies, approaches to decrease nutrient loads, and establishment and testing of transboundary monitoring).

The process has included a high level of stakeholder involvement, including regular stakeholder meetings at the national and basin levels. Implementation of a joint Strategic Action Plan, approved by the riparians in 2020, has been supported by the GEF and the Adaptation Fund and through national investments. A nexus assessment focusing on hydropower and floods, and on sustainable biomass and forest management contributes to the involvement of important sectors in the management of the basin (UNECE, 2022). The learning workshop *Gender equality for sustainable development in the Drin basin* (2020), held in the framework of the project 'Promoting the Sustainable Management of Natural Resources in Southeastern Europe, through the use of the nexus approach' by the Austrian Development Agency (ADA), GWP and UNECE, discussed gender-related challenges and opportunities relevant to the water–food–energy–ecosystem approach in the Drin basin, enhancing the understanding of the basic concepts of gender equality among stakeholders.

8.2.2 National Policy Dialogues of the EU Water Initiative

Since 2006, UNECE and its Water Convention Secretariat, jointly with the Organisation for Economic Co-operation and Development (OECD) and in close cooperation with national authorities, has been implementing National Policy Dialogues (NPDs) in countries of Eastern Europe, the Caucasus and Central Asia under the EU Water Initiative (EUWI), funded mainly by the European Union. The International Office for Water (IOW) and the Environment Agency Austria have also been involved in this work since 2016. NPDs have strengthened water governance and integrated water resources management (IWRM) in line with the provisions of the Water Convention, its Protocol on Water and Health, and EU Directives. It is a specific feature of the NPDs that they are involving a broader base of stakeholders, such as representatives of civil society, academia and the private sector, than is usually the case in national water policy discussions. Capacity-building on modern water management principles has been an important aspect of the NPDs (UNECE, 2022).

Outcomes of such support in Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine in 2016–2021 (European Union, 2021; UNECE, 2022) included:

- Five transboundary basins (of the Dniester, Kura, Khrami-Debeda, Neman and Western Dvina Rivers) progressed with development of joint legal frameworks;
- Hundreds of knowledge products such as technical reports, databases, maps and web services were delivered and nine water laboratories modernized, including with the delivery of 400 units of state-of-the-art equipment items for water monitoring and analysis;
- Forty-four surveys were carried out in rivers, ground- and coastal waters, covering over 1,000 sites;

● ● ●
A water-smart society leads to a more resilient water sector, with water security and safety as essential goals

- Water information systems in the six countries were modernized to provide transparent data on the status and use of water resources; and
- Around 30 million people are benefiting from 11 new or revised River Basin Management Plans and water monitoring practices that are closer to EU standards.

Outcomes of support in Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan included:

- A multi-stakeholder water–food–energy–ecosystems nexus dialogue in the Syr Darya basin in 2013–2015;
- Progress with strategic planning, such as a water sector reform strategy in Tajikistan for 2016–2025 involving the uptake of the basin management principle, and water safety indicators in Kyrgyzstan;
- Modernized legislation in Turkmenistan, such as a new water code, adopted in 2016 with IWRM elements, and accession by that country to the Water Convention; and
- Capacity-building and research on the state of the Kigach, Ural/Zhayik, Bolshoy and Malyi Rivers shared by Kazakhstan and the Russian Federation, and development of an action plan in 2015–2018.

8.2.3 Water-oriented living labs for a water-smart society

Water Europe has been established to promote water-related innovation, research and development in the region. It is a multi-stakeholder association with over 250 members, representing the whole diversity of water-related innovation. All Water Europe activities and positions are guided by its Water Vision (2017) and the ambition to achieve a water-smart society (Water Europe, n.d.).

A water-smart society leads to a more resilient water sector, with water security and safety as essential goals. It responds to the need for major societal changes in response to climate change and demographic trends.

Water Europe has developed the model of Water-Oriented Living Labs (WOLLS) to promote the co-creation, validation and deployment of innovations to achieve a water-smart society. Experts among Water Europe’s members form Vision Leadership Teams – Water Smart Industry, Water Smart City and Water Smart Rural – providing guidance.

WOLLS work on the integration of technologies with new business and governance models, and on innovative policies to address the pressing water and water-related challenges in full compliance with SDGs 6 and 17 (Water Europe, n.d.).

Water Europe selected 105 WOLLS in its 2019 *Atlas of Water-Oriented Living Labs* (Water Europe, 2019), expanding the networks of existing WOLLS, supporting the creation of new WOLLS, and exploring funding opportunities by leading the WOLLS pillar of the EU co-funded partnership Water4All. An annual action plan for the Network of WOLLS establishes priorities for the urban, rural and industrial water-related environments.

8.2.4 The International Joint Commission

The International Joint Commission (IJC) between Canada and the United States of America (USA) has a long history and demonstrates good practices for successful water cooperation and for the establishment of partnerships not only across borders but also within countries and between sectors, administrative levels and other stakeholders.

The IJC was created by the Boundary Waters Treaty of 1909 for the purpose of settling and preventing transboundary water disputes between Canada and the USA. The IJC's activities commence when governments issue a Directive. The IJC works independently to study issues and makes recommendations back to governments. Once recommendations are accepted, the IJC assumes a monitoring and reporting function.

The IJC's rich history of resolving water apportionment and flood management issues is linked to a strong engagement with involved communities. Public outreach and engagement are foundational components of the IJC's activities. Article XII of the 1909 Boundary Waters Treaty states that "... in any proceeding, or inquiry, or matter within its jurisdiction under this treaty, all parties interested therein shall be given convenient opportunity to be heard..." (The Boundary Waters Treaty, 1909).

Providing all interested parties with convenient opportunities to be heard is prominently included in all IJC activities and is the core principle for its communications programme.

As detailed in its Rules of Procedure (IJC, n.d.), the IJC fulfils this obligation by holding public hearings before issuing an Order or submitting final reports to the governments. For hearings to be meaningful, the IJC must also inform the public about the matters it is considering.

For the past 40 years, the IJC has also taken a proactive approach by involving stakeholders as members of its boards and advisory groups. More recently, the IJC has endeavoured to involve members of indigenous communities in its work.

One of the recent experiences is the concept of 'adaptive management' used by the watershed (basin) boards to monitor and review international water regulation plans across the transboundary waters. Adaptive management enables the IJC's boards to respond quickly to changing conditions. This is particularly important in view of the changing climate. In the watershed boards, a broad range of stakeholders are represented.

In 2022, the IJC has undertaken the 50th anniversary review of the 1972 Great Lakes Water Quality Agreement. The *Great Lakes Horizon* project identifies factors that could impact the Great Lakes (which hold 20% of the world's freshwater resources – US EPA, n.d.) ecologically, economically, socially and culturally over the next 30+ years, and provides suggestions regarding potential improvements of the Agreement.

Another key initiative implemented in support of SDG 6 is the *Great Lakes Manure Management Framework*. The 2019 Great Lakes Water Quality Board's report on manure management included research from a very diverse group of stakeholders from agriculture, nutrient research and water treatment organizations (IJC, 2019). Partnerships, including with regional governmental agencies and institutions, are key to establishing an implementation plan.

8.2.5 Equitable access to water and sanitation in Armenia

In its efforts to improve access to water and sanitation, in 2015–2016, Armenia undertook a self-assessment of equitable access to water and sanitation, using the Equitable Access Score-Card (UNECE/WHO Regional Office for Europe, 2019). This innovative analytical tool, based on the *Protocol on Water and Health* (UNECE/WHO Regional Office for Europe, 1999), helps governments and other stakeholders to establish a baseline measure of equity in access to water and sanitation, identify policy gaps and priority areas for actions, agree on further actions, and evaluate progress through a process of self-assessment (UNECE/WHO Regional Office for Europe, 2013).

The self-assessment exercise was carried out by the NGO Armenian Women for Health and Healthy Environment under the coordination of the State Committee of Water Economy under the Ministry of Agriculture.⁴⁹ The exercise brought together the Ministry of Health, the Ministry of Territorial Administration and Infrastructure, the Public Services Regulatory Commission, the Ministry of Nature Protection, the Ministry of Education and Science, and the Ministry of Labour and Social Affairs of Armenia. The Office of the Human Rights Defender of Armenia was a partner in the exercise. Stakeholders from the private sector, universities and civil society also participated, providing inputs.

The exercise identified the challenge of guaranteeing water supply for almost 579 rural communities that were neither connected to the centralized water supply system nor serviced by water companies. Obtaining water supply was found to be particularly problematic for schools. Information on access to water and sanitation by vulnerable and marginalized groups was scarcely available or lacking from official sources. It became evident that the existing legal framework lacked definition of the term ‘vulnerable and marginalized groups’, and there were no public policies to sufficiently help improve access for these various groups (UNECE/WHO Regional Office for Europe, 2019).

The self-assessment process led to strong interministerial collaboration in addressing these issues. An Action Plan on Equitable Access to Water and Sanitation for the period 2018–2020 identified priority measures to reduce geographical disparities and provide access to water and sanitation for vulnerable and marginalized groups. The self-assessment also triggered a legislative reform to include a definition of vulnerable and marginalized groups in the Water Code.

The self-assessment exercise strengthened the governance framework for guaranteeing human rights to water and sanitation in Armenia by capitalizing on new data and information gathered through the use of the Equitable Access Score-Card (UNECE/WHO Regional Office for Europe, 2013). Through 2012–2020, the Equitable Access Score-Card has been applied at the national, subnational or municipal level in 12 countries of the UNECE region, enhancing knowledge of the situation of equitable access to water and sanitation through self-assessments and awareness-raising and fostering the adoption of measures to further ensure equitable access.

8.3 Latin America and the Caribbean

This section describes several different types of partnerships and forms of cooperation related to water management in Latin America and the Caribbean. It covers examples found at different scales (i.e. local, national, and transboundary basins) as well as other cross-sectoral productive experiences. These partnerships are mainly water-based or closely connected to water-dependent sectors, such as agriculture. The evidence points to limited engagement outside the water-based domain, such as water initiatives linked to social justice, gender, education or job creation, or even other environment-related aspects, such as biodiversity.

8.3.1 Water-related partnerships and other coordination efforts

Local level

The most common water-related partnerships at the local level in Latin America and the Caribbean are established for overseeing drinking water supply and sanitation services, particularly in rural areas. Agricultural producer groups (such as WUAs; see Section 2.2) for the management of irrigation water are also widespread, given the relevance of this activity in the region. One common trait of these associations is that they usually operate independently of urban area regulators with varying levels of involvement from national-level authorities.

⁴⁹ Currently the Water Committee is under the Ministry of Territorial Administration and Infrastructure.

● ● ●
There are several different types of partnerships and forms of cooperation related to water management in Latin America and the Caribbean

Rural drinking water and sanitation

In Latin America and the Caribbean, rural drinking water and sanitation services are generally led by community organizations, such as administrative boards or water vigilance committees. An estimated 80,000 of these associations were active in the region's rural and peri-urban areas in 2011 (AVINA, 2011). Most of these organizations are responsible for the operation and maintenance of services, which depend on the collection of fees. However, these associations tend to have weak management capacities, mainly due to the lack of funding, insufficiently trained technicians, poor or insufficient infrastructure, and/or the difficulty of agreeing on rates or fees with the local population. Faced with these issues, the promotion of new management models based on efficiency, enhanced technical assistance and appropriate subsidies are generally required to improve and expand overall service for rural and peri-urban populations (Mejía Betancourt et al., 2016).

Another challenge is related to the regulation of said partnerships, which varies significantly across countries in the region. For example, the drinking water and sanitation management boards in Ecuador need to have a legal status and must affiliate their staff to social security. These demands induce community organizations to avoid legalization and therefore tend to remain informal (Foro de los Recursos Hídricos, 2013). Similar situations are found in rural areas of the Plurinational State of Bolivia and Peru. In Chile, the Rural Water Systems are managed, maintained and operated by local committees or cooperatives, which benefit from infrastructure, advice and assistance provided by the state. For the operation of the service, a license must be issued, while tariffs should guarantee the sustainability of the system (Gobierno de Chile, 2015).

Agricultural associations – Irrigation boards

Irrigation boards or committees are found all across the region. Frequently, they operate independently and are privately funded. However, there are some interesting examples of coordination and state involvement. In Jamaica, the WUA organizes private farmers into a cohesive self-governing unit, which manages an irrigation system. Farmers are members and shareholders and are responsible for governing the organizations through democratic processes (Government of Jamaica, 2015). In Peru, legal support from the state for the collective management of irrigation water has played a fundamental role in strengthening collective action for water management across different basins (MINAGRI, 2015; Muñoz Portugal, 2020).

Regionally, the participation of women in local irrigation boards has been low. This is partly explained by the low ratio of women's land ownership, while land ownership is in many cases a precondition for legally participating in irrigation boards, although there are other prevailing sociocultural constrictions as well (Saravia Matus et al., 2022).

National and transboundary basin levels

National level

Basin management organizations have a long history in the region. Organizations and systems vary in structure, continuity, stakeholders or functions, even within the same country. However, most of these associations focus on data-monitoring, research, coordination of actions, regulation, planning, financing, and development and administration, among other aspects, and often face similar challenges related to technical capacity, governance structures and, particularly, funding (GWP/INBO, 2009).

The launch of the National Basin Plan of the Plurinational State of Bolivia led to the creation of basin management organizations. These organizations serve as interlocutors with the executing entities of investment projects, and as the intercommunal entities for the management of the natural resources of the micro-basins. They are established based on existing social organization structures (unions, brands, irrigation organizations, etc.).

The sustained operation of these organizations requires the support of the Municipal Autonomous Government and other local authorities, in addition to the legitimacy granted by the recognition of the social or indigenous organizations that are water users.

In Brazil, there are River Basin Committees whose primary functions are to approve water resources management plans, to set the price and charge for use, and to serve as intermediaries in the event of conflicts between users. These committees are comprised of representatives of the federal, state and municipal governments, water users and civil society. In this case, having associated support organizations or funds to carry out their activities is key to the committees' effectiveness. Thus, efforts to create effective coordination between committees is crucial as many are still unable to fulfil their mission (Formiga, 2014). Likewise, in Mexico, the decentralization of water resources management from the national to the basin level includes the participation of federal, state and municipal government, together with representative water users and sectoral organizations (CONAGUA, 2014).

In Panama, the River Basin Committees are organized by the Ministry of the Environment. These committees promote coordination and cooperation between the public sector, private organizations and civil society on water issues, and coordinate the preparation and implementation of the Environmental Territorial Planning Plan for the hydrographic basin and the Management, Development, Protection and Watershed Conservation Plan. Basin Committees were established for 84.6% of the national territory during the 2015–2019 period, thus highlighting the political support given to this type of partnership (Gobierno de Panamá, 2020).

As in the local-level analysis, gender disparities can be identified among the decision-makers at the national level. In the case of Peru, one 2020 study identified 20 key roles in water management, of which 19 were for less than 35% performed by women. At the national management level (National Water and Sanitation Superintendency), only 29% of managers were women. At the regional and basin level, only 17% of basin presidencies were held by women, while in the case of Irrigation Water Users Board presidencies only 6% were women (Carrillo Montenegro and Remy Simatovic, 2020).

However, the current gender gap in governance and decision-making in the water sector has been recognized by policy-makers across Latin America and the Caribbean, and in fact, of all gender-related water policies established over the past 20 years, 58% address gender equality in governance and participation in the sector (Saravia Matus et al., 2022).

Water funds can be defined as multi-stakeholder partnerships that design financial and governance mechanisms to address water insecurity and act collectively through nature-based solutions (NBS) in support of sustainable river basin management (see Box 3.1 and Chapter 12). In Latin America and the Caribbean, there are 26 water funds in 9 countries⁵⁰ and 14 more are being created (Box 8.2) (Alianza Latinoamericana de Fondos de Agua, n.d.).

Transboundary level

In Latin America, only 4 of the 22 countries (Argentina, Brazil, Ecuador and Paraguay) have arrangements for at least 90% of the surface of their transboundary basins. Furthermore, in ten countries, the area of the transboundary river and lake basins covered by operational arrangements does not reach 10%. There are however, several encouraging examples (UNECE/UNESCO, 2021).

⁵⁰ In Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, Guatemala, Mexico and Peru.

Box 8.2 Santiago Maipo Water Fund

To address water security challenges in the Maipo River basin, particularly the growing water deficit (mega-drought), the Santiago Maipo Water Fund brings together multiple water users to find collective solutions. The objective of this partnership is to implement projects aligned with six strategic lines of action: (i) source water protection, (ii) water use efficiency, (iii) information management, (iv) risk management, (v) awareness and communication, and (vi) territorial planning. For instance, the water fund has launched a demonstration project based on restoration and reforestation for the protection of natural habitats, such as high Andean wetlands and key riparian areas in the Maipo River basin. A pioneering initiative for environmental monitoring of wetlands has also been launched. The fund has the support of the Metropolitan Regional Government and forms part of the Resilience Strategy of the city of Santiago.

Source: Fondo de Agua Santiago-Maipo (n.d.).

One particular case is the Binational Commission for the Integrated Management of Water Resources of Transboundary Hydrographic Basins between Peru and Ecuador, created in 2017 as an intergovernmental organization to promote exchange and cooperation between representatives of the two countries. Its objective is to consolidate bilateral coordination, cooperation and participation, with an ecosystemic and sustainable vision, for the most appropriate use and management of water resources in the nine basins shared between both nations. It has a Binational Technical Secretariat that technically and politically oversees the Commission and the Committees of the nine transboundary basins. For their part, the Committees are responsible for executing the development plans for each basin. Some of the functions of the Binational Commission are to agree on the framework of policies and strategies to promote IWRM, establish mechanisms for the implementation of national IWRM strategies, approve basin plans, analyse the technical-economic proposals of the committees, propose dialogue mechanisms, propose climate change adaptation and mitigation measures as well as early warning systems for extreme events, and establish financing mechanisms (Ecuador and Peru, 2017).

Despite delays in the implementation of the Commission due to political instability in both countries' governments and the health emergency related to the COVID-19 pandemic, Presidential meetings have been arranged to agree and implement IWRM plans for all transboundary basins (starting with Zarumilla, Catamayo – Chira and Puyango – Tumbes), as well as other technical studies (GWP, 2021). However, according to GWP (2021), the Regulation for the Binational Commission may face some key challenges in the near future, such as the need to improve information exchange, adopt water quality protocols, mobilize additional resources and implement conflict resolution mechanisms.

Other coordination efforts

There are additional instances of inter-institutional coordination where public, private and community actors work together with the aim of improving water management. At the national level, one example is the Inter-Institutional and Sectoral Commission for Water, Sanitation and Hygiene (COMISASH) of Nicaragua. This involves public- and private-sector entities, academia, community and national networks, and national as well as international NGOs.

One of the most relevant examples in the region is the case of the Water Cabinet in the Dominican Republic. Created as an advisory council to increase efficiency and agility in decision-making, it coordinates state water policy, previously dispersed in institutions such as the National Institute of Hydraulic Resources, the National Institute of Potable Waters and Sewers, the Ministry of Environment and Natural Resources, the Dominican Hydroelectric Generation Company, and the Santo Domingo Water and Sewerage Corporation, with their local versions in each region (Gobierno de la República Dominicana, 2021a; 2021b). One of the main advantages of this Cabinet is that it is held within the Ministry of Economy, Planning and Development, and holds regular meetings with the president of the country, thus providing key evidence for decisions on water management that directly affect economic output, public health and the quality of the environment in the country. The Water Cabinet recognizes the triple dimension of water as a human right, an economic resource and a natural resource, and outlined the need of a public investment programme of more than US\$8.5 billion through 2030 (equivalent to 7% of the Gross Domestic Product (GDP) in 2022) (UNECLAC, 2022). Moreover, it also intends to achieve a National Water Pact that will allow for the preservation and availability of water in the future (World Bank, 2021). In other words, the high-level political endorsement is recognized here as an essential element to foster a water management transition involving different stakeholders.

At the transnational level, different intergovernmental initiatives pursue the implementation of good practices and cooperation. One example is the Caribbean Water & Sewerage Association Inc. (CAWASA), an organization of public and private water services providers. In Latin American countries, the Association of Water and Sanitation Regulators (ADERASA) aims to draw common lessons and formulate best practices, particularly to address efficiency and regulatory challenges. The Caribbean WaterNet focuses on improving the development of functional capacities for IWRM and resilience to disaster risks. Similarly, the Central American Integration System (SICA) is established as a space for cooperation around the consensual use of water resources. They have proposed the Regional Strategy for the Integrated Management of Water Resources and its respective Plan for the Integrated Management of Water Resources as regional instruments for harmonization in water management.⁵¹ Likewise, the Andean Community (consisting of the Plurinational State of Bolivia, Colombia, Ecuador and Peru) has also adopted a strategy for comprehensive management of water resources, seeking synergies with governmental and non-governmental actors such as academia, indigenous peoples, local communities and organized civil society, among others (Comunidad Andina, 2020). Despite these efforts, it is necessary to highlight that Latin America and the Caribbean has the lowest regional score in adopting integrated water management (37%), ultimately indicating that efforts in this respect still need to increase (UNEP, 2021).

8.3.2 Conclusions

Although there are valuable examples of water-based partnerships in Latin America and the Caribbean, their performance remains challenged by limited technical capacity and funding. Based on the examination of these, it is possible to conclude that basin-level management is of central importance to both public and private stakeholders. However, the level of adoption of IWRM remains rather low in the region. In this respect, high-level political support for water-related partnership initiatives is identified as a key enabler.

At the local level, most water-related organizations remain sectorial in their focus, either aimed at rural drinking water and sanitation supply, or at agricultural irrigation purposes, which is also a reflection of low levels of IWRM. Both types of organizations still need to be framed within basin-level management, and there is often no evidence of this connection. Although basin organizations have been evolving over time to empower social participation and communal agreements, the available examples of partnerships and other forms of cooperation indicate that there is still a void regarding those that connect water to other closely linked issues, such as education.

8.4 Asia and the Pacific

Water resources management has significantly contributed to the increasing economic and social welfare of the region over the last decade, through the provision of basic water and sanitation hygiene (WASH) services, and improved food production, industrial development, and ecosystem-based services. However, Asia and the Pacific remains far from being on track to meet the targets of SDG 6.

Several of the region's major river basins are experiencing high to critical levels of water stress, including the Krishna and Ziya River basins (Figure 8.2). Compounded by the effects of climate change, these stress levels are reported to be increasing (UN-Water/UNESCAP, 2022). Competition among the agriculture, industry, energy, and drinking water sectors will intensify as demands rise due to rapid urbanization and population growth (among others), exercising even greater pressure on water resources (FAO, 2021).

⁵¹ For more information, please see: www.sica.int/

• • •
Women, who are primarily responsible for water collection in local communities, often have limited participation in water management due to traditional norms and practices, such as power imbalances and sociocultural factors

Inequity in terms of water access remains an issue. Households with low education that also belong to the bottom 40% in wealth distribution face higher restrictions in access to basic sanitation (UNESCAP, 2018). Women and vulnerable groups suffer more from limited access to water and sanitation (Brighton, n.d.; UNESCAP, 2018). Furthermore, women, who are primarily responsible for water collection in local communities, often have limited participation in water management due to traditional norms and practices, such as power imbalances and sociocultural factors (Thai and Guevara, 2019).

Other critical regional challenges include inadequate sanitation services, pollution – both very closely related (WWAP, 2017) – as well as shortcomings in transboundary cooperation.

Enhancing governance and policy coherence, including through cooperation, partnerships and multi-stakeholder engagement at all levels, has been identified as a key priority for achieving progress on sustainable water management across Asia and the Pacific (UN-Water/UNESCAP, 2022).

8.4.1 Partnerships in Asia and the Pacific

In Asia and the Pacific, multi-stakeholder partnerships and cooperation at all scales are critical for supporting a more sustainable approach to water management, including through greater policy coherence – spanning across the climate, disaster risk reduction, agriculture, energy, urban and rural development, environment, health and finance sectors – and enhanced water governance at local, national and regional (especially transboundary) levels.

Intra-sectoral partnerships

At the local level, WUAs can support effective water management strategies (see Section 2.2). In Cambodia, Nepal and the Philippines, WUAs have helped mobilize investments from development agencies such as the International Fund for Agricultural Development (IFAD), specifically receiving technical and financial support on projects involving irrigation canals, drainage structures and water conservation systems (IWMI, 2011).

Multi-stakeholder partnerships sharing a common objective in the water sector also exist, involving local communities, national ministries and NGOs. Community participation was the important factor to ensure sustainability of water projects in the Solomon Islands (Alexander et al., 2012), on Apo Island in the Philippines (Hind et al., 2010) and in the Songkhram River basin in Thailand (Piman and Ghimire, 2022).

Public–private partnerships (PPPs) have been set up for infrastructure projects supporting water distribution, treatment and transmission (ADB, 2022), benefiting 67.5 million people in Asia and the Pacific in 2013 (Jensen, 2017). There has been an increase in PPPs for water services in China, Singapore and South Korea since 2000, but some have experienced a lack of sustainability when financial viability is not ensured (see Section 13.4). This happens when there is limited fiscal commitment from both private and government sectors and tariff risks are high. Sustainability is also jeopardized when projects have not been incorporated in a national water plan (ADB, 2022).

Evidence suggest that women’s participation in the assessment and implementation of PPPs is increasing (Almeida et al., 2020), and that women’s involvement in decision-making leads to their economic empowerment (Indarti et al., 2019).

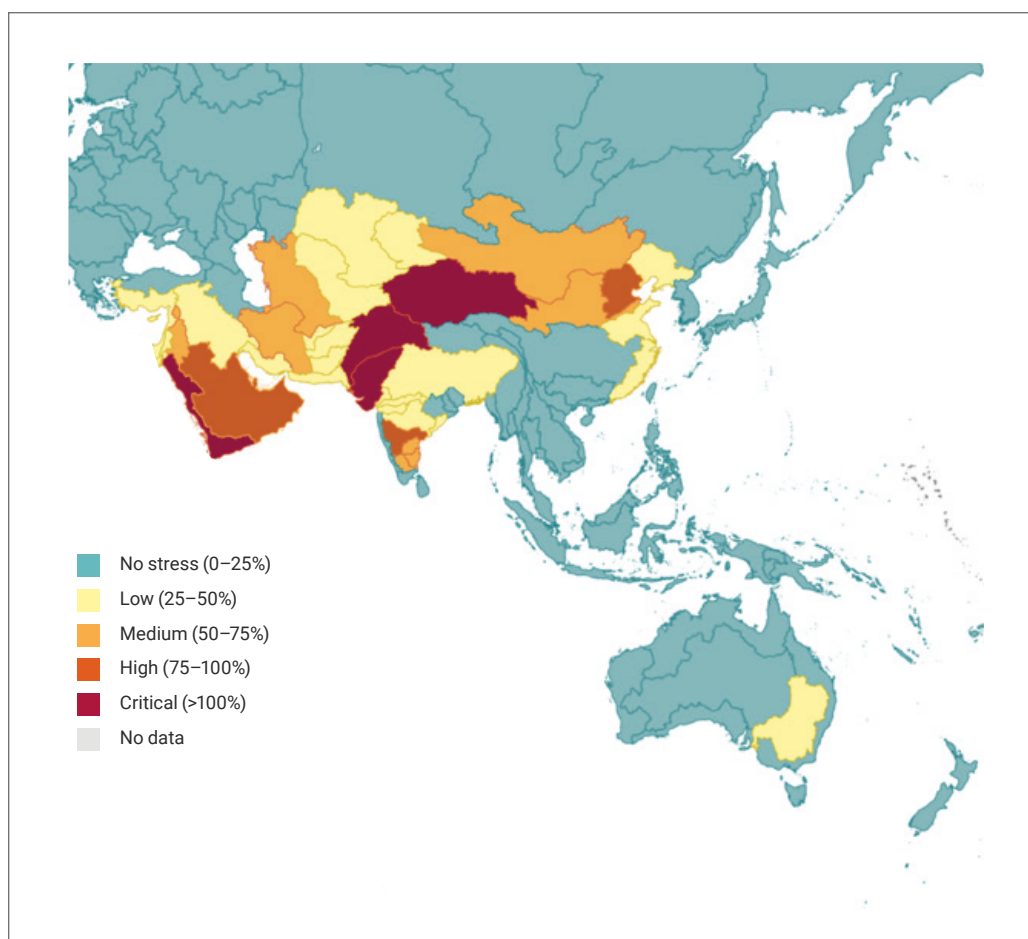
Cooperation and partnerships between countries sharing transboundary water resources are also critical for Asia and the Pacific. For example, the Mekong River Commission (MRC) was established in 1995 as a result of the *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*. The MRC collects water-related data and

Figure 8.2

Water stress levels in major river basins in Asia and the Pacific, 2018

Note: "The water stress is calculated as the ratio between (a) the amount of freshwater resources consumed in the three economic sectors (Agriculture, Service and Industry) and (b) the total renewable freshwater resources after deducting the amount of water needed to support existing environmental services, also indicated as environmental flows." (AQUASTAT, 2022).

Source: AQUASTAT (n.d.a).



information, increases stakeholder awareness, and supports cooperation among its Member States through consultations and the adoption of water management strategies, including on flood management and mitigation, as well as water use monitoring (MRC, n.d.).

Cross-sectoral partnerships

Asia and the Pacific records generally high levels of IWRM implementation (GWP/UNEP-DHI, 2021), which attest to a focus on both water and land management for social and economic development.

The Network of Asian River Basin Organizations (NARBO) serves as a platform for fostering regional cooperation in water governance, using IWRM. Since 2004, NARBO has contributed significantly through advocacy, awareness-raising, information exchange, capacity development and active participation in water-related conferences (ADB/ADBI/CRBOM/Japan Water Agency, 2015).

Cross-sectoral cooperation can also be effective in watershed governance. In China, the River Chief System (RCS) is a horizontal cooperation mechanism between different ministries from the municipal offices, the Environment Protection Agency, the Finance Bureau and the Water Conservancy Bureau, among others. The RCS has been implemented in 31 provinces since 2018, where visible improvements in surface water quality and the overall ecological condition of watersheds have been reported (Wang, et al., 2021).

Extra-sectoral partnerships

As water is a cross-cutting issue, partnerships and cooperation are key to integrated approaches to water management spanning across key sectors.

