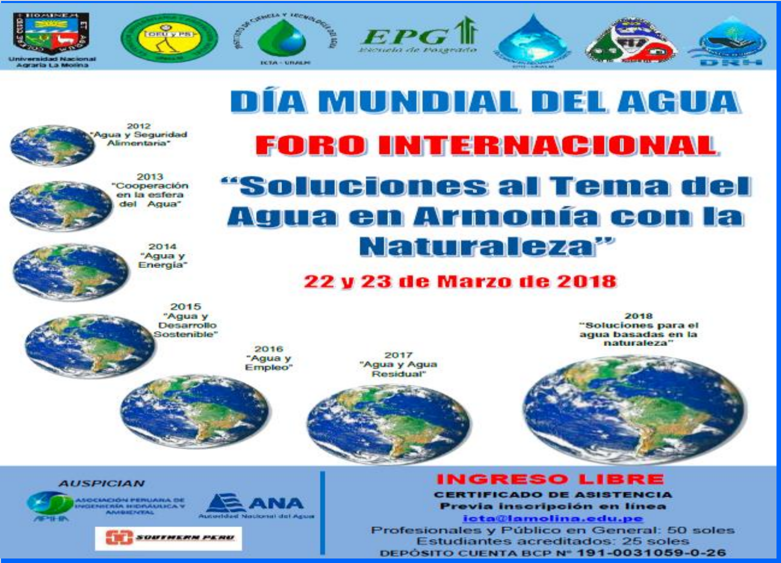

Universidad Nacional Agraria La Molina

ICTA - UNALM

EPG Escuela de Posgrado

DRH

DÍA MUNDIAL DEL AGUA

FORO INTERNACIONAL

"Soluciones al Tema del Agua en Armonía con la Naturaleza"

22 y 23 de Marzo de 2018

2012
"Agua y Seguridad Alimentaria"

2013
"Cooperación en la esfera del Agua"

2014
"Agua y Energía"

2015
"Agua y Desarrollo Sostenible"

2016
"Agua y Empleo"

2017
"Agua y Agua Residual"

2018
"Soluciones para el agua basadas en la naturaleza"

AUSPICIAN

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Gerente de Recursos Hídricos de Southern Peru Copper Corp.
Presidente de la Asociación Peruana de Ingeniería Hidráulica y Ambiental , APIHA

RESUMEN

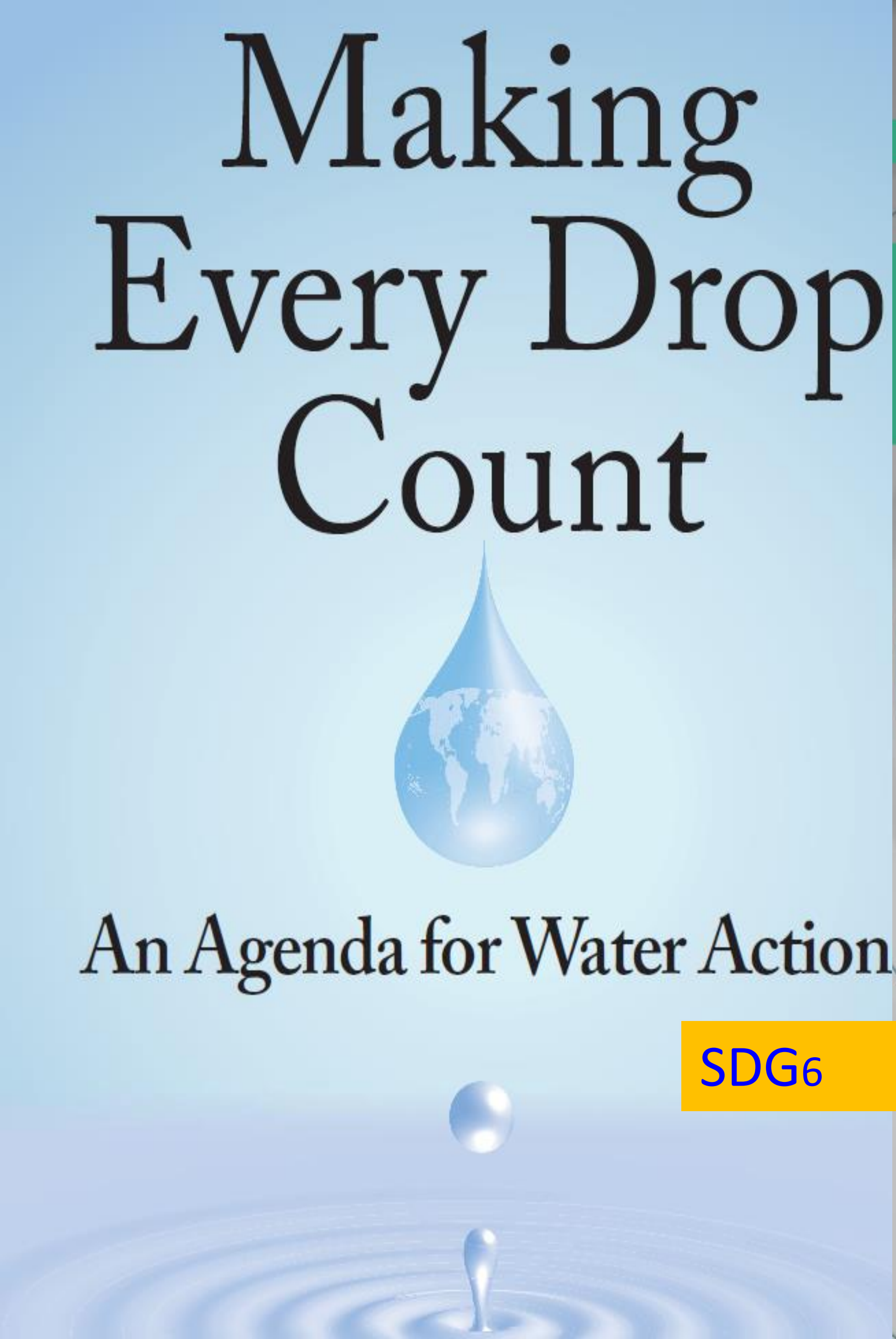
1. Agua y medio ambiente, un gran desafio (NbS)..!

2. Visión integrada del tema (SDG6-Nbs)....

3. Enfoques a nivel global y a nivel país...
   a. Disponibilidad,
   b. Calidad,
   c. Gestión del riesgo en eventos extremos

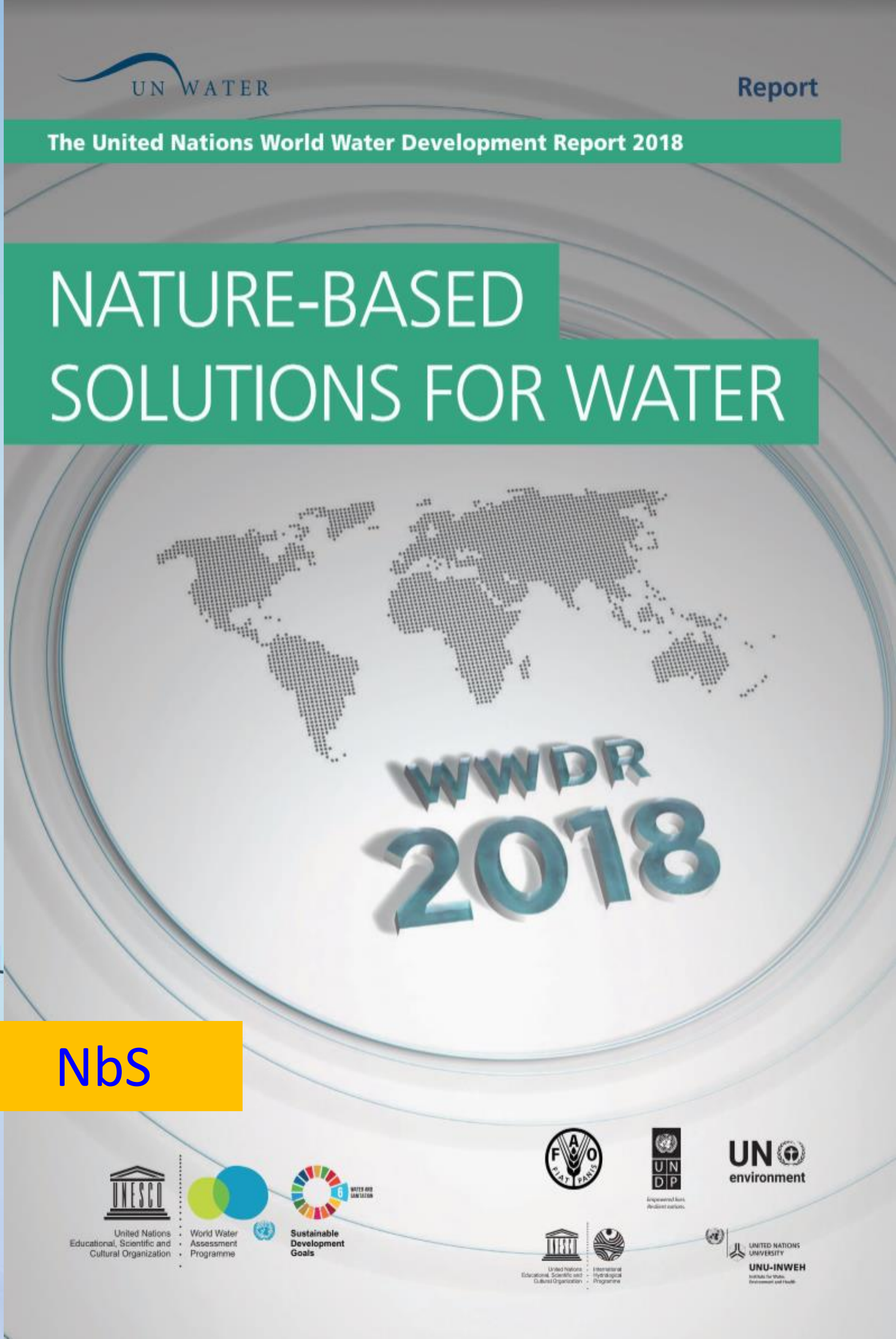
4. Analizando las tendencias.....

5. Puntos y temas de reflexión para la investigación en el país...



Making Every Drop Count

An Agenda for Water Action



UN WATER

Report

The United Nations World Water Development Report 2018

NATURE-BASED SOLUTIONS FOR WATER

WWDR 2018

United Nations Educational, Scientific and Cultural Organization

World Water Assessment Programme

Sustainable Development Goals

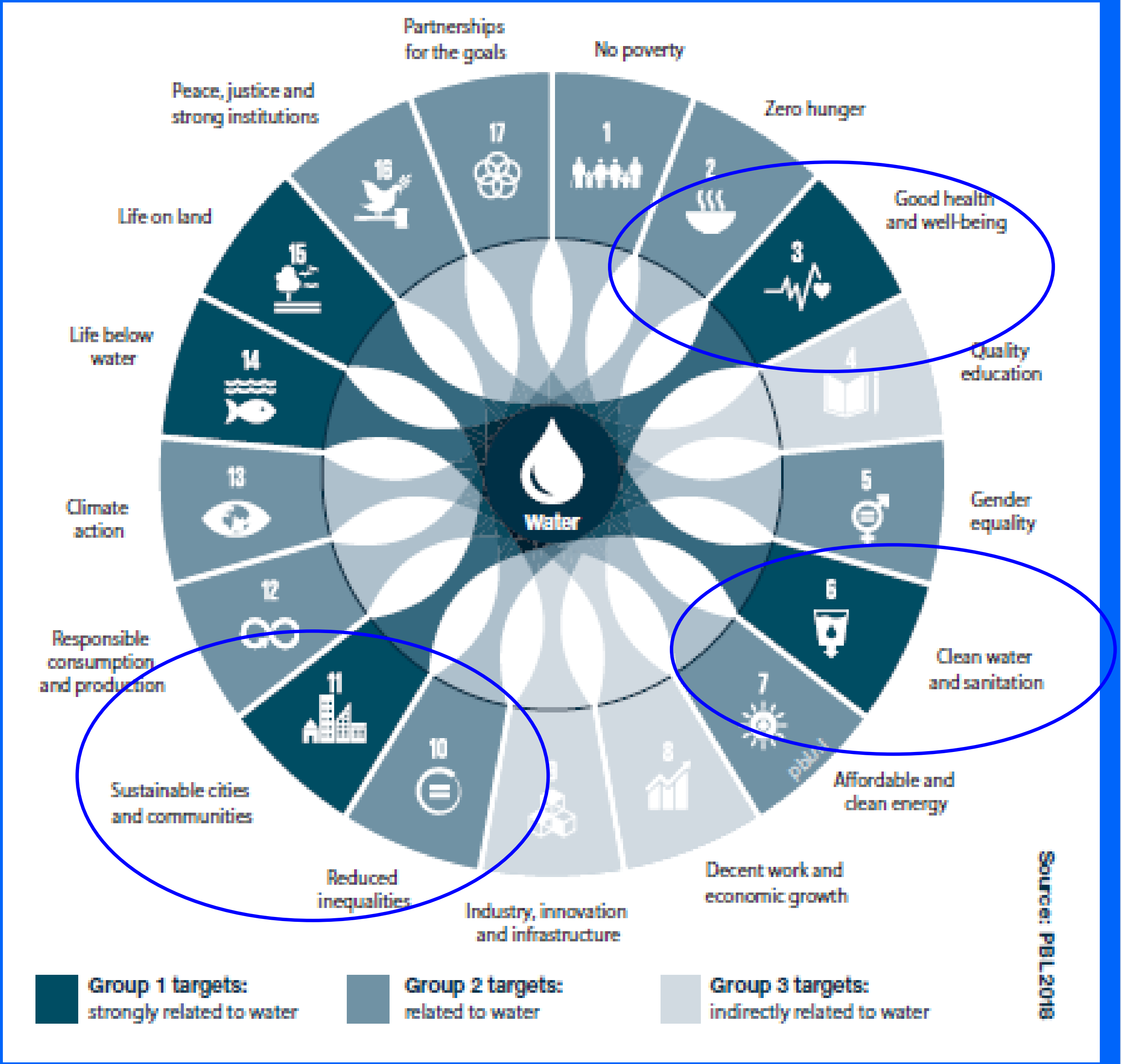
UN environment

UNITED NATIONS UNIVERSITY

UNU-INWEH

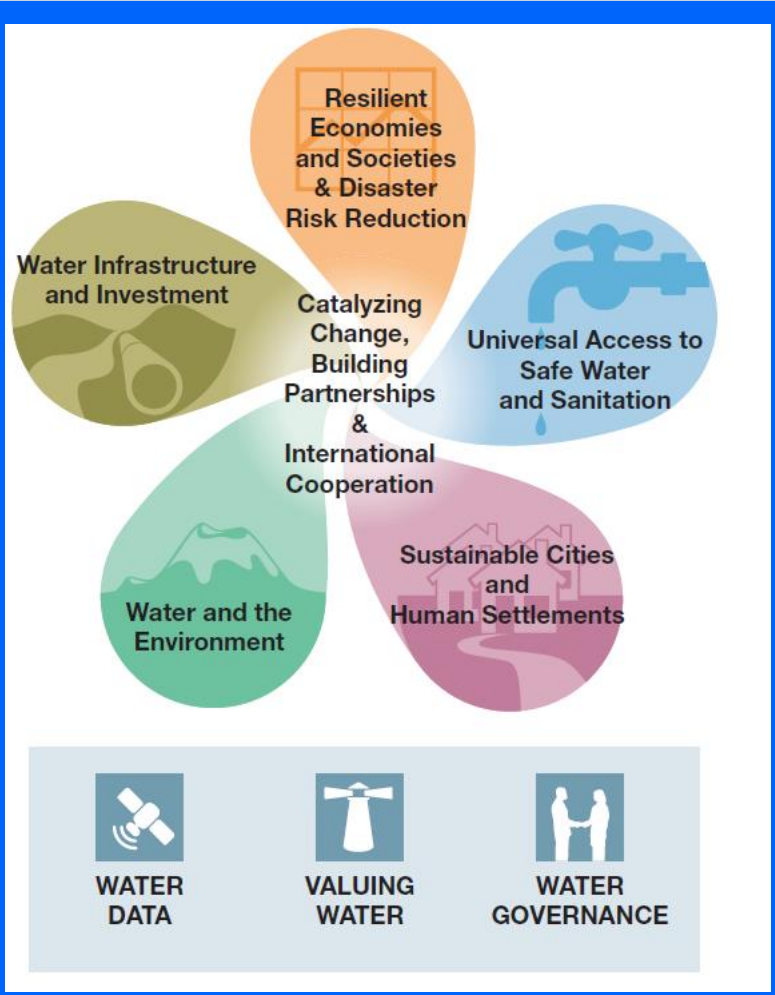
SDG6 NbS

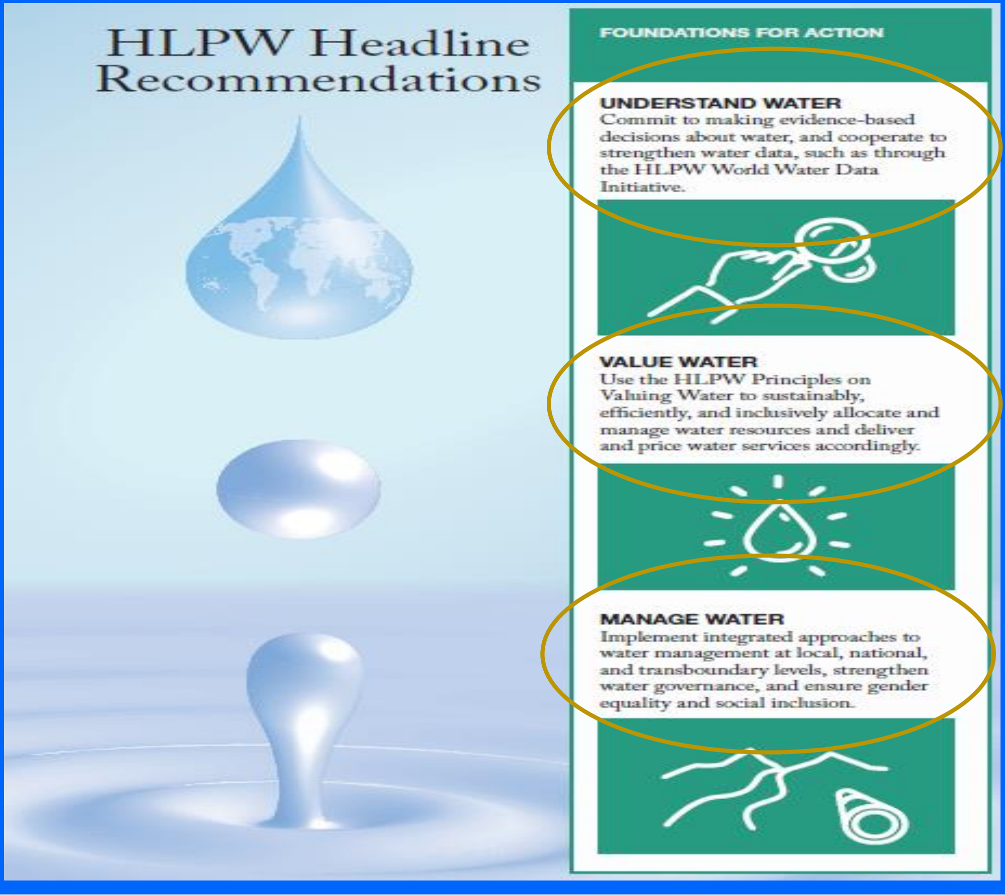
Como acelerar en el pais el logro de los SDG6..?


Partnerships for the goals
No poverty
Zero hunger
Good health and well-being
Quality education
Gender equality
Clean water and sanitation
Affordable and clean energy
Decent work and economic growth
Industry, innovation and infrastructure
Reduced inequalities
Sustainable cities and communities
Responsible consumption and production
Climate action
Life below water
Life on land
Peace, justice and strong institutions
17
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Water
pbl.nl
Group 1 targets: strongly related to water
Group 2 targets: related to water
Group 3 targets: indirectly related to water

Source: PBL 2018

Una agenda muy clara para la acción… High Level Panel on Water,2016 HLPW


Resilient Economies and Societies & Disaster Risk Reduction
Water Infrastructure and Investment
Catalyzing Change, Building Partnerships & International Cooperation
Universal Access to Safe Water and Sanitation
Sustainable Cities and Human Settlements
Water and the Environment
WATER DATA
VALUING WATER
WATER GOVERNANCE



HLPW Headline Recommendations

FOUNDATIONS FOR ACTION

UNDERSTAND WATER
Commit to making evidence-based decisions about water, and cooperate to strengthen water data, such as through the HLPW World Water Data Initiative.

VALUE WATER
Use the HLPW Principles on Valuing Water to sustainably, efficiently, and inclusively allocate and manage water resources and deliver and price water services accordingly.

MANAGE WATER
Implement integrated approaches to water management at local, national, and transboundary levels, strengthen water governance, and ensure gender equality and social inclusion.

AT THE LOCAL, COUNTRY AND REGIONAL LEVELS

LEADING AN INTEGRATED AGENDA

ENSURE UNIVERSAL ACCESS TO SAFE WATER & SANITATION

Address gaps in service delivery models, technology and behavior change which limit access to sustainable drinking water and sanitation for all – including the needs of women, girls, people with disabilities, and communities in vulnerable situations, recognizing access to safe drinking water and sanitation services as a fundamental human right.

BUILD RESILIENT SOCIETIES AND ECONOMIES, REDUCING DISASTER RISK

- Shift the focus of disaster management from response to preparedness and resilience.
- Create incentives for water users, including irrigators, to use water efficiently, to not pollute water, and to promote its reuse.
- Take action where water-related risks may exacerbate fragility, conflict, or forced displacement, and affect peace and security.

INCREASE WATER INFRASTRUCTURE INVESTMENT

Improve the enabling environment for investment in sustainable water-related infrastructure and services, in order to at least double current levels of investment.

NURTURE ENVIRONMENTAL WATER

Value environmental contributions to water management, prevent degradation and pollution of watersheds, rivers, lakes and aquifers, and where necessary, restore and maintain acceptable environmental conditions and water quality.

DEVELOP SUSTAINABLE CITIES

Implement an integrated approach to urban water management in line with the Habitat III New Urban Agenda, aiming at more adaptable and resilient infrastructure.

AT THE GLOBAL LEVEL

CATALYZING CHANGE, BUILDING PARTNERSHIPS & INTERNATIONAL COOPERATION

PROMOTE INNOVATION

Support programs, such as the HLPW Water Innovation Engine, which foster the uptake of new water-related business models and technologies.