Integrated solutions, such as water–energy–food nexus approach, can help identify interlinkages and orient priorities in managing and allocating water for its multiple uses (Mitra et al., 2020), assessing co-benefits, neutrality and trade-offs (Rasul and Neupane, 2021). The GWP supports countries and regional organizations in developing and implementing nexus-integrated plans on cross-sectoral projects (GWP, 2020).

The water–energy–food nexus is also critical in a transboundary context. One partnership addressing this issue is the transboundary water cooperation arrangement established by the Mahakali Treaty (Pancheshwar Multipurpose Project) between India and Nepal, which aims to achieve water and energy security for both parties (Shrestha and Ghale, 2016; MoJS, n.d.). Although the Pancheshwar Multipurpose Project is long delayed, several beneficial impacts have been highlighted in terms of irrigation and flood control, and lessening energy shortages (Kunwar, 2014).

In Tuvalu, where water resources are affected by recurring storms and droughts related to El Niño-Southern Oscillation (ENSO) cycles, the government formulated the Sustainable and Integrated Water and Sanitation Policy (2012–2021),⁵² addressing the sustainable management of water resources as well as integrated policies on climate change and disaster risks. This resulted in a more comprehensive approach addressing the gaps between the policy outcome individually achieved by different government agencies (Gheuens et al., 2019).

The Small Island Developing States Accelerated Modality of Action (SAMOA Pathway) Pathway focuses on interlinkages among sustainable energy, natural resource management and green economy commitments to provide holistic adaptation measures, which includes water and ocean-based approaches (Commonwealth Foundation, 2015).

8.4.2 Conclusions

In Asia and the Pacific, multi-stakeholder partnerships and cooperation at all scales are critical for supporting sustainable water management and integrated approaches related to water, including at the transboundary level.

It is critical to strengthen existing partnerships and networks, to enhance existing platforms for better stakeholder engagement at all levels, and to ensure that all relevant stakeholders are included in water governance. Further developing governance approaches at subnational and national levels, engaging all parts of government, would support the mainstreaming and financing of water management required to achieve SDG 6, and lead to progress across other water-dependent sectors.

8.5 The Arab region

Characterized by its arid to semi-arid climate, the Arab region suffers from surface water scarcity. Over 392 million people in the region live with less than 1,000 m³ of renewable freshwater per capita per year (AQUASTAT, n.d.b; UNDESA, 2019). This and other rising challenges, such as climate change, high dependency on transboundary water resources and high usage of water resources by the agricultural sector, require successful cooperation and partnership initiatives, in order to collectively progress towards the sustainable management

⁵² Please see here for the original document: <https://reliefweb.int/report/tuvalu/sustainable-and-integrated-water-and-sanitation-policy-2012-2021>.

● ● ●
Most Arab states largely rely on rivers and/or aquifers that are shared with neighbouring countries (within and outside the region) for their water supply

of water resources and an improved water security in the region. This section explores some of the partnerships and cooperation modalities in the region, from regional to transboundary to cross-sectoral.

8.5.1 Ministerial-level cooperation

In June 2008, the General Secretariat of the League of Arab States approved the proposal to establish the Arab Ministerial Water Council (AMWC). This institution aims to develop cooperation and coordinate efforts among Arab states (League of Arab States, n.d.). In 2011, the AMWC adopted the *Arab Strategy for Water Security in the Arab Region to Meet the Challenges and Future Needs for Sustainable Development 2010–2030* (AMWC, 2012). This document is a framework for programmes and activities in all areas of water resources, especially the following: IWRM, development and preservation of water resources in quantity and quality, water demand management, support to coordination and cooperation in shared basins, and protecting Arab rights to water in transboundary water resources and in occupied territories. The strategy has been updated in 2022 to reflect current progress and emerging issues relevant to water security in the region.

In addition to consolidating regional efforts and collaboration on water security, the strategy action plan has helped to advance:

- Inclusion of water security in national development strategies and in policies related to economy and climate change;
- Setting of priorities for supporting water security on the national level through collaboratively working with regional organizations and neighbouring countries;
- Regional cooperation in research and data-sharing; and
- Investments under regional cooperation for advancing water security through technological innovations.

The AMWC further coordinates efforts on other regional water priorities, such as transboundary water cooperation. The United Nations Economic and Social Commission for Western Asia (UNESCWA), as mandated by the AMWC, drafted the guidance principles for Arab cooperation in the management of transboundary water resources and presented them at an intergovernmental meeting organized by UNESCWA and the League of Arab States in 2017. The guidelines have been under discussion since then, but their adoption has yet to be formally approved. Several challenges have hindered the process, including the difficulty of holding physical meetings due to COVID-19 and, most importantly, the political sensitivity tied to current developments on major transboundary surface water basins in the region. However, these guidelines constitute an institutional mechanism for dialogue and agreements on transboundary water issues as well as an opportunity to develop capacities of many state actors.

8.5.2 Transboundary water cooperation in the Arab region

Most Arab states largely rely on rivers and/or aquifers that are shared with neighbouring countries (within and outside the region) for their water supply. In fact, 15 out of the 22 Arab states are riparian to a shared surface water basin, and all Arab states, except the Comoros, are riparian to a shared aquifer. This makes cooperation on transboundary water resources essential for the region's water security. Despite certain inter-state tensions between some neighbouring countries, several examples of cooperation modalities do exist in the region, including transboundary aquifers. The Nubian Sandstone Aquifer System (NSAS), the Northwestern Sahara Aquifer System (NWSAS) and the Orontes River basin are among those where such cooperation arrangements are in place.

For the NSAS, a Joint Authority formed by Egypt and Libya was launched in 1991 and was later joined by Sudan and Chad. This Joint Authority aims at serving the social and economic development of NSAS countries by studying, protecting and planning the uses of NSAS water resources (NSAS-JA, n.d.). The gathering and sharing of data often form a critical challenge in transboundary settings (see Section 10.3). To overcome this challenge, the four riparian countries of the NSAS have signed two agreements that have advanced data-sharing, monitoring and modelling. Cooperation in the NWSAS is fostered through a consultation mechanism facilitated by the Sahara and Sahel Observatory in the form of a steering committee constituted of representatives from water authorities of each riparian country. This consultation mechanism offers cooperation on data exchanges, research, and management and monitoring of water resources. However, it does not legally restrict any of the riparian countries from abstracting groundwater. The NWSAS cooperation mechanism was initiated with the support and funding of the international community, resulting in a mechanism prototype for other aquifers in the Arab region.

Formal cooperation on the Orontes River basin between Lebanon and the Syrian Arab Republic started in 1972 when the two riparian States signed a bilateral agreement concerning water use. It was further developed in 1991 through the *Fraternity, Cooperation and Coordination Treaty* (Syrian Lebanese Higher Council, 1991), establishing the formal basis for cooperation between the two countries in the domain of water and other sectors. The treaty led to the establishment of a Lebanese–Syrian Joint Committee for Shared Water in addition to several agreements that were signed thereafter to enhance cooperation between the riparian countries. This cooperation has improved the management of the transboundary water resources through river infrastructure development and shared allocation between countries (UNESCWA/BGR, 2013).

These transboundary cooperation arrangements have led to improved water management through iterative trust-building processes among riparian countries that started with targeted data-sharing, information-gathering and scientific research and then developed into more robust cooperation modalities.

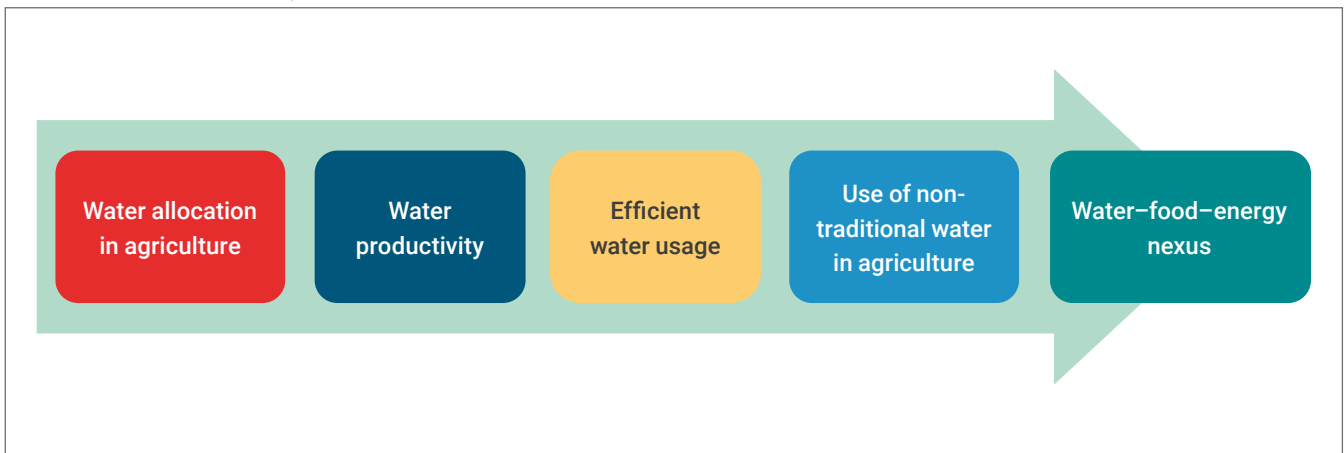
8.5.3 Cross-sectoral cooperation

The High-Level Joint Committee for Water and Agriculture

After several years of working towards coordination between the water and agricultural sectors, the First Joint Meeting of Arab Ministers of Agriculture and Water was convened under the auspices of the League of Arab States with the support of UNESCWA and the Food and Agriculture Organization of the United Nations (FAO) in 2019 (UNESCWA, 2019). The meeting resulted in the adoption of the terms of reference for the Joint Ministerial Committee and its Joint Secretariat, comprised of the Arab Organization for Agricultural Development (AOAD) and AMWC. This ministerial meeting was concluded with a call for the effective integration of water and food security issues into the national sustainable development strategies and the adoption of the Cairo Declaration urging governments and partners to reinforce regional coordination and to harmonize policies across both sectors to face the impacts of climate change and water scarcity.

The High-Level Joint Committee for Water and Agriculture strives to achieve greater institutional coordination between the agriculture and water sectors, particularly to improve intergovernmental coordination to support policy coordination and coherence for optimizing water use in the agriculture sector and for food production, both at the national and regional levels. So far, the High-Level Joint Committee for Water and Agriculture has set five priority areas of work (Figure 8.3).

Figure 8.3 The five priority areas of work of the High-Level Joint Committee for Water and Agriculture



Source: Authors.

The achievements of this cross-sectoral cooperation include drafting an action plan for the implementation of the Cairo Declaration, adopting a regional guideline for water allocation in the agriculture sector and issuing a scoping paper on the use of non-conventional water resources. Work is in progress to pilot the water use allocation guidelines in several Arab states.

8.5.4 Regional networks and initiatives

Several regional partnerships and cooperation initiatives have been initiated in the region in response to water priorities such as implementing IWRM and finding solutions to deal with the consequences of water scarcity or climate change. These initiatives have succeeded in bringing together partners and building synergies to address regional challenges and priorities of the water sector.

RICCAR

The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) is the outcome of the first Arab Ministerial Declaration on Climate Change (2007), which recognized the potential impacts that climate change may have on development in the Arab region (UNESCWA, n.d.a). RICCAR is implemented through an inter-agency collaborative partnership involving 11 partner organizations,⁵³ including UNESCWA. Commitment and support for the initiative have been further articulated by Arab states through follow-up resolutions adopted by AMWC, the Arab Permanent Committee for Meteorology (APCM) and the Council of Arab Ministers Responsible for the Environment (CAMRE). The regional initiative aims to assess the impacts of climate change on freshwater resources in the Arab region and to examine

⁵³ RICCAR is implemented through an inter-agency collaborative partnership involving 11 partner organizations, namely UNESCWA, the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), FAO, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the League of Arab States Secretariat, the Swedish Meteorological and Hydrological Institute (SMHI), the United Nations Educational, Scientific and Cultural Organization (UNESCO) Cairo Office, the United Nations Environment Programme (UNEP), the United Nations Office for Disaster Risk Reduction (UNISDR), the United Nations University Institute for Water, Environment and Health (UNU-INWEH), and the World Meteorological Organization (WMO). In addition to the resources provided by the partner agencies, funding is provided by the Swedish International Development Cooperation Agency (Sida) and the German Federal Ministry for Economic Cooperation and Development (BMZ), which financially support RICCAR through the Adaptation to Climate Change in the Water Sector in the Middle East and North Africa Region (ACCWaM) project (UNESCWA et al., 2017).

their implications for socio-economic and environmental vulnerabilities, based on regional specificities (UNESCWA et al., 2017). In 2017, it has launched the first Arab domain climate modelling ensembles, which in turn are used to assess the impact of climate change on subdomains and transboundary resources in the Arab region.

Specific outcomes of RICCAR in relation to regional cooperation include (RICCAR, n.d.):

- Establishing an Arab knowledge hub on climate and water;
- Creating a common platform for assessing, addressing and identifying regional climate change challenges;
- Providing a common and comparable scientific understanding of climate change impacts and associated vulnerabilities across the Arab region;
- Increasing the capacity of Arab water ministries and meteorological institutions to engage in climate prediction and climate change projection; and
- Informing policy dialogue, negotiations and exchange among Arab decision-makers.

WSI

The FAO Water Scarcity Regional Initiative (WSI) was established in 2013 as a ‘partnership platform’ for strengthening coordination and collaboration among institutional partners (FAO, 2013). Partners⁵⁴ signed a ‘Partnership Pledge’ expressing their strong interest and willingness to work together to support the implementation of relevant collaborative strategies, in the context of the Arab Water Security Strategy and the Arab Strategy for Sustainable Agricultural Development (2005–2025). The primary focus areas of the initiative include: (i) adopting global standards for water accounting systems; (ii) expanding the knowledge base for irrigation efficiency and water productivity; (iii) improving groundwater governance; (iv) using non-conventional water resources; (v) adapting to climate change; (vi) managing drought; and (vii) implementing scenario analysis, including the water–energy–food nexus approach, to identify safe operational boundaries for water.

Specific outputs of WSI collaborative initiative include:

- Coordinated planning and implementation of joint activities between regional partners;
- Better understanding of, and responding to, countries’ priority areas/needs;
- Contribution to updating and enhancing the scope of ongoing and future regional strategies in water, food and climate change; and
- Supporting member countries in issuing policies and identifying sustainable practices in agriculture to boost productivity, improve food security and better manage water resources.

⁵⁴ Arab Centre for the Studies of Arid Zones and Drylands (ACSAD), Arab Organization for Agricultural Development (AOAD), Arab Water Council (AWC), Centre for Environment and Development for the Arab Region and Europe (CEDARE), Desert Research Center (DRC), ESCWA, FAO, German Agency for International Cooperation (GIZ), International Centre for Agricultural Research in Dry Areas (ICARDA), International Centre for Biosaline Agriculture (ICBA), International Fund for Agricultural Development (IFAD), International Water Management Institute (IWMI), League of Arab States (LAS), National Water Research Center (NWRC) Egypt, UNESCO, World Bank and World Food Programme (WFP).

AWARENET

The Arab Integrated Water Resources Management Network (AWARENET) is an independent regional network of training and research institutes, NGOs, government institutions, civil society and experts in the field of water, engaged in the elaboration and delivery of capacity development programmes and resource materials on IWRM policies and practices for the Arab region. Part of the International Capacity Development Network for Sustainable Water Management's (Cap-Net UNDP) global network of networks, AWARENET was established in March 2002 with support from UNESCWA and a number of regional and international organizations, and is currently hosted by UNESCWA. It aims to spread knowledge through sharing experiences and information during workshops and trainings. AWARENET currently includes more than 680 members from the Arab region – of which at least 30% are women – and has worked on capacity development through structured training on several topics, including IWRM, innovative technologies and climate change assessments (AWARENET, n.d.).

Outcomes of AWARENET (UNESCWA, n.d.b) include:

- Raising regional understanding and awareness about water-related challenges in the Arab region;
- Offering capacity-building activities;
- Initiating regional forums and discussion groups; and
- Creating professional opportunities.

8.5.5 Conclusions

The Arab region is a water-scarce region facing many challenges exacerbated by climate change impacts, high dependency on transboundary water resources, low irrigation efficiency in the agricultural sector, and conflict, among others. This more than ever necessitates national and regional cooperation and partnerships to collectively meet the region's growing water needs.

Several cooperation and partnership arrangements have already been initiated in the Arab region despite the financial and political barriers that might hinder collaboration. These arrangements have demonstrated the importance of collaborative efforts, trust-building processes and data exchange for better water management. Such cooperation arrangements and partnerships are a starting point and a prototype for replication across Arab countries. However, given the immense challenges, more partnerships and increased collaboration are needed to accelerate the level of achievement of the water-related goals, especially to secure additional financing, advance innovation and share information.

References

- Adams, E. A. and Zulu, L. C. 2015. Participants or customers in water governance? Community-public partnerships for peri-urban water supply. *Geoforum*, Vol. 65, pp. 112–124. doi.org/10.1016/j.geoforum.2015.07.017.
- Adams, E. A., Sambu, D. and Smiley, S. L. 2019. Urban water supply in Sub-Saharan Africa: Historical and emerging policies and institutional arrangements. *International Journal of Water Resources Development*, Vol. 35, No. 2, pp. 240–263. doi.org/10.1080/07900627.2017.1423282.
- ADB (Asian Development Bank). 2022. *A Governance Approach to Urban Water Public-Private Partnerships: Case Studies and Lessons from Asia and the Pacific*. Manila, ADB. www.adb.org/publications/governance-approach-urban-water-ppps.
- ADB/ADBI/CRBOM/Japan Water Agency (Asian Development Bank/Asian Development Bank Institute/Center for River Basin Organizations and Management/Japan Water Agency). 2015. *NARBO: A Decade of Achievements (2004–2014) – Promoting Integrated Water Resources Management and Improving Water Governance*. Mandaluyong City, Philippines, Asian Development Bank. www.adb.org/sites/default/files/publication/161909/adbi-narbo-decade-achievements-2004-2014.pdf.
- Alexander, T., Manele, B., Schwarz, A.M., Topo, S. and Liliqeto, W. 2012. *Principles for Best Practice for Community Resource Management in Solomon Islands*. Jakarta, Coral Triangle Support Partnership. https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/988/3027.pdf?sequence=1&isAllowed=y.
- Alianza Latinoamericana de Fondos de Agua. n.d. La Alianza Latinoamericana de Fondos de Agua website. www.fondosdeagua.org/es/.
- Almeida, R., Cassang, A., Lin, D. and Abe, M. 2020. *Public-Private Partnership System and Sustainable Development in Asia and the Pacific*. ESCAP MPFD Working Papers WP/20/07. www.unescap.org/sites/default/files/publications/WP_20_07_PPP%20Network_final_web.pdf.
- AMWC (Arab Ministerial Water Council). 2012. *Arab Strategy for Water Security in the Arab Region to Meet the Challenges and Future Needs for Sustainable Development 2010–2030*. Cairo, AMWC. www.unescwa.org/sites/default/files/event/materials/arab_strategy_for_water_security-english_translation-2012_0.pdf.
- AQUASTAT. 2022. *Level of Water Stress by Major River Basin Calculated on the Water Consumption*. FAO. https://data.apps.fao.org/catalog/dataset/b1a616c0-6b73-4625-a413-237e4677c469.
- _____. n.d.a. *Aquastat – FAO Aquamaps. Level of Water Stress by Major River Basin Calculated on the Water Consumption*. https://data.apps.fao.org/aquamaps/?share=f-88fbb746-f95b-4b86-9806-9b12eb7d5eea. (Accessed on 29 November, 2022)
- _____. n.d.b. *Aquastat: FAO's Global Information System on Water and Agriculture*. Rome, Food and Agriculture Organization of the United Nations (FAO) www.fao.org/aquastat/statistics/query/index.html. (Accessed on 29 November, 2022)
- AUDA-NEPAD/AfDB/AMCOW/ICA/GWP (African Union Development Agency – New Partnership for Africa's Development/African Development Bank/African Ministers' Council on Water/Infrastructure Consortium for Africa/Global Water Partnership). n.d. *AIP Continental Africa Water Investment Programme*. www.gwp.org/globalassets/documents/gwpsa/aip-brochure.pdf.
- AVINA. 2011. *Annual Report 2011: Leadership for Sustainable Development in Latin America*. Fundación Avina. www.avina.net/wp-content/uploads/2019/03/2011-eng.pdf.
- AWARENET (Arab Integrated Water Resources Management Network). n.d. *Introduction: Who we are*. AWARENET website. https://awarenet.info/index.php/introduction/.
- AWS Africa (Alliance for Water Stewardship) Africa. n.d. *About AWS Africa*. AWS Africa website. https://a4ws-africa.org/about?.
- Brighton, V. n.d. *The Impact of Water Scarcity on Rural Groups in the Asia-Pacific Region*. Aid and International Development Forum. www.aidforum.org/docs/Water_Scarcity_Report_Rev.pdf.
- Carrillo Montenegro, P. and Remy Simatovic, M. I. 2020. *Brechas de género en la gestión del agua y la infraestructura natural* [Gender gaps in water management and natural infrastructure]. Lima. https://pefssp.org/wp-content/uploads/2020/08/Brechas-de-G%C3%A9nero-y-Gesti%C3%B3n-del-Agua-en-la-Infraestructura-Natural.pdf (In Spanish.)
- Commonwealth Foundation. 2015. *The SAMOA Pathway: Recommendations from Commonwealth Civil Society*. Commonwealth Foundation. https://commonwealthfoundation.com/wp-content/uploads/2015/08/Commonwealth-Insights_SAMOA-Pathway.pdf.
- Comunidad Andina. 2020. *Carta Ambiental Andina* [Andean Letter on the Environment]. Press release, 1st December 2020. www.comunidadandina.org/notas-de-prensa/carta-ambiental-andina/. (In Spanish.)
- CONAGUA (Comisión Nacional del Agua). 2014. *Ley de Aguas Nacionales y su Reglamento* [National Water Law and its Regulations]. Coyoacán, Mexico www.conagua.gob.mx/conagua07/publicaciones/publicaciones/sgaa-37-12.pdf. (In Spanish.)
- Dill, B. 2010. Public–public partnerships in urban water provision: The case of Dar es Salaam. *Journal of International Development*, Vo. 22, No. 5, pp. 611–624. doi.org/10.1002/jid.1601.
- Ecuador and Peru. 2017. *Acuerdo que establece la Comisión Binacional para la Gestión Integrada de los Recursos Hídricos de las Cuencas Hidrográficas Trasfronterizas entre la República del Ecuador y la República del Perú* [Agreement that establishes the Binational Commission for the Integrated Management of the Water Resources of the Transboundary Hydrographic Basins between Ecuador and Peru]. www.asambleanacional.gob.ec/es/system/files/rd_328210moreno_328210_467234-ecuador-peru-28-05-2018_0.pdf. (In Spanish.)
- European Union. 2021. *The European Union Water Initiative Plus – Supports the Transition to Healthy Waters in Eastern Partnership Countries*. EUWI+ EU Water Initiative for Eastern Partnership. www.euwipluseast.eu/en/component/content/article/447-all-activities/activites-global-project-2/news-global-project/887-euwi-top-ten-success-stories?Itemid=397.
- FAO (Food and Agriculture Organization of the United Nations). 2013. *The Regional Initiative on Water Scarcity in the Near East: A Collaborative Strategy and Partnership to Address the Water-Food Security Nexus*. FAO. www.fao.org/documents/card/en/c/067764a8-bba7-4b2c-b617-25edf13e4a47/.
- _____. 2021. *Water Scarcity Program (WSP) for Asia-Pacific*. Bangkok, FAO. www.fao.org/publications/card/en/c/CB4417EN/.
- Fondo de Agua Santiago-Maipo. n.d. *Santiago-Maipo Water Fund*. www.fondosdeagua.org/content/dam/tnc/nature/en/documents/latin-america/SantiagoMaipoWaterFund.pdf.
- Formiga, R. 2014. *Water Resources Management in Brazil: Challenges and New Perspectives*. Brazil Water Learning Series. 24 April–03 June 2014. World Bank. https://www.worldbank.org/content/dam/Worldbank/Feature%20Story/SDN/Water/events/Rosa_Formiga_Johnson_Presentacion_Ingles-3.pdf.
- Foro de los Recursos Hídricos. 2013. *La gestión comunitaria del agua para consumo humano y el saneamiento en Ecuador. Diagnóstico y propuesta*. [Community management of water for human consumption and sanitation in Ecuador. Diagnosis and proposal.] Quito, Foro de los Recursos Hídricos. www.camaren.org/documents/lagestioncomunitaria.pdf. (In Spanish.)

- Galaa, S. Z. and Bukari, F. I. M. 2014. Water tariff conflict resolution through indigenous participation in tri-water sector partnerships: Dalun cluster communities in northern Ghana. *Development in Practice*, Vol. 24, No. 5–6, pp. 722–734. doi.org/10.1080/09614524.2014.940852.
- Gheuens, J., Nagabhatla, N. and Perera, E. D. P. 2019. Disaster-risk, water security challenges and strategies in Small Island Developing States (SIDS). *Water*, Vol. 11, No. 4, Article 637. doi.org/10.3390/w11040637.
- Gobierno de Chile. 2015. *Resumen Ejecutivo Evaluación Programas Gubernamentales (EPG): Programa Infraestructura Hidráulica de Agua Potable Rural (APR)*. [Executive Summary of the Evaluation of Government Programmes: Rural Drinking Water Hydraulic Infrastructure Programme]. www.dipres.gob.cl/597/articles-141243_r_ejecutivo_institucional.pdf. (In Spanish.)
- Gobierno de la República Dominicana. 2021a. *Informe Nacional Voluntario 2021. Crecimiento con equidad y respeto al medioambiente* [Voluntary national review 2021: Growth with equity and respect for the environment]. https://mepyd.gob.do/publicaciones/informe-nacional-voluntario-2021-crecimiento-con-equidad-y-respeto-al-medioambiente. (In Spanish.)
- _____. 2021b. *Diálogo de las reformas 2021. Reformas del sector agua. Propuesta Institucional* [Dialogue of the reforms 2021: Water sector reforms. Institutional Proposal]. Gabinete del Sector Agua. https://ces.gob.do/dialogo_reformas/01%20agua/Agua.%20Propuesta%20Institucional%20V0.pdf. (In Spanish.)
- Gobierno de Panamá. 2020. *Libre de pobreza y desigualdad – La sexta Frontera. Informe Nacional Voluntario de los ODS* [Free from poverty and inequality – The sixth frontier. Voluntary national review of progress towards the SDGs]. www.gabinetesocial.gob.pa/wp-content/uploads/2020/10/PanamaLibredePobrezayDesigualdad.pdf. (In Spanish.)
- Government of Jamaica. 2015. *Water Sector Policy*. www.rwsl.gov.jm/wp-content/uploads/2021/05/Water-Sector-Policy-.pdf.
- Grasham, C. F., Korzenevica, M. and Charles, K. J. 2019. On considering climate resilience in urban water security: A review of the vulnerability of the urban poor in sub-Saharan Africa. *Wiley Interdisciplinary Reviews (WIREs): Water*, Vol. 6, No. 3, Article e1344. doi.org/10.1002/wat2.1344.
- GWP (Global Water Partnership). 2020. *Nexus: Water, Food, Energy, and Ecosystems (WFEE)*. GWP website. www.gwp.org/en/we-act/themesprogrammes/Nexus-Water-Food-Energy-Ecosystems/.
- _____. 2021. *Transboundary Freshwater Security Governance Train: Interactive Online Session: River Basin Organisations and the Implementation of Legal Commitments*. 16 March 2021. www.gwp.org/contentassets/092e5da4a6b0454ab98526442b143961/mooc-event-16-march-ppts.pdf.
- GWP/INBO (Global Water Partnership/International Network of Basin Organizations). 2009. *Manual para la Gestión Integrada de Recursos Hídricos en Cuencas* [Manual for the integrated management of water resources in basins]. GWP/INBO. www.rioc.org/IMG/pdf/RIOC_GWP_Manual_para_la_gestion_integrada.pdf. (In Spanish.)
- GWP/UNEP-DHI (Global Water Partnership/United Nations Environment Programme DHI Centre on Water and Environment). 2021. *Progress on Integrated Water Resources Management (IWRM) in the Asia-Pacific Region 2021: Learning Exchange on Monitoring and Implementation towards SDG 6.5.1*. www.gwp.org/contentassets/895105e56f3c4feaa33a6361ae44f7ac/web-version-new-cover_final-report-sdg-6.5.1-progress-asia-2021.pdf.
- Hepworth, N., Agol, D., Von Wiren-Lehr, S. and O’Grady, K. 2011. *Alliance for Water Stewardship Kenya Case Study – Exploring the Value of Water Stewardship Standards in Africa*. Technical Report. Alliance for Water Stewardship/Marks and Spencer/GIZ/BMZ.
- Hind, E. J., Hiponia, M. C. and Gray, T. 2010. From community-based to centralised national management—A wrong turning for the governance of the marine protected area in Apo Island, Philippines? *Marine Policy*, Vol. 34, No. 1, pp. 54–62. doi.org/10.1016/J.MARPOL.2009.04.011.
- IJC (International Joint Commission). 2019. *Oversight of Animals Feeding Operations for Manure Management in the Great Lakes Basin*. A report submitted to the International Joint Commission by the Great Lakes Water Quality Board. www.ijc.org/sites/default/files/2020-01/WQB_ManureManagementReport_2019.pdf.
- _____. n.d. *Rules of Procedure*. IJC website. https://ijc.org/en/who/mission/principles/rules-of-procedure.
- Indarti, N., Rostiani, R., Megaw, T. and Willetts, J. 2019. Women’s involvement in economic opportunities in water, sanitation and hygiene (WASH) in Indonesia: Examining personal experiences and potential for empowerment. *Development Studies Research*, Vol. 6, No. 1, pp. 76–91. doi.org/10.1080/21665095.2019.1604149.
- Isundwa, K. F. and Mourad, K. A. 2019. The potential for water stewardship partnership in Kenya. *Arabian Journal of Geosciences*, Vol. 12, No. 12, pp. 1–21. doi.org/10.1007/s12517-019-4506-x.
- IWaSP (International Water Stewardship Programme). n.d.a. *Prepare Phase Success Story – Zambia*. https://ceowatermandate.org/wraf/wp-content/uploads/sites/22/2017/10/IWaSP_PPrepare_Zambia_Lusaka_03.08.2017.pdf.
- _____. n.d.b. *Act Phase Success Story – River Rwizi, Uganda*. http://ceowatermandate.org/wraf/wp-content/uploads/sites/15/2017/07/IWaSP_ACT_Uganda-River-Rwizi_17.05.2017.pdf.
- _____. n.d.c. *Mlalakua River Restoration Project (MRRP)*. https://ceowatermandate.org/natural-resources-risk-action-framework/resource/mlalakua-river-restoration-project-mrrp/.
- IWMI (International Water Management Institute). 2011. *Water User’s Associations in the Context of Small Holder Agriculture: A Systematic Review of IFAD Funded Water User Association in Asia*. Submitted to International Fund for Agricultural Development (IFAD) by International Water Management Institute (IWMI). www.un.org/waterforlifedecade/water_cooperation_2013/pdf/wuas_and_small_holder_agriculture.pdf.
- Jensen, O. 2017. Public–private partnerships for water in Asia: A review of two decades of experience. *International Journal of Water Resources Development*, Vol. 33, No. 1, pp. 4–30. doi.org/10.1080/07900627.2015.1121136.
- Kunwar, M. B. 2014. Rationale of Pancheshwar Multipurpose Project for reduction of energy crisis and mitigating the impacts of Mahakali flood and subsequent economic development of Nepal and India. *Hydro Nepal: Journal of Water, Energy and Environment*, Vol. 14, pp. 16–20. doi.org/10.3126/hn.v14i0.11247.
- League of Arab States. n.d. *النظام الأساسي للمجلس الوزاري العربي للمياه* [Organization of the Arab Ministerial Water Council]. www.lasportal.org/ar/councils/ministerialcouncil/Pages/MCouncilAbout.aspx?RID=10. (Accessed in April 2022) (In Arabic.)
- Liddle, E. S., Mager, S. M. and Nel, E. L. 2016. The importance of community-based informal water supply systems in the developing world and the need for formal sector support. *The Geographical Journal*, Vol. 182, No. 1, pp. 85–96. doi.org/10.1111/geoj.12117.
- Mejía Betancourt, A., Castillo, O., Vera, R. and Arroyo, V. 2016. *Agua potable y saneamiento en la nueva ruralidad de América Latina* [Drinking water and sanitation in the new rurality of Latin America]. Development Bank of Latin America (CAF). https://scioteca.caf.com/handle/123456789/918. (In Spanish.)
- MINAGRI (Ministerio de Agricultura y Riego). 2015. *Reglamento de la Ley Núm. 30157, Ley de las Organizaciones de Usuarios de Agua* [Regulation of Law Nr. 30157, Law on Water User Organizations]. Decreto Supremo N° 005-2015-MINAGRI Perú. https://sinia.minam.gob.pe/normas/decreto-supremo-que-aprueba-reglamento-ley-ndeg-30157-ley-las. (In Spanish.)
- Mitra, B. K., Sharma, D., Kuyama, T., Pham, B. N., Islam, G. M. T. and Thao, P. T. M. 2020. Water–energy–food nexus perspective: Pathway for Sustainable Development Goals (SDGs) to country action in India. *APN Science Bulletin*, Vol. 10, No. 1, pp. 34–40. doi.org/10.30852/sb.2020.1067.