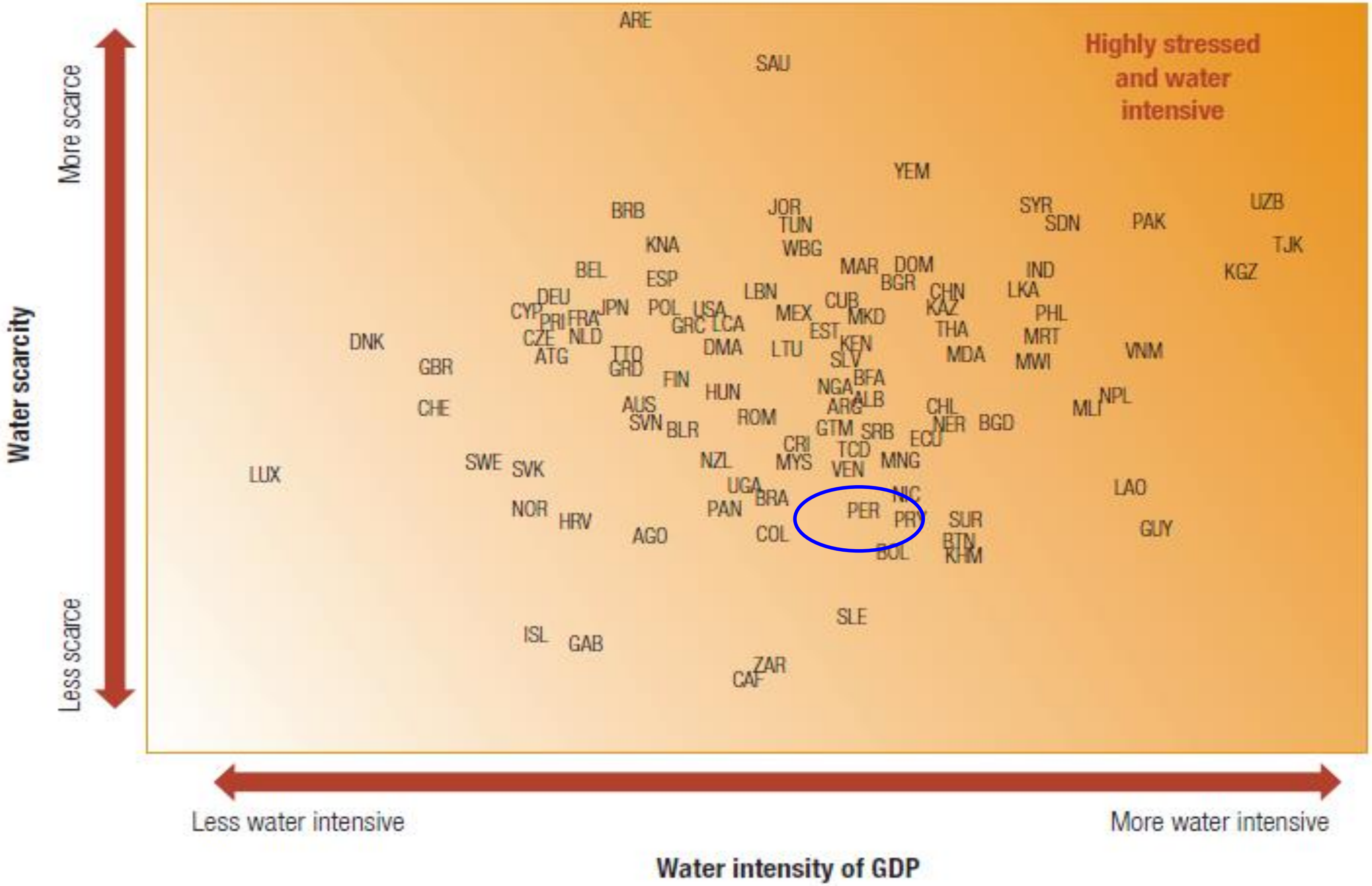
STRENGTHEN PARTNERSHIPS

Motivate all water use sectors to value water, embrace water stewardship, strengthen their collaboration, and participate in integrated water resource management.

INCREASE GLOBAL WATER COOPERATION

Strengthen the UN system's support to member states and its coordination of water matters by establishing UN meetings on water at the highest possible level, consider a scientific panel on water and promote international cooperation. Using the UNGA Water Action Decade as a platform for policy dialogue, exchanges of best practices, and building global partnerships.

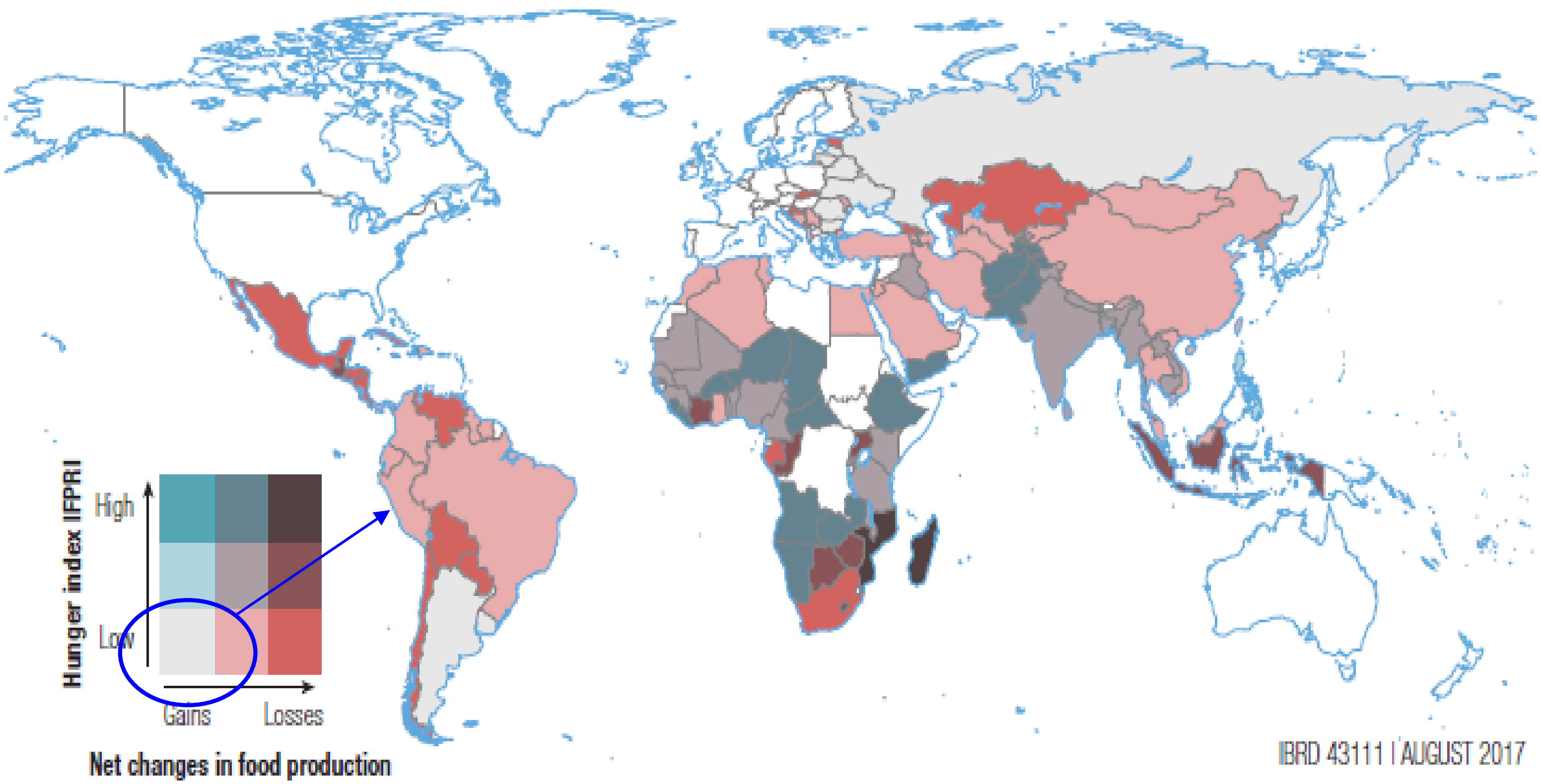
FIGURE 1.1 Comparison of Water-Intensive and Water-Scarce Economies



Sources: Water data: AQUASTAT database of the Food and Agriculture Organization (FAO); Output data: World Bank World Development Indicators.

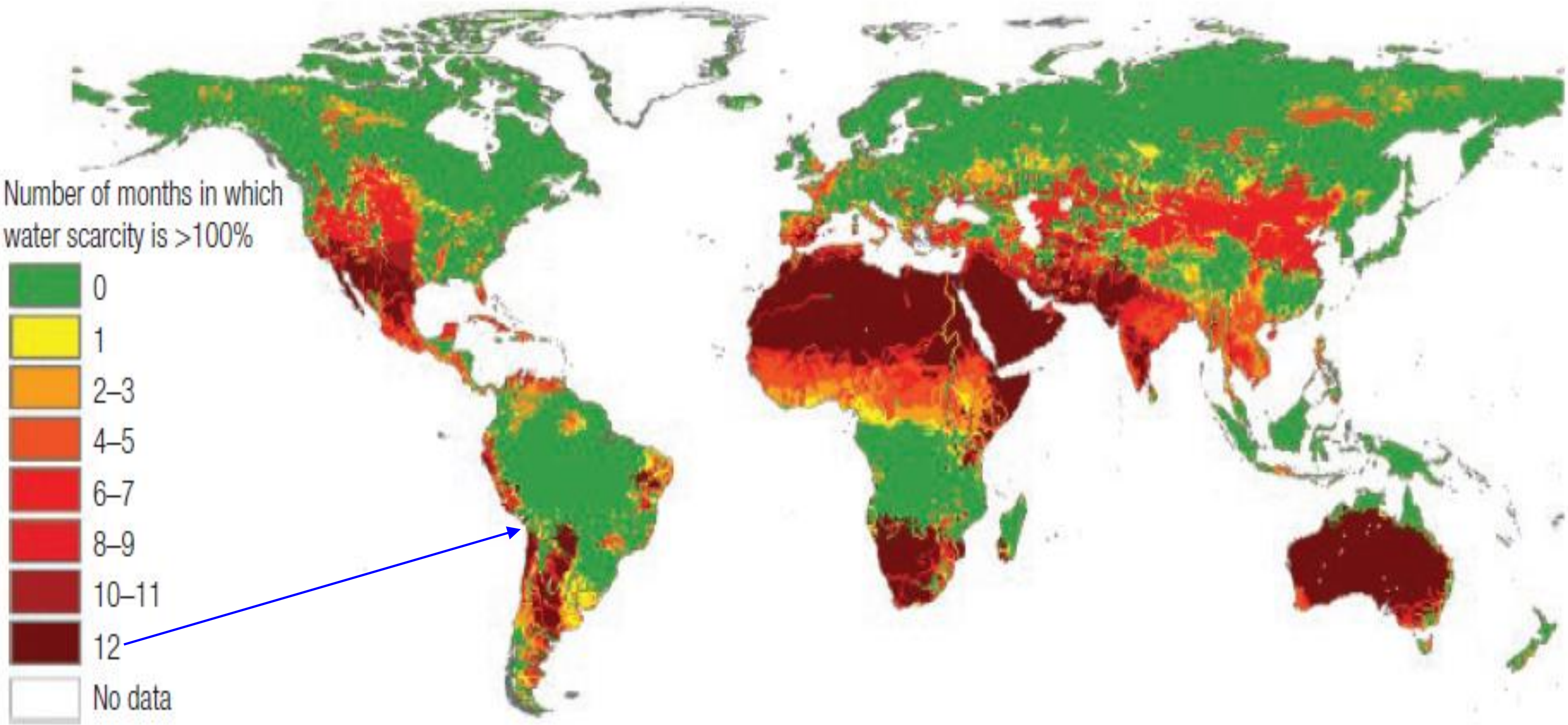
Note: Figure 1.1 compares water intensity of GDP with water scarcity. Water intensity of GDP is measured as the ratio of total economic output to total water withdrawals, and water scarcity is measured as the ratio of total water withdrawals to renewable freshwater resources. Country abbreviations are ISO codes.