- MoJS (Ministry of Jal Shakti). n.d. *India-Nepal Cooperation*. Department of Water Resources, River Development and Ganga Rejuvenation website. <http://jalshakti-dowr.gov.in/international-cooperation/bilateral-cooperation-with-neighbouring-countries/india-nepal-cooperation>.
- MRC (Mekong River Commission). n.d. *Mekong River Commission*. MRC website. www.mrcmekong.org/about/mrc/.
- Muñoz Portugal, I. 2020. Acción y gestión colectiva del agua en los valles de Moche y Virú en la costa peruana [Collective action and water management in the Moche and Virú valleys on the Peruvian coast]. *Problemas del Desarrollo, Revista Latinoamericana de Economía* (Mexico), Vol. 51, No. 200, pp. 77–101. doi.org/10.22201/iiiec.20078951e.2020.200.68186. (In Spanish.)
- Nagabhatla, N., Cassidy-Neumiller, M., Francine, N. N. and Maatta, N. 2021. Water, conflicts and migration and the role of regional diplomacy: Lake Chad, Congo Basin, and the Mbororo pastoralist. *Environmental Science and Policy*, Vol. 122, pp. 35–48. doi.org/10.1016/j.envsci.2021.03.019.
- Niva, V., Taka, M. and Varis, O. (2019). Rural-urban migration and the growth of informal settlements: A socio-ecological system conceptualization with insights through a “water lens”. *Sustainability*, Vol. 11, No. 12, Article 3487. doi.org/10.3390/su11123487.
- NSAS-JA (Nubian Sandstone Aquifer System-Joint Authority). n.d. الهيئة المشتركة لدراسة وتنمية خزان الحجر الرملي النوبي [Nubian Sandstone Aquifer System-Joint Authority]. www.nsasja.org/found_ar.php. (In Arabic.) (Accessed on 2 December 2022).
- Piman, T. and Ghimire, U. 2022. Community-based ecosystem management for wetlands resilience in Thailand’s Songkhram River Basin. SEI (Stockholm Environment Institute) website. www.sei.org/featured/community-ecosystem-wetland-resilience-thailand-songkhram/.
- Rasul, G. and Neupane, N. 2021. Improving policy coordination across the water, energy, and food, sectors in South Asia: A framework. *Frontiers in Sustainable Food Systems*, Vol. 5, Article 602475. doi.org/10.3389/fsufs.2021.602475.
- RICCAR (Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region). n.d. RICCAR website. <https://riccar.org/>.
- Saravia Matus, S., Gil, M., Sarmanto, N., Blanco, E., Llavona, A. and Naranjo, L. 2022. *Brechas, Desafíos y Oportunidades de Agua y Género en América Latina y el Caribe* [Gaps, challenges and opportunities in water and gender in Latin America and the Caribbean]. Serie Recursos Naturales y Desarrollo. United Nations Economic Commission for Latin America and the Caribbean (UNECLAC). <https://repositorio.cepal.org/handle/11362/48605>.
- Shrestha, A. and Ghale, R. 2016. *Transboundary Water Governance in the Hindi Kush Himalaya Region – Beyond the Dialectics of Conflict and Cooperation*. Himalayan Adaptation, Water and Resilience (HI-AWARE) Working Papers No. 7. Kathmandu, International Centre for Integrated Mountain Development (ICIMOD). <https://hdl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/57517/IDL-57517.pdf>.
- Syrian Lebanese Higher Council, 1991. *الجمهورية العربية السورية والجمهورية اللبنانية معاهدة الأخوة والتعاون والتنسيق بين* [Fraternity, Cooperation and Coordination Treaty between the Republic of Lebanon and the Syrian Arab Republic]. www.syrleb.org/SD08/msf/1507751751_.pdf.
- Tijani, M. N. n.d. *AMCOW Pan-African Groundwater Program (APAGroP): AMCOW Agenda for Sustainable Management of Groundwater Resources and Trans-boundary Aquifers in Africa*. GGRETA Online Course on Groundwater Management in Africa Lake and River Basin Organizations.
- Thai, N. V. and Guevara, J. R. 2019. Women and water management: A policy assessment—A case study in An Giang Province, Mekong delta, Vietnam. *Asia-Pacific Journal of Rural Development*, Vol. 29, No. 1, pp. 77–97. doi.org/10.1177/1018529119860949.
- The Boundary Waters Treaty of 1909. 1909. *The Boundary Waters Treaty of 1909*. International Joint Commission (IJC). www.ijc.org/sites/default/files/2018-07/Boundary%20Water-ENGFR.pdf.
- UNDESA (United Nations Department of Economic and Social Affairs). 2019. *World Population Prospects 2019*. New York, United Nations. <https://population.un.org/wpp/>.
- UNECE (United Nations Economic Commission for Europe). 1992. *Convention on the Protection and Use of Transboundary Watercourses and International Lakes*. Helsinki, 17 March 1992, UNECE. unece.org/environment-policy/water/about-the-convention/introduction.
- _____. 1998. *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*. Aarhus, Denmark, 25 June 1998. <https://unece.org/environment-policy/public-participation/aarhus-convention/text>.
- _____. 2022. *The Water Convention: 30 Years of Impact and Achievements on the Ground*. Geneva, UNECE. <https://unece.org/environment-policy/publications/water-convention-30-years-impact-and-achievements-ground>.
- UNECE/UNESCO (United Nations Economic Commission for Europe/United Nations Educational, Scientific and Cultural Organization). 2021. *Progress on Transboundary Water Cooperation – Global Status of SDG Indicator 6.5.2 and Acceleration Needs*. Paris, United Nations/UNESCO. www.unwater.org/publications/progress-transboundary-water-cooperation-2021-update.
- UNECE/WHO Regional Office for Europe (United Nations Economic Commission for Europe/World Health Organization Regional Office for Europe). 1999. *Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes*. London, 17 June 1999. <https://unece.org/environment-policy/water/protocol-on-water-and-health/about-the-protocol/introduction>.
- _____. 2013. *The Equitable Access Score-Card: Supporting Policy Processes to Achieve the Human Right to Water and Sanitation*. Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Geneva, UNECE. <https://unece.org/environment-policy/publications/equitable-access-score-card-supporting-policy-processes-achieve>.
- _____. 2019. *The Human Rights to Water and Sanitation in Practice: Findings and Lessons Learned from the Work on Equitable Access to Water and Sanitation under the Protocol on Water and Health in the Pan-European Region*. Geneva, UNECE. <https://unece.org/environment-policy/publications/human-rights-water-and-sanitation-practice-findings-and-lessons>.
- UNECLAC (United Nations Economic Commission for Latin America and the Caribbean). 2022. *Report on the Latin American and Caribbean Regional Process to Accelerate the Achievement of SDG 6 – Regional Inputs for the Mid-Term Review of the International Decade for Action, “Water for Sustainable Development 2018-2028” and the United Nations Water Conference 2023*. UNECLAC. www.cepal.org/sites/default/files/events/files/report_on_the_latin_american_and_caribbean_regional_process_to_accelerate_the_achievement_of_sdg_6.pdf.
- UNEP (United Nations Environment Programme). 2021. *Progress on Integrated Water Resources Management: Tracking SDG 6 Series – Global Indicator 6.5.1 Updates and Acceleration Needs*. Nairobi, UNEP. www.unwater.org/publications/progress-integrated-water-resources-management-2021-update.
- UNESCAP (Economic and Social Commission for Asia and the Pacific). 2018. *Inequality of Opportunity in Asia and the Pacific: Water and Sanitation*. Social Development Policy Papers No. 2018-05. Bangkok, UNESCAP. www.unescap.org/sites/default/files/Water_Sanitation_report_20181122.pdf.
- UNESCWA (United Nations Economic and Social Commission for Western Asia). 2019. *Arab Agriculture and Water Ministers Agree to Join Hands against Impacts of Climate Change, Land Degradation and Water Scarcity*. Press release, Beirut–Cairo, 4 April 2019. www.unescwa.org/news/arab-agriculture-and-water-ministers-agree-join-hands-against-impacts-climate-change-land#:~:text=%EF%BB%BFBeirut%2DCairo%2C%204%20April,regional%20coordination%20mechanisms%20and%20harmonize.
- _____. n.d.a. *Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR)*. UNESCWA website. <https://archive.unescwa.org/climate-change-water-resources-arab-region-riccar>.

- _____. n.d.b. *AWARENET Arab Integrated Water Resources Management Network*. UNESCWA website. www.unescwa.org/awarenet.
- UNESCWA/BGR (United Nations Economic and Social Commission for Western Asia/Bundesanstalt für Geowissenschaften und Rohstoffe). 2013. *Inventory of Shared Water Resources in Western Asia*. Beirut, United Nations. waterinventory.org.
- UNESCWA (United Nations Economic and Social Commission for Western Asia) et al. 2017. *Arab Climate Change Assessment Report – Executive Summary*. Beirut, UNESCWA. https://riccar.org/sites/default/files/2018-07/RICCAR-Executive%20Summary-online_1.pdf.
- United Nations Security Council. 1999. *Resolution 1244 (1999) Adopted by the Security Council at its 4011th Meeting, on 10 June 1999*. S/RES/1244 (1999). <https://digitallibrary.un.org/record/274488>.
- UN-Water/UNESCAP (Economic and Social Commission for Asia and the Pacific). 2022. *Mid-Term Review of the UN Water Action Decade: Input from the Asia Pacific Consultation*. Report Summary. www.unescap.org/sites/default/d8files/event-documents/UNWaterActionDecade%20AP%20consultation_0.pdf.
- US EPA (United States Environmental Protection Agency). n.d. *Facts and Figures about the Great Lakes*. US EPA website. www.epa.gov/greatlakes/facts-and-figures-about-great-lakes.
- Wang, B., Wan, J. and Zhu, Y. 2021. River chief system: An institutional analysis to address watershed governance in China. *Water Policy*, Vol. 23, No. 6, pp. 1435–1444. doi.org/10.2166/wp.2021.113.
- Water Europe. 2019. *Atlas of the EU Water Oriented Living Labs*. Brussels, Water Europe. <https://watereurope.eu/wp-content/uploads/2019/07/Atlas-of-the-EU-Water-Oriented-Living-Labs.pdf>.
- _____. n.d. *Water-Oriented Living Labs*. Water Europe website. <https://watereurope.eu/water-oriented-living-labs/>.
- WHO/UNICEF (World Health Organization/United Nations Children’s Fund). 2021. *Progress on Household Drinking Water, Sanitation and Hygiene 2000–2020: Five Years into the SDGs*. Geneva, WHO/UNICEF. www.who.int/publications/i/item/9789240030848. Licence: CC BY-NC-SA 3.0 IGO.
- World Bank. 2021. *The Dream of Having your Own and Constant Water*. Feature Story, 30 August 2021. World Bank website. www.worldbank.org/en/news/feature/2021/08/26/el-sueno-de-tener-agua-propia-y-constante.
- _____. 2022. *Cooperation in International Waters in Africa (CIWA)*. World Bank website. www.worldbank.org/en/programs/cooperation-in-international-waters-in-africa.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000247153>.

Chapter 9

Education and capacity development

UNESCO-IHP | Wouter Buytaert, Anil Mishra, Jorge Ellis and Abou Amani

With contributions from:

Dave Kraemer (IAH), Yasmina Rais El Fenni and Themba Gumbo (Cap-Net),
Christophe Cudennec (IAHS), Jodie Miller and Yuliya Vystavna (IAEA),
Gaetano Casale (IHE Delft)



9.1 Introduction

Optimal access to a relevant knowledge base is essential to make informed decisions on water resources and water-related risk management, to empower local communities to take action to achieve water security, and to minimize negative impacts on people's access and safety.

Education and capacity development are crucial to establish this knowledge base, and to accelerate the development, adoption and institutionalization of more sustainable and equitable water management practices. Education and capacity development are activities that involve the sharing of knowledge and skills, both of which are impossible without partnerships between teachers, (experienced and novice) students, institutions, and other providers and recipients of information.

The type and modality of these partnerships is changing rapidly, both because of a change in the requirements and needs of decision-makers, but also because of new opportunities and approaches to implement and enhance education and capacity-building for sustainable development (Alaerts and Zeverbergen, 2022).

Technological progress is a major driver of such new opportunities. The recent COVID-19 pandemic, in particular, has given a major boost to the development of digital content and the adoption of information and communication technologies (ICT) for teaching and training worldwide. For example, the International Capacity Development Network for Sustainable Water Management (Cap-Net UNDP) experienced a 200% increase in demand for online courses during the pandemic (Cap-Net, 2019; 2021).

Awareness that scientific knowledge needs to be better integrated with other knowledge bases, such as local and indigenous knowledge, is also increasing. This is particularly relevant for managing water resources and risks. In many parts of the world, water management is shaped by local knowledge and practices, such as the *qanat* systems of northern Africa and the Middle East (ICQHS, n.d.), or water sowing and harvesting in the Andes (Ochoa-Tocachi et al., 2019).

Integrating these diverse knowledge bases requires strengthening, and furthering the adoption of multidirectional forms of knowledge exchange, such as occurs in communities of practice and professional networks. As women often play a major role in traditional water management, this also provides opportunities for women's empowerment and gender mainstreaming (Feijoo and Fürst, 2021).

Maximizing these opportunities poses several challenges. Some of them are technical in nature, such as creating inclusive online platforms and systems that maximize access to disadvantaged groups and communities. But partnerships for more efficient, sustainable and equitable education and capacity development on water can also benefit from a stronger adoption of approaches such as communities of practice, citizen science, open innovation and life-long learning.

9.2 Education and training

The COVID-19 pandemic has had a major impact on most aspects of human society, including on scientific and educational practices. In some cases, this has hindered the generation of knowledge and capacity, including the delivery of training needed to achieve the Sustainable Development Goals (SDGs).

However, the pandemic has also accelerated the development and uptake of novel approaches to education, training and capacity development, making use of the latest ICT technologies. An unprecedented body of online learning material has come online, from recorded lectures to immersive 3-dimensional virtual field trips and so-called massive open online courses (MOOCs).

● ● ●
In many parts of the world, water management is shaped by local knowledge and practices

This provides a unique opportunity to support education and capacity development worldwide, particularly for the Global South. Although a substantial share of this material has been made available for free online, active partnerships are needed to make the most of this evolution in the context of water management. The application of e-learning in poor regions remains a challenge, in part because of a lack of basic facilities such as reliable internet connections and ICT equipment. E-learning materials should also be adapted to the local geographical, cultural and socio-economic context, translated to local languages, and disseminated to relevant interest groups. This is particularly relevant for water. Many textbooks and e-learning materials mostly use data and examples from temperate regions such as Europe and North America. Hydrometeorological and climate conditions, as well as infrastructure availability, are very different in the tropics, where water security is most severely threatened and capacity is most limited.

North–South and South–South inter-institutional educational collaboration can make e-learning materials locally relevant, improve their quality, and train local teachers and academics to make best use of those materials in local curricula. The United Nations Educational, Scientific and Cultural Organization (UNESCO) Water Family, which includes approximately 30 water-related category 2 centres as well as 70 water-related UNESCO Chairs and the University Twinning and Networking Programme (UNITWIN),⁵⁵ is a prime example of a partnership that aims to enhance institutional and human capacities through knowledge-sharing and collaboration. The category 2 centres also function as regional and global hubs to foster collaborative action and capacity development on strategic priorities including water.

The increased flexibility and accessibility of e-learning also presents a unique opportunity to widen participation, and to stimulate the rights and access to education for women. Partnerships between e-learning content providers and representatives of underrepresented groups can reinforce the development of material that promotes inclusion, widening participation and gender equality. Concerning the latter, the Global Multi-stakeholder Coalition that supports the ‘Call for Action to accelerate gender equality in the water domain’ initiative,⁵⁶ coordinated by UNESCO’s World Water Assessment Programme (WWAP), is a recent example of an active partnership that spurs the development and implementation of gender-inclusive strategies and transformative actions. The Global Coalition is composed of Member States’ institutions, UN agencies, international and regional organizations, non-governmental organizations (NGOs), official development assistance (ODA) agencies, and representatives of the private sector and civil society.

Despite these and other opportunities, vocational and practical education remains a challenge for e-learning. Many practical skills in water management require a combination of theoretical understanding and tactile experience that can only be acquired by doing, with proper on-site coaching and mentoring. Online demonstrations, tutorials and videos, for example on laboratory procedures or hydrometric measurements, can support in-person learning. But this will require building partnerships between e-learning providers, on-site teachers and mentors, and professionals like water resources technicians. Ensuring the local relevance and applicability of the taught skills, tools and instruments in local hydrological settings is key in such partnerships (Box 9.1).

Greater uptake and development of open science, as advocated by the *UNESCO Recommendation on Open Science*, can also support local relevance of, access to, and dissemination of training materials (UNESCO, 2021). Open Science promotes not only the co-development and sharing of knowledge (e.g. through open courseware), but also tools and techniques to create locally relevant knowledge, for example through open software,

⁵⁵ For more information, please see: www.unesco.org/en/education/unitwin.

⁵⁶ For more information, please see: www.unesco.org/en/articles/call-action-accelerate-gender-equality-water-domain.



Partnerships that focus on knowledge co-creation instead of knowledge transfer aim to embrace the diversity of expertise and experience within a knowledge system

open laboratories and open innovation. An example of successful collaborative Open Science is open-source hardware, which applies the open-source philosophy to the design of technology such as computing devices, sensors and networking devices, among others (see Section 11.2). This has yielded popular products such as the Raspberry Pi and Arduino microcomputers⁵⁷ and fostered global collaborative development efforts among volunteers and enthusiasts – often referred to as the *maker community* (Tauro et al., 2019).

These efforts have produced a wealth of online information and documentation that support new partnerships between technology providers and end users, including in areas such as hydrological and meteorological observations. For example, the Trans-African Hydro-Meteorological Observatory (TAHMO)⁵⁸ leverages open-source hardware technology to develop and install a network of weather stations across Africa. TAHMO partners with local universities and companies to develop new agricultural and hydro-meteorological farming services, as well as teaching and training.

Open-source technologies are also instrumental in supporting citizen science. Many citizen science projects are cross-disciplinary partnerships that bring together scientists, water professionals and the broader public. These projects often have a strong educational dimension, and are increasingly used to build awareness on local issues, such as water pollution and equitable resource allocation, and to increase transparency and inclusivity (Fraisl et al., 2020). Because of their practical approach, citizen science projects can also be instrumental in involving youth and young professionals. Citizen science projects using low-cost weather stations have been used worldwide to teach schoolchildren about local meteorological and hydrological processes (e.g. Paul et al., 2020; see Section 11.3).

9.3

Knowledge co-creation and communities of practice

Partnerships that focus on knowledge co-creation instead of knowledge transfer aim to embrace the diversity of expertise and experience within a knowledge system. This is particularly relevant in the context of water. In many parts of the world, water resources management practices incorporate traditional elements, ranging from local expert knowledge on spring water availability and flood frequency, to highly sophisticated systems such as ancient water sowing and harvesting (e.g. *paar* systems in western Rajasthan, India, and *amunas* in Peru). This can (and should) also include the knowledge and experience of women (Feijoo and Fürst, 2021), who often play an integral role in water management, especially in rural settings.

Over the last decades, engineering-based water management approaches have often disfavoured traditional practices, which risk being phased out or forgotten (Kreamer, 2021). However, the limitations of engineering solutions based on large-scale infrastructure are becoming increasingly clear. Their high capital costs and limited flexibility hinder the development of adaptive water resources management in the face of the uncertain effects of climate change. Local practices, which are often based on natural processes that provide multiple ecosystem services, have the potential to add such flexibility and adaptive capacity (Vörösmarty et al., 2021).

Integrating local solutions in river basin and aquifer management require partnerships between governments, water supply companies and local communities. In 2014, the Peruvian government passed a law on the implementation of benefit-sharing mechanisms for ecosystem services (Box 9.2). This law requires water supply companies to invest in watershed interventions that benefit downstream water users and upstream communities

⁵⁷ For more information, please see: www.arduino.cc/.

⁵⁸ For more information, please see: <https://tahmo.org/>.

Box 9.1 H₂O Maghreb: A training partnership responding to Morocco's water challenges

The lack of a skilled workforce in a water-scarce country like Morocco prevents industry and agriculture from exploiting the full potential of growth (through improved water use efficiency and water quality/pollution control, among others). Responding to Morocco's water challenges, the United Nations Industrial Development Organization (UNIDO) launched the project *H₂O Maghreb* in 2017, as a public–private development partnership between the Moroccan government, the United States Agency for International Development (USAID), the Moroccan National Institute for Water and Electricity (ONEE), and the private sector partners Festo Didactic SE and EON Reality (UNIDO, 2019). Festo Didactic and EON Reality have created a Virtual Reality Aquatronics training simulator that features several water and wastewater scenarios in which users interact with a virtual water treatment plant, operate machinery and perform emergency procedures. Virtual reality applications introduce professionals to new disciplines and technologies, as well as to situations that are dangerous and difficult to reproduce.

H₂O Maghreb introduces cutting-edge solutions to urgent water needs in Morocco and the region, while improving the skills and employability of young Moroccans by providing them with a market-driven training programme in a newly established water training hub (USAID, 2022). By developing a new water management curriculum, the project brought together the public and private sector to provide innovative training and equipment. The *H₂O Maghreb* training programme combines elements from different professions (e.g. mechanics, electronics, hydraulics, chemistry, biology) to address the challenges of improving water management, access to water and water quality in a systematic manner (UNIDO, 2019).

Additional information about the H₂O Maghreb training programme can be found at <https://lkdfacility.org/h2o-maghreb/>.

that live in water supply areas. This has incentivized partnerships between government agencies, such as the Peruvian water industry regulator SUNASS, water supply companies and representatives of local civil society (Dextre et al., 2022).

Such partnerships for knowledge co-production prompt scientists to engage in a dialogue with other knowledge bases and develop ways to integrate these in novel solutions for water security. This requires transdisciplinary approaches, bringing together experts in technical water management with disciplines such as public policy, human geography, gender and anthropology.

One way to foster such partnerships is by establishing communities of practice around specific challenges, such as developing climate change adaptation and mitigation strategies (Chapter 7). These challenges can bring together theorists, practitioners and beneficiaries, and achieve the diversity that is needed to develop robust, innovative and inclusive approaches that respect the rights of all stakeholders (UN-Water, n.d.).

9.4 Life-long learning

Life-long learning (i.e. continuous development) is becoming an increasingly recognized driver of the creation and application of innovative solutions in many sectors, including water (RWSN, 2022). However, life-long learning can only be successful if it starts from a solid base of essential skills and understanding of water processes and technologies. This requires more and stronger global partnerships to provide high-quality and locally relevant vocational and high-education training programmes.

Stronger partnerships between educators and water professionals can help training programmes adapt to changing needs, for example by creating specialized training courses that fill specific gaps or meet specific demands. This is especially relevant for women and professionals from rural regions in the Global South (RWSN, 2022), and can be supported by networks such as learned societies and communities of practice. Life-long learning also broadens career development pathways and can promote workforce retention.

Box 9.2 Partnering for sustainable water management: The Andean monitoring network iMHEA

The Initiative for the Hydrological Monitoring of Andean Ecosystems (iMHEA) was founded in 2009 by the NGO CONDESAN (Consortium for the Sustainable Development of the Andean Eco-Region) as a small grassroots network of professionals from academia and civil society, with a common interest in understanding the impact of land use on Andean water resources. It has since then grown into a network of 22 partners, monitoring 51 catchment areas at 24 sites along the Andes. iMHEA started as a technical network sharing expertise on data collection, analysis and experimental design, evolving into a broader knowledge co-creation partnership with a stronger focus on community involvement, knowledge exchange and support for local decision-making.

In Peru, the network has played an instrumental role in the operationalization of a new law on hydro-ecosystem benefit-sharing mechanisms (MERESE). Several water companies responsible for the implementation of MERESE projects have become a member of iMHEA, receiving access to expertise on hydrological sensor technologies, monitoring protocols and data analysis.

iMHEA operates largely as a virtual network with online documentation, seminars and meetings, but it organizes a yearly in-person assembly for training, discussion and interaction. It does not receive central funding but relies on contributions from its members and joint fund raising. Two remarkable characteristics of this network are its grassroots origins and open nature, and its focus on knowledge-sharing between academia, government, industry and civil society.

Source: iMHEA (n.d.).

Partnerships between scientists, entrepreneurs and venture capitalists can support the integration of new technologies and innovation in capacity development, through the incubation of start-up companies, the creation of innovation hubs, and the local commercialization of new ideas and solutions (see Chapter 11). This has the potential to create new jobs and commercial activity, but also to actively stimulate the participation of women and minorities in the workforce.

In each of these efforts, rigorous and transparent monitoring and evaluation of the impact of education and training is essential to track progress, and to ensure accountability.

References

- Alaerts, G. J., and Zevenbergen, C. 2022. Editorial: From knowledge and capacity development to an implementation science: Policy concepts and operational approaches. *Water Policy*, Vol. 24, No. 5, pp. v–x. doi.org/10.2166/wp.2022.002.
- Cap-Net (International Capacity Development Network for Sustainable Water Management). 2019. *Annual Report 2019*. Cap-Net. <https://cap-net.org/wp-content/uploads/2020/10/Cap-Net-Progress-Report-2019.pdf>.
- _____. 2021. *2021 Annual Report Summary*. Cap-Net. <https://cap-net.org/wp-content/uploads/2022/02/Cap-Net-UNDP-2021-Annual-Report-Summary-1.pdf>.
- Dextre, R. M., Eschenhagen, M. L., Camacho Hernández, M., Rangelcroft, S., Clason, C., Couldrick, L. and Morera, S. 2022. Payment for ecosystem services in Peru: Assessing the socio-ecological dimension of water services in the upper Santa River basin. *Ecosystem Services*, Vol. 56, Article 101454. doi.org/10.1016/j.ecoser.2022.101454.
- Feijoo, E. and Fürst, S. (eds.). 2021. *Women's Empowerment through Rural Water Supply Activities: A Practical Guide by and for Practitioners of the Rural Water Supply Network*. St. Gallen, Switzerland, The Rural Water Supply Network (RWSN) Secretariat, Skat Foundation. www.rural-water-supply.net/en/resources/details/942.