MAP 2.2 Food Production Losses over the Past Decade and Food Insecurity, 2001–13


Hunger index IFPRI
High
Low
Gains
Losses
Net changes in food production
IBRD 43111 | AUGUST 2017

Sources: Data on food production losses were calculated according to the methodology described above. Food insecurity is measured using the International Food Policy Research Institute (IFPRI) Hunger Index. Countries that are excluded (shown in white) either have no data for the Hunger Index or are not surveyed.

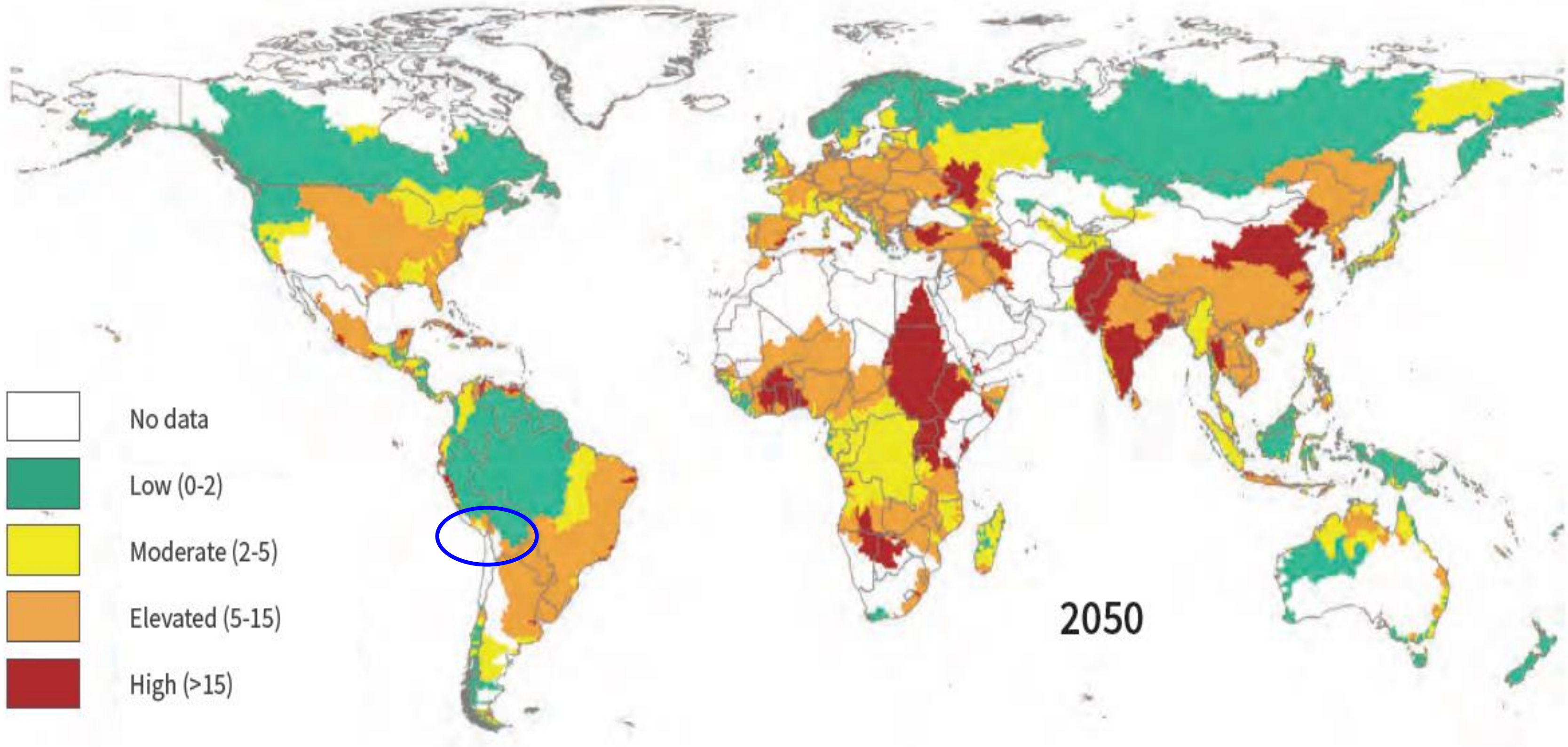
MAP 2.3 Regions That Experience Severe Water Scarcity throughout the Year, 1996–2005


Number of months in which water scarcity is >100%
0
1
2–3
4–5
6–7
8–9
10–11
12
No data

Source: Mekonnen and Hoekstra 2016.

Note: Water scarcity > 100 percent reflects a situation where net surface and groundwater withdrawals plus environmental flow requirements are greater than the available supply.

Water quality risk projections....

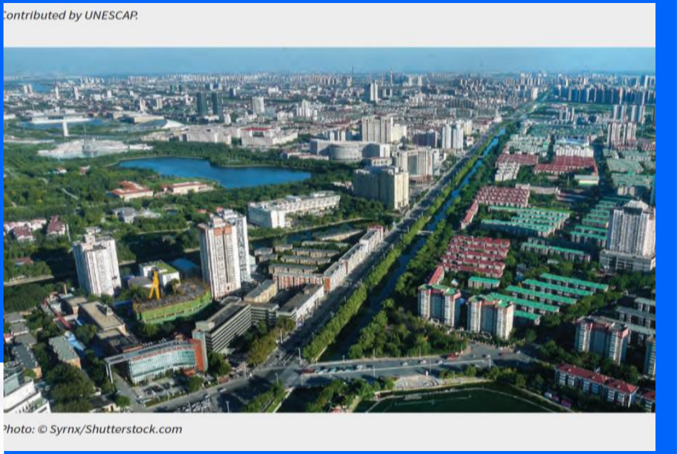

No data
Low (0-2)
Moderate (2-5)
Elevated (5-15)
High (>15)
2050

*Commonwealth Scientific and Industrial Research Organization

**This scenario takes account of a drier future (as projected by the CSIRO climate change model) and a medium level of socio-economic growth.

Source: Veolia/IFPRI (2015, fig. 3, p. 9).

Edificios verdes



ontributed by UNESCAP.
hoto: © Syrnx/Shutterstock.com

Ciudades esponja

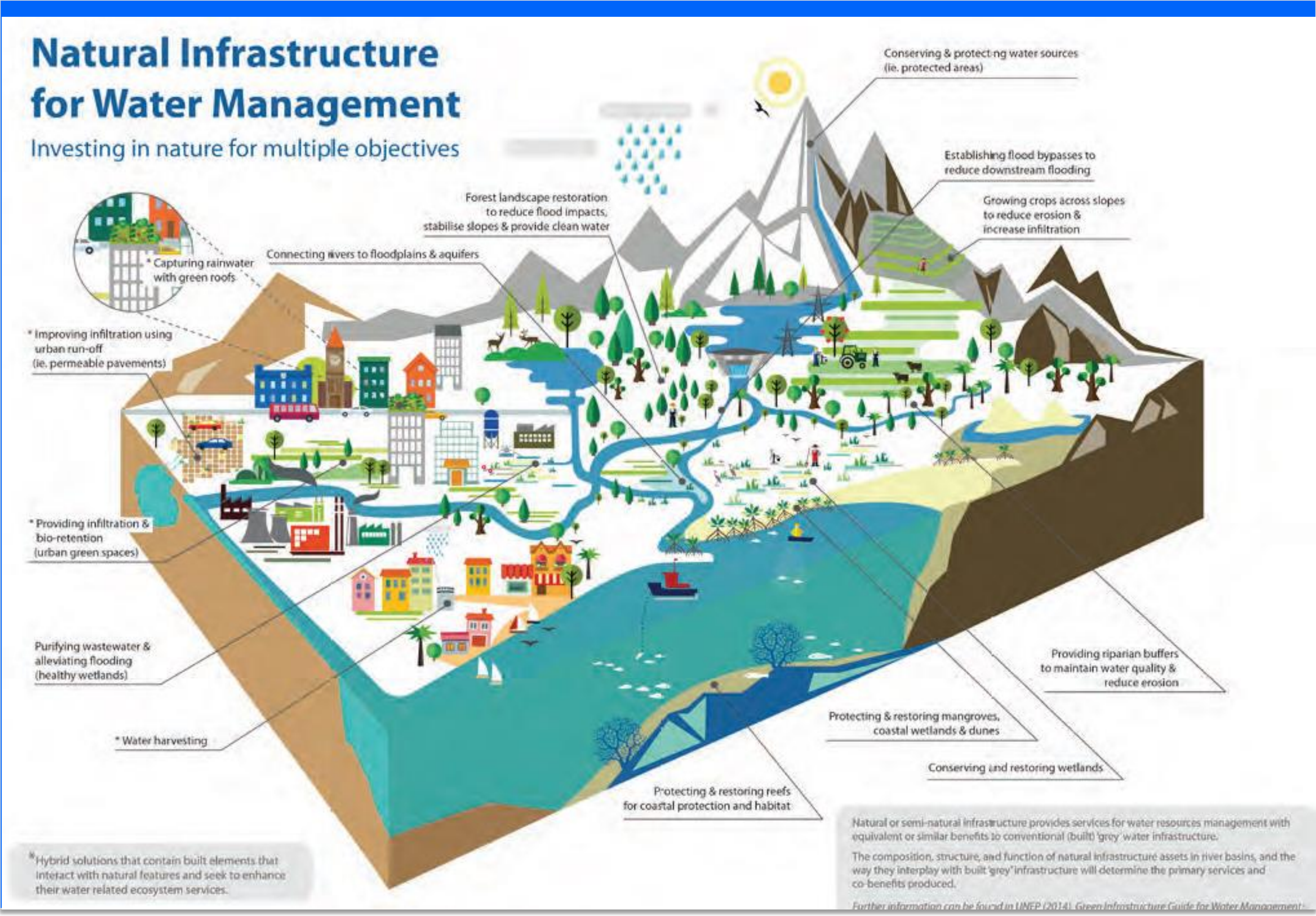
Ganadería originaria...

Incrementando la recarga de acuíferos

Fomentando humedales y habitats

Natural Infrastructure for Water Management

Investing in nature for multiple objectives


Conserving & protecting water sources (ie. protected areas)
Establishing flood bypasses to reduce downstream flooding
Growing crops across slopes to reduce erosion & increase infiltration
Forest landscape restoration to reduce flood impacts, stabilise slopes & provide clean water
Connecting rivers to floodplains & aquifers
* Capturing rainwater with green roofs
* Improving infiltration using urban run-off (ie. permeable pavements)
* Providing infiltration & bio-retention (urban green spaces)
Purifying wastewater & alleviating flooding (healthy wetlands)
* Water harvesting
Protecting & restoring reefs for coastal protection and habitat
Conserving and restoring wetlands
Protecting & restoring mangroves, coastal wetlands & dunes
Providing riparian buffers to maintain water quality & reduce erosion

*Hybrid solutions that contain built elements that interact with natural features and seek to enhance their water related ecosystem services.