- Fraisl, D., Campbell, J., See, L., Wehn, U., Wardlaw, J., Gold, M., Moorthy, I., Arias, R., Piera, J., Oliver, J. L., Masó, J., Penker, M., and Fritz, S. 2020. Mapping citizen science contributions to the UN sustainable development goals. *Sustainability Science*, Vol. 15, pp. 1735–1751. doi.org/10.1007/s11625-020-00833-7.
- ICQHS (International Centre on Qanats and Historic Hydraulic Structures). n.d. ICQHS website. <https://icqhs.org>. (Accessed in August 2022)
- iMHEA (Iniciativa Regional de Monitoreo Hidrológico de Ecosistemas Andinos). n.d. iMHEA website. <http://imhea.org/>. (Accessed in June 2022 – In Spanish.)
- Kreamer, D. K. 2021. The pitfalls, perils, and promise of hydrophilanthropy. *Groundwater*, Vol. 59, No. 4, pp. 470–471. doi.org/10.1111/gwat.13112.
- LKDF (Learning and Knowledge Development Facility). n.d. *H₂O Maghreb*. LKDF website. <https://lkdfacility.org/h2o-maghreb/>. (Accessed in October 2022)
- Ochoa-Tocachi, B. F., Bardales, J. D., Antiporta, J., Pérez, K., Acosta, L., Mao, F., Zulkafli, Z., Gil-Ríos, J., Angulo, O., Grainger, S., Gammie, G., De Bièvre, B. and Buytaert, W. 2019. Potential contributions of pre-Inca infiltration infrastructure to Andean water security. *Nature Sustainability*, Vol. 2, pp. 584–593. doi.org/10.1038/s41893-019-0307-1.
- Paul, J. D., Cieslik, K., Sah, N., Shakya, P., Parajuli, B. P., Paudel, S., Dewulf, A. and Buytaert, W. 2020. Applying citizen science for sustainable development: Rainfall monitoring in western Nepal. *Frontiers in Water*, Vol. 2, Article 581375. doi.org/10.3389/frwa.2020.581375.
- RWSN (The Rural Water Supply Network). 2022. *RWSN Draft Lifelong Learning Strategy*. Consultation draft July 2022. St. Gallen, Switzerland, Skat Foundation. www.rural-water-supply.net/_ressources/documents/default/1-1069-2-1658489471.pdf.
- Tauro, F., Selker, J., Van de Giesen, N., Abrate, T., Uijlenhoet, R., Porfiri, M., Manfreda, S., Caylor, K., Moramarco, T., Benveniste, J., Ciralo, G., Estes, L., Domeneghetti, A., Perks, M. T., Corbari, C., Rabiei, E., Ravazzani, G., Bogena, H., Harfouche, A., Brocca, L., Maltese, A., Wickert, A., Tarpanelli, A., Good, S., Lopez Alcalá, J. M., Petroselli, A., Cudennec, C., Blume, T., Hut, R. and Grimaldi, S. 2018. Measurements and observations in the XXI century (MOXXI): Innovation and multi-disciplinarity to sense the hydrological cycle. *Hydrological Sciences Journal*, Vol. 63, No. 2, pp. 169–196. doi.org/10.1080/02626667.2017.1420191.
- UNESCO (United Nations Educational, Scientific and Cultural Organization). 2021. *UNESCO Recommendation on Open Science*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf00000379949.locale=en>.
- UNIDO (United Nations Industrial Development Organization). 2019. *Responding to Morocco's Water Challenge*. UNIDO website. www.unido.org/stories/responding-moroccos-water-challenge.
- UN-Water. n.d. *Human Rights to Water and Sanitation*. UN-Water website. www.unwater.org/water-facts/human-rights/. (Accessed in June 2022)
- USAID (United States Agency for International Development). 2022. *H₂O Maghreb Partnership*. Fact sheet. USAID. www.usaid.gov/sites/default/files/2022-05/USAID-H2O_Maghreb_FactSheet_072020.pdf.
- Vörösmarty, C. J., Stewart-Koster, B., Green, P. A., Boone, E. L., Flörke, M., Fischer, G., Wiberg, D. A., Bunn, S. E., Bhaduri, A., McIntyre, P. B., Sadoff, C., Liu, H. and Stifel, D. 2021. A green-gray path to global water security and sustainable infrastructure. *Global Environmental Change*, Vol. 70, Article 102344. doi.org/10.1016/j.gloenvcha.2021.102344.

Chapter 10

Data, information and monitoring

IWMI

Patience Mukuyu, Jonathan Lautze,
Simon Langan and Stefan Uhlenbrook

WWAP

Richard Connor

With contributions from:

Rui Ferreira (IAHR-EMI)



10.1 Introduction

• • •
Transparency in data generation and information-sharing strengthens trust among the various and often competing users of water resources

Data and information provide evidence as to where, when and how much water resources there are, how they are used, and how their management can be sustainably improved. Despite the essential importance of data and information in water-related decision-making, a range of challenges exists in producing holistic data sets, including a general lack of data across all use sectors, limited sex-disaggregated data (Miletto et al., 2019), temporal and spatial variability in local water availability, and difficulties (or reluctance) in sharing data, especially across international borders (Mukuyu et al., 2020).

To achieve the targets of the sixth Sustainable Development Goal (SDG 6), developing and enhancing partnerships and cooperation are required to bring together concerned parties at global, regional and national scales. Key partners include researchers and data providers, as well as investors and implementers such as governments, civil society, businesses and development agencies. A broader engagement process involving partners in priority-setting, planning, data collection and joint development of data governance mechanisms fosters collective ownership. Recognition of each partners' mandate and role, emphasizing complementarities and synergies, supports the establishment and development of appropriate partnerships.

Building the trust or realize successful partnerships to support data, information and monitoring activities will require time, transparency and mutual respect. At initial stages, areas of common interest need to be explored, expectations discussed, trust built and a common understanding constructed of what the partnership will ultimately seek to achieve. Throughout the partnership, consultation, communication and consensus-building are critical in supporting these processes.

The SDG6 Global Acceleration Framework (UN-Water, 2020) highlights data and information as one of the five key accelerators needed to meet set targets for attaining sustainable water and sanitation for all. Transparency in data generation and information-sharing strengthens trust among the various and often competing users of water resources. This chapter highlights partnerships and cooperative efforts that show potential for improving the generation and application of water-related data and information.

10.2 Transforming data into information and action

The breadth and scope of water-relevant data is vast. Partnerships are therefore necessary to ensure that relevant data are effectively generated and processed into useful information. As such, partnerships have the potential to ultimately influence policies, investments and decisions towards meeting the SDG 6 targets.

Information is arguably more important than data, as the practical use of data is limited unless converted into information. While the conversion process should be unbiased and transparent, this is not always the case – indeed, the process might be highly political. And while data may be considered to be neutral (depending on *what*, *where* and *when* data are collected, and by *whom*), the information generated after data analysis may not be. This is why open cooperation and participation, involving both information generators and users, are paramount.

Some examples of how data are transformed into information for application in decision-making, and ultimately action, are provided in Table 10.1.

Considering demographic and other socio-economic aspects of water data enhances their potential for application and use. Gender disaggregation of data, for example concerning access to water supply services, is critical in pinpointing the actual beneficiaries, leading to interventions designed to provide more equitable allocations of the often limited water resources. Data analytics on marginalized groups, such as women and children, help target

Table 10.1 Examples of how water-related data are transformed into information and action

Data	Information	Action
Stream gauge (height) measurements	Trends in annual streamflow patterns	Determine and apply restrictions to water withdrawals when the streamflow is below specified levels
Rain gauge measurements + floodplain mapping	Probabilistic floodplain risk analysis	Apply land use incentives/restrictions
Lead concentrations (in water samples)	Evaluate lead levels against drinking water standards to identify violations	Alert customers when lead levels exceed safe drinking water standards
Daily volume of water treated by municipal supply system	Correlate volume of treated water with the number of low-flush toilets installed over time, to determine their impact on water savings	Take decisions on investing in a low-flush toilet rebate programme

Source: Adapted from Internet of Water Coalition (n.d.).

developmental assistance, investments and policy reforms where they are most needed (Miletto et al., 2019). Partnerships bringing together local community organizations, service providers and regulatory authorities can be key to ensuring that data generated are representative. In general, the more data are disaggregated, the greater their potential for practical analysis.

10.3 Data generation and sharing

The majority of water-related data pertain either to water availability (including quality) or to water use. Monitoring water resources' quality and quantity generates data that can foster a general understanding of water availability and guide its equitable allocation (see Box 9.2).

Open-access global data repositories can be used at national and regional scales, but such data tend to lack the spatial resolution required for more targeted interventions. The data, where available, are generally not disaggregated. Government agencies tasked with resource monitoring and management often lack the capacity to generate all the data needed to address emerging water-related economic and social issues.

In view of strengthening its national data managements systems, South Africa, for example, has developed a data management strategy for water and sanitation, proposing three main interventions for partnerships: (i) form partnerships and intergovernmental cooperation agreements for data-sharing; (ii) negotiate data-sharing agreements; and (iii) ensure adherence to data-sharing agreements (DWS, 2020).

Joint monitoring of transboundary water resources promotes a shared understanding of the system and provides a platform where data can be shared in real time and applied in a timely manner. As more data are generated, water use planning can thus be supported by evidence to harness shared benefits across the transboundary landscape and manage water in transboundary basins or aquifers more sustainably.

The value of collaboration in data collection should not be underestimated, especially in a transboundary context (Box 10.1). Joint monitoring can defuse potential cross-boundary tensions before they manifest, and enhance trust across borders (United Nations, 2022).

Data exchange in transboundary basins may sometimes fall short of its objectives in terms of facilitating data-driven decision-making. A global assessment of shared basins revealed that a reasonable proportion of river basins exchange some data, but the breadth of such

Box 10.1 Joint monitoring of groundwater levels across borders

In the Tuli Karoo Transboundary aquifer system shared by Botswana, South Africa and Zimbabwe, efforts to generate data about the system have been improved through cooperation. Prior to this intervention, monitoring had not been managed in an integrated manner, resulting in limited spatial and temporal data about the system and how it can sustainably support the livelihoods of the mainly rural communities through food security and climate resilience. Joint groundwater-monitoring allows for the assessment of long-term and annual changes in aquifer storage due to climate change and water withdrawals.

Collaboration among the three country governments, the regional entity (the Southern African Development Community Groundwater Management Institute) and the basin organization (the Limpopo Watercourse Commission) led to the co-design of the groundwater monitoring system.

Borehole along the Shashe River in Botswana – one of the four selected for the groundwater monitoring system



Photo: G. Y. Ebrahim

Source: Adapted from Ebrahim et al. (2021).

● ● ●
In a transboundary context, joint monitoring can defuse potential cross-boundary tensions before they manifest, and enhance trust across borders

exchange is often limited and irregular (Mukuyu et al., 2020). The open exchange of data is often driven by mutual needs, for example to minimize flood impacts or to manage transboundary infrastructure. As such, data-sharing is much more likely to be considered successful if it responds to a palpable need and serves practical uses, as opposed to feeding data 'graveyards' where data are collected and not interpreted and applied (IWMI, 2021; Alferes et al., 2014).

Transboundary actors such as river basin organizations, national government entities, academic institutions, as well as development organizations, are repositories of data that can be streamlined and shared through shared platforms. In order to harmonize various databases, within and across borders, linkages need to be created beyond government institutions, including with private data partners, such as private companies (Kölbel et al., 2018) and landowners.

Partnerships also offer the opportunity to validate and verify generated data, thereby improving data reliability.

10.4 Data accessibility and interoperability

In many countries, obtaining access to data and sharing them transparently remain important challenges. Water-related data, in particular, are often generated by different users (or ‘sectors’) and therefore not interoperable for multiple users due to differences in terminology and other factors (Cantor et al., 2018). Transparency supports better management of water resources and promotes accountability when dealing with challenges such as pollution and over-abstraction.

In the United States of America (USA), California’s Open and Transparent Water Data Platform⁵⁹ brings together various interested parties (e.g. State and federal agencies, data experts, data providers and data consumers) to build an integrated platform for sharing and accessing water data (Cantor et al., 2018). These efforts are in line with the ‘FAIR’ principles for data management – findable, accessible, interoperable, and reusable (Wilkinson et al., 2016). Through interaction with various stakeholders, use cases for data were developed for the State of California with the aim of addressing different data needs and creating linkages and partnerships across sectors (Cantor et al., 2018).

Another example is provided by the World Meteorological Organization (WMO), which has partnered with various entities to drive the generation and application of water data through the World Water Data Initiative started by the Government of Australia. This initiative encourages an ‘open water data policy’, where governments are encouraged to make their data openly available and shared (Bureau of Meteorology, 2017).

10.5 Trends in monitoring and data accessibility

Shortcomings in the development and maintenance of infrastructure for monitoring surface water – and especially groundwater – has resulted in data gaps in biophysical data. Coupled with weak political will for supporting monitoring activities, funding for maintaining such networks has been cited as a challenge for some national governments (UNECE, 2019).

However, with the advent of the digital era and the rollout and uptake of mobile phones, the potential for data generation is phenomenal. The ability of satellites to produce remotely sensed data, along with the *internet of things* and associated sensors, are also increasingly providing high-frequency data in real time (Chapter 11), in some ways resulting in a ‘drowning in data’ situation. Nonetheless, there is still a need for on-the-ground monitoring data, which serve to validate and calibrate remote sensors and enable machine learning. Such direct observation data, and mechanisms for data-sharing and strengthening capacities, are still largely lacking, particularly in developing countries where limited monitoring infrastructure, governance and technical capacity can be constraining.

Data management can be enhanced to improve direct benefit. When the time-lag between data generation and application in decision-making is too long, the risk of a mismatch between the two increases. The incompatibility of data with intended applications can also impede usefulness. The data value chain has to be efficient to ensure that maximum value is derived from generated data in order to address water scarcity, pollution and other challenges in a timely manner. The idea of public data brokers in the context of water resources management may be worth considering in terms of timely response and the consolidation of data dispersed across numerous repositories. Data brokers typically harness data from different sources and provide them to users in the form that is most useful and actionable. One such example is the Water Point Data Exchange platform,⁶⁰ which harmonizes data from different sources to improve rural water access.

⁵⁹ For more information, please see: <https://water.ca.gov/ab1755>.

⁶⁰ For more information, please see: www.waterpointdata.org.

● ● ●
Shortcomings in the development and maintenance of infrastructure for monitoring surface water, and especially groundwater, has resulted in data gaps in biophysical data

According to the International Water Management Institute (IWMI): *“Incentives for data exchange may not be sufficiently evident to those involved in river basin management. One way to stimulate data sharing is to focus on a common need, e.g., flood or drought mitigation, or improving water quality to support ecosystem services. Such practical and tangible uses of data may serve as a catalyst that enables increased data flows. Data-driven decisions and policies have become more critical, particularly with the increased frequency of extreme weather events as a result of climate change. Therefore, response times have to be shorter. An adequate flow of data is needed to enable such responses”* (IWMI, 2021, p. 5). The use and application of data can thus be stimulated through aligning with specific needs.

There are new opportunities from digital innovations, ranging from the development of novel sensors to emerging remote sensing applications, as well as the quantitative and qualitative data generated through social media and citizen science (see Section 11.3).

Remote sensing from Earth observation allows platforms to support flood awareness and preparedness, particularly at the scale of large transnational river basins. The Global Flood Awareness System (GloFAS)⁶¹ provides meteorological situation maps, early flood detection (up to 30 days in advance) and seasonal river flow outlooks (up to 16 weeks in advance). NASA’s Near Real Time Global Flood Mapping System also provides near real-time data for response during flooding disasters. This same information is also valuable for flood mitigation, preparedness and recovery, including for planning large-scale infrastructure, settling insurance claims following flood disasters, and planning community rebuilding.⁶²

Web-based platforms can enable users to: (i) receive and analyse sensed rainfall data; (ii) convert rainfall data into runoff through calibrated hydrological modelling; (iii) receive and analyse sensed hydrometric data; (iv) conduct hydrodynamic numerical simulations forced with hydrometric data or other hydrological data; and (v) translate the results of a combination of numerical results and sensed data into parameters that may be communicated to authorities to trigger alert levels or to issue warnings (Sweta, 2014; Woldegebrael et al., 2022).

At the regional level, the FANFAR⁶³ project (Reinforced cooperation to provide operational flood forecasting and alerts in West Africa) gathers a cascade of actors from various disciplines at regional, national and local levels from 17 countries in West and Central Africa (Figure 10.1) where flooding is a growing concern due to climate change. Flood risk notifications can be provided through e-mail and SMS to subscribed users.

National and subnational flood monitoring initiatives and early warning systems generally focus on emergency response (alerts and warnings) or preparedness (risk assessment). The Iowa Flood Inundation System⁶⁴ (IFIS) (Demir et al., 2018), for example, is a comprehensive decision support system that provides real-time information on streams and weather, forecasts, maps and damage estimates for floods in the State of Iowa in the USA. As a way to promote inclusive participation, IFIS has augmented reality features to raise awareness and inform decision-makers, including a holographic visualization of inundation in some locations.

⁶¹ For more information, please see: www.globalfloods.eu/general-information/forecast-viewer-info/.

⁶² For more information, please see: www.earthdata.nasa.gov/learn/find-data/near-real-time/modis-nrt-global-flood-product.

⁶³ For more information, please see: <https://fanfar.eu/>.

⁶⁴ For more information, please see: <https://iowafloodcenter.org/projects/iowa-watershed-approach-hydrologic-network-2/>.

Figure 10.1 Actors involved in improving flood management in West Africa under the FANFAR project



Source: Based on FANFAR (n.d.).

10.6 Next steps

Three key interventions targeted at basin and country levels could accelerate the generation, application and exchange of water-related data and information to enable effective water management and speed up achievement of SDG 6 targets:

1. Encourage partnerships between state and non-state actors in generating, harmonizing and interpreting water-related data, streamlined into established data management and information systems;
2. Strengthen cooperation around transboundary joint monitoring and data and information exchange for sustainable basin and aquifer management through targeted actions that promote application of data and information;
3. Promote more participative data generation, analysis and information-sharing, for example through the inclusion of women and youth, with increasing focus on disaggregated data on socio-economic indicators and the use of traditional knowledge.

In support of all of the above, there is a need to build awareness around water resource monitoring and data and information management as well as to strengthen individual and institutional capacity across and within societies, organizations and sectors to improve water management. Ultimately, the aim is to reduce vulnerability, and increase resilience and sustainability.

References

- Alferes, J., Copp, J., Weijers, S. and Vanrolleghem, P. A. 2014. Innovative water quality monitoring: Automation of data assessment in practical scenarios. *Proceedings of the IWA World Water Congress 2014*. Lisbon, 21–26 September 2014.
- Bureau of Meteorology. 2017. *Good Practice Guidelines for Water Data Management Policy: World Water Data Initiative*. Melbourne, Australia, Bureau of Meteorology, Australian Government.
- Cantor, A., Kiparsky, M., Kennedy, R., Hubbard, S., Bales, R., Cano Pecharroman, L., Guivetchi, K., McCready, C. and Darling, G. 2018. *Data for Water Decision Making: Informing the Implementation of California's Open and Transparent Water Data Act through Research and Engagement*. Berkeley, Calif., Center for Law, Energy & the Environment, UC Berkeley School of Law. doi.org/10.15779/J28H01.
- Cloke, H. L. and Pappenberger, F. Ensemble flood forecasting: A review. *Journal of Hydrology*, Vol. 375, No. 3–4, pp. 613–626. doi.org/10.1016/j.jhydrol.2009.06.005.
- Demir, I., Yildirim, E., Sermet, Y. and Sit, M. A. 2018. FLOODSS: Iowa flood information system as a generalized flood cyberinfrastructure. *International Journal of River Basin Management*, Vol. 16, No. 3, pp. 393–400. doi.org/10.1080/15715124.2017.1411927.
- DWS (Department of Water and Sanitation). 2020. *Data Management Strategy for Water and Sanitation in South Africa*. Pretoria, Directorate: Water Information Integration, Department of Water and Sanitation of South Africa.
- Ebrahim, G. Y., Lautze, J., Ngoni, B., Fhedzisani, R., Siziba, T., Munyai, B. and Pavelic, P. 2021. *Groundwater Monitoring Network Design for the Tuli Karoo Transboundary Aquifer. Conjunctive Surface-Groundwater Management of SADC's Shared Waters: Generating Principles Through Fit-for-Purpose Practice Project*. Pretoria, International Water Management Institute (IWMI). <http://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2021/03/GroundwaterMonitoringTuliKarooFINAL.pdf>.
- FANFAR (Operational Flood Forecasting and Alert in West Africa). n.d. *FANFAR: Reinforced Cooperation to Provide Operational Flood Forecasting and Alerts in West Africa*. FANFAR website. <https://fanfar.eu/about/>.
- Internet of Water Coalition. n.d. *What are Data, Information, and Knowledge?* Nicholas Institute, Duke University. <https://internetofwater.org/valuing-data/what-are-data-information-and-knowledge/>.
- IWMI (International Water Management Institute). 2021. *Data Sharing in Transboundary Waters: Current Extent, Future Potential and Practical Recommendations*. IWMI Water Policy Brief No. 43. Colombo, IWMI. doi.org/10.5337/2021.232.
- Kölbl, J., Strong, C., Noe, C. and Reig, P. 2018. *Mapping Public Water Management by Harmonizing and Sharing Corporate Water Risk Information*. Technical Note. World Resources Institute (WRI). www.wri.org/publication/mapping-public-water.
- Miletto, M., Pangare, V. and Thuy, L. 2019. *Tool 1 – Gender-Responsive Indicators for Water Assessment, Monitoring and Reporting*. UNESCO WWAP Toolkit on Sex-disaggregated Water Data. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000367971?posInSet=1&queryId=e1c28f52-4ada-4168-9e52-85405ca4dd42>.
- Mukuyu, P., Lautze, J., Rieu-Clarke, A., Saruchera, D. and McCartney, M. 2020. The devil's in the details: Data exchange in transboundary waters. *Water International*, Vol. 45; No. 7–8, pp. 884–900. doi.org/10.1080/02508060.2020.1850026.
- Sweta, L.O. 2014. Early warning systems and disaster management using mobile crowdsourcing. *International Journal of Science and Research*, Vol. 3, No. 4, pp. 356–365.
- UNECE (United Nations Economic Commission for Europe). 2019. *Water Convention's Future Directions on Monitoring and Data Exchange in Transboundary Basins Outlined based on Experience and Needs of over 70 Countries*. UNECE website. <https://unece.org/environment/news/water-conventions-future-directions-monitoring-and-data-exchange-transboundary>.
- UN-Water. 2020. *The Sustainable Development Goal 6 Global Acceleration Framework*. Geneva, UN-Water. www.unwater.org/publications/the-sdg-6-global-acceleration-framework/.
- United Nations. 2022. *The United Nations World Water Development Report 2022: Groundwater: Making the Invisible Visible*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J. W., Da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., Gonzalez-Beltran, A., Gray, A. J. G., Groth, P., Goble, C., Grethe, J. S., Heringa, J., Hoen, P. A. C., Hoof, R., Kuhn, T., Kok, R., Kok, J., Lusher, S. J., Martone, M. E., Mons, A., Packer, A. L., Persson, B., Rocca-Serra, P., Roos, M., Van Schaik, R., Sansone, S. A., Schultes, E., Sengstag, T., Slater, T., Strawn, G., Swertz, M. A., Thompson, M., Van der Lei, J., Van Mulligen, E., Velterop, J., Waagmeester, A., Wittenburg, P., Wolstencroft, K., Zhao, J. and Mons, B. 2016. The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, Vol. 3, Article 160018, pp. 1–9. doi.org/10.1038/sdata.2016.18.
- Woldegebrael, S. M., Kidanewold, B. B. and Melesse, A. M. 2022. Development and evaluation of a web-based and interactive flood management tool for Awash and Omo-Gibe basins, Ethiopia. *Water*, Vol. 14, No. 14, Article 2195. doi.org/10.3390/w14142195.

Chapter 11

Innovation

UNESCO IHP

Wouter Buytaert, Anil Mishra, Koen Verbist and Jorge Ellis

With contributions from:

Emmanuel Cheo (UNU-EHS), Xavier Leflaive (OECD),
Serdar Turkeli and Sanae Okamoto (UNU-MERIT), and
Christophe Cudennec (IAHS)



11.1 Introduction

Managing global water resources and water-related risks relies on a wide range of technologies, from measuring water fluxes and stores in the natural environment to drinking water and wastewater treatment, desalination, and grey water recycling. Partnerships can accelerate the development and uptake of innovative technologies through knowledge transfer, entrepreneurship and applied research.

Taking account of social innovations, for example regarding working conditions, education, community development or health, can further enhance these partnerships, making them more transparent, robust, sustainable, resilient and inclusive.

But the introduction of both technological and social innovations also incurs challenges and risks. New technologies may be developed or leveraged by specific interest groups and elites, and reinforce existing inequalities. Social innovation may require large time investments for dialogue, or create conflicts if the process fails. Adequate safeguards and policies should be designed to minimize these risks.

11.2 Technological innovations

Technological innovations are reshaping all facets of water management. As Chapter 10 describes, new information and communication technologies give unprecedented opportunities to monitor, diagnose and control water resources systems from source to tap. New technologies are making the exploitation of new and non-conventional water sources more feasible. For example, solar energy may allow harvesting drinking water from the air (Lord et al., 2021), simultaneous production of electricity and freshwater (Wang et al., 2019), or strengthening the water–food–energy system resilience (e.g., the Agrophotovoltaics in Africa project implemented by UNU-EHS, (n.d.)). Innovations in treatment technologies are creating opportunities for the recycling and reuse of wastewater (WWAP, 2017).

Digitization is increasingly making available practices, tools and other resources that are in turn ushering in a new era of water management. The increased use of internet of things (IoT), sensor technologies and modelling applications is creating opportunities to monitor water management systems more accurately. Analysing these data streams relies increasingly on technologies such as big data, blockchain and artificial intelligence.

Making best use of new technologies will require the strengthening and extension of traditional partnerships, but also the development and implementation of novel modes of collaboration and new business models for innovation and technological acceleration. Strengthening and extending South–North and South–South partnerships between universities encourages the transfer of new technologies and innovative skills. Business incubators and accelerators can facilitate partnerships between universities, budding entrepreneurs and venture capital providers. Such incubators are becoming increasingly common in the developed world but should be strengthened and expanded in middle- and low-income countries. Partnerships through the creation of communities of practice for knowledge co-creation and innovation with partners from the North and South could go a long way towards developing technically feasible, economically viable, socially acceptable and locally adaptable solutions in response to core challenges in the field of water security.

Intellectual property issues, such as restrictive licences and patents, can pose challenges to the sharing of technologies, even within partnerships. The adoption of the Open Science principles (see Section 9.2), as advocated by the *UNESCO Recommendation on Open Science*, can help avoid intellectual property issues and promote a more sustainable and equitable approach to technology-sharing (UNESCO, 2021). These principles are well established in software development, where they have been a major driver of leveraging

● ● ●
Partnerships can accelerate the development and uptake of innovative technologies through knowledge transfer, entrepreneurship and applied research

information and communication technologies for development (ICT4D). It is increasingly adapted beyond software, in fields such as computational hardware, data management systems and environmental systems. The development and dissemination of open hardware solutions rely strongly on global partnerships of volunteers and enthusiasts, often referred to as the *maker community*.

Examples of open hardware-based solutions in the water domain include water quantity and quality sensing solutions, such as the Mayfly data logger,⁶⁵ or the water sensors developed by the University of Minnesota (USA).⁶⁶ Developing innovation and commercialization partnerships based on open-science principles may require a different approach to business model development, relying less on licencing revenue and more on services. A successful example of such a business is the woman-owned company mWater, which provides a data platform for the water, sanitation and hygiene (WASH) sector, using an innovative, free and open-access business model.⁶⁷

Novel partnerships across the wider water and sanitation industry are needed to accelerate the uptake of new technologies for water processing, distribution and treatment. These industries tend to be risk-averse, and innovation needs to be fully integrated in a wider value chain (Leflaive et al., 2020). This can be achieved through partnerships between industry and technology providers, such as universities and entrepreneurs. Such initiatives can help create job opportunities, for example for youth in the Global South who have grown up with digital technologies, and who can apply the acquired skills to leapfrog the classic development path. This may boost economic growth and job creation in many key sectors of the economy, while also providing pathways out of poverty. Maximizing this potential requires well-designed policy frameworks that stimulate demand for innovation, typically by making visible the costs of prevailing approaches and signalling the benefits of innovation.

11.3 Social innovation

New partnerships can also emerge from social innovations (i.e. new social practices that address social needs better than existing solutions), of which the rise of citizen science is a prominent example. Citizen science is essentially a partnership between professional scientists and citizen volunteers to further scientific knowledge in a specific area or topic. While citizen science has its roots in the scientific discovery process, it is increasingly applied to generate evidence for decision-making.

Citizen science can act as an agent of social inclusion and local-level participation and bring a sense of ownership in shaping evidence-based policies. Its approach often contains a series of steps that build the capacities of the local representative target groups to better identify outstanding and common issues. In this regard, citizen science brings leadership and ownership together, as well as global and local concerns and solutions.

Early citizen science projects in the water sector were mostly related to weather observations, either manually or through personal automatic weather stations. However, the increasing availability of technologies has triggered a broader range of citizen science projects in water, of which water quality is particularly popular (e.g. the Earthwatch Freshwater Watch project).⁶⁸

⁶⁵ For more information, please see: www.envirodiy.org/mayfly/hardware/.

⁶⁶ For more information, please see: <https://northernwidget.com/products/>.

⁶⁷ For more information, please see: www.mwater.co/.

⁶⁸ For more information, please see: <https://earthwatch.org.uk/get-involved/freshwater-watch>.

● ● ●
Citizen science can act as an agent of social inclusion and local-level participation and bring a sense of ownership in shaping evidence-based policies

Citizen science projects have predominantly originated in highly developed regions, but the application of citizen science projects in a development context is increasing (Box 11.1). This can have a range of benefits beyond the creation of new scientific evidence. It can increase the transparency, trustworthiness and credibility of water management, and be a powerful tool to enhance awareness and motivate behavioural change (Nardi et al., 2021; European Commission, n.d.). Moreover, it enables groups and individuals to participate in the generating of scientific evidence that may otherwise be left out.

Citizen science is one example of a larger and broader effort to develop new and innovative partnerships to enhance participation and collaboration within the water sector. In the United Kingdom (UK), the Catchment Based Approach (CaBA)⁶⁹ is a recently established collaborative platform between civil society, the government, local water authorities, water companies and business to promote an inclusive approach to river basin management. CaBA partnerships are actively working in more than 100 river catchments with the aim of protecting the water environment and maximizing the environmental, social and economic benefits they generate. Forty percent of these partnerships carry out monitoring and citizen science. The CaBA directly supports many of the targets of the UK Government's 25 Year Environment Plan.

Establishing such partnerships is crucial to support the development and implementation of catchment interventions such as nature-based solutions (NBS) (WWAP/UN-Water, 2018) and climate resilience water management (UNESCO/UN-Water, 2020). However, the multi-benefit and multi-stakeholder nature of interventions such as NBS can entail a potentially complex design and negotiation process to balance the benefits and potential disadvantages of different intervention scenarios. It is necessary to include stakeholders from outside the water sector in these partnerships to develop and implement arrangements such as benefit-sharing and compensation between upstream and downstream populations within a river basin.

Water funds (see Boxes 3.1 and 8.2; Chapter 12) are increasingly popular mechanisms to achieve such benefit-sharing. One of the oldest and most successful initiatives is the Fund for the Protection of Water of the city of Quito (FONAG, n.d.). FONAG was established in 2000 as a partnership between the water supply company of Quito and the international environmental non-governmental organization (NGO) The Nature Conservancy, but it currently includes several other commercial, governmental and civil society actors. With an allocated yearly budget of US\$3.4 million, the fund currently manages around 20,000 hectares of land within the Guayllabamba River basin, for the purpose of improving the reliability and quality of Quito's water supply, as well as enhancing biodiversity, sustainable agriculture and local livelihoods.

Global climate change poses a complex challenge to sustainable catchment management, imposing multiple stressors and risks, and requiring novel arrangements and partnerships between affected stakeholders. One of such approaches is the Climate Risk Informed Decision Analysis (CRIDA) methodology. CRIDA is the result of a multi-partner process auspiced by the United Nations Educational, Scientific and Cultural Organization (UNESCO). It presents a methodological framework to implement participatory, bottom-up approaches to the identification of water security risks related to hydro-climatic events. This methodology promotes the involvement of local communities and stakeholders in its design. By combining local insights with scientific evaluation and modelling, it aims to identify the most useful and locally relevant adaptation strategies, and to design more robust pathways that are in line with local needs (UNESCO/ICIWaRM, 2018).

⁶⁹ For more information, please see: <https://catchmentbasedapproach.org>.

11.4 Challenges

Developing and supporting partnerships for technological and social innovation holds promise to make water management more efficient, robust and inclusive, but also faces challenges. The inclusion of a wider range of stakeholders in the knowledge generation and governance process inevitably reveals diverging interests, viewpoints or knowledge gaps, increasing the potential for friction and conflict. This needs to be carefully managed, using robust, transparent and fair negotiation processes.

The introduction of novel partnerships may also cause the disruption of established governance processes. For example, citizen science can have a strong impact on local environmental management processes. The resulting evidence of citizen science projects can be used to contest decisions and support specific political agendas. But it can also change power relations, as it tends to put this knowledge in the hands of actors that traditionally do not participate actively in the governance process. This incurs a risk of destabilizing the decision-making processes, a risk that needs to be managed carefully (Dewulf et al., 2019).

Similarly, the introduction of new technologies and innovations, such as ICT to facilitate new partnerships, may favour participation of those that are more knowledgeable and able to pick up those technologies. Access to, and knowledge about, those technologies may be highly uneven, especially in a development context where the poor may not have proper access to internet, mobile phones and similar technologies, not to mention electricity. Care should therefore be taken that the introduction of new technologies does not lead to unintended side effects, such as a widening of the digital divide (Mirza et al., 2019).

Box 11.1 Citizen science for development

Citizen science is a partnership in which volunteers, scientists and potentially other partners jointly create new scientific knowledge. While some projects focus only on the intellectual challenge, citizen science is increasingly explored as a means to support sustainable development. For example, community-based hydro-meteorological monitoring can help filling gaps in statutory monitoring networks and generate information that can support local water resources management. Efforts in Ethiopia and Nepal have shown that community-based monitoring can produce reliable and consistent measurements (Walker et al., 2016; Davids et al., 2019). In South Africa, the Water Research Commission* is putting major efforts in engaging citizens in water quality monitoring, while citizen science is also explored as a method to generate evidence for the implementation of the Sustainable Development Goals (SDGs) (Fritz et al., 2019). A major challenge of applying citizen science in a development context is to create sufficient value for volunteer participants to ensure long-term sustainability of citizen science activities.

* For more information, please see: www.wrc.org.za/.

References

- Davids, J. C., Devkota, N., Pandey, A., Prajapati, R., Ertis, B. A., Rutten, M. M., Lyon, S. W., Bogaard, T. A. and Van de Giesen, N. 2019. Soda bottle science – Citizen science monsoon precipitation monitoring in Nepal. *Frontiers in Earth Science*, Vol. 7, Article 46. doi.org/10.3389/feart.2019.00046.
- Dewulf, A., Karpouzoglou, T., Warner, J., Wesselink, A., Mao, F., Vos, J., Tamas, P., Groot, A. E., Heijmans, A., Ahmed, F., Hoang, L., Vij, S. and Buytaert, W. 2019. The power to define resilience in social–hydrological systems: Toward a power-sensitive resilience framework. *WIREs Water*, Vol. 6, No. 6, pp. 1–14. doi.org/10.1002/wat2.1377.
- European Commission. n.d. *Examining the Use and Practices of Citizen Science for EU Policies*. JRC Science Hub Communities, European Commission website. <https://ec.europa.eu/jrc/communities/en/community/citizensdata>. (Accessed in June 2022)
- FONAG (Fondo para la Protección del Agua). n.d. FONAG website. www.fonag.org.ec. (Accessed in July 2022 – In Spanish.)
- Fritz, S., See, L., Carlson, T., Haklay, M., Oliver, J. L., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L. A., Schade, S., Wehn, U., Abrate, T., Anstee, J., Arnold, S., Billot, M., Campbell, J., Espey, J., Gold, M., Hager, G., He, S., Hepburn, L., Hsu, A., Long, D., Masó, J., McCallum, I., Muniafu, M., Moorthy, I., Obersteiner, M., Parker, A. J., Weisspflug, M. and West, S. 2019. Citizen science and the United Nations Sustainable Development Goals. *Nature Sustainability*, Vol. 2, No. 10, pp. 922–930. doi.org/10.1038/s41893-019-0390-3.
- Leflaive, X., Kriebler, B. and Smythe, H. 2020. *Trends in Water-Related Technological Innovation: Insights from Patent Data*. OECD Environment Working Papers No. 161. Paris, OECD Publishing. doi.org/10.1787/821c01f2-en.
- Lord, J., Thomas, A., Treat, N., Forkin, M., Bain, R., Dulac, P., Behrooz, C. H., Mamutov, T., Fongheiser, J., Kobilansky, N., Washburn, S., Truesdell, C., Lee, C. and Schmaelzle, P. H. 2021. Global potential for harvesting drinking water from air using solar energy. *Nature*, Vol. 598, No. 7882, pp. 611–617. doi.org/10.1038/s41586-021-03900-w.
- Mirza, M. U., Richter, A., Van Nes, E. H. and Scheffer, M. 2019. Technology driven inequality leads to poverty and resource depletion. *Ecological Economics*, Vol. 160, pp. 215–226. doi.org/10.1016/j.ecolecon.2019.02.015.
- Nardi, F., Cudennec, C., Abrate, T., Allouch, C., Annis, A., Assumpção, T., Aubert, A. H., Béro, D., Braccini, A. M., Buytaert, W., Dasgupta, A., Hannah, D. M., Mazzoleni, M., Polo, M. J., Sæbø, Ø., Seibert, J., Tauro, F., Teichert, F., Teutonico, R., Uhlenbrook, S., Wahrmann Vargas, C. and Grimaldi, S. 2021. Citizens AND Hydrology (CANDHY): conceptualizing a transdisciplinary framework for citizen science addressing hydrological challenges. *Hydrological Sciences Journal*. doi.org/10.1080/02626667.2020.1849707.
- UNESCO (United Nations Educational, Scientific and Cultural Organization). 2021. *UNESCO Recommendation on Open Science*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en>.
- UNESCO/ICIWaRM (United Nations Educational, Scientific and Cultural Organization/International Centre for Integrated Water Resources Management). 2018. *Climate Risk Informed Decision Analysis (CRIDA): Collaborative Water Resources Planning for an Uncertain Future*. Paris/Alexandria, Va., UNESCO/ICIWaRM Press. <https://unesdoc.unesco.org/ark:/48223/pf0000265895>.
- UNESCO/UN-Water (United Nations Educational, Scientific and Cultural Organization/UN-Water). 2020. *The United Nations World Water Development Report 2020. Water and Climate Change*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000372985.locale=en>.
- UNU-EHS (United Nations University – Institute for Environment and Human Security). n.d. *Agrophotovoltaics for Mali and The Gambia: Sustainable Electricity Production by Integrated Food, Energy and Water Systems (APV-MaGa)*. <https://unu.edu/projects/agrophotovoltaics-for-mali-and-the-gambia-sustainable-electricity-production-by-integrated-food-energy-and-water-systems-apv-maga.html>. (Accessed in November 2022).
- Walker, D., Forsythe, N., Parkin, G. and Gowing, J. 2016. Filling the observational void: Scientific value and quantitative validation of hydrometeorological data from a community-based monitoring programme. *Journal of Hydrology*, Vol. 538, pp. 713–725. doi.org/10.1016/j.jhydrol.2016.04.062.
- Wang, W., Shi, Y., Zhang, C., Hong, S., Shi, L., Chang, J., Li, R., Jin, Y., Ong, C., Zhuo, S. and Wang, P. 2019. Simultaneous production of fresh water and electricity via multistage solar photovoltaic membrane distillation. *Nature Communications*, Vol. 10, No. 1, Article 3012. doi.org/10.1038/s41467-019-10817-6.
- WWAP (UNESCO World Water Assessment Programme). 2017. *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000247153>.
- WWAP/UN-Water (UNESCO World Water Assessment Programme/UN-water). 2018. *The United Nations World Water Development Report 2018. Nature-Based Solutions for Water*. Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000261424>.

Chapter 12

Financing

OECD

Helen Laubenstein

WWAP

Richard Connor

With contributions from:

Xavier Leflaive and Harry Smythe (OECD),
Neil Dhot (AquaFed), Matt Austin (Water.org),
Marianne Kjellén (UNDP), Angie Saleh (SWA),
and Iulia Trombitcaia (UNECE)



12.1 Introduction

Better cooperation can accelerate tackling the financing challenge for water security. The overall levels of financing for water, which are projected to increase in the future, are well below what is currently required. The estimated costs of meeting Sustainable Development Goal 6 (SDG 6) exceed US\$1 trillion per year, which is the equivalent to 1.2% of global gross product (Strong et al., 2020). In particular, achieving universal and equitable access to safe drinking water for all by 2030 could require tripling current investment levels (Hutton and Varughese, 2016). These estimates underscore the urgency to scale up existing financing flows for water.

Existing funds are best channelled where they deliver the greatest positive outcomes. Evidence suggests that some water-related funds may be poorly targeted, failing to reach the projects that maximize benefits (Andres et al., 2019; Leflaive and Hjort, 2020). Mistargeted water, sanitation and hygiene (WASH) subsidies, for example, can be counterproductive and potentially reduce the benefits of water services (United Nations, 2021).

Better cooperation across all stakeholders can both scale up current investments and help channel existing funds more effectively. This requires strengthening cooperation both on the *demand* side of finance, notably within the 'water community', such as water service providers and users, and on the *supply* side of finance, including development finance agencies and commercial investors. It also requires better coordination and communication *between* the demand and supply side for water finance.

12.2 Cooperation on the demand side of finance

The demand side of finance refers to actors seeking funding and financing for water-related projects. They include national and local governments responsible for water infrastructure development; project developers (e.g. construction, engineering and maintenance firms); water service providers (e.g. municipal water utilities); and households investing in domestic sanitation facilities, among others. These actors might seek financing for the upfront costs of a project, and funding for the operation and maintenance of existing assets through a recurrent revenue stream (e.g. tariffs and user fees).

Better cooperation on the demand side of finance helps optimize the use of existing funds and can generate additional funding streams. Water-related investments deliver benefits to a variety of actors, sectors and policy domains. Investing in water recharge/retention measures in a specific area, for example, can improve irrigation possibilities and livelihoods for farmers, water availability for villages or industry, and maintain ecosystem functioning. At the same time, some water-related interventions can potentially create negative effects for other users – for example, a dam for water storage and hydropower production will invariably affect water availability further downstream. This creates particular issues in transboundary settings. As water-related interventions can have effects over the entire water system, the catchment area or a specific landscape, they might positively or negatively affect future investment opportunities over a longer time horizon (OECD, 2020a; Brown et al., 2022).

In practice, water-related investments often fail to adequately account for synergies and their implications on other actors, sectors and overall water security. Stakeholders that operate in single disciplinary silos and planning processes are often unable to support the design and implementation of cross-cutting interventions (OECD, 2022; Alaerts, 2019; Cardascia, 2019). In transboundary settings, there is a general lack of cooperation between riparian states in many of the world's basins, undermining funding for water resource management and transboundary basin development (UNECE, 2021).

Improved cooperation can help account for these interdependencies, create synergies and manage trade-offs more effectively, and thus optimize investment choices. Strong cooperation across actors and sectors helps design integrated projects that pursue multiple policy goals and select those that can unlock opportunities for others (OECD, 2022). A reforestation

• • •
Improved cooperation can help account for interdependencies, create synergies and manage trade-offs more effectively, and thus optimize investment choices

project, for instance, can improve water quality, and at the same time open opportunities for eco-tourism. Strong coordination across different policy objectives (e.g. on food security, gender, and other Sustainable Development Goals) and strategic planning approaches that account for future developments, such as climate change or demographics, ensure that financial flows are channelled to projects that strengthen resilience and help avoid costly retro-fitting, maladaptation and future additional investment needs (OECD, 2022; 2020a; Brown et al., 2022). Box 12.1 gives an example for such a strategic planning approach in which water investments are embedded in a larger development strategy. The Niger River basin provides another example for an integrated planning approach, supported through development finance. The German Agency for International Cooperation (GIZ) financed technical assistance to develop a legal framework for transboundary cooperation and to prepare and implement a comprehensive planning framework with a particular focus on the water–energy–food security nexus for the basin (GIZ, n.d.; UNECE, 2021).

Better coordination across stakeholders can also generate additional funding streams for water-related investments from various sources. Different actors can have an interest in contributing to water security in their area; for example, both an environment ministry and a beverage company might see benefits in investing in improved water quality. Cooperation mechanisms are key for bringing these beneficiaries together and facilitate joint financing of relevant projects. Water funds (see Boxes 3.1 and 8.2) are examples of multi-stakeholder platforms that pool funding from various actors within a spatial area for nature-based solutions (NBS) contributing to water security (Trémolet et al., 2019). One example is the Monterrey Metropolitan Water Fund in Mexico that has leveraged US\$9.1 million, including a non-refundable contribution from an international brewery, into efforts aimed at maximizing the environmental services provided by the San Juan River basin, which include increasing infiltration and reducing runoff, as well as resilience and climate change adaptation (Latin American Water Funds Partnership, n.d.). Another example of private actors investing in improved water management practices is Danone and its suppliers in the United States of America (USA), spending US\$16 million to promote soil conservation practices to increase water retention and protect watersheds and biodiversity (CDP, 2021).

12.3 Cooperation on the supply side of finance

The supply side of finance refers to the actors providing funding and financing for water-related investments. They include national and local governments managing public budgets and procurement; public banks and development finance agencies (e.g. regional development banks) offering grants and preferential loans; commercial financial institutions, such as private banks or institutional investors (e.g. pension funds and insurance companies), providing debt and equity financing; and philanthropy and other donors.

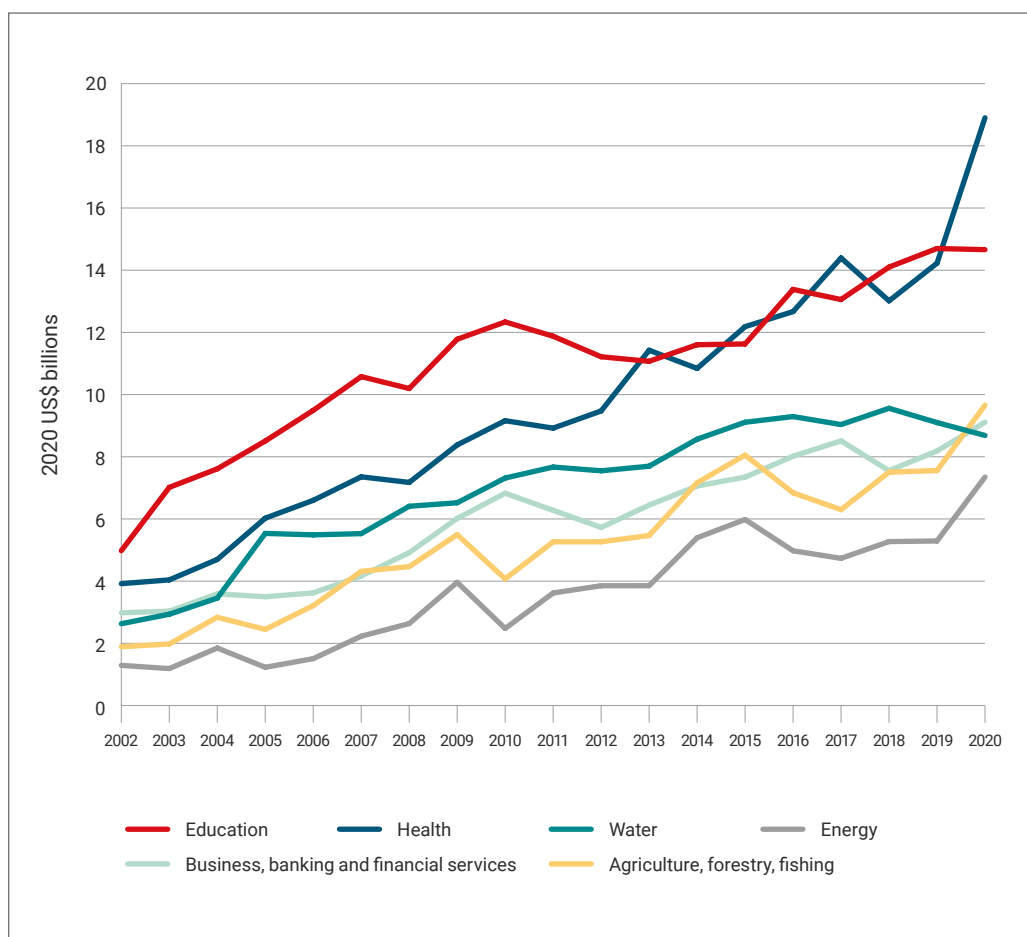
Water-related investments have historically been financed by public budgets, including international transfers, with contributions from water users (e.g. water tariffs). Official development assistance (ODA) for water⁷⁰ increased steadily since the beginning of the millennium, from US\$2.7 billion in 2002 up to US\$9.6 billion in 2018, then dropping to US\$8.7 billion in 2020 (Figure 12.1). Compared to other sectors, these funds represent a minor share of total ODA, with just below 4% allocated to water over the 2016–2020 average (OECD.stat, n.d.). In most instances, public and development finance are not used as a catalytic force to crowd in additional capital, and private finance remains limited for water-related investments (OECD, 2019; 2022). To give an order of magnitude, the amount of private finance mobilized through official development finance for water supply and sanitation totalled US\$4.6 billion between 2016 and 2020, compared to over US\$48 billion for the energy sector (Figure 12.2; OECD.stat, n.d.).

⁷⁰ The presented category 'water' is the sum of data on ODA flows for water supply & sanitation, agricultural water resources and hydroelectric power plants.

Figure 12.1

Trend of official development assistance for water and selected sectors

Note: Presented ODA flows for 'water' include flows for water supply and sanitation, agricultural water resources, and hydroelectric power plants. The two latter categories are thus not included in the flows for 'agriculture, forestry, fisheries' and 'energy', respectively.



Source: Author, based on OECD.stat (n.d.).

Box 12.1 Strategic investment pathways in Zambia

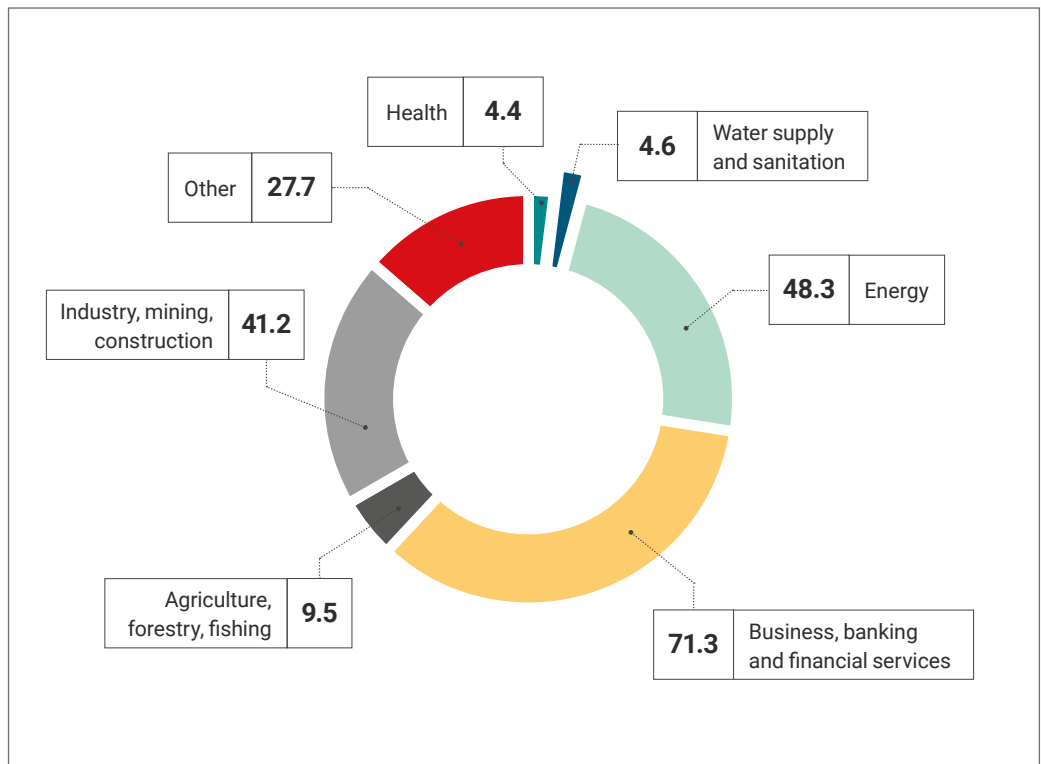
While financiers typically focus on the availability of a pipeline of bankable projects, government authorities and project developers need to situate these pipelines within broader strategic investment pathways to ensure they are resilient and contribute to water security and sustainable growth over the long term and broader spatial scale. The Zambian 2017–2021 National Development Plan (NDP) provides an example of how water is established as a contributor to a range of development objectives and how water-related projects are strategically positioned and funded within a broader development strategy.

The Zambian NDP consists of five strategic pillars, two of which are directly relevant to water: 'economic diversification' and 'human welfare'. For the former, the NDP focuses on meeting increasing water demand for energy and agricultural production, as well as domestic water needs, through the construction of small, medium and large dams. Additionally, inter-basin water transfer schemes are promoted to transfer water resources from water-abundant to water-scarce parts of the country. For the pillar on enhancing human welfare, expanding access to water and sanitation services (WSS) is a central component. The NDP prioritizes infrastructure development in both rural and urban areas, efforts to improve resilience of WSS, as well as education for better health. To cover its costs, the NDP explicitly refers to additional private finance for WSS and water resources management, such as public–private partnerships (PPPs). In 2018, Zambia's PPP Act was amended to strengthen the legislative framework for PPPs and a dedicated PPP Department was established within the Ministry of Finance.

Overall, the plan's clusters provide a platform for coordination among public and private actors to support project planning, financing and implementation. Engagement in the NDP clusters also provides a means to contribute to the development of the next NDP, and thus establishes a consistent long-term development strategy for the country.

Source: OECD (2020a).

Figure 12.2
Private finance mobilized through official development finance across sectors (US\$ billion), 2016–2020



Note: The total represents all sector-allocable mobilized private finance.

Source: Author, based on OECD.stat (n.d.).

Better cooperation among the different sources of finance can support co-financing arrangements and leverage multiple sources of finance.

Co-financing arrangements can spread the risk of an investment among multiple financiers with differing risk appetites and requirements. For example, risks and associated expected returns vary over time depending on the phase of the project cycle: they decrease when a project is maturing, or through public support financing. Different types of financiers and financial instruments can hence be added or replaced in later project phases (Gietema, 2022; OECD, 2022; Money, 2017). Further, ministries of finance play an important role in allocating public budgets and setting the conditions for effective sector (co-)financing. They hold important coordination functions both horizontally with other ministries and vertically with local governments and service providers. In Mozambique, for example, the cooperation between the parliamentary Planning and Budget Committee and the civil society organization Mozambique Budget Forum contributed significantly to limiting budget cuts for the WASH sector (SWA, 2020).

Public or development finance can be used strategically to improve the risk–return profile of a project and to mobilize additional private investment – so-called ‘blended finance’ arrangements.

Development finance can reduce investment barriers for commercial actors and serve as a market-building instrument (OECD, 2019; Goksu et al., 2017). Blended finance approaches can be applied as a structuring instrument to reduce the perceived risk of a project, for example through guarantees and other risk reduction mechanisms; or to enhance the expected returns of a project, relative to its perceived risk, for example by covering up-front costs and hence lowering the overall repayable costs of a project (OECD, 2022). They can help transform ‘nearly bankable’ projects into viable projects. An example are public–private partnerships (PPPs) for water infrastructure projects (Box 12.2). A key variable in such arrangements is how investment risks are allocated across private and public financiers. Traditionally, the public sector takes on a considerable share of the risk, while the private investors’ risk remains relatively low, and thus more attractive. Some innovative co-financing arrangements exist, which transfer parts of the risks to the private investors, for example in the form of equity finance or performance-based repayment schemes (OECD, 2021a).

Although essential to bridge the financing gap, high availability of development finance tends to crowd out private finance, which stresses the need for stronger coordination across development finance institutions. When development finance is easily accessible, it can reduce the incentives for project owners to attract additional private finance. For example, water utilities with easy access to concessional finance have lower incentives to strengthen their performance and financial position required to access commercial finance. Hence, this trend can impede greater accountability and financial sustainability of the sector and create market distortions. In such cases, it is vital that blended finance arrangements have a transitory and market-building nature with a clear exit strategy. This requires more structured coordination and cooperation across development finance actors on their blended finance engagement, beyond the single transaction. An innovative option could be to channel funds to the users (e.g. households), supporting them with their water bills and thus providing a revenue stream for the service provider. This could transform poor areas into a market segment and help extend services to previously unserved areas (Kjellén, 2021). Generally, while there is agreement about the need for better cooperation between development finance actors, in practice there seems to be competition for ‘good’ investment opportunities, and actions on the ground remain fragmented (OECD, 2019).

Further challenges around co-financing arrangements are their complexity and context-specificity, leading to high transaction costs and rendering them difficult to replicate and scale up. Strengthening capacity and technical assistance for both water and financial actors, as well as improving the enabling environment for investment can help address these challenges. Public funds can be used for project preparation and to lower transaction costs, for pilot projects to develop and test new financing instruments in specific contexts, and to support their scaling up (OECD, 2022; 2021b; AIIB, 2019).

12.4 Cooperation between the supply and demand side of finance

In addition to strong cooperation within the demand and supply sides of finance, improved coordination and communication between them is vital to overcome existing investment barriers and channel financing flows effectively. Better cooperation between the two communities encompasses improved understanding of (i) the supply and demand side’s respective perceptions, characteristics and requirements; (ii) intermediary institutions and their diverse functions; and (iii) the translation of water-related risks and benefits into expressions relevant and understandable to the financial sector.

12.4.1 Strengthening mutual understanding

Both on the supply and demand side of finance, there can be a lack of understanding of the others’ distinct characteristics and requirements, and a mismatch in knowledge and capacity between the two communities. On the demand side of finance, project developers often have limited capacity to prepare bankable project proposals with adequate documentation of risks and returns, necessary to attract financiers. Water infrastructure projects often suffer from poor project pre-feasibility preparation and pipeline identification structuring. Project developers might have limited understanding of the requirements of lenders, and information on creditworthiness and performance of a potential project or its borrowers might be lacking. On the supply side, financiers have limited knowledge of the water sector and the related risks and opportunities. Existing financial mechanisms often do not match the characteristics of the sector. Notably, financiers might lack data, track records and adequate analytical tools to assess the risks associated to water-related investment, which leads to perceived high risks, and lowers the attractiveness for lenders to invest in the sector (Martini, 2022).

Although there is a variety of financiers with different risk–return appetites and fiduciary requirements, there is a lack of matching arrangements due to limited coordination and mutual understanding between the water and finance communities. In fact, different water-

Box 12.2 Blended finance example: The As Samra wastewater treatment plant expansion in Jordan

The As Samra wastewater treatment plant is the first in the Middle East to have used a combination of private, local government and donor financing, which can serve as inspiration for similar projects in emerging markets. This blended financial package was put in place with a viability gap funding mechanism and grant financing.

The 2012-initiated project consists of the expansion of the As Samra wastewater treatment plant. It aims at expanding services for initially 2.3 million inhabitants to around 3.5 million people, thus covering 70–75% of the population of Amman and Zarqa (two of Jordan's most populous cities) by 2025. The total expansion costs of US\$223 million were co-financed by a US\$93 million grant from The Millennium Challenge, and a US\$20 million grant from the Government of Jordan. This combination of donor and public funding, referred to as 'viability gap funding', was critical in leveraging an additional US\$110 million in private financing. The largest share of US\$102 million came from private debt (banks), and a smaller share of US\$8 million was mobilized in equity by the contracted private operator, The Samra Plant Company (SPC). The duration of the Build-Operate-Transfer contract is 25 years, including 3 years for construction and 22 years of operation and maintenance, running until 2037.

In sum, by bringing down the capital costs, the grant funding enabled the project to be financially viable, thus benefiting the government and local rate-payers, without subsidizing the private sector. This new mechanism provides significant leverage and is likely to allow new projects to materialize.