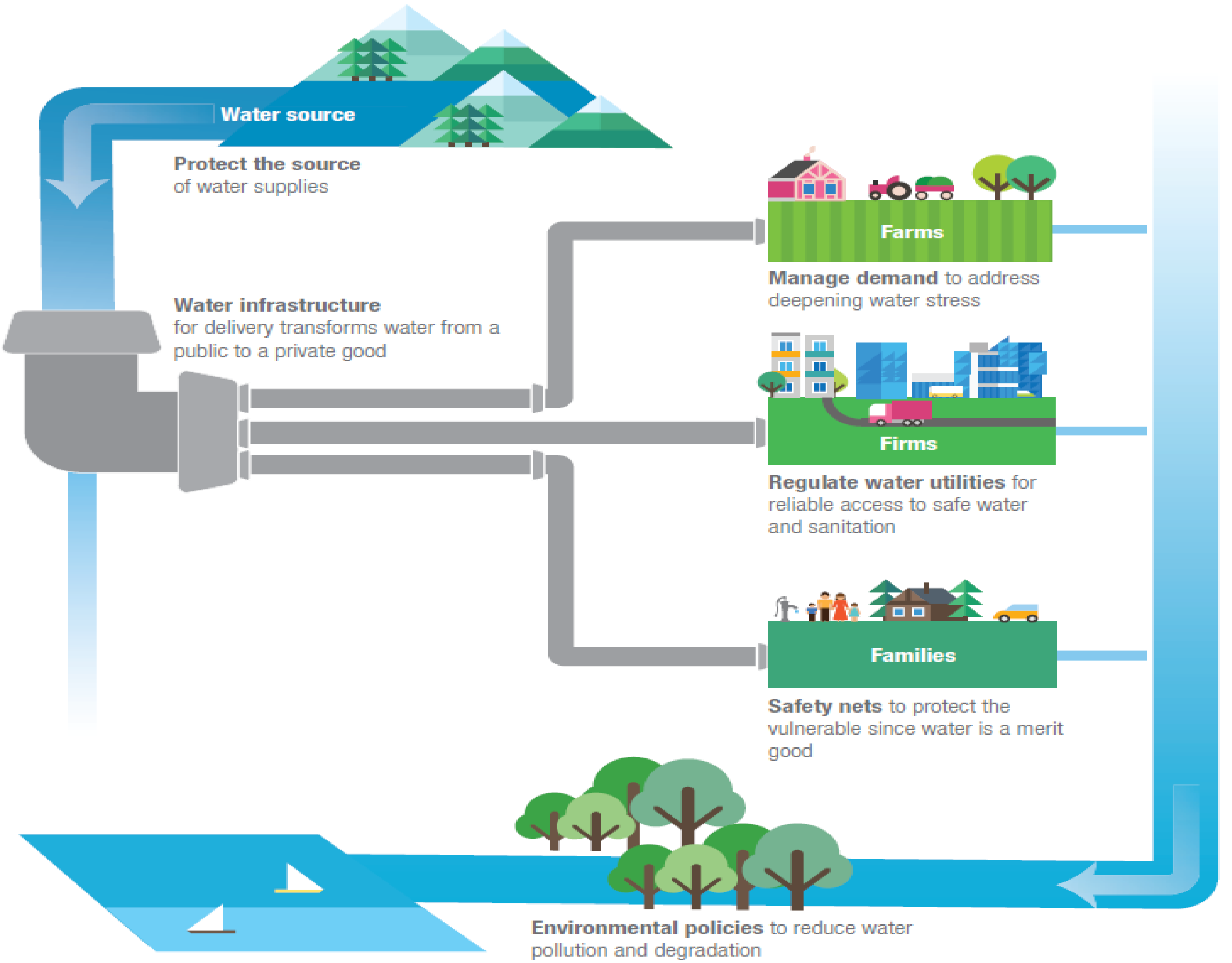
Natural or semi-natural infrastructure provides services for water resources management with equivalent or similar benefits to conventional (built) 'grey' water infrastructure.

The composition, structure, and function of natural infrastructure assets in river basins, and the way they interplay with built 'grey' infrastructure will determine the primary services and co-benefits produced.

Further information can be found in UNEP (2014) Green Infrastructure Guide for Water Management:

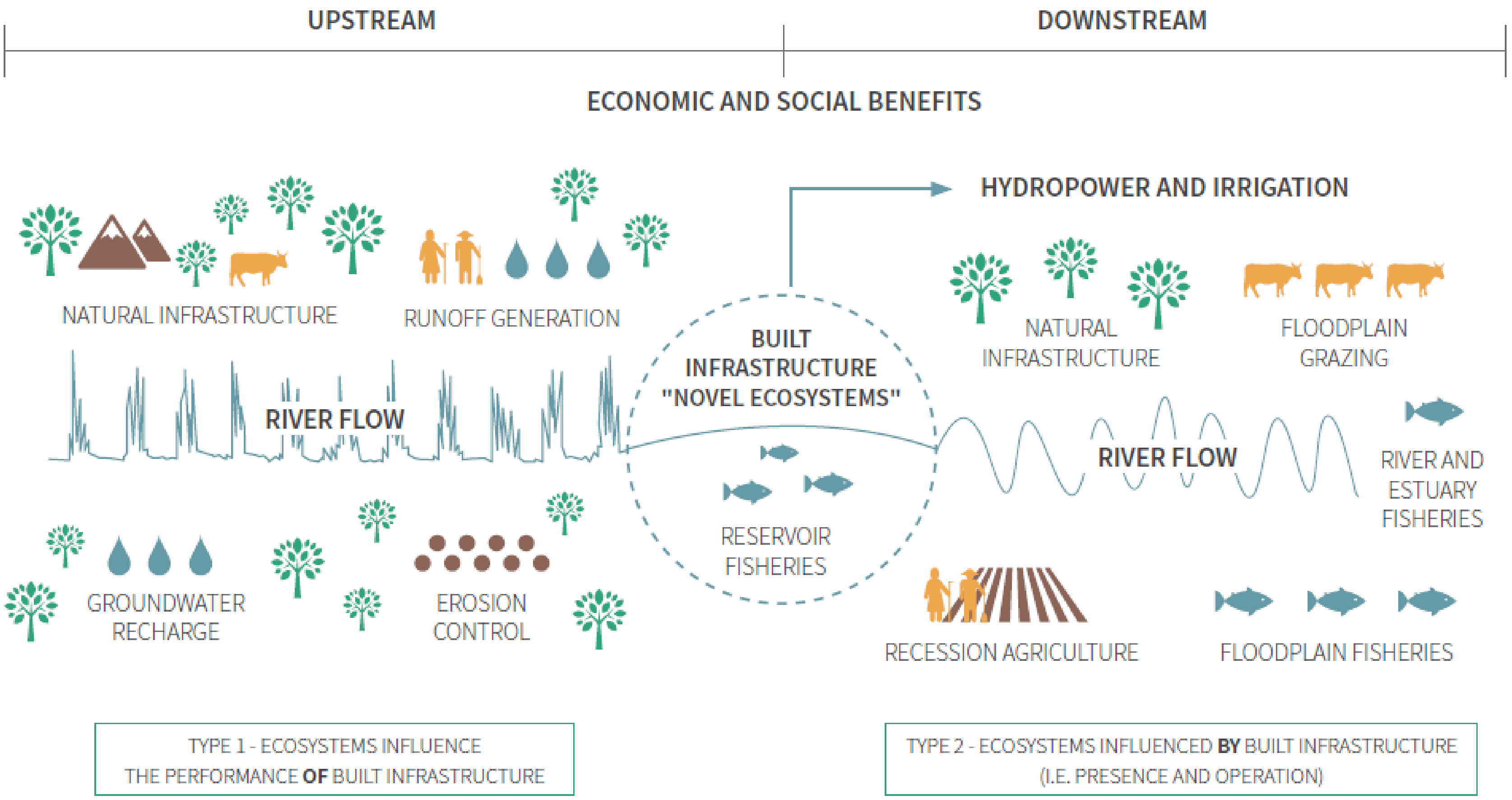
Source: Infographic 'Natural Infrastructure for Water Management', © IUCN Water 2015.

FIGURE 5.1 The Economic Cycle of Water


Water source
Protect the source of water supplies
Water infrastructure for delivery transforms water from a public to a private good
Farms
Manage demand to address deepening water stress
Firms
Regulate water utilities for reliable access to safe water and sanitation
Families
Safety nets to protect the vulnerable since water is a merit good
Environmental policies to reduce water pollution and degradation

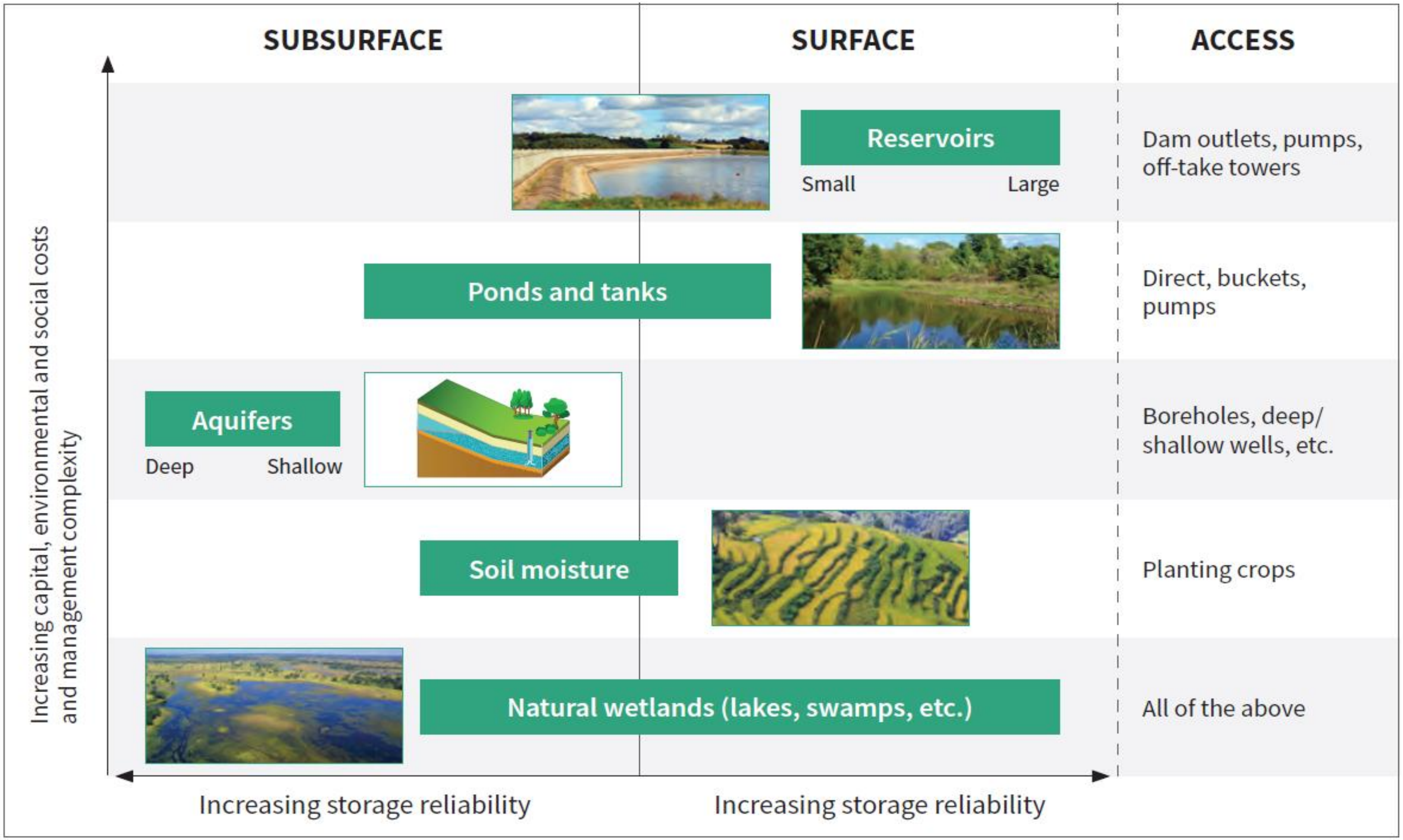
balancing three competing priorities: efficiency, equity, and sustainability.