Sources: WWF (2020, pp. 37–38); Kolker and Tremolet (2016); MCC (2018); private communication from Veolia to AquaFed (July 2022).

related projects reflect distinct risk–return profiles and characteristics, depending on the type of investment (scale, capital intensity, repayment periods, time horizons), different types of risks (credit and transfer risks, regulatory and policy risks, performance risks, etc.) and returns (economic, financial and social). Therefore, distinct projects might attract different types of investors. For instance, short-term investments, such as leakage reduction, could be more attractive for commercial financiers, while larger, longer-term investments (such as water network expansion with long payback periods) might be more appealing to concessional finance and institutional investors (Goksu et al., 2017). Investments for water supply and sanitation facilities at the household level require specific financial products, such as micro-credits for low-income consumers and households, and could attract finance from impact investors (water.org, 2021). NBS are water-related projects that require intense and lasting cooperation between financiers and project owners, since their intended benefits often develop with less predictability and over longer time horizons (OECD, 2020b). Generally, water infrastructure tends to be capital-intensive with long lifespans, which requires financing arrangements for high initial investments with long payback periods of about 20–30 years. For these projects, it is challenging to attract private investors, who tend to prefer shorter-term arrangements, and long-term finance on affordable terms is hence often unavailable (OECD, 2018; Cardascia, 2019; Alaerts, 2019).

A better communication and coordination on risks and returns of water-related projects, as well as on risk appetites of different investor types can thus help match suitable investors to different projects with corresponding characteristics. Strategic use of public funds for capacity-building on risk assessment and documentation, knowledge-sharing on financial arrangements, and performance-benchmarking can foster this coordination – all leading to better matching.

12.4.2 Coordinating intermediaries and their diverse functions

Intermediary institutions play a central role in connecting the demand and supply side of finance and facilitating their cooperation. 'Intermediaries' encompass a wide range of organizations across the water investment value chain that improve the connections between the interests and capabilities of the water and financing communities. They take on a variety of roles and functions across various geographies and scales from the international to the local level. Examples include dedicated financing facilities, preparing investment opportunities and financing arrangements (e.g. the Dutch seed-funded Water Finance Facility), government entities working on improving the enabling environment for finance facilitation in a specific country, and non-governmental organizations (NGOs) fostering sectoral knowledge and partnerships (e.g. the World Wildlife Fund for Nature – WWF) (Lardoux de Pazzis and Muret, 2021; Trémolet et al., 2019). For instance, intermediaries can support financial institutions in building out their water-related loan portfolios and linking

• • •
**Better
coordination
across
stakeholders
can generate
additional
funding streams
for water-related
investments from
various sources**

them with suitable sources of capital from investors or development finance agencies, as done by the non-profit organization water.org and the associated asset manager WaterEquity (WaterEquity, n.d.).

Intermediaries and their different functions emerge in an ad-hoc way, and their activities are often driven by an opportunistic approach and political agendas, which leads to gaps and overlaps in responsibilities. For example, an analysis showed that there is an abundance of organizations focusing on providing financial mechanisms, while there is a lack of bankable projects in the sector that could benefit from these financial mechanisms. Yet, interventions focusing on improving operational efficiency – a prerequisite for bankable projects – are covered to a lesser extent by existing intermediaries, revealing a gap of service needed for the sector. Similarly, the abundance of intermediaries makes it difficult and costly for the actors on both sides to identify the adequate intermediaries for their specific needs (Lardoux de Pazzis and Muret, 2021).

There is hence room to better coordinate the functions of intermediary institutions. While their spontaneous emergence may have value and reflects the dynamics of the local environment, some strategic support or guidance can help to better respond to the full range of service providers' and financiers' needs along the investment value chain. National and local governments have a role to play to ensure that intermediaries build partnerships that deliver value for money at local, landscape and broader level.

12.4.3 Speaking the language of finance

Current developments on sustainable finance definitions can serve as common language between the water and finance communities and provide guidance on the documentation of benefits of water-related investments. Green or sustainable finance taxonomies, for instance, provide frameworks for how to take into account and document climate or other environmental benefits. When highlighting compliance with such criteria, water-related investments could provide transparent and standardized information, which is vital for financiers' confidence, and further attract new investor or donor types (OECD, 2020c; 2022). For example, in 2020, 80% of ODA allocated to water was labelled as contributing to 'climate change adaptation'.⁷¹ For other policy objectives, such as 'climate change mitigation' and 'biodiversity', these percentages are significantly lower (19% and 5% respectively) (OECD.stat, n.d.), suggesting there is room to coordinate and communicate mutual benefits between water and other objectives more explicitly to financiers (see Section 7.5). Therefore, taxonomies and similar approaches can help attract attention towards the water sector, despite possibly increasing complexity and administrative burdens related to project preparation and reporting.

Better communication and consideration of potential impacts of water risks on the financial sector can put water on financiers' agenda and trigger investment in water security. The risk–return profile of an individual water-related project is not the only issue of relevance for financial actors. Broader risks to water security can also have significant effects on the financial sector. For example, global economic losses related to urban property flood damages have been estimated at US\$120 billion per year (Sadoff et al., 2015), which can affect mortgage risks and markets. If not properly addressed, flooding could cause local mortgage default crises, which could propagate across international financial markets and thus undermine global financial stability (Mandel et al., 2021; Tett, 2019). Similarly, water scarcity can slow water-intensive industrial production (e.g. semi-conductor production in Taipei, the Taiwan province of China (Agence France Presse, 2021)), and thus affect supply chains and international commodity markets, and hence the financial markets.

⁷¹ Based on the Rio markers labelled 'Significant' and 'Principle'.

Redirecting financing flows from investments that are vulnerable to water risks towards those that foster water security and resilience requires action on various fronts. Scientific data on water resources need to be translated into understandable information for credit rating agencies and other financial actors, calling for better cooperation between the natural science and finance communities. Governments and central banks play a role in developing requirements on water-related risk disclosure for companies and financial actors. Central banks can help develop tools and methodologies for stress testing and thus help quantify the importance of water security for financial stability. Partnerships and networks are vital for these endeavours to ensure knowledge-sharing and harmonization of approaches. The Central Banks and Supervisors Network for Greening the Financial System (NGFS), as well as the Taskforces on Climate-Related and Nature-Related Financial Disclosures (TCFD and TNFD) are relevant examples (OECD, 2021b; 2021c).

12.5 Conclusions

Strong cooperation both within and between the supply and demand side of finance is essential to tackle the financing challenge – and can be fostered through dedicated events and initiatives. At a global scale, the Roundtable on Financing Water⁷² provides a platform to convene and substantiate dialogue between the water and finance communities. It has helped advance several related issues, captured in a flagship report (OECD, 2022). The SDG6 Global Acceleration Framework is a unifying initiative that mobilizes UN agencies, governments, civil society and the private sector around ‘financing’ and four other cross-cutting ‘accelerators’. Further, the UN 2023 Water Conference aims to showcase mechanisms to intensify cooperation and partnerships in relation to financing water security, across different sectors and geographies, paving the way forward for intensified exchange and new partnerships for the coming years towards the SDGs and beyond.

References

- Agence France Presse. 2021. Taiwan’s worst drought in decades deepens chip shortage jitters. *IndustryWeek*, 21 April 2021. www.industryweek.com/supply-chain/article/21161812/taiwans-worst-drought-in-decades-deepens-chip-shortage-jitters.
- AiIB (Asia Infrastructure Investment Bank). 2019. *Asian Water Sector Analysis. A Technical Background for the Asian Infrastructure Investment Bank (AIIB) Water Sector Strategy*, August 2019. www.aiib.org/en/policies-strategies/operational-policies/public-consultation-draft-water-sector-strategy/content/_download/AiIB-Water-Sector-Analysis-Final.pdf.
- Alaerts, G. J. 2019. Financing for water—water for financing: A global review of policy and practice. *Sustainability*, Vol. 11, No. 3, Article 821. doi.org/10.3390/su11030821.
- Andres, L., Thibert, M., Lombana Cordoba, C., Danilenko, A. V., Joseph, G. and Borja-Vega, C. 2019. *Doing More with Less: Smarter Subsidies for Water Supply and Sanitation*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/32277>. License: CC BY 3.0 IGO.
- Brown, C., Boltz, F. and Dominique, K. 2022. *Strategic Investment Pathways for Resilient Water Systems*. OECD Environment Working Papers No. 202. Paris, OECD Publishing. doi.org/10.1787/9afacd7f-en.
- Cardascia, S. 2019. *Financing Water Infrastructure and Landscape Approaches in Asia and the Pacific*. Background Paper. Session 4, Roundtable on Financing Water, 26–27 November 2019, Manila.
- CDP. 2021. *A Wave of Change: The Role of Companies in Building a Water-Secure World*. Global Water Report 2020. London, CDP Worldwide. www.cdp.net/en/research/global-reports/global-water-report-2020.
- Gietema, H. 2022. Financial structuring: Key tool for water sector investments. X. Leflaive, K. Dominique and G. Alaerts (eds.), *Financing Investment in Water Security: Recent Development and Perspectives*. Amsterdam, Elsevier, pp. 55–78.
- GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH). n.d. Transnational water management in the River Niger Basin. GIZ website. www.giz.de/en/worldwide/14938.html. (Accessed in November 2022)
- Goku, A., Trémolet, S., Kolker, J. and Kingdom, B. 2017. *Easing the Transition to Commercial Finance for Sustainable Water and Sanitation*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/27948>. License: CC BY 3.0 IGO.

⁷² The Roundtable on Financing Water is a joint initiative of the OECD, the Netherlands, the World Water Council and the World Bank and provides a global public–private platform for dialogue on financing water security.

- Hutton, G. and Varughese, M. 2016. *The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene*. Washington, DC, World Bank. <https://openknowledge.worldbank.org/handle/10986/23681>. License: CC BY 3.0 IGO.
- Kolker, J. E. and Tremolet, S. C. M. 2016. *Blended Financing for the Expansion of the As-Samra Wastewater Treatment Plant in Jordan*. Case Studies in Blended Finance for Water and Sanitation. Washington, DC, World Bank Group. <http://documents.worldbank.org/curated/en/959621472041167619/Blended-financing-for-the-expansion-of-the-as-samra-wastewater-treatment-plant-in-jordan>.
- Kjellén, M. 2021. *Sustainable Sanitation for Health and Dignity*. UNDP Blog. www.undp.org/blog/sustainable-sanitation-health-and-dignity.
- Lardoux de Pazzis, A. and Muret, A. 2021. *The Role of Intermediaries to Facilitate Water-Related Investment*. OECD Environment Working Papers No. 180. Paris, OECD Publishing. doi.org/10.1787/0d5a7748-en.
- Latin American Water Funds Partnership. n.d. *Metropolitan Water Fund of Monterrey (FAMM)*. www.fondosdeagua.org/en/the-water-funds/water-fund-maps/metropolitan-water-fund-of-monterrey-famm/ (Accessed on 25 July 2022).
- Leflaive, X. and Hjort, M. 2020. *Addressing the Social Consequences of Tariffs for Water Supply and Sanitation*. OECD Environmental Working Papers No. 166. Paris, OECD Publishing. doi.org/10.1787/afede7d6-en.
- Mandel, A., Tiggeloven, T., Lincke, D., Koks, E., Ward, P. and Hinkel, J. 2021. Risks on global financial stability induced by climate change: The case of flood risks. *Climatic Change*, Vol. 166; Article 4. doi.org/10.1007/s10584-021-03092-2.
- Martini, M., 2022. Financing instruments and the ecology of the financial system. X. Leflaive, K. Dominique and G. Alaerts (eds.), *Financing Investment in Water Security Recent Development and Perspectives*. Amsterdam, Elsevier, pp. 79–100.
- MCC (Millennium Challenge Corporation). 2018. *As-Samra Wastewater Treatment Plant Expansion Project*. www.mcc.gov/resources/story/section-jor-ccr-as-samra-project.
- Money, A. 2017. *Projects, Investors, Risks and Returns*. Background Paper for the 2nd Roundtable Meeting on Financing Water, 13 September 2017. [www.oecd.org/env/resources/Money%20\(2017\)%20Projects,%20investors,%20risks%20and%20returns.pdf](http://www.oecd.org/env/resources/Money%20(2017)%20Projects,%20investors,%20risks%20and%20returns.pdf).
- OECD.stat. n.d. *Development. Flows based on individual projects (CRS)*. <https://stats.oecd.org/> (Data extracted on 21 July 2022).
- OECD (Organisation for Economic and Co-operation Development). 2018. *Financing Water: Investing in Sustainable Growth*. Policy Perspectives. OECD Environmental Policy Paper No. 11. Paris, OECD Publishing. doi.org/10.1787/bf67ec4e-en.
- _____. 2019. *Making Blended Finance Work for Water and Sanitation: Unlocking Commercial Finance for SDG 6*. Paris, OECD Publishing. doi.org/10.1787/5efc8950-en.
- _____. 2020a. *Strategic Investment Pathways: The Zambezi Basin Case Study. Water Resources and the Enabling Environment for Investment that Drives Sustainable Development*. [www.oecd.org/water/OECD-\(2020\)-Strategic-investment-pathways-%20Zambezi-case-study.pdf?](http://www.oecd.org/water/OECD-(2020)-Strategic-investment-pathways-%20Zambezi-case-study.pdf?)
- _____. 2020b. *Nature-Based Solutions for Adapting to Water-Related Climate Risks*. OECD Environment Policy Papers No. 21. Paris, OECD Publishing. doi.org/10.1787/2257873d-en.
- _____. 2020c. *Recent Developments on the EU Sustainable Finance Agenda and the Implications for Water*. Background Paper. 6th Roundtable Meeting on Financing Water, 7–8 December. www.oecd.org/water/Session4-Recent-developments-on-the-EU-sustainable-finance-agenda-and-the-implications-for-water.pdf.
- _____. 2021a. *Aligning and Scaling Up Financing Flows for Water Security and Climate Action*. Background Paper for Session 2: Water as a lever for climate action: The investment opportunity, 8th Roundtable Meeting on Financing Water, 23–24 September. www.oecd.org/water/Background-paper-RT-on-Financing-Water-and-Climate-Action-Session-2.pdf.
- _____. 2021b. *Discussion Highlights: 8th Roundtable Meeting on Financing Water, Thematic Meeting on Climate Action, 23–24 September 2021*. www.oecd.org/water/Summary-and-Highlights-Roundtable-on-Climate-Action-23-24-September-2021.pdf.
- _____. 2021c. *Watered Down? Investigating the Financial Materiality of Water-Related Risks in the Financial System*. Background Paper Session 3 of the 8th Roundtable on Financing Water, 23–24 September. www.oecd.org/water/Background-paper-RT-on-Financing-Water-and-Climate-Action-Session-3.pdf.
- _____. 2022. *Financing a Water Secure Future*. OECD Studies on Water. Paris, OECD Publishing. doi.org/10.1787/a2ecb261-en.
- Sadoff, C., Hall, J. W., Grey, D., Aerts, J. C. J. H., Ait-Kadi, M., Brown, C., Cox, A., Dadson, S., Garrick, D., Kelman, J., McCormick, P., Ringler, C., Rosegrant, M., Whittington, D. and Wiberg, D. 2015. *Securing Water, Sustaining Growth*. Report of the GWP/OECD Task Force on Water Security and Sustainable Growth. Oxford, UK, University of Oxford. www.gwp.org/globalassets/global/about-gwp/publications/the-global-dialogue/securing-water-sustaining-growth.pdf.
- Strong, C., Kuzma, S., Vionnet, S. and Reig, P. 2020. *Achieving Abundance: Understanding the Cost of a Sustainable Water Future*. Working Paper. Washington, DC, World Resources Institute (WRI). www.wri.org/research/achieving-abundance-understanding-cost-sustainable-water-future.
- SWA (Sanitation and Water for All). 2020. *Water & Sanitation: How to Make Public Investment Work, A Handbook for Finance Ministries*. New York, SWA. www.sanitationandwaterforall.org/handbook-finance-ministers-how-make-public-investment-work.
- Tett, G. 2019. Climate change could cause a new mortgage default crisis. *Financial Times*, 26 September 2019.
- Trémolet, S., Favero, A., Karres, N., Toledo, M., Kampa, E., Lago, M., Anzaldúa, G., Vidaurre, R., Tarpey, J., Makropoulos, C., Lykou, A., Hanania, S., Rebollo, V. and Anton, B. 2019. *Investing in Nature for Europe Water Security*. London, The Nature Conservancy/Ecologic Institute/ICLEI. www.ecologic.eu/17059.
- UNECE (United Nations Economic Commission for Europe). 2021. *Funding and Financing of Transboundary Water Cooperation and Basin Development*. Geneva, United Nations. <https://unece.org/environment-policy/publications/funding-and-financing-transboundary-water-cooperation-and-basin>.
- United Nations. 2021. *The United Nations World Water Development Report 2021: Valuing Water*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000375724?posInSet=4&queryId=f81e1ff6-68a0-4247-99cb-2812370c933c>.
- water.org. 2021. *People, Progress, Possibility. Annual Report 2021*. https://water.org/documents/231/Water.org_2021_annual_report.pdf.
- WaterEquity. n.d. *What we do*. <https://waterequity.org/what-we-do/>.
- WWF (World Wildlife Fund for Nature) 2020. *Bankable Nature Solutions*. www.panda.org/discover/our_focus/finance/bankable_nature_solutions/.

Chapter 13

Governance: A ‘whole-of-society’ approach

UNDP

Marianne Kjellén and Catherine Wong

With contributions from:

Barbara van Koppen, Labisha Uprety and Patience Mukuyu (IWMI), Ornit Avidar, Barbara Willaarts and Ting Tang (IIASA), Lesha Witmer (WfWP), Nidhi Nagabhatla and Philippe De Lombaerde (UNU-CRIS), Maria Carreño Lindelien (IUCN), Neil Dhot (AquaFed), and Angie Saleh (SWA)



‘Governance’ – beyond ‘government’ – involves not only relevant government departments and agencies, but also the private sector and civil society. This chapter explains how a ‘whole-of-society’ approach – involving civil society as well as the public and private sectors in the joint pursuit of common solutions to complex problems – contributes to building effective partnerships and cooperation. A whole-of-society approach embraces both formal and informal institutions in seeking a generalized agreement across society about policy goals and the means to achieve them. This chapter explores four key elements of this approach, each essential in building a solid path towards achieving the sixth Sustainable Development Goal (SDG 6) and the broader pursuits of water, food and climate security.

Trust and hope are fundamental building blocks for social cohesion and security. Trust is the ‘lubricant’ needed to ‘grease the wheels’ of the economy, and hope can be the mortar that holds societies together.

Meaningful participation and inclusive stakeholder engagement take time but stand to generate trust and hope. Policy and project processes need to adapt to the concerns and potential contribution of different groups. Yet, openness, time and resources invested in the co-creation of a project, a policy or a whole-of-society agreement on an issue will greatly accelerate the desired behaviour change and cross-societal adherence to agreed pursuits.

Strategic integration of cross-sectoral and stakeholder concerns involves developing norms, standards and allocation methods that affect water use efficiency and the protection of resources across sectors. Individuals and organizations take decisions affecting the use and protection of water all the time. Strategic decision-making about policies and regulation sets framework conditions that give direction to these every-day decisions. Strategic integration and policy cohesion stand to make integrated water resources management (IWRM) more effective.

Good governance, where the ‘good’ includes qualities like transparency, accountability, professionalism and the capacity of public institutions, along with values of fairness, justice and the respect for human rights; and where ‘governance’ implies a recognition that it is not only governments but society as a whole that makes development happen.

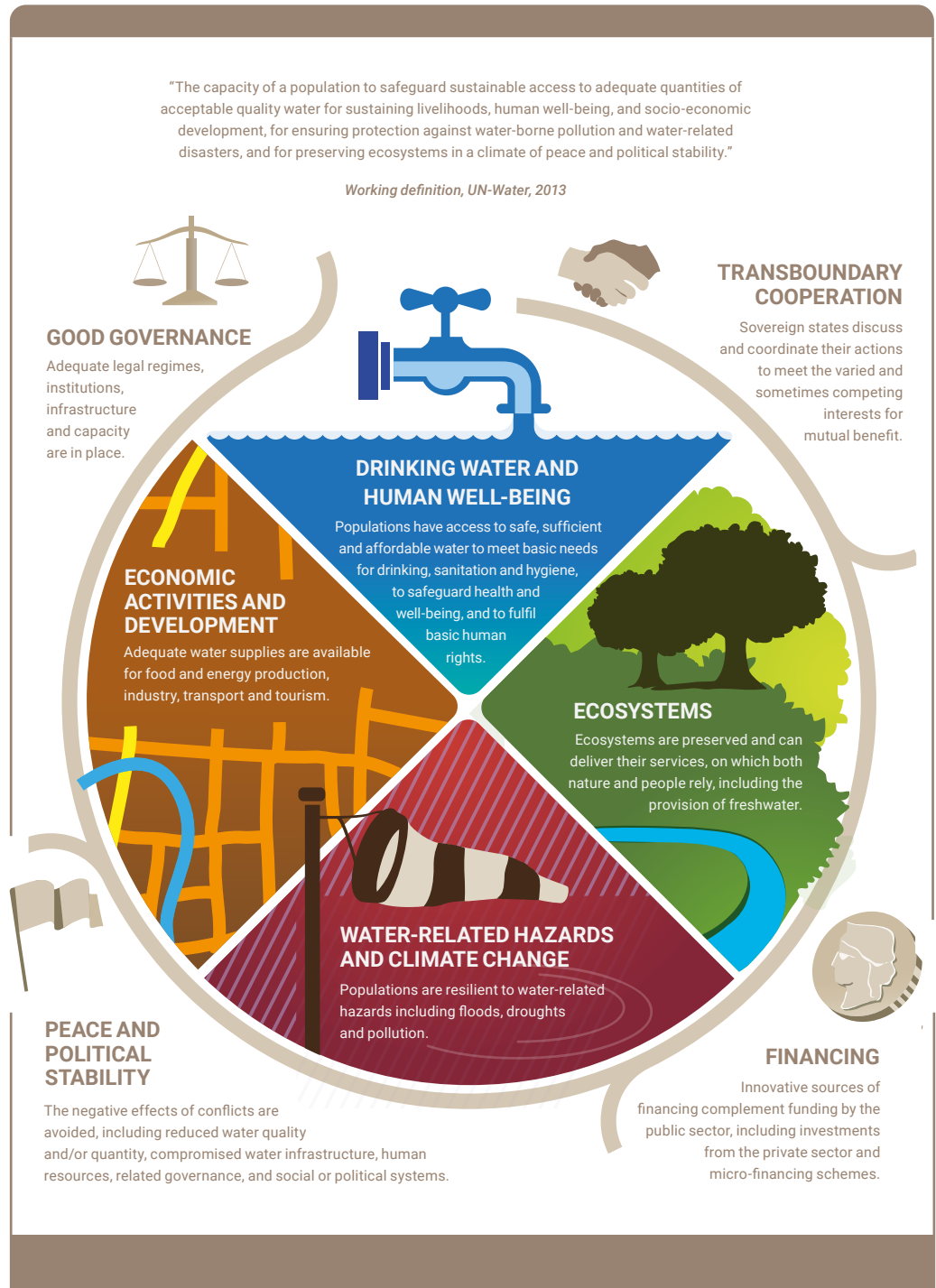
13.1 Enhanced cooperation over water, food and climate security

Cooperation and partnerships can manifest as loosely formed networks or people simply working together to address a joint need or goal. These are the motions through which societies build water security, food security, and more recently also climate security, for its populations to thrive. Governments build legitimacy by ensuring conditions that are conducive for people to meet their basic needs like food and water security (Boccaletti, 2021) and broader aspirations in life. Inversely, interfering with people’s livelihood strategies undermines government legitimacy (Tripp, 1989). Over the past few years, uncertainty has unsettled people’s lives and eroded trust in unprecedented ways: people who feel insecure trust others less and are more prone to politically extreme positions (UNDP, 2022).

The provisioning systems that cater for our daily needs are vulnerable to the destructive forces of conflict, distrust and hopelessness. This section highlights the cooperation required to meet the daily needs of humans.

Water security can be understood as *“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”* (UN-Water, 2013a, p. 1). As suggested in Figure 13.1, water security also involves good governance, financing and transboundary cooperation.

Figure 13.1
What is water security?



Source: UN-Water (2013b).

Food security, as defined by the 1996 World Food Summit, exists “...when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences...” (FAO, 2006, p. 1). It relates to food availability, access, utilization, and stability. War, inequality and discrimination obstruct people’s livelihoods and erode their just ‘entitlement’ to food. Where people are destitute, market forces may be involved in pulling food and other necessities out of people’s reach, even to the point of starvation (Sen, 1981).

On top of pre-existing risks to water and food security, the climate crisis is having cascading effects on the stability and functioning of the natural environment, the economy and society. Climate change can act as a risk multiplier, exacerbating underlying vulnerabilities and compounding existing grievances (DPPA, n.d.).

• • •
A whole-of-society approach embraces both formal and informal institutions in seeking a generalized agreement across society about policy goals and the means to achieve them

Climate change has already had adverse impacts on water and food provisioning, and roughly half of the world's population experience severe water scarcity for at least some part of the year, due to both climatic and non-climatic drivers (IPCC, 2022). The report *States of Fragility* by the Organisation for the Economic Co-operation and Development (OECD, 2022) finds the world to be grappling with a series of crises. A quarter of the world's population – three quarters of people living in extreme poverty – encounter themselves in fragile contexts.

Peaceful cooperation safeguards water, food and climate security. Water cooperation and diplomacy involve contacts and cooperation between water users and other groups of society (e.g. journalists) as well as multilateral treaty-making and institution-building (Yeganeh and Bakhshandeh, 2022; Klimes et al., 2019). Beyond fortifying integrity and trust, water cooperation also involves the sharing of benefits from water allocation, use and protection.

In water resources management, explicit benefit-sharing to enhance the productivity of shared water resources has been advocated as an alternative to water allocation by water volume (Sadoff and Grey, 2002). Cooperatively exploring options among a variety of benefit streams from the shared use of water resources is also a key strategy for water security (IUCN, 2020). Goods and services (benefits) include electricity from hydropower, disaster risk reduction from flood regulation, increased land productivity from irrigated agriculture, as well as improved access to markets, goods transport and human interaction from navigation across rivers and lakes. Strosser et al. (2017) also point to non-economic benefits like improved environmental stewardship, regional integration and political gains.

Broadly, benefit-sharing can help optimize resource use across economic sectors, stakeholders and countries (UNECE, 2015). Even without formal partnership agreements, humans have traded goods and services during millennia. Trading goods for which water is used in its production is referred to as 'virtual water' trade (Hoekstra, 2003).

Early applications of benefit-sharing frameworks were to resolve the rising competition for water between urban and rural, domestic, industrial, and agricultural uses (Garrick et al., 2019). Moreover, rather than between different sectors or user groups, one may also delve into benefit-sharing within communities. The sharing of benefits would at this level closely relate to the division of labour and control over resources between genders and different social groups. Analysing such practices from a benefit-sharing perspective could help devise alternative divisions of control and labour with potentially more equitable outcomes.

Benefit-sharing, by design (where planned as part of water resources management) or by default (where trade moves virtual water across basins and continents) stands to greatly enhance allocation efficiency. A broader discussion across society can also engage in a meaningful discussion regarding the fairness of the outcomes of benefit-sharing and other development policies.

13.2 Who's at the table? On meaningful participation

Who participates (or not), and how, makes all the difference to the outcomes of any partnership or cooperative arrangement (United Nations, 2021). This section highlights efforts to broaden stakeholder participation and the methodologies for meaningful inclusion, mostly at the level of the United Nations, but also at the more critical regional or local level.

The United Nations has recognized – explicitly since the first United Nations Conference on Environment and Development (UNCED), the Earth Summit, in 1992 – that achieving sustainable development requires active participation of all sectors of society. Nine 'Major Groups'⁷³

⁷³ The nine 'Major Groups' comprise: Women, children & youth; indigenous peoples; non-governmental organizations; local authorities; workers and trade unions; business & industry; scientific & technological community; and farmers (Sustainable Development Goals Knowledge Platform, n.d.).

• • •
With recognition of the roles that women fulfil as leaders and change-makers in water governance, women and men can foster more sustainable resource management partnerships

of stakeholders were formalized in the Agenda 21, and subsequently expanded to other stakeholders in the deliberations of the High-Level Political Forum (Sustainable Development Goals Knowledge Platform, n.d.).

Bodies like the United Nations Permanent Forum on Indigenous Issues (UNPFII) provide high-level expert advice to the Economic and Social Council related to the economic and social development, culture, environment, education, health and human rights of indigenous communities (UNDESA, n.d.). The Special Rapporteur on the human rights to safe drinking water and sanitation has also strongly endorsed compliance with the recommendations of the UNPFII, in particular regarding indigenous peoples' human rights to safe drinking water and sanitation (Arrojo Agudo, 2022).

Seeing accountability as a cornerstone of the human rights framework and essential for the implementation of the 2030 Agenda, the Sanitation and Water for All partnership has created a Mutual Accountability Mechanism. This tool encourages partners to register commitments that are grounded in global and national plans and to hold each other accountable on their specific, measurable and time-bound actions on achieving SDG 6. The platform also provides an opportunity to collaborate, discuss, learn, reflect and share experiences. In mid-2022, there were 197 government commitments, supported by 89 commitments from civil society organizations, 33 from research and learning, 18 from the private sector, and 59 from external support agencies (SWA, n.d.).

At the local level, on-the-ground research by the International Water Management Institute (IWMI) in the Saptari district of Nepal illustrates the effects of (the lack of) participation and inclusion on the distribution of resources. In this case, the deployment of government-subsidized solar-powered irrigation pumps ignored marginalized and women farmers, who consequently had lower access to subsidies (Shrestha and Uprety, 2021). All partnerships importantly need to recognize and manage gender dynamics in order for outcomes to be effective and equitable.

Despite the acknowledged essential role of women in peacebuilding, conflict management and security (see e.g. landmark resolution 1325 by Security Council in 2000, and subsequent resolutions; UN Women, n.d.),⁷⁴ women's role of women in water diplomacy is still underestimated (GWP-Med/GWH, 2020). With recognition of the roles that women fulfil as leaders and change-makers in water governance, women and men can foster more sustainable resource management partnerships (Aguilar Rojas and Iza, 2011; Fauconnier et al., 2018). Initiated by the Stockholm International Water Institute (SIWI) in 2017, 'Women in Water Diplomacy' networks are getting increased visibility (see e.g. the Global Network Forum held in conjunction with the World Water Week, 2022⁷⁵).

The cruciality of cultural sensitivity and local knowledge (Chambers, 1997; Crewe and Harrison, 1998; Banerjee and Duflo, 2011) is recognized in mainstream development work, but where participatory processes go wrong, they can also lead to an unjust and illegitimate exercise of power (Cooke and Kothari, 2001). Whereas multi-stakeholder engagement is lauded as promoting effective governance – enhancing transparency and accountability (Bäckstrand, 2006; Munyua, 2016) – critics suggest that it may produce multiple and sometimes contradicting agendas, resulting in unnecessary confusion and complexity (Nunan et al., 2016).

In sum, the challenge of participation resides in the 'how'. Meaningful participation contributes greatly to partnerships around the joint pursuit of sustainable development. Ill-conceived participatory exercises, however, may at best be a waste of people's time. Development partners need to be serious, honest and careful about participation.

⁷⁴ For example, see the landmark resolution 1325 by Security Council in 2000, and subsequent resolutions 1820 (2008), 1888 (2009), 1889 (2009), 1960 (2010), 2106 (2013), 2122 (2013), 2242 (2015), 2467 (2019), and 2493 (2019) (UN Women, n.d.).

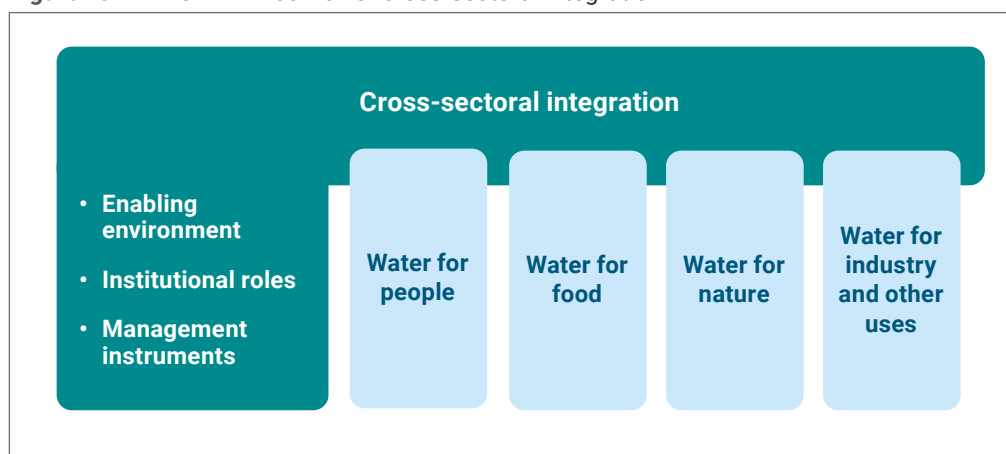
⁷⁵ For more information about this event, please see: <https://worldwaterweek.org/event/10314-a-rising-tide-shared-vision-for-women-in-water-diplomacy>.

13.3 Strategic integration, cross-sectoral coordination and multi-use water systems

This section delves into the need for strengthened horizontal coordination to avoid that a well-intended measure to address one issue becomes detrimental to (or creates) another, as for example in the case of climate change ‘maladaptation’ (Schipper, 2020). In this respect, UN-Water (2016) has examined how approaching different SDG targets may lead to synergies, but also to counterproductive outcomes.

As agreed to by all countries in the 2030 Sustainable Development Agenda (United Nations, 2015), IWRM remains a primary framework for cross-sectoral coordination to be applied at all levels (SDG Target 6.5). IWRM is as a process that promotes the coordinated development and management of water, land and related resources. Graphically, IWRM can be represented as a ‘comb’ (Figure 13.2), pointing to the importance of the enabling environment, the institutional framework and management instruments *across* the different uses in water-dependent sectors.

Figure 13.2 The IWRM ‘comb’ for cross-sectoral integration



Source: GWP (2000, fig. 3, p. 29).

Whereas the global call for IWRM implementation was formalized in 1992 (UNCED, 1992), nearly half of the world’s countries still report ‘low’ or ‘medium-low’ levels of IWRM implementation almost 30 years later (UNEP, 2021). Overcoming the institutional fragmentation around the different uses of water remains elusive – though the urgency of the climate crisis may potentially be stimulating progress (UNDP/SIWI/UNICEF, forthcoming).

One way in which cross-sectoral considerations get incorporated in practice is through multi-purpose or multi-use infrastructure. Traditional systems have fared well in this regard (see Section 9.3). For example, the *wewa-ellangava* or tank cascade system was an ancient water harvesting technique traditionally used in dry zones of Sri Lanka to provide water for both agricultural and domestic use. Abandoned during the colonial period, these multi-purpose systems have since been put to use again, some two millennia after their construction (Abeywardana et al., 2018). Local partnerships are important in this context, and household infrastructure investments for self-supply are often in need of greater recognition and support from governments (Sutton and Butterworth, 2021).

Community-level partnerships have been found to better respond to people’s domestic and productive water needs (Chapter 4). Such multiple-use water services have been observed in Africa, Asia and Latin America (Van Koppen et al., 2014), noting that every woman or man, smallholder or pastoralist, is also a domestic water user. Also, where farmers autonomously develop irrigation and have an entrepreneurial mindset to invest their own resources, they can innovate to improve productivity and reach new markets (Izzi et al., 2021). Moving from a single use to a multi-purpose system may only require low incremental costs but stands to generate high incremental benefits (Winrock International, 2007). For example, increasing service levels beyond domestic uses enables productive uses near people’s homes and promotes nutrition and food security (Vinca et al., 2021; Willaarts et al., 2021).

13.4 Regulation and public–private partnerships

• • •
**Community-level
partnerships have
been found to
better respond to
people’s domestic
and productive
water needs**

In relation to water and sanitation services provision, the role of regulation has become more prominent with the separation of roles induced by the privatization and remunicipalization of services (Gerlach and Franceys, 2010; Kjellén, 2006). Mandates and roles relating to services provision and to infrastructure asset ownership and regulation are increasingly separated and carried out by different actors (PPP-LRC, 2020; CPI, 2022). The partner constellations vary, but if the formal private sector plays a key role they are often referred to as public–private partnerships (PPPs).

Public authorities, acting on behalf of the state, in principle determine whether and how to bring private operators in to deliver water and sanitation services. The authorities retain their sovereign duties for ensuring the progressive fulfilment of the human rights to safe drinking water and sanitation. Financiers may also induce governments to commercialize or delegate water supply services to the private sector (Kjellén, 2006). *“Simultaneously, the private sector at large has a responsibility in the fulfilment of the rights, and can also violate the rights through impacts from industrial activities”* (Heller et al., 2020, p. 13). In the report of the Special Rapporteur on the topic of human rights and the privatization of water and sanitation services (UNGA, 2020), many recommendations were given to states, relating to transparency, accountability and enforcement mechanisms, as well as the normative contents of legislation and contract obligations.

To be successful, PPPs need to build upon cooperation that is beneficial to all stakeholders; they need to serve the public interest while providing a decent return to the service provider. Both private sector and public sector operations are more effective in countries with clear, predictable and stable legislative frameworks, as these allow long-term investment to be supported with confidence and receive a reasonable return (BEIS, 2022). Conducive regulatory arrangements are, however, not always in place. In the case of the New Cairo Wastewater Treatment Plant (Box 13.1), a central PPP unit was created to support project delivery (Salvador et al., 2016).

Further, there is an important difference between situations where private services providers are involved ‘by design’ and situation where involvement happens informally ‘by default’ as a community response to the lack of formal services provision (Kjellén, 2006; Kjellén and McGranahan, 2006). Research suggests that pro-poor regulatory outcomes have been constrained by a limited understanding of alternative providers (Gerlach and Franceys, 2010). The different prices charged by informal water vendors (by necessity charging the full cost of the service) and public providers (at times even delivering services below the cost of water production, typically to the wealthier segments of the population) explain why the poor pay more for water (Collignon and Vézina, 2000; UNDP, 2006). Furthermore, poorly designed subsidies can generate perverse incentives for service providers (Andres et al., 2019). Addressing such inequalities and perverse subsidies would require a whole-of-society approach to challenge the business models and interests vested in maintaining the status quo.

A World Bank review of utility reforms in Africa (Heymans et al., 2016) found several cases with good water services delivered across the population in large, poor and rapidly growing cities in arid climates, like Ouagadougou and Niamey, as well as in countries with low governance effectiveness. Exploring what *“allowed or enabled”* (p. xiii) the turnaround of underperforming utilities, it was found in all five cases studied that progress *“started with improvements in the political economy of the sector and utility serving the city”* (p. xiii). Both local and international partnerships are of importance for enabling these game changers: whereas the political and economic conditions and commitments setting these cities on the path to reform cannot be created by outsiders, external support agencies have a critical role to play with financing and technical assistance.

13.5 Good governance: a whole-of-society partnership approach

Box 13.1 Public–private partnership on New Cairo Wastewater Treatment Plant

Establishing good governance arrangements was essential to the public–private partnership (PPP) that created the award-winning New Cairo Wastewater Treatment Plant in Egypt. This plant has the capacity to serve over one million residents and reuses wastewater to increase drinking water supply, reduce costs and improve environmental quality.

When the project was initiated, Egypt did not have a specific law to regulate PPPs, so the Ministry of Finance decided to establish the PPP Central Unit to promote the involvement of private companies (Salvador et al., 2016). This Unit oversees the study, application, implementation and coordination with Ministries to ensure that project proposals are supported by sound analysis and necessary budget approvals, and that partners are selected through fair competition (PPP-LRC, 2021).

Contributed by Aquafed.

Good governance embraces a range of principles, like transparency, the rule of law, respect for human rights, and commitment to equality, peace and security. It involves a range of institutions, management instruments and approaches for their implementation (WWAP, 2019; United Nations, 2021; OECD, 2015). The governance framework relates to the full chain of principles and instruments through to the actual policy implementation (Pretorius, 2003; Ménard et al., 2018). Indeed, the elements of a governance framework are all interrelated, and are ideally formed ‘in partnership’ with the whole population.

The whole-of-society approach has been proposed to foster meaningful participation for the 2030 Agenda (Cázarez-Grageda, 2018), and the *OECD Public Integrity Handbook* (OECD, 2020) asserts that a whole-of-society approach enables individuals, civil society and companies to interact with public officials, play a critical role in setting the public agenda and influence public decisions.

In a similar manner, water pollution may be more effectively addressed by way of a common understanding of the need for improved water quality. The global review of Environmental Rule of Law (UNEP, 2019) noted that, too often, implementation of environment laws falls far short of what is required to address environmental challenges. To address this shortcoming, participatory monitoring and public disclosure of information can help actors across society and the economy to understand their own role in avoiding pollution and environmental degradation. With a whole-of-society agreement, an industry may become more motivated to invest in clean technology. A broad-based understanding and motivation across society, underpinned by the necessary regulation and a credible threat of enforcement, can help further progress towards cleaner and more sustainable modes of production and consumption.

In 2017, the United Nations Environment Assembly decided to address water pollution to protect and restore water-related ecosystems. This spurred the formation of the World Water Quality Alliance (UNEP, n.d.) as an open community of practice with several workstreams currently under implementation. Among the workstreams, the Social Engagement Platform⁷⁶ seeks to promote transparent, multi-stakeholder processes for water management to bridge the gap between national-level policy, and governance and implementation on the ground.

Developing policy goals in a participatory manner – even if the process takes time – accelerates implementation. This is because an inclusive policy process helps galvanize the necessary whole-of-society agreement and support for the inclusively formulated goals, which then greatly aids the policy implementation and realization of development objectives.

If you want to go fast, go alone.

If you want to go far, go together.

⁷⁶ For more information, please see: www.unep.org/explore-topics/water/what-we-do/world-water-quality-alliance-wwqa-partnership-effort/social.

References

- Abyewardana, N., Bebermeier, W. and Schütt, B. 2018. Ancient water management and governance in the dry zone of Sri Lanka until abandonment, and the influence of colonial politics during reclamation. *Water*, Vol. 10, No. 12, Article 1746. doi.org/10.3390/w10121746.
- Aguilar Rojas, G. and Iza, A. 2011. *Governance of Shared Waters: Legal and Institutional Issues*. Gland, Switzerland/Bonn, Germany, International Union for Conservation of Nature (IUCN)/IUCN Environmental Law Centre. portals.iucn.org/library/sites/library/files/documents/EPLP-058-rev-En.pdf.
- Andres, L. A., Thibert, M., Lombana Cordoba, C., Danilenko, A. V., Joseph, G. and Borja-Vega, C. 2019. *Doing More with Less: Smarter Subsidies for Water Supply and Sanitation*. Washington, DC, World Bank. openknowledge.worldbank.org/handle/10986/32277.
- Arrojo Agudo, P. 2022. *Human Rights to Safe Drinking Water and Sanitation of Indigenous Peoples: State of Affairs and Lessons from Ancestral Cultures*. Report of the Special Rapporteur on the human rights to safe drinking water and sanitation. A/HRC/51/24. www.ohchr.org/sites/default/files/documents/issues/water/2022-11-04/A-HRC-51-24-Friendly-version-EN.pdf.
- Bäckstrand, K. 2006. Multi-stakeholder partnerships for sustainable development: Rethinking legitimacy, accountability and effectiveness. *European Environment*, Vol. 16, No. 5, pp. 290–306. doi.org/10.1002/eet.425.
- Banerjee, A. V. and Duflo, E. 2011. *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York, PublicAffairs.
- BEIS (Department for Business, Energy and Industrial Strategy). 2022. *Economic Regulation Policy Paper*. Government of the United Kingdom, Department for Business, Energy and Industrial Strategy. assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1051261/economic-regulation-policy-paper.pdf.
- Boccaletti, G. 2021. *Water: A Biography*. New York, Pantheon Books.
- Cáez-Grageda, K. 2018. *The Whole of Society Approach: Levels of Engagement and Meaningful Participation of Different Stakeholders in the Review Process of the 2030 Agenda*. Bonn, Germany, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). www.partners-for-review.de/wp-content/uploads/2018/11/Whole-of-Society-P4R-Discussion-Paper-Oct.-2018.pdf.
- Chambers, R. 1997. *Whose Reality Counts? Putting the First Last*. London, Intermediate Technology Publications.
- Collignon, B. and Vézina, M. 2000. *Independent Water and Sanitation Providers in African Cities: Full Report of a Ten-Country Study*. Washington, DC, World Bank. documents1.worldbank.org/curated/en/327341468280743783/pdf/multi0page.pdf.
- Cooke, B. and Kothari, U. (eds.). 2001. *Participation. The New Tyranny?* London, Zed Books.
- CPI (Centre for Public Impact). 2022. *Unlocking Public Service Improvement through more Collaborative Regulatory Practice*. Insight paper. www.centreforpublicimpact.org/assets/documents/GMCA_Insight_Paper_Regulation.pdf.
- Crewe, E. and Harrison, E. 1998. *Whose Development? An Ethnography of Aid*. London, Zed Books.
- DPPA (Department of Political and Peacebuilding Affairs). n.d. *Addressing the Impact of Climate Change on Peace and Security*. DPPA website. dppa.un.org/en/climate-peace-security.
- FAO (Food and Agriculture Organization of the United Nations). 2006. *Food Security*. Policy Brief. www.fao.org/fileadmin/templates/faotaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.
- Fauconnier, I., Jenniskens, A., Perry, P., Fanaian, S., Sen, S., Sinha, V. and Witmer, L. 2018. *Women as Change-Makers in the Governance of Shared Waters*. Gland, Switzerland, International Union for Conservation of Nature (IUCN). portals.iucn.org/library/sites/library/files/documents/2018-036-En.pdf.
- FuturENVIRO. n.d. Two Spanish case studies ranked in the UN Top 20 for public-private partnerships and post-COVID reconstruction. FuturENVIRO website.
- Garrick, D., De Stefano, L., Turley, L., Jorgensen, I., Aguilar-Barajas, I., Schreiner, B., De Souza Leão, R., O'Donnell, E. and Horne, A. 2019. *Dividing the Water, Sharing the Benefits: Lessons from Rural-to-Urban Water Reallocation*. Washington, DC, World Bank Group. documents1.worldbank.org/curated/en/383181561530825618/pdf/Dividing-the-Water-Sharing-the-Benefits-Lessons-from-Rural-to-Urban-Water-Reallocation.pdf.
- Gerlach, E. and Franceys, R. 2010. Regulating water services for all in developing economies. *World Development*, Vol. 38, No. 9, pp. 1229–1240. doi.org/10.1016/j.worlddev.2010.02.006.
- GWP (Global Water Partnership). 2000. *Integrated Water Resources Management*. TAC Background Papers No. 4. Stockholm, GWP. www.gwp.org/globalassets/global/toolbox/publications/background-papers/04-integrated-water-resources-management-2000-english.pdf.
- GWP-Med/GWH (Global Water Partnership-Mediterranean/Geneva Water Hub). 2020. *Empowering Women in Water Diplomacy in the Middle East and North Africa: A Comparative Study of Egypt, Jordan, Lebanon, Morocco and Palestine*. www.gwp.org/globalassets/global/gwp-med-files/list-of-programmes/women-in-water-diplomacy/www-comparative-study.pdf.
- Heller, L., De Albuquerque, C., Roaf, V. and Jiménez, A. 2020. Overview of 12 years of Special Rapporteurs on the human rights to water and sanitation: Looking forward to future challenges. *Water*, Vol 12, No. 9, Article 2598. doi.org/10.3390/w12092598.
- Heymans, C., Eberhard, R., Ehrhardt, D. and Riley, S. 2016. *Providing Water to Poor People in African Cities Effectively: Lessons from Utility Reforms*. Washington, DC, World Bank. openknowledge.worldbank.org/handle/10986/25115?locale-attribute=en.
- Hoekstra, A. Y. 2003. *Virtual Water Trade: Proceedings of the International Expert Meeting on Virtual Water Trade*. Research Report Series No. 12. Delft, The Netherlands, Institute for Water Education (IHE DELFT). www.waterfootprint.org/media/downloads/Report12.pdf.
- IPCC (Intergovernmental Panel on Climate Change). 2022. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policymakers. Cambridge, UK/New York, Cambridge University Press. www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.
- IUCN (International Union for Conservation of Nature and Natural Resources). 2020. *Sharing the Benefits from River Basin Management: From Theory to Practice*. Gland, Switzerland, IUCN. www.iucn.org/sites/default/files/content/documents/2021/iucn_benefit_sharing_river_basin_management_final_march2021_vs2.pdf.
- Izzi, G., Denison, J. and Veldwisch, G. J. (eds.). 2021. *The Farmer-Led Irrigation Development Guide: A What, Why and How-To for Intervention Design*. Washington, DC, World Bank. pubdocs.worldbank.org/en/751751616427201865/FLID-Guide-March-2021-Final.pdf.

- Kjellén, M. 2006. *From Public Pipes to Private Hands: Water Access and Distribution in Dar es Salaam, Tanzania*. PhD Thesis. Stockholm, Stockholm University, Department of Human Geography.
- Kjellén, M. and McGranahan, G. 2006. *Informal Water Vendors and the Urban Poor*. Human Settlements Discussion Paper Series. London, International Institute for Environment and Development (IIED). www.iied.org/sites/default/files/pdfs/migrate/10529IIED.pdf.
- Klimes, M., Michel, D., Yaari, E. and Restiani, P. 2019. Water diplomacy: The intersect of science, policy and practice. *Journal of Hydrology*, Vol. 575, pp. 1362–1370. doi.org/10.1016/j.jhydrol.2019.02.049.
- Ménard, C., Jimenez, A. & Tropp, H. 2018. Addressing the policy-implementation gaps in water services: The key role of meso-institutions. *Water International*, Vol. 43, pp. 13–33. doi.org/10.1080/02508060.2017.1405696.
- Munyua, A. W. 2016. Exploring the multi-stakeholder experience in Kenya. *Journal of Cyber Policy*, Vol. 1, No. 2, pp. 206–221. doi.org/10.1080/23738871.2016.1249898.
- Nunan, F., Kairu, A., Kairo, J. G. and Wanjiru, C. 2016. *Achieving Multi-Level, Integrated Governance of Coastal Ecosystems in Kenya*. Coastal Ecosystem Services in East Africa (CESEA) Research Brief 1. Birmingham, UK, University of Birmingham, International Development Department. assets.publishing.service.gov.uk/media/5ad76b5a40f0b617dca7160c/MLG_coastal_brief_Kenya_Nov_2016_final_0_0.pdf.
- OECD (Organisation for Economic Co-operation and Development). 2015. *OECD Principles on Water Governance*. www.oecd.org/cfe/regionaldevelopment/OECD-Principles-on-Water-Governance-en.pdf.
- _____. 2020. *OECD Public Integrity Handbook*. Paris, OECD Publishing. doi.org/10.1787/ac8ed8e8-en.
- _____. 2022. *States of Fragility 2022*. Paris, OECD Publishing. doi.org/10.1787/c7fedf5e-en.
- PPP-LRC (Public-Private Partnership Legal Resource Center). 2020. *Water Regulation: Separate Regulatory Body with Licensing Regime*. PPP-LRC website.
- _____. 2021. *PPP Unit Egypt*. PPP-LRC website. ppp.worldbank.org/public-private-partnership/library/ppp-unit-egypt.
- Pretorius, L. 2003. Six contributions to understanding ‘gaps between policy and implementation’: An overview and comments. *Politeia*, Vol. 22, No. 1, pp. 6–21. journals.co.za/doi/pdf/10.10520/EJC88083.
- Sadoff, C. W. and Grey, D. 2002. Beyond the river: The benefits of cooperation on international rivers. *Water Policy*, Vol. 4, No. 5, pp. 389–403. doi.org/10.1016/S1366-7017(02)00035-1.
- Salvador, J., Trillas, F., Ricart, J. E. & Rodríguez Planas, M. 2016. *New Cairo Wastewater Treatment Plant (Egypt)*. IESE Business School of Navarra/PPP for Cities. unece.org/fileadmin/DAM/ceci/documents/2016/PPP/PPP_for_Cities-Barcelona/Case_study_AQUALIA_WW_Egypt.pdf.
- Schipper, E. L. F. 2020. Maladaptation: When adaptation to climate change goes very wrong. *One Earth*, Vol. 3, No. 4, pp. 409–414. doi.org/10.1016/j.oneear.2020.09.014.
- Sen, A. 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford, UK, Clarendon Press.
- Shrestha, S. and Uprety, L. 2021. *Solar Irrigation in Nepal: A Situation Analysis Report*. Colombo, International Water Management Institute (IWMI). solar.iwmi.org/wp-content/uploads/sites/43/2021/08/NEPAL-SITUATION-ANALYSIS-REPORT.pdf.
- Strosser, P., De Paoli, G. and Efimova, T. 2017. *The Potential Benefits of Transboundary Co-operation in Georgia and Azerbaijan: Kura River Basin*. OECD Environment Working Paper No 114. Paris, OECD Publishing. doi.org/10.1787/a14da8ec-en.
- Sustainable Development Goals Knowledge Platform. n.d. *Major Groups and Other Stakeholders (mGoS)*. Sustainable Development Goals Knowledge Platform website. sustainabledevelopment.un.org/mgos.
- Sutton, S. and Butterworth, J. 2021. *Self-Supply: Filling the Gaps in Public Water Supply Provision*. Rugby, UK, Practical Action Publishing.
- SWA (Sanitation and Water for All). n.d. *Mutual Accountability Mechanism*. Sanitation and Water for All website. www.sanitationandwaterforall.org/about/our-work/mutual-accountability-mechanism.
- Tripp, A. M. 1989. *Defending the Right to Subsist: The State vs. the Urban Informal Economy in Tanzania*. Wider Working Papers. Helsinki, World Institute for Development Economics Research (UNU-WIDER). www.wider.unu.edu/sites/default/files/WP59.pdf.
- UN-Water. 2013a. *Water Security & the Global Water Agenda*. UN-Water Analytical Brief. Hamilton, Ont., Institute for Water, Environment and Health (UNU-INWEH). www.unwater.org/sites/default/files/app/uploads/2017/05/analytical_brief_oct2013_web.pdf.
- _____. 2013b. *What is Water Security? Infographic*. UN-WATER website. www.unwater.org/publications/what-water-security-infographic.
- _____. 2016. *Water and Sanitation Interlinkages across the 2030 Agenda for Sustainable Development*. Geneva, UN-Water. www.unwater.org/sites/default/files/app/uploads/2016/08/Water-and-Sanitation-Interlinkages.pdf.
- UN Women. n.d. *Global Norms and Standards: Peace and Security*. UN Women webpage. www.unwomen.org/en/what-we-do/peace-and-security/global-norms-and-standards#_WPS_resolutions.
- UNCED (United Nations Conference on Environment and Development). 1992. *Report of the United Nations Conference on Environment and Development*. Rio de Janeiro, Brazil, 3–14 June 1992. www.un.org/esa/dsd/agenda21/Agenda%2021.pdf.
- UNDESA (United Nations Department of Economic and Social Affairs). n.d. *Indigenous Peoples – Permanent Forum*. UNDESA website. www.un.org/development/desa/indigenouspeoples/unpfii-sessions-2.html.
- UNDP (United Nations Development Programme). 2006. *Human Development Report 2006 – Beyond Scarcity: Power, Poverty and the Global Water Crisis*. New York, UNDP. <https://hdr.undp.org/content/human-development-report-2006>.
- _____. 2022. *Human Development Report 2021/2022 – Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World*. New York, UNDP. www.undp.org/egypt/publications/human-development-report-2021-22-uncertain-times-unsettled-lives-shaping-our-future-transforming-world.
- UNDP/SIWI/UNICEF (United Nations Development Programme/Stockholm International Water Institute/United Nations Children’s Fund). Forthcoming. *Cooperation Opportunities for Improved Integration Across SDG6*.
- UNECE (United Nations Economic Commission for Europe). 2015. *Policy Guidance Note on the Benefits of Transboundary Water Cooperation: Identification, Assessment and Communication*. Geneva, UNECE. unece.org/fileadmin/DAM/env/water/publications/WAT_Benefits_of_Transboundary_Cooperation/ECE_MP.WAT_47_PolicyGuidanceNote_BenefitsCooperation_1522750_E_pdf_web.pdf.
- UNEP (United Nations Environmental Programme). 2019. *Environmental Rule of Law: First Global Report*. Nairobi, UNEP. www.unep.org/resources/assessment/environmental-rule-law-first-global-report.
- _____. 2021. *Progress on Integrated Water Resources Management: Tracking SDG 6 Series – Global Indicator 6.5.1 Updates and Acceleration Needs*. Nairobi, UNEP. www.unwater.org/publications/progress-on-integrated-water-resources-management-651-2021-update/.