Figure 2.1 The relationship between built infrastructure and ecosystem services


UPSTREAM
DOWNSTREAM
ECONOMIC AND SOCIAL BENEFITS
HYDROPOWER AND IRRIGATION
NATURAL INFRASTRUCTURE
RUNOFF GENERATION
RIVER FLOW
BUILT INFRASTRUCTURE "NOVEL ECOSYSTEMS"
RESERVOIR FISHERIES
NATURAL INFRASTRUCTURE
FLOODPLAIN GRAZING
RIVER FLOW
RIVER AND ESTUARY FISHERIES
GROUNDWATER RECHARGE
EROSION CONTROL
RECESSION AGRICULTURE
FLOODPLAIN FISHERIES
TYPE 1 - ECOSYSTEMS INFLUENCE THE PERFORMANCE OF BUILT INFRASTRUCTURE
TYPE 2 - ECOSYSTEMS INFLUENCED BY BUILT INFRASTRUCTURE (I.E. PRESENCE AND OPERATION)

Source: CGIAR WLE (2017, fig. 1, p. 5, developed using some results from WISE-UP to Climate).

Figure 4.7 Water storage continuum


SUBSURFACE
SURFACE
ACCESS
Reservoirs
Small
Large
Dam outlets, pumps, off-take towers
Ponds and tanks
Direct, buckets, pumps
Aquifers
Deep
Shallow
Boreholes, deep/ shallow wells, etc.
Soil moisture
Planting crops
Natural wetlands (lakes, swamps, etc.)
All of the above
Increasing capital, environmental and social costs and management complexity
Increasing storage reliability
Increasing storage reliability

Source: Adapted from McCartney and Smakhtin (2010, fig. 2, p. 5).

Bahia de Ite al 2017, áreas recupetradas 1500 has. 1998-2013

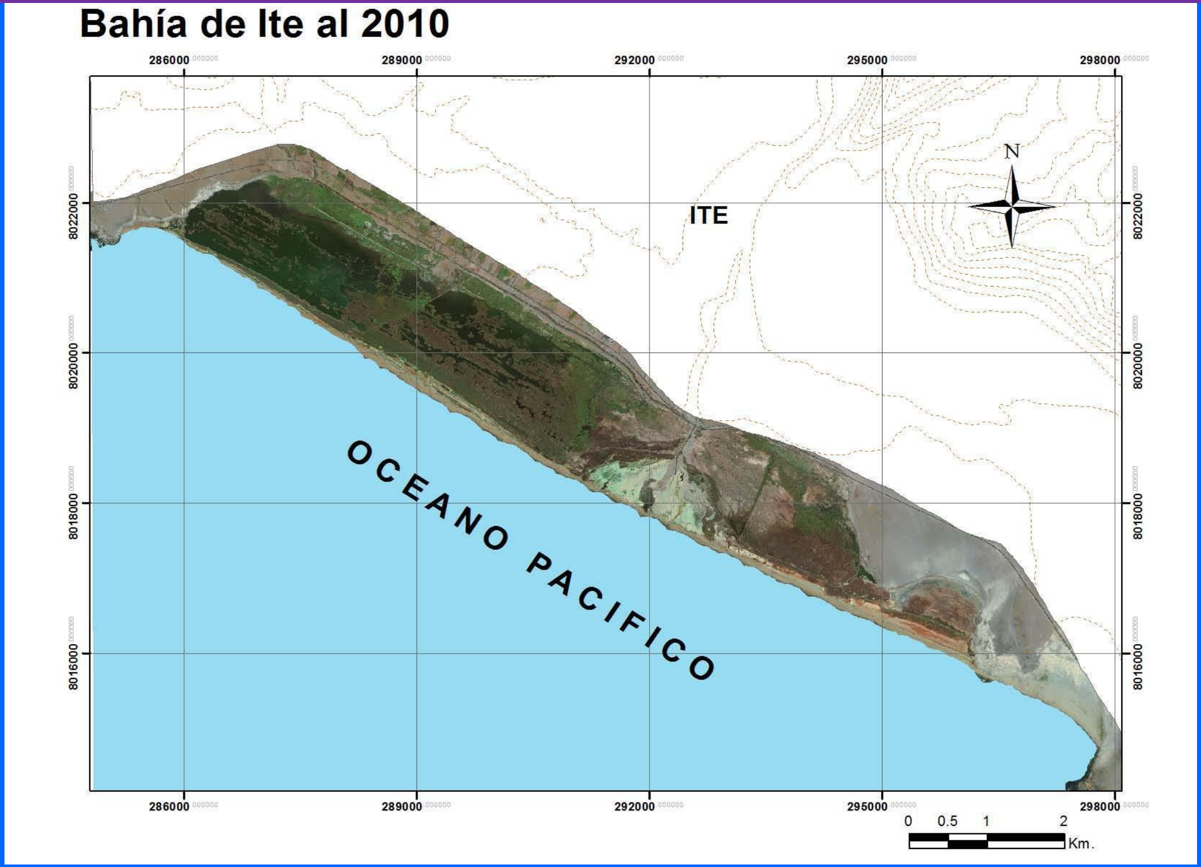

Bahía de Ite al 2010
286000
289000
292000
295000
298000
8022000
8020000
8018000
8016000
N
ITE
OCEANO PACIFICO
0
0.5
1
2
Km.

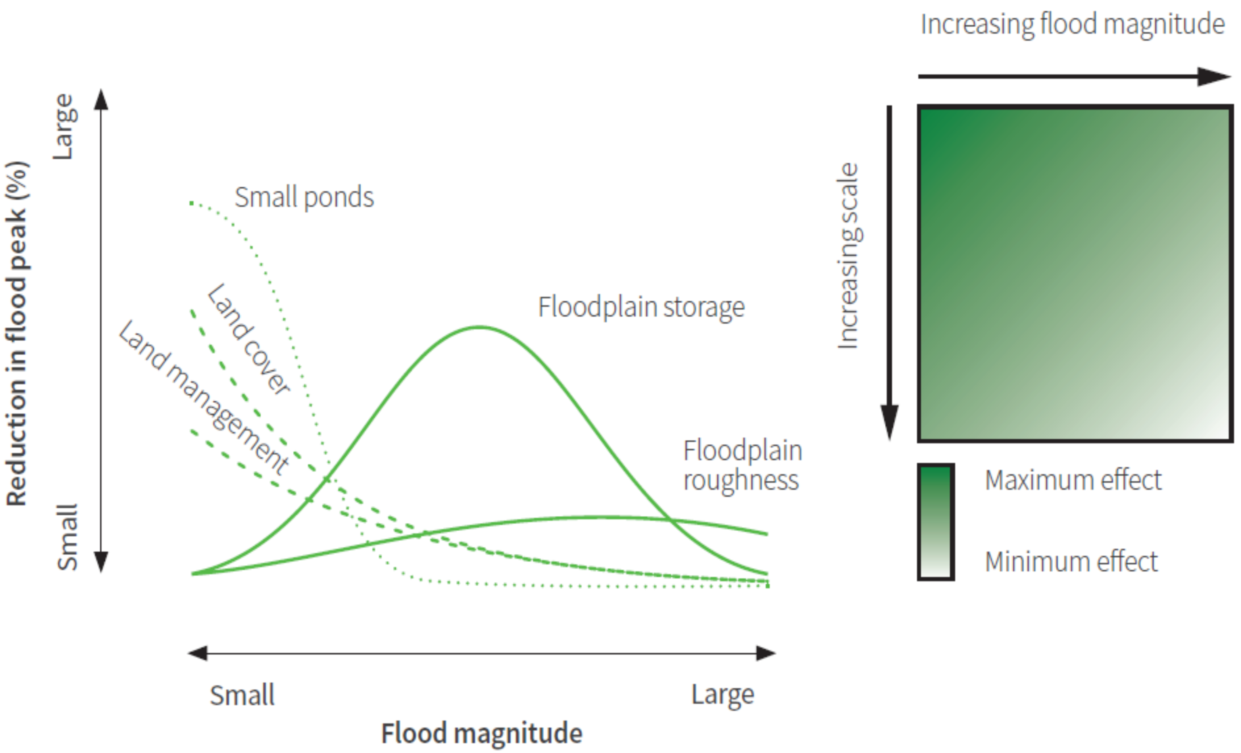
Table 1.2 Green infrastructure solutions for water resources management

Water management issue (primary service to be provided)		Green infrastructure solution	Location				Corresponding Grey infrastructure solution (at the primary service level)
			Watershed	Floodplain	Urban	Coastal	
Water supply regulation (incl. drought mitigation)		Re/afforestation and forest conservation	🟩				Dams and groundwater pumping Water distribution systems
		Reconnecting rivers to floodplains		🟩			
		Wetlands restoration/conservation	🟩	🟩	🟩		
		Constructing wetlands	🟩	🟩	🟩		
		Water harvesting*	🟩	🟩	🟩		
		Green spaces (bioretention and infiltration)			🟩		
		Permeable pavements*			🟩		
Water quality regulation	Water purification	Re/afforestation and forest conservation	🟩				Water treatment plant
		Riparian buffers		🟩			
		Reconnecting rivers to floodplains		🟩			
		Wetlands restoration/conservation	🟩	🟩	🟩		
		Constructing wetlands	🟩	🟩	🟩		
		Green spaces (bioretention and infiltration)			🟩		
		Permeable pavements*			🟩		
	Erosion control	Re/afforestation and forest conservation	🟩				Reinforcement of slopes
		Riparian buffers		🟩			
		Reconnecting rivers to floodplains		🟩			
	Biological control	Re/afforestation and forest conservation	🟩				Water treatment plant
		Riparian buffers		🟩			
		Reconnecting rivers to floodplains		🟩			
		Wetlands restoration/conservation	🟩	🟩	🟩		
		Constructing wetlands	🟩	🟩	🟩		
	Water temperature control	Re/afforestation and forest conservation	🟩				Dams
		Riparian buffers		🟩			
		Reconnecting rivers to floodplains		🟩			
		Wetlands restoration/conservation	🟩	🟩	🟩		
		Constructing wetlands	🟩	🟩	🟩		
		Green spaces (shading of water ways)			🟩		
Moderation of extreme events (floods)	Riverine flood control	Re/afforestation and forest conservation	🟩				Dams and levees
		Riparian buffers		🟩			
		Reconnecting rivers to floodplains		🟩			
		Wetlands restoration/conservation	🟩	🟩	🟩		
		Constructing wetlands	🟩	🟩	🟩		
		Establishing flood bypasses		🟩			
	Urban stormwater runoff	Green roofs			🟩		Urban stormwater infrastructure
		Green spaces (bioretention and infiltration)			🟩		
		Water harvesting*	🟩	🟩	🟩		
		Permeable pavements*			🟩		
	Coastal flood (storm) control	Protecting/restoring mangroves, coastal marshes and dunes				🟩	Sea walls
		Protecting/restoring reefs (coral/oyster)				🟩	

*Built elements that interact with natural features to enhance water-related ecosystem services.

Source: UNEP-DHI/IUCN/TNC (2014, table 1, p. 6).

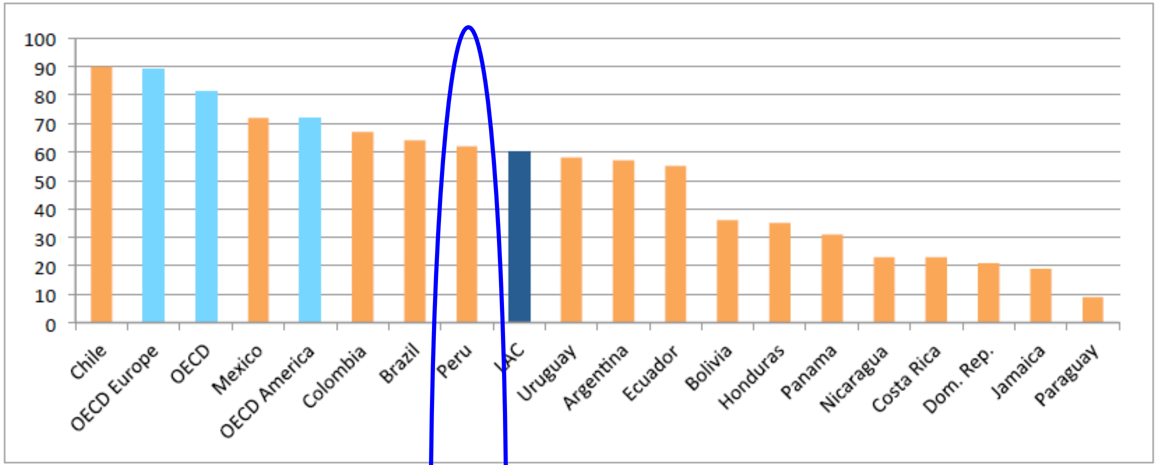
Figure 4.5 Effect of different NBS interventions on flood peak reduction (left) and combined effect of basin-wide interventions with flood magnitude (right)



Source: Dadson et al. (2017, fig. 3, p. 18).

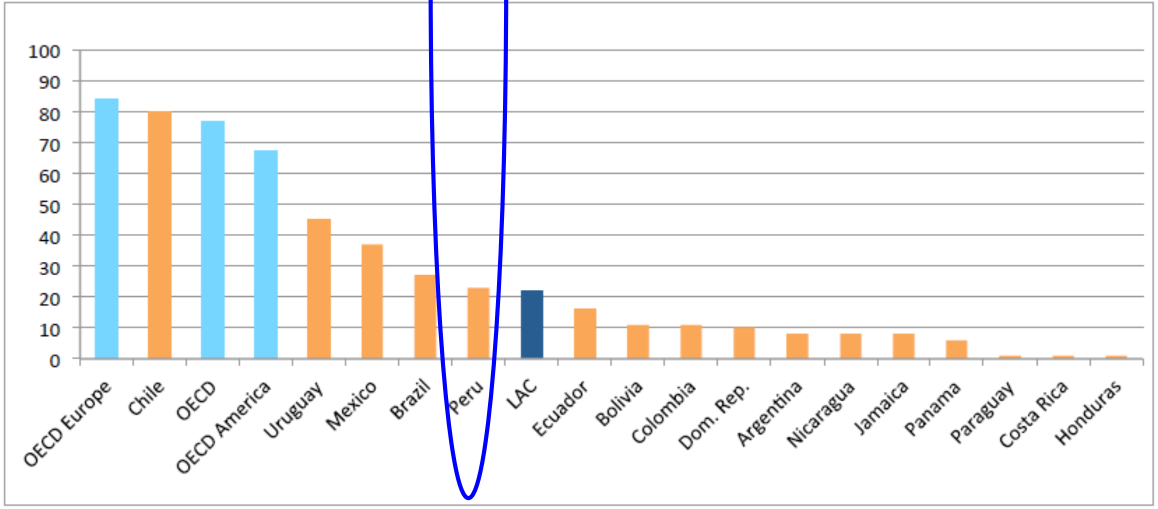
Sewerage network (% population connected) for selected countries in 2015

Source: OECD data 2015 and WHO/UNCEF, 2017

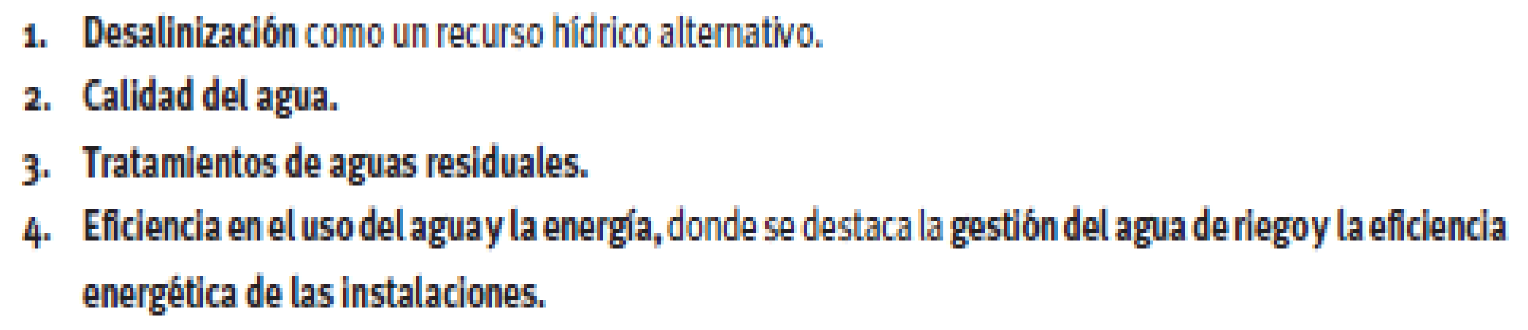


Wastewater treatment (% population connected) for selected countries in 2015

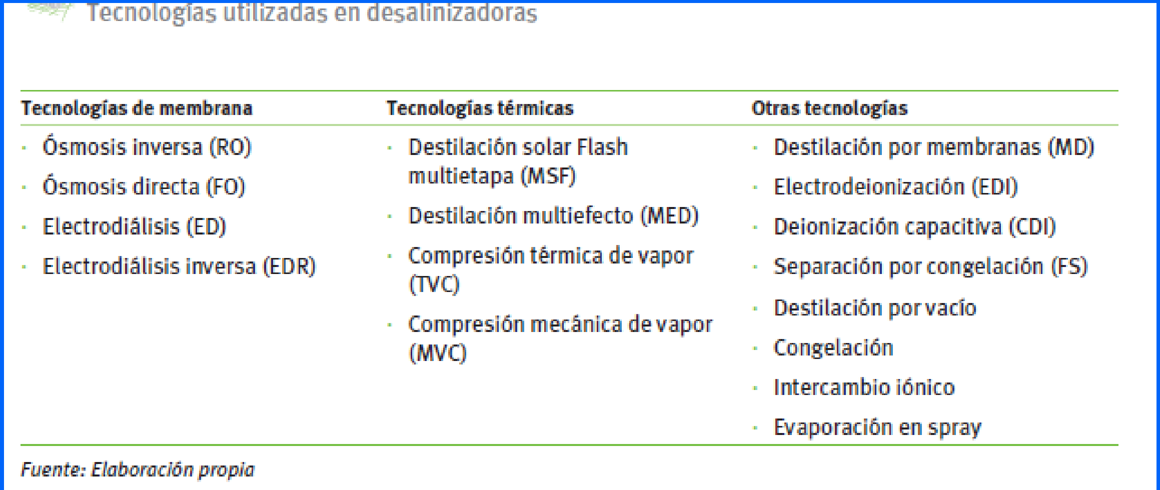
Source: OECD data 2015 and WHO/UNCEF, 2017



A paradigm shift is needed in the region regarding wastewater planning, management, and financing at the regional and project levels



1. **Desalinización** como un recurso hídrico alternativo.
2. **Calidad del agua.**
3. **Tratamientos de aguas residuales.**
4. **Eficiencia en el uso del agua y la energía,** donde se destaca la **gestión del agua de riego y la eficiencia energética de las instalaciones.**



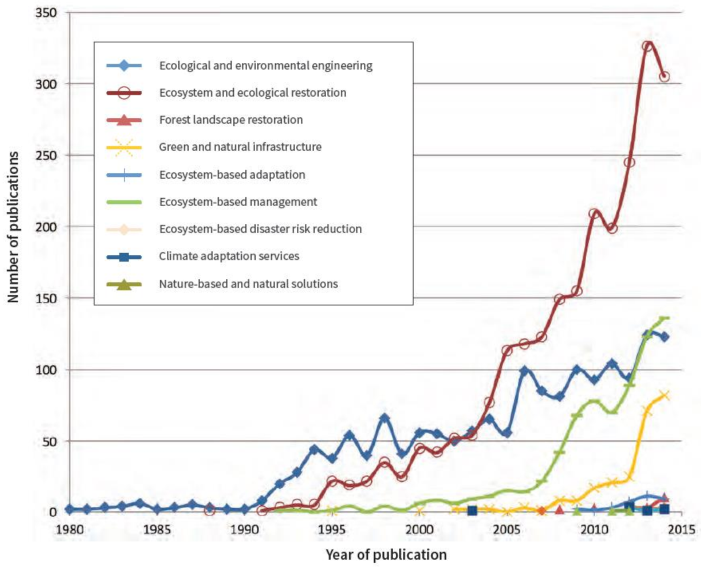
Tecnologías utilizadas en desalinizadoras

Tecnologías de membrana	Tecnologías térmicas	Otras tecnologías
· Ósmosis inversa (RO) · Ósmosis directa (FO) · Electrodiálisis (ED) · Electrodiálisis inversa (EDR)	· Destilación solar Flash multietapa (MSF) · Destilación multiefecto (MED) · Compresión térmica de vapor (TVC) · Compresión mecánica de vapor (MVC)	· Destilación por membranas (MD) · Electrodeionización (EDI) · Deionización capacitiva (CDI) · Separación por congelación (FS) · Destilación por vacío · Congelación · Intercambio iónico · Evaporación en spray

Fuente: Elaboración propia

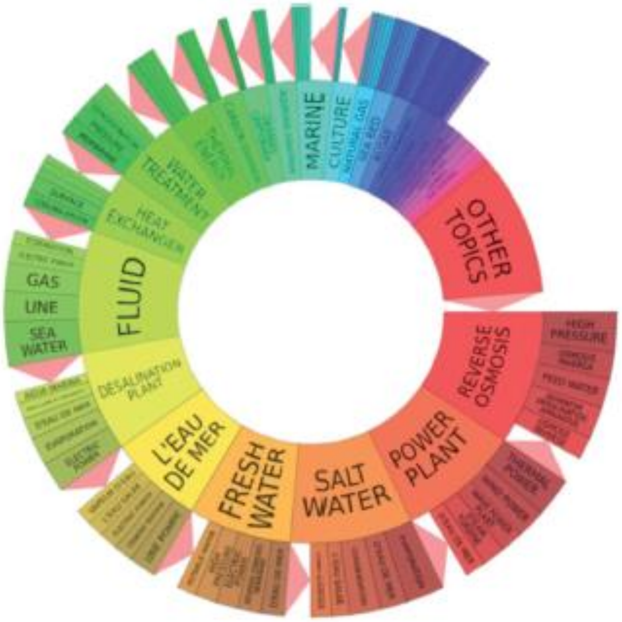
Tendencias en la investigación y patentes....