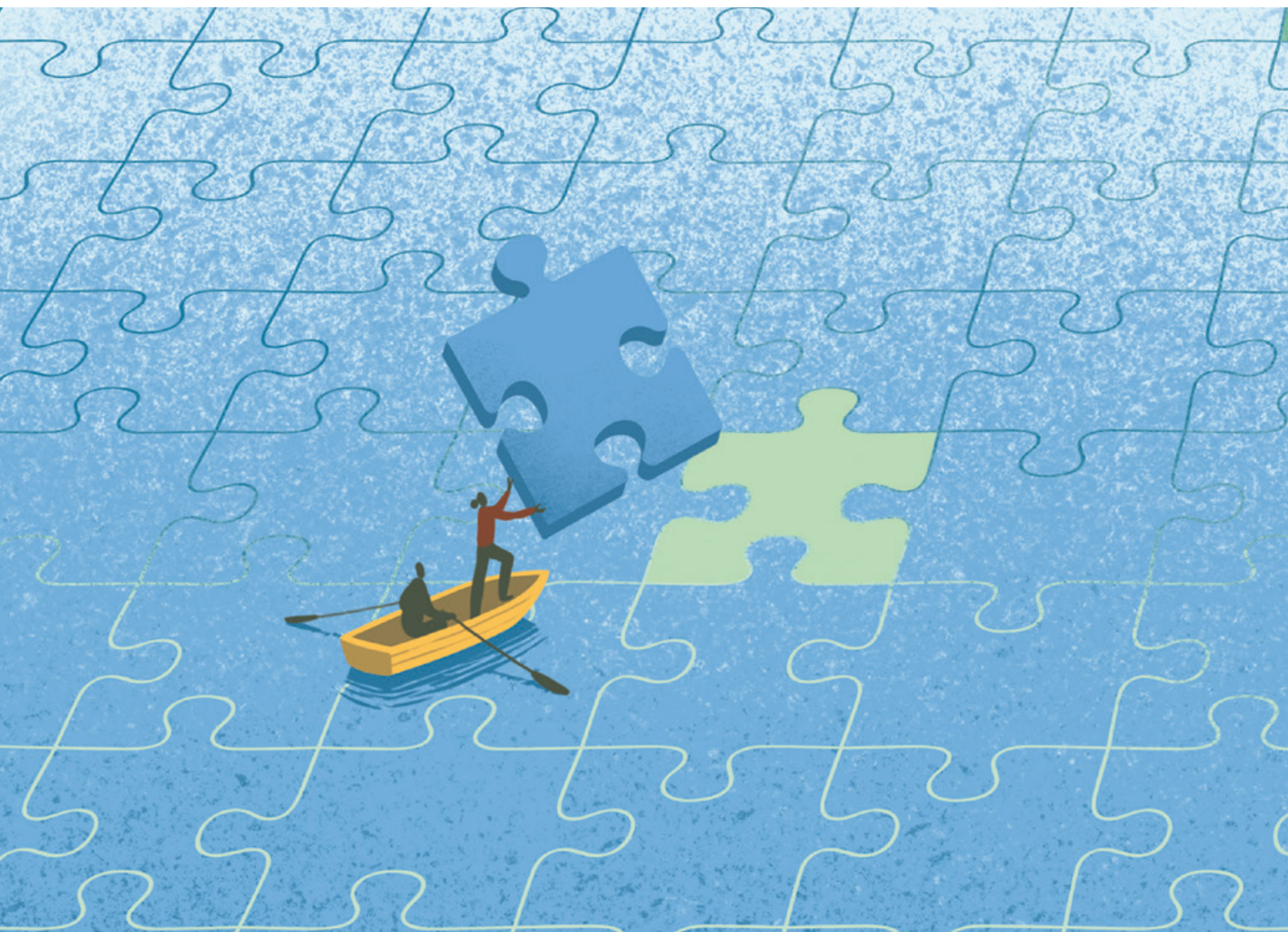
- _____. n.d. *World Water Quality Alliance (WWQA) – A Partnership Effort*. UNEP website. www.unep.org/explore-topics/water/what-we-do/improving-and-assessing-world-water-quality-partnership-effort.
- UNGA (General Assembly of the United Nations). 2020. *Human Rights and the Privatization of Water and Sanitation Service: Note by the Secretary-General*. Seventy-fifth session. A/75/208. documents-dds-ny.un.org/doc/UNDOC/GEN/N20/189/97/PDF/N2018997.pdf?OpenElement.
- United Nations. 2015. *Transforming Our World: the 2030 Agenda for Sustainable Development*. Resolution adopted by the General Assembly on 25 September 2015. A/RES/70/1. New York, United Nations. documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/89/PDF/N1529189.pdf?OpenElement.
- _____. 2021. *The United Nations World Water Development Report 2021: Valuing Water*. Paris, UNESCO. unesdoc.unesco.org/ark:/48223/pf0000375724.
- Van Koppen, B., Smits, S., Rumbaitis del Rio, C. and Thomas, J. B. 2014. *Scaling up Multiple Use Water Services: Accountability in the Water Sector*. Rugby, UK, Practical Action Publishing. www.iwmi.cgiar.org/Publications/Books/PDF/scaling_upmus_accountability_in_water_sector.pdf.
- Vinca, A., Parkinson, S., Riahi, K., Byers, E., Siddiqi, A., Muhammad, A., Ilyas, A., Yogeswaran, N., Willaarts, B., Magnuszewski, P., Awais, M., Rowe, A. and Djilali, N. 2021. Transboundary cooperation a potential route to sustainable development in the Indus basin. *Nature Sustainability*, Vol. 4, pp. 331–339. doi.org/10.1038/s41893-020-00654-7.
- Willaarts, B., Vinca, A., Parkinson, S., Riahi, K., Byers, E. and Heyl, A. 2021. *Cooperation and Joint Investments are Key to Sustainable Development in the Indus Basin*. IIASA Policy Brief No. 28. Laxenburg, Austria, International Institute for Applied Systems Analysis (IIASA). iiasa.ac.at/sites/default/files/2021-09/IIASA%20POLICY%20BRIEF%20%2328.pdf.
- Winrock International. 2007. *Multiple Use Water Services for the Poor: Assessing the State of Knowledge*. Arlington, Va., Winrock International. winrock.org/wp-content/uploads/2016/02/Multiple-Use-Water-Services-for-the-Poor-Assessing-the-State-of-Knowledge.pdf.
- WWAP (UNESCO World Water Assessment Programme). 2019. *The United Nations World Water Development Report 2019: Leaving No One Behind*. Paris, UNESCO. unesdoc.unesco.org/ark:/48223/pf0000367306.
- WWW (World Water Week). 2022. *A Rising Tide: Shared Vision for Women in Water Diplomacy*. Online & On-site session, 30 August 2022. worldwaterweek.org/event/10314-a-rising-tide-shared-vision-for-women-in-water-diplomacy.
- Yeganeh, Y. and Bakhshandeh, E. 2022. Iran's model of water diplomacy to promote cooperation and prevent conflict over transboundary rivers in Southwest Asia. *World Affairs*, Vol. 185, No. 2. doi.org/10.1177/00438200221081210.

Chapter 14

Conclusions

WWAP

Richard Connor, David Coates and Michela Miletto



Nearly every water-related intervention involves some kind of partnership. From local to global scales, operating across different user groups with varying intentions, and functioning within a range of formal and informal structures, the sheer number and diversity of examples presented in this report can be dizzying.

Cooperation is critical to achieving water-related goals and targets, and any 'acceleration' of progress towards the sixth Sustainable Development Goal (SDG 6) depends heavily on the efficient and productive performance of partnerships. However, this report has shown that evaluating their performance – individually or overall – in terms of accelerating progress is challenging and rarely undertaken.

Partnerships and cooperative arrangements, within the water community and beyond, are not created equal nor are they necessarily comparable or always entirely beneficial to society at large. Furthermore, there is no 'one-size-fits-all' approach given the number of factors at play in terms of scope, thematic area, beneficiaries, partners, politics and personalities, among other factors. Consequently, there has never been a formal comparative review of such initiatives across the water domain.

While some have clearly accomplished their set objective(s), it can be more difficult to assess the extent to which other partnerships have truly been successful. Indeed, most published commentaries are inherently subjective. While some – be they instigators, participants, beneficiaries or outside observers – may regard a given partnership as 'successful', others may deem the outcomes to be inappropriate, insufficient, or even counterproductive. Furthermore, it is not generally in the nature of agencies (and people) to openly disclose – and even less to accept responsibility for – their mistakes, shortcomings and failures, even though these can provide some of the best lessons learned. Case studies that fully disclose failures, budgets and unintended consequences are rare compared to those showcasing the positive.

Despite the lack of a common performance evaluation methodology, a sound body of evidence emerges from the examples in this report to support a number of practical conclusions with respect to partnerships and cooperation over water.

14.1 Guiding principles for successful partnerships and cooperation

Inclusive stakeholder participation promotes buy-in and ownership. Taking account of the different perspectives of those involved (e.g. ethical and social values) helps determine a clear, shared vision of the objectives, outcomes and results, based on a common understanding of the problem(s). Working collectively, where all engaged parties are provided the opportunity to make tangible contributions, requires open, equitable and transparent processes (Chapter 13). This is arguably most obvious when pursuing a common objective (i.e. ***intra-sectoral partnerships*** – see Chapter 1), for example in the design and deployment of water supply and sanitation systems for rural communities, informal settlements and displacement camps (Chapter 4), or for realizing efficiency gains and improved equity in irrigation schemes and food security through agricultural water user associations (WUAs) (Chapter 2). However, participation has also been critical to partnerships aimed at achieving multiple water-related goals, including health (Chapter 6) and environmental outcomes (Chapter 3).

There is increasing attention to the role and contributions of local and indigenous communities in effective partnerships (Chapters 8, 13), taking account of their knowledge and unique perspectives (Chapters 7, 9). Water-related human rights form a strong theme throughout this report. But apart from being a desired outcome in itself, a human-rights based approach that encompasses non-discrimination, transparency, accountability and sustainability has been shown to promote greater equity and inclusion in collaborative processes (Chapters 4, 8 and 13).

Limited inclusion of women in cooperative mechanisms has been identified as a major cause of project underperformance (Chapter 2). However, the full and effective involvement of women in partnerships has been found to greatly improve the design, impact and delivery of water services and broader water-related goals. A gender perspective can be particularly effective in the targeted delivery of water, sanitation and hygiene (WASH) interventions (Chapter 6) and in identifying multiple needs and outcomes (Chapter 3). While the participation of women often remains low (Chapters 3, 8), there is increasing effort to proactively engage women; for example through e-learning opportunities (Chapter 9) or dedicated training and education (Box 5.6).

Diversity expands co-benefits and improves performance. Different partners are likely to have different interests and motivations, not least in terms of prioritizing co-benefits (Table 3.1). For example, while public sector/government partners may focus on social and environmental co-benefits, public and private water utility partners are mainly concerned with reducing infrastructure risks, ensuring compliance and reducing costs, whereas industry's concerns include supply chain resilience and brand value. Diverse motivations, but with a consensus on actions required, help increase and diversify overall benefits. For example, **cross-sectoral partnerships** involving agricultural (Chapter 2), industrial (Chapter 4), domestic (Chapter 5) and/or environmental (Chapter 3) interests, among others, can help identify and maximize potential cross-benefits and mitigate negative impacts. Environmental co-benefits are among those most often highlighted in the report, along with data/information-sharing and co-financing. The diversity and scale of the benefits forge strong interests among stakeholders and potential partners across the water domain.

A broad yet integrated approach generates complementary solutions to multiple challenges. Because of the inter-sectoral nature of water, crossing the social, environmental and economic pillars of sustainable development, it has often been demonstrated that involving actors from outside the water community can be central to successful partnerships (UN-Water, 2016). **Extra-sectoral partnerships** are needed that go beyond the water management and services sectors in order to help balance competing needs and promote equitable benefit-sharing (United Nations, 2018; 2021). For example, efforts to mitigate greenhouse gas emissions and adapt to climate change through water management interventions (UNESCO/UN-Water, 2020) can directly benefit from close cooperation with the climate community through knowledge-sharing as well as financing (Chapter 7). Integrated water resources management and the various 'nexus' approaches (Chapter 2) provide comprehensive frameworks for achieving multiple objectives.

Reliable data and information strengthen partnerships, and vice versa. Government agencies tasked with resource monitoring and management often lack the capacity to generate all the data required to address water-related economic and social challenges (Chapter 10). Partnerships can facilitate and enhance data-gathering (e.g. joint monitoring) and information generation for the benefit of all parties. An open and transparent exchange of data and information is also integral to effective cooperation and builds trust between partners. The great value of such cooperation has been highlighted throughout the report, particularly in the context of transboundary basins and aquifers (Chapter 8; Box 10.1). However, the same applies equally to both intra- and cross-sectoral partnerships. Cooperation is also critical for the generation of disaggregated socio-economic data (including for gender) required to target actions towards specific beneficiaries.

Citizen science can act as an agent of social inclusion and local-level participation, and bring a sense of ownership in shaping evidence-based policies (Chapter 11). It is increasingly used to build awareness on local issues (e.g. water pollution), has a strong educational dimension, and often involves and empowers women, youth and young professionals (Chapter 9). However, better understanding of challenges and drawbacks of citizen science is needed (Chapter 3).

Collective action creates additional opportunities for financing. It is critical that the course corrections to achieve SDG 6 include mobilization of financial resources. Funding gaps impede progress, and funding from different sources is often uncoordinated and sometimes even counterproductive. This is particularly an issue when funding transboundary basin projects. Evidence suggests that some water-related funds may be poorly targeted, failing to reach the projects that maximize benefits (Chapter 12). Partnerships create opportunities to pool often limited resources and share risks, thus improving the business case for investors and financiers. Financiers themselves can benefit from cooperation through co-financing arrangements, as leveraging multiple sources of finance spreads investment risks among multiple financiers with differing risk thresholds. Innovative funding mechanisms such as water funds (Boxes 3.1, 8.2; Chapters 11 and 12) illustrate how progress can be accelerated through a structured, participative approach to financing.

Potential impediments to cooperation need to be identified, acknowledged and avoided. For example, unclear and/or overlapping mandates among partners can lead to confusion and the duplication of efforts, and seed internal competition. Corruption, in all its many forms, and hidden agendas can undermine opportunities for honest cooperation. Authoritarian approaches, including coercion and non-democratic approaches, asymmetric sharing of data and information, and exorbitant or otherwise prohibitive costs and expenditures, can also distort internal processes and, ultimately, impede outcomes. Avoiding such detrimental conditions requires strong leadership that allows for dissenting views to be heard, thereby fostering trust in and legitimacy of the process and of the partnership itself.

14.2 Aligning roles, including responsibilities and contributions

At the **community and grass-roots levels**, local partners, often represented by non-governmental organizations (NGOs), are in a position to give local stakeholders a voice. Local partners can also help provide more relevant data and information, including monitoring on-the-ground progress. Beyond these essential contributions, the success of many grass-roots initiatives illustrated throughout this report demonstrates the value of having local partners actually lead collaborative processes. Indicator 6.b.1 for SDG 6 specifically refers to this (Figure P.10).

A fundamental role of **government** is to provide the enabling environment in which partnerships and cooperation can innovate (Chapter 11) and flourish. They are responsible for establishing and overseeing regulatory frameworks, and are often expected to contribute with financial, technical and institutional support. However, as exemplified in the case of WUAs (Chapter 3), the unilateral imposition of centralized or national directives (often through by-laws or rules) can fail to take account of local knowledge and leadership and undermine equitable and inclusive participation in decision-making and benefit-sharing.

Governments should also make all relevant data open-access without costs to users, and promote their dissemination (Chapter 10). In addition to geophysical data, socio-economic data need to be made accessible, provided that privacy rights are not infringed.

Regional, and particularly **basin-level** partnerships, such as river basin organizations, are the heart and soul of transboundary water resources management. While cooperation over transboundary basins and aquifers has been shown to deliver multiple benefits (Chapters 7 and 8), the vast majority of the world's internationally shared aquifers do not yet have any formal cooperative agreement (Prologue Part 2; United Nations, 2022).

As might be expected in a report developed through UN-Water, many partnerships illustrated in this report operate at the **international level** among UN agencies (including all who have participated in the writing of this report), or between UN agencies and international NGOs.

These partnerships provide platforms to deliver on the UN-Water Global Acceleration Framework accelerators of financing, governance, capacity development, innovation, and data and information, to “*deliver fast results at an increased scale*” on the SDG 6 targets (UN-Water, 2020). Partnerships among UN agencies and others are also a conspicuous feature of efforts to monitor and report on progress towards the SDG 6 targets (Prologue Part 2). The difficulties encountered due to insufficient or incomplete data across the indicators highlight the need for even more strengthened partnerships to be able to adequately track progress.

UN Agencies are working closely with international and local NGOs, as well as governments, to address water-related challenges, for example, issues related to water supply, sanitation, hygiene and health, including pandemics (Chapter 6), and broader issues such as the ways in which water is impacted by and/or drives human displacement (Chapter 4). Indeed, all the super-national forms of cooperation (SDGs, UN Conventions, etc.) require sound data and scientifically formulated evidence (climate change is another example), which are generated and disseminated through partnerships.

The business value of adding water-related environmental, social and governance (ESG) and water stewardship, through strategic partnerships and cooperation, has become increasingly embedded in corporate models by the **private sector** (Chapter 5). Partnerships have supported local and national governments in protecting human rights, realigning business and environmental goals, creating efficiencies in administration and service delivery, improving the fairness and transparency of regulation, and advocating for increased quantity and quality of donor aid to developing countries.

Research and academic institutions are often relied on as knowledge generators and brokers, and help to underpin science- and evidence-based decision-making. They also play prominent roles in education and capacity development through partnerships in developing countries.

Coda

Safeguarding water, food and energy security through sustainable water management, providing water supply and sanitation services to all, supporting human health and livelihoods, mitigating the impacts of climate change and extreme events, and sustaining and restoring ecosystems and the valuable services they provide, are all pieces of a great and complex puzzle.

Only through partnerships and cooperation can the pieces come together.

And everyone has a role to play.

References

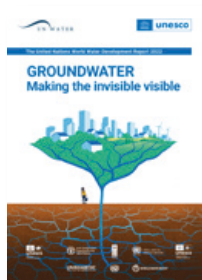
- UNESCO (United Nations Educational, Scientific and Cultural Organization)/ UN-Water. 2020. *The United Nations World Water Development Report 2020: Water and Climate Change*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000372985.locale=en>.
- United Nations. 2018. *Sustainable Development Goal 6: Synthesis Report 2018 on Water and Sanitation*. New York, United Nations. www.unwater.org/sites/default/files/app/uploads/2018/12/SDG6_SynthesisReport2018_WaterandSanitation_04122018.pdf.
- _____. 2021. *The United Nations World Water Development Report 2021: Valuing Water*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000375724>.
- _____. 2022. *The United Nations World Water Development Report 2022. Groundwater: Making the Invisible Visible*. Paris, UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000380721>.
- UN-Water. 2016. *Water and Sanitation Interlinkages across the 2030 Agenda for Sustainable Development*. Geneva, Switzerland. www.unwater.org/publications/water-and-sanitation-interlinkages-across-2030-agenda-sustainable-development.
- _____. 2020. *The Sustainable Development Goal 6 Global Acceleration Framework*. Geneva, UN-Water. www.unwater.org/publications/the-sdg-6-global-acceleration-framework/.

Abbreviations and acronyms

ADECOR	Asociación de Desarrollo Comunitario Rural (Rural Community Development Association)	FESAN	Federación Nacional de Cooperativas de Servicios Sanitarios de Chile (Chilean National Federation for Sanitation Services Cooperatives)
AfDB	African Development Bank	FONAG	Fondo para la Protección del Agua (Fund for the Protection of Water of the city of Quito)
AIP	Continental Africa Water Investment Programme	GAF	Global Acceleration Framework
AMCOW	African Ministers' Council on Water	GDP	Gross Domestic Product
AMR	antimicrobial resistance	GEF	Global Environmental Facility
AMWC	Arab Ministerial Water Council	GHP	Global Handwashing Partnership
AOAD	Arab Organization for Agricultural Development	GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German Agency for International Cooperation GmbH)
APAGroP	Pan-African Groundwater Program	GPA	Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities
ASA	Articulação Semiárido Brasileiro (Brazilian Semi-Arid Network)	GPI	Global Peatlands Initiative
AUDA-NEPAD	African Union Development Agency-New Partnership for Africa's Development	GW²I	Global Wastewater Initiative
AWARENET	Arab Integrated Water Resources Management Network	GWCL	Ghana Water Company Limited
AWS	Alliance for Water Stewardship	GWOPA	Global Water Operators' Partnerships Alliance
CaBA	Catchment Based Approach	GWP	Global Water Partnership
Cap-Net	International Capacity Development Network for Sustainable Water Management	GWP-Med	GWP Mediterranean
CBO	Community-Based Organization	HH4A	Hand Hygiene for All
CDP	formerly the Carbon Disclosure Project	ICT	Information and Communication Technologies
CEC	contaminant of emerging concern	IFAD	International Fund for Agricultural Development
CIWA	Cooperation in International Waters in Africa	IFIS	Iowa Flood Inundation System
COP	Conference of the Parties	IFRC	International Federation of Red Cross and Red Crescent Societies
COVID-19	Coronavirus-2019	IGRAC	International Groundwater Resources Assessment Centre
CPP	Community–Public Partnership	IJC	International Joint Commission
CRIDA	Climate Risk Informed Decision Analysis	IMHEA	Iniciativa Regional de Monitoreo Hidrológico de Ecosistemas Andinos (Initiative for the Hydrological Monitoring of Andean Ecosystems)
CWRA	City Water Resilience Approach	IMI-SDG6	Integrated Monitoring Initiative for the Sustainable Development Goal 6
DALYs	Disability-Adjusted Life Years	IOM	International Organization for Migration
ESG	Environmental, Social and Governance	IPCC	Intergovernmental Panel on Climate Change
ESP	Ecosystem Services Partnership		
ESVD	Ecosystem Service Value Database		
EU	European Union		
FAMM	Fondo de Agua Metropolitano de Monterrey (Monterrey Metropolitan Water Fund)		
FAO	Food and Agriculture Organization of the United Nations		

IRWR	Internal Renewable Water Resources	TAHMO	Trans-African Hydro-Meteorological Observatory
IWaSP	International Water Stewardship Programme	UK	United Kingdom of Great Britain and Northern Ireland
IWMI	International Water Management Institute	UN	United Nations
IWRM	Integrated Water Resources Management	UNDP	United Nations Development Programme
LIUC	Low-Income Urban Community	UNECA	United Nations Economic Commission for Africa
LVWATSA	Lake Victoria Water and Sanitation Initiative	UNECE	United Nations Economic Commission for Europe
MCR2030	Making Cities Resilient 2030	UNEP	United Nations Environment Programme
MERESE	Mecanismos de Retribución por Servicios Ecosistémicos (Mechanisms for Retribution for Ecosystem Services)	UNESCO	United Nations Educational, Scientific and Cultural Organization
MoU	Memorandum of Understanding	UNESCO-IHP	UNESCO Intergovernmental Hydrological Programme
MRC	Mekong River Commission	UNESCWA	United Nations Economic and Social Commission for Western Asia
NAP	National Adaptation Plan (in Chapters 3 and 7)	UNFCCC	United Nations Framework Convention on Climate Change
NAP	National Action Plan (in Chapter 6)	UNICEF	United Nations Children’s Fund
NARBO	Network of Asian River Basin Organizations	UNIDO	United Nations Industrial Development Organization
NBS	Nature-Based Solutions	UNPFII	United Nations Permanent Forum on Indigenous Issues
NDCs	Nationally Determined Contributions	USA	United States of America
NDP	National Development Plan	US EPA	United States Environmental Protection Agency
NGO	Non-Governmental Organization	VGP	Viability Gap Funding
NPD	National Policy Dialogue	W+W	Women + Water
NSAS	Nubian Sandstone Aquifer System	WASH	Water, Sanitation and Hygiene
NTD	neglected tropical disease	WASH FIT	Water and Sanitation for Health Facility Improvement Tool
NWSAS	Northwestern Sahara Aquifer System	WEFE	Water–Energy–Food–Ecosystem
O&M	Operation and Maintenance	WHO	World Health Organization
ODA	Official Development Assistance	WMO	World Meteorological Organization
OECD	Organisation for Economic Co-operation and Development	WOLL	Water-Oriented Living Lab
P1MC	Programa Um Milhão de Cisternas (One Million Cisterns Programme)	WOP	Water Operators’ Partnership
PACE	Personal Advancement and Career Enhancement	WRM	Water Resources Management
PPE	personal protective equipment	WSI	Water Stewardship Initiative (in Chapter 5)
PPP	Public–Private Partnership	WSI	Water Scarcity Regional Initiative (in Chapter 8)
RBO	River Basin Organization	WSP	Water Safety Plan
RCS	River Chief System	WSS	Water and Sanitation Services
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region	WUA	Water User Association
SDG	Sustainable Development Goal	WWF	World Wildlife Fund for Nature
SIWI	Stockholm International Water Institute		
SMEs	Small and Medium Enterprises		
SUN	Scale Up Nutrition		
SWA	Sanitation and Water for All		

THE UNITED NATIONS WORLD WATER DEVELOPMENT REPORT



ISBN 978-92-3-100507-7

© UNESCO 2022

248 pages

Price: EUR 55.00

WWDR 2022 Full colour, with boxes, figures, maps, tables, notes, photographs, references, and list of abbreviations and acronyms, as well as Forewords by UNESCO Director-General Audrey Azoulay and UN-Water Chair and IFAD President Gilbert F. Hounbo



ISBN 978-92-3-100576-3

© UNESCO 2023

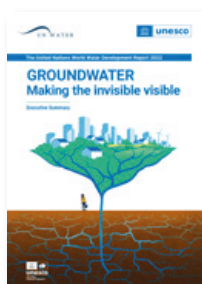
212 pages

Price: EUR 55.00

WWDR 2023 Full colour, with boxes, figures, maps, tables, notes, photographs, references, and list of abbreviations and acronyms, as well as Forewords by the United Nations Secretary-General António Guterres, UNESCO Director-General Audrey Azoulay and UN-Water Chair and ILO Director-General Gilbert F. Hounbo

To download the PDF format of the report and associated publications, WWDR previous editions and media material, please visit: <https://en.unesco.org/wwap>.

ASSOCIATED PUBLICATIONS



Executive Summary of the WWDR 2022

12 pages

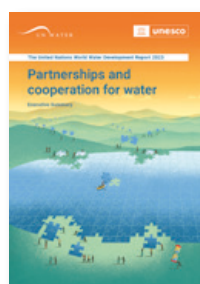
Available in Arabic, Chinese, English, French, German, Hindi, Italian, Korean, Portuguese, Russian and Spanish



Facts and Figures from the WWDR 2022

8 pages

Available in English, French, Italian, Portuguese and Spanish



Executive Summary of the WWDR 2023

12 pages

Available in Arabic, Chinese, English, French, German, Hindi, Italian, Korean, Mongolian, Portuguese, Russian and Spanish



Facts, Figures and Action Examples from the WWDR 2023

16 pages

Available in English, French, Italian, Portuguese and Spanish

To download these documents, please visit: <https://en.unesco.org/wwap>

UN-Water coordinates the efforts of United Nations entities and international organizations working on water and sanitation issues. By doing so, UN-Water seeks to increase the effectiveness of the support provided to Member States in their efforts towards achieving international agreements on water and sanitation. UN-Water publications draw on the experience and expertise of UN-Water's Members and Partners.

SDG 6 Progress Update 2021 – summary

This summary report was published in 2021 ahead of the one-day high-level President of the General Assembly Meeting on Water. The report provides an executive update on progress towards all targets of SDG 6 and identified priority areas for acceleration. It was produced by the UN-Water Integrated Monitoring Initiative for SDG 6, presenting new country, regional and global data on all the SDG 6 global indicators.

SDG 6 Progress Update 2021 – 8 reports, by SDG 6 global indicator

Published in 2021, this series of reports provides an in-depth update and analysis of progress towards the different SDG 6 targets and identifies priority areas for acceleration: *Progress on household drinking water, sanitation and hygiene 2000-2020* (WHO and UNICEF), *Progress on wastewater treatment* (WHO and UN-Habitat), *Progress on ambient water quality* (UNEP), *Progress on water-use efficiency* (FAO), *Progress on level of water stress* (FAO), *Progress on integrated water resources management* (UNEP), *Progress on transboundary water cooperation* (UNECE and UNESCO) and *Progress on water-related ecosystems* (UNEP). The reports, produced by the responsible custodian agencies, presented new country, region and global data on the SDG 6 global indicators.

United Nations World Water Development Report

The United Nations World Water Development Report is UN-Water's flagship report on water and sanitation issues, focusing on a different theme each year. The report is published by UNESCO on behalf of UN-Water, and its production is coordinated by the UNESCO World Water Assessment Programme. The report gives insight on main trends concerning the state, use and management of freshwater and sanitation, based on work done by the Members and Partners of UN-Water. Launched in conjunction with World Water Day, the report provides decision-makers with knowledge and tools to formulate and implement sustainable water policies. It also offers best practices and in-depth analyses to stimulate ideas and actions for better stewardship in the water sector and beyond.

UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS)

The GLAAS report is produced by WHO on behalf of UN-Water. It provides a global update on the policy frameworks, institutional arrangements, human resource base, and international and national finance streams in support of water and sanitation. It is a substantive input into the activities of Sanitation and Water for All as well as the progress reporting on SDG 6 (see above).

The progress reports of the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP)

The JMP is affiliated with UN-Water and is responsible for global monitoring of progress towards SDG 6 targets for universal access to safe and affordable drinking-water and adequate and equitable sanitation and hygiene services. Every two years, the JMP releases updated estimates and progress reports for WASH in households, schools and health care facilities.

Policy and Analytical Briefs

UN-Water's Policy Briefs provide short and informative policy guidance on the most pressing freshwater-related issues that draw upon the combined expertise of the United Nations system. Analytical Briefs provide an analysis of emerging issues and may serve as basis for further research, discussion and future policy guidance.

UN-WATER PLANNED PUBLICATIONS

- **SDG 6 Synthesis Report 2023 on Water and Sanitation**
- **Country Acceleration Case Studies**
- **UN-Water Policy Brief on Gender and Water**
- **UN-Water Policy Brief on Transboundary Waters Cooperation – update**

The United Nations designates specific days, weeks, years and decades as occasions to mark particular events or topics in order to promote, through awareness and action, the objectives of the Organization.



International observances are occasions to educate the general public on issues of concern, to mobilize political will and resources to address global problems, and to celebrate and reinforce achievements of humanity.

The majority of observances have been established by resolutions of the United Nations General Assembly. World Water Day (22 March) dates back to the 1992 United Nations Conference on Environment and Development where an international observance for water was recommended.

The United Nations General Assembly responded by designating 22 March 1993 as the first World Water Day. It has been held annually since then and is one of the most popular international days together with International Women's Day (8 March), the International Day of Peace (21 September) and Human Rights Day (10 December).

Every year, UN-Water – the UN's coordination mechanism on water and sanitation – sets a theme for World Water Day corresponding to a current or future water-related challenge. This theme also defines the theme of the United Nations World Water Development Report that is presented on World Water Day. The publication is UN-Water's flagship report and provides decision-makers with tools to formulate and implement sustainable water policies. The report also gives insight on main trends including the state, use and management of freshwater and sanitation, based on work by the Members and Partners in UN-Water.

The report is published by UNESCO, on behalf of UN-Water, and its production is coordinated by the UNESCO World Water Assessment Programme.

At current rates, progress towards SDG 6 is off-track. The 2023 edition of the *United Nations World Water Development Report (WWDR)* describes how building partnerships and enhancing cooperation across all dimensions of sustainable development are essential to accelerating progress towards all the targets of SDG 6 and realizing the human rights to water and sanitation.

Partnerships and cooperation take place in almost any water-related endeavour and water resources management has a long history of experience with partnerships, both good and bad. This report reviews this experience, highlighting how enhancing positive and meaningful cooperation amongst the water, sanitation and broader 'development' communities is required to accelerate progress.

The intersectoral nature of water, crossing all the social, economic and environmental pillars of sustainable development, also requires the exploration of opportunities for new models of partnerships and cooperation across all scales, from the municipal, national and basin levels through to the global. This report addresses how the water and sanitation community can internally collaborate more effectively by maximizing complementarity, as well as reach out to other sectors and realms of decision-making where water plays a critical (but often times misunderstood or ignored) role in meeting their own objectives and amplifying co-benefits.

The year 2023 marks the first major conference of the United Nations (UN) dedicated to water since 1977. As the UN system's principal authoritative report on water, the *WWDR 2023* directly informs the UN conference deliberations, as well as the mid-term comprehensive review of the International Decade for Action, 'Water for Sustainable Development 2018–2028'.

The *United Nations World Water Development Report* is UN-Water's flagship report on water and sanitation issues, focusing on a different theme each year. The report is published by UNESCO, on behalf of UN-Water and its production is coordinated by the UNESCO World Water Assessment Programme. The report gives insight on main trends concerning the state, use and management of freshwater and sanitation, based on work done by the Members and Partners of UN-Water. Launched in conjunction with World Water Day, the report provides decision-makers with knowledge and tools to formulate and implement sustainable water policies. It also offers best practices and in-depth analyses to stimulate ideas and actions for better stewardship in the water sector and beyond.



This publication is financed by
the Government of Italy and Regione Umbria.



Regione Umbria