Figure 1.6 Trends in the number of research papers mentioning NBS and related approaches, 1980–2014

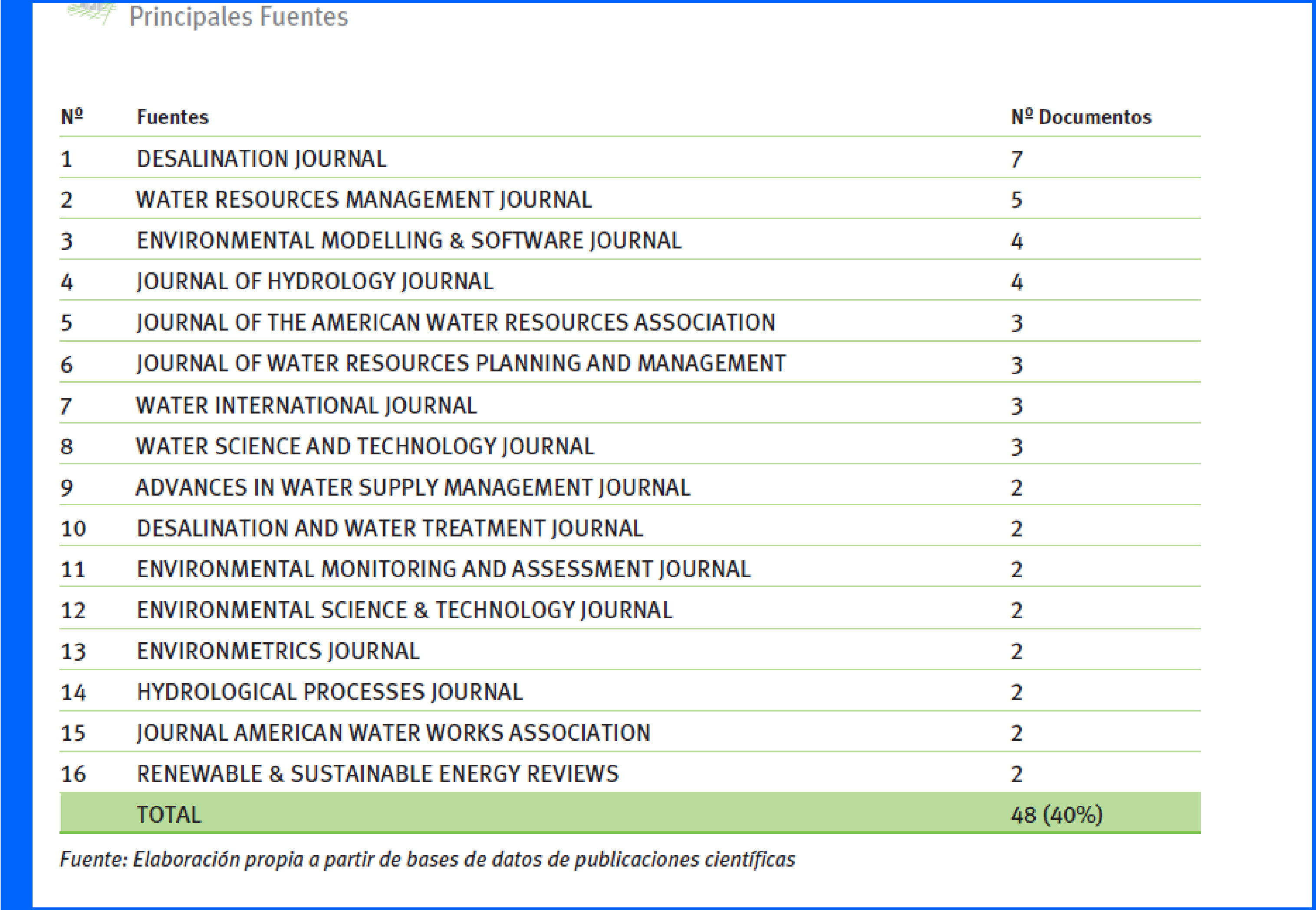


Note: 'Nature-based' and 'natural' solutions are terms not in wide use in the academic community and trends in their use are therefore not well reflected there.

Mapa de términos de las familias de patentes (2000-2014)



Fuente: Elaboración del sistema a partir de bases de datos de patentes utilizada

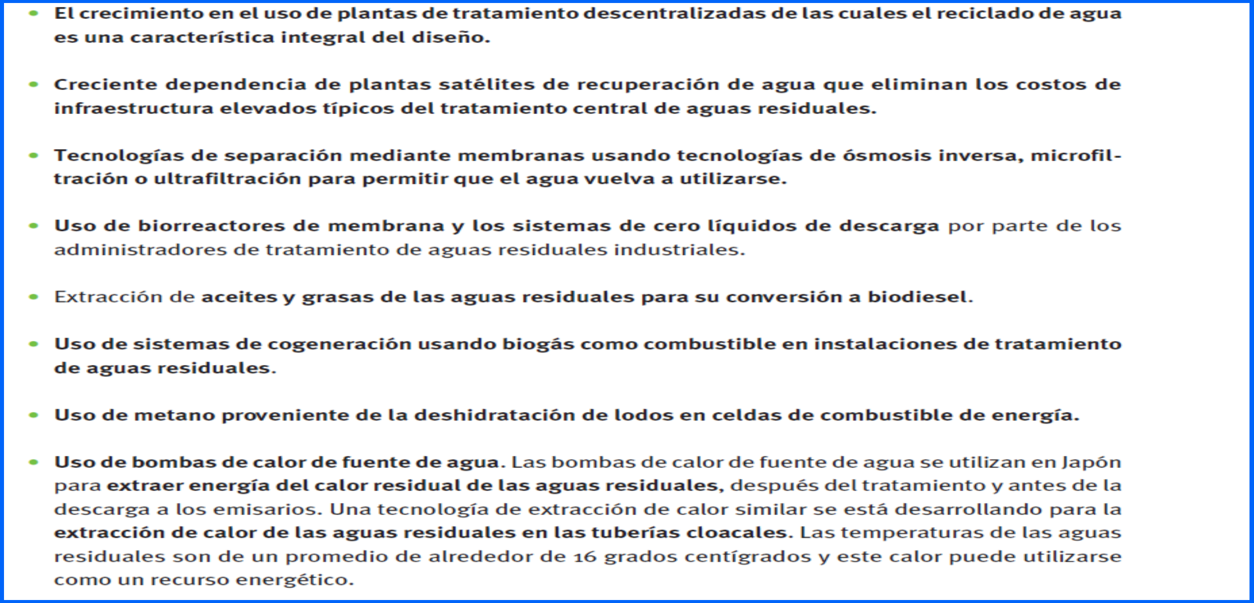


Principales Fuentes

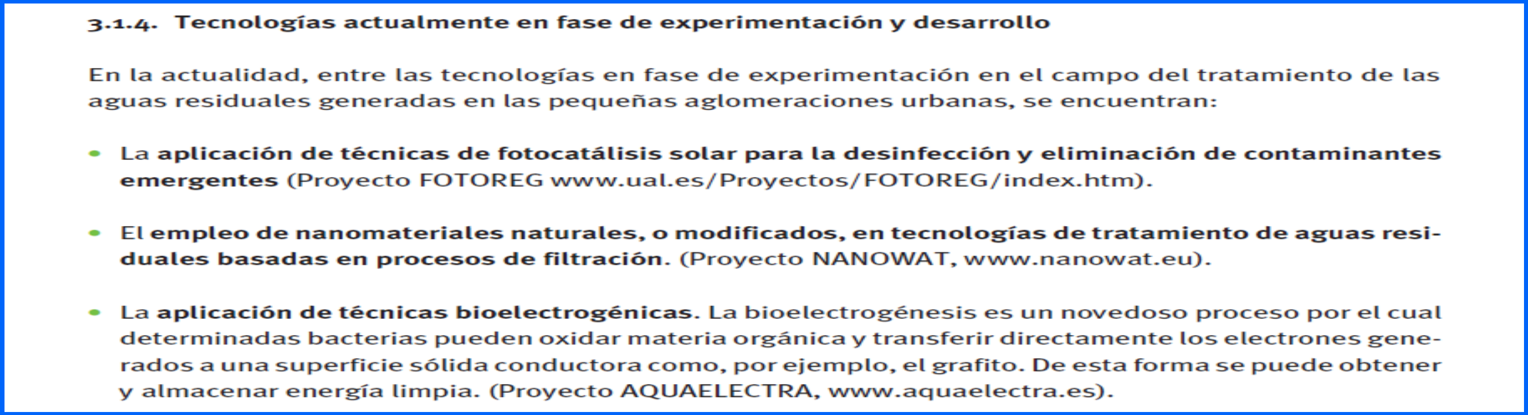
Nº	Fuentes	Nº Documentos
1	DESALINATION JOURNAL	7
2	WATER RESOURCES MANAGEMENT JOURNAL	5
3	ENVIRONMENTAL MODELLING & SOFTWARE JOURNAL	4
4	JOURNAL OF HYDROLOGY JOURNAL	4
5	JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION	3
6	JOURNAL OF WATER RESOURCES PLANNING AND MANAGEMENT	3
7	WATER INTERNATIONAL JOURNAL	3
8	WATER SCIENCE AND TECHNOLOGY JOURNAL	3
9	ADVANCES IN WATER SUPPLY MANAGEMENT JOURNAL	2
10	DESALINATION AND WATER TREATMENT JOURNAL	2
11	ENVIRONMENTAL MONITORING AND ASSESSMENT JOURNAL	2
12	ENVIRONMENTAL SCIENCE & TECHNOLOGY JOURNAL	2
13	ENVIRONMETRICS JOURNAL	2
14	HYDROLOGICAL PROCESSES JOURNAL	2
15	JOURNAL AMERICAN WATER WORKS ASSOCIATION	2
16	RENEWABLE & SUSTAINABLE ENERGY REVIEWS	2
	TOTAL	48 (40%)

Fuente: Elaboración propia a partir de bases de datos de publicaciones científicas

Aguas residuales,
Un 1er. Reto…



- **El crecimiento en el uso de plantas de tratamiento descentralizadas de las cuales el reciclado de agua es una característica integral del diseño.**
- **Creciente dependencia de plantas satélites de recuperación de agua que eliminan los costos de infraestructura elevados típicos del tratamiento central de aguas residuales.**
- **Tecnologías de separación mediante membranas usando tecnologías de ósmosis inversa, microfiltración o ultrafiltración para permitir que el agua vuelva a utilizarse.**
- **Uso de biorreactores de membrana y los sistemas de cero líquidos de descarga** por parte de los administradores de tratamiento de aguas residuales industriales.
- Extracción de **aceites y grasas de las aguas residuales para su conversión a biodiesel.**
- **Uso de sistemas de cogeneración usando biogás como combustible en instalaciones de tratamiento de aguas residuales.**
- **Uso de metano proveniente de la deshidratación de lodos en celdas de combustible de energía.**
- **Uso de bombas de calor de fuente de agua.** Las bombas de calor de fuente de agua se utilizan en Japón para **extraer energía del calor residual de las aguas residuales,** después del tratamiento y antes de la descarga a los emisarios. Una tecnología de extracción de calor similar se está desarrollando para la **extracción de calor de las aguas residuales en las tuberías cloacales.** Las temperaturas de las aguas residuales son de un promedio de alrededor de 16 grados centígrados y este calor puede utilizarse como un recurso energético.



3.1.4. Tecnologías actualmente en fase de experimentación y desarrollo

En la actualidad, entre las tecnologías en fase de experimentación en el campo del tratamiento de las aguas residuales generadas en las pequeñas aglomeraciones urbanas, se encuentran:

- La **aplicación de técnicas de fotocatálisis solar para la desinfección y eliminación de contaminantes emergentes** (Proyecto FOTOREG www.ual.es/Proyectos/FOTOREG/index.htm).
- El **empleo de nanomateriales naturales, o modificados, en tecnologías de tratamiento de aguas residuales basadas en procesos de filtración.** (Proyecto NANOWAT, www.nanowat.eu).
- La **aplicación de técnicas bioelectrogénicas.** La bioelectrogénesis es un novedoso proceso por el cual determinadas bacterias pueden oxidar materia orgánica y transferir directamente los electrones generados a una superficie sólida conductora como, por ejemplo, el grafito. De esta forma se puede obtener y almacenar energía limpia. (Proyecto AQUAELECTRA, www.aquaelectra.es).

- Necesitamos abordar adecuadamente los temas de aguas: dimensión, costo,operatividad y sostenibilidad de acuerdo a nuestro nivel de Desarrollo.
- Requerimos acceder a un Know-how sin restricciones para su desarrollo continuo.
- Necesitamos incorporar valor NBS a nuestros proyectos/investigaciones para avanzar lo técnico-cientifico optimizndo costos en el mediano plazo.
- El comportamiento de nuestras fuentes de agua es único y requerimos conocerlas bien: data, Tecnología, y manejo sostenible en costo.

GRACIAS..!!

Laguna Vizcachas , 4550 msnm Feb. 2013