



PBL Netherlands Environmental
Assessment Agency

THE GEOGRAPHY OF FUTURE WATER CHALLENGES

BENDING THE TREND

POLICY SUMMARY

in the context of the UN 2023 Water Conference

The Geography of Future Water Challenges

Bending the Trend

Policy Summary in the context of the UN 2023 Water Conference

THE GEOGRAPHY OF FUTURE WATER CHALLENGES

BENDING THE TREND

POLICY SUMMARY
in the context of the UN 2023 Water Conference

CONTENTS

Key messages	7
Introduction	11
1 Water and water systems are essential to life, but under heavy pressure	13
2 Current value systems and policies will not suffice to make the change	15
3 River-basin and water-systems approach in 4 hotspot landscapes	16
4 Much can be achieved under a High ambition pathway	20
5 Many co-benefits for the SDGs	24
6 The UN 2023 Water Conference: will voluntary commitments bend the trend?	26
7 Rising to the challenge: changing gear and direction	27
Appendix	32
References	34

Key messages

- **High urgency to tackle water and climate change challenges**
Water is essential to life and related to all human activities, but our freshwater resources and water systems are under heavy pressure and hundreds of millions of people are at risk of too little, too dirty or too much water. The pressures and risks are projected to intensify under future population growth and economic development, exacerbated by climate change. The many recently observed more frequent, high-intensity weather extremes and impacts due to climate change are beyond expectations and underline the immediate urgency to take action.
- **The essential role of water is structurally overlooked in current values, practices and policies**
The importance of water for nearly everything we value and want to achieve is structurally undervalued and overlooked, and the interrelated global water, climate and biodiversity crises show that current value systems, policies and economic practices are not suited to cope with the increasing pressures of socio-economic development and climate change. While the UN 2023 Water Conference has greatly boosted the attention for water, the proposed assignment of a global water envoy and the over 800 voluntary commitments from public and private organisations will not be enough to structurally bend the trend.
- **Bending the trend requires structural rebalancing of water and human development**
In all relevant sectors and by all relevant actors, water and its related values should be both valued as a critical resource and perceived as a potential threat to life, societies, economies and nature. Only then will policies be structurally changed so that they support rather than obstruct the required transition towards a sustainable, just and secure water world for all. The High ambition pathway in our study structurally rebalances human development and water by steering land use and spatial development to restore the functioning and quality of water systems, protecting and restoring natural areas and environmental flows, reducing water use and water pollution, and reducing vulnerability to the projected impacts of climate change.
- **Much can be achieved under a High ambition pathway**
Under the High ambition pathway, projections show that much can be achieved by 2070 (Figure 1). Major gains concern a reduction in the impacts of new large hydropower dams; a structural reduction in water use in agriculture, households and industries; the provision of safe drinking water, hygiene and sanitation facilities for all, thus reducing preventable diseases and deaths that predominantly impact women and children; a reduction in flood risks and nutrient pollution of rivers and coastal seas; the prevention of further subsidence in deltas; the preservation of ecological quality of river systems; more crop per drop being produced in dryland regions due to improved water management and crop production; and a reduction in the risks of local and transboundary conflict. The projected strong improvements by 2070 under the High ambition pathway are reflected in most regions, but least of all in Sub-Saharan Africa, South Asia and Southeast Asia. An even higher level of collective effort will be needed in those regions.

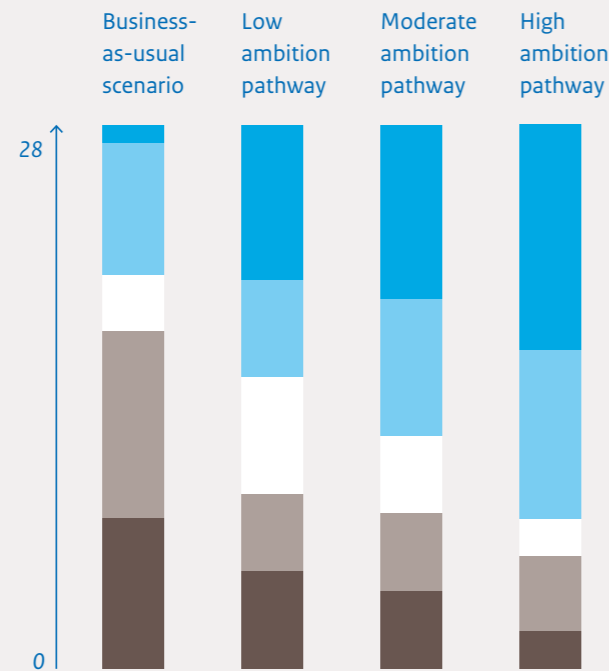
Figure 1. Much improvement can be achieved

Especially under a High ambition pathway, much can be achieved in tackling the water and climate-related challenges, with many co-benefits for the SDGs.

Number of the assessed indicators (28 in total) for the four hotspot landscapes (see Appendix 1) that will deteriorate or improve between 2020 and 2070.

Improvement or deterioration (2020–2070)

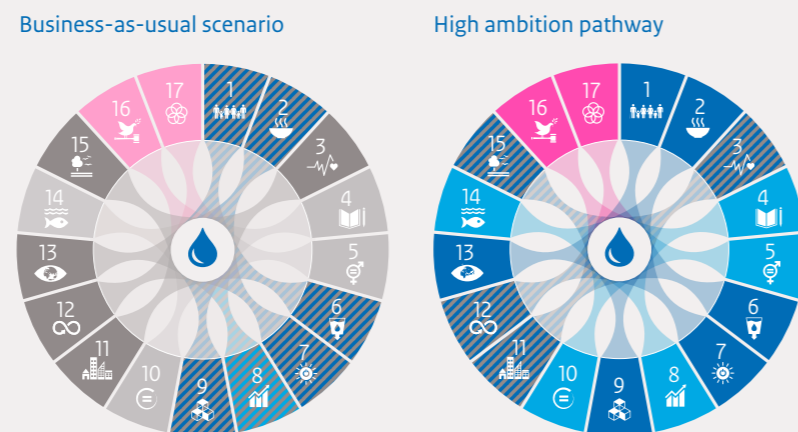
- > 35% improvement
- 5–35% improvement
- Less than 5% change
- 5–35% deterioration
- > 35% deterioration



Potential co-benefits for the SDGs

- Positive (qualitative/quantitative)
- Negative (qualitative/quantitative)
- Positive and negative (qualitative/quantitative)
- Conditional (not fulfilled / fulfilled)

Source: PBL



The High ambition pathway also contributes to reducing the disruption of two of the nine critical planetary boundaries, i.e. freshwater flow and the biochemical nutrient flow of phosphorus and nitrogen. In spite of a population growth of 30% and a tripling of global GDP, total global water withdrawal by 2070 is projected to decrease by around 34% compared to 2020, and the polluting nutrient emissions to water to decrease by around 10%.

- **Many co-benefits for the Sustainable Development Goals (SDGs)**

Water is linked to all the SDG values and the high ambition efforts to reduce the water- and climate-related risks have many co-benefits for all the SDGs and their interlinkages (Figure 1). Although there are many synergies across the various domains, a wicked sustainability problem rises with respect to the construction of large hydropower dams: on the one hand, these dams contribute to the production of renewable energy (SDG 7), while, on the other, they lead to the displacement of local communities and disruption of water and sediment flows, fish migration and the sediment supply to downstream deltas and coasts, resulting in a loss of the ecological quality of rivers, deltas and their wetland areas.
- **Long-term water- and mission-based policies required on all levels, from local to global**

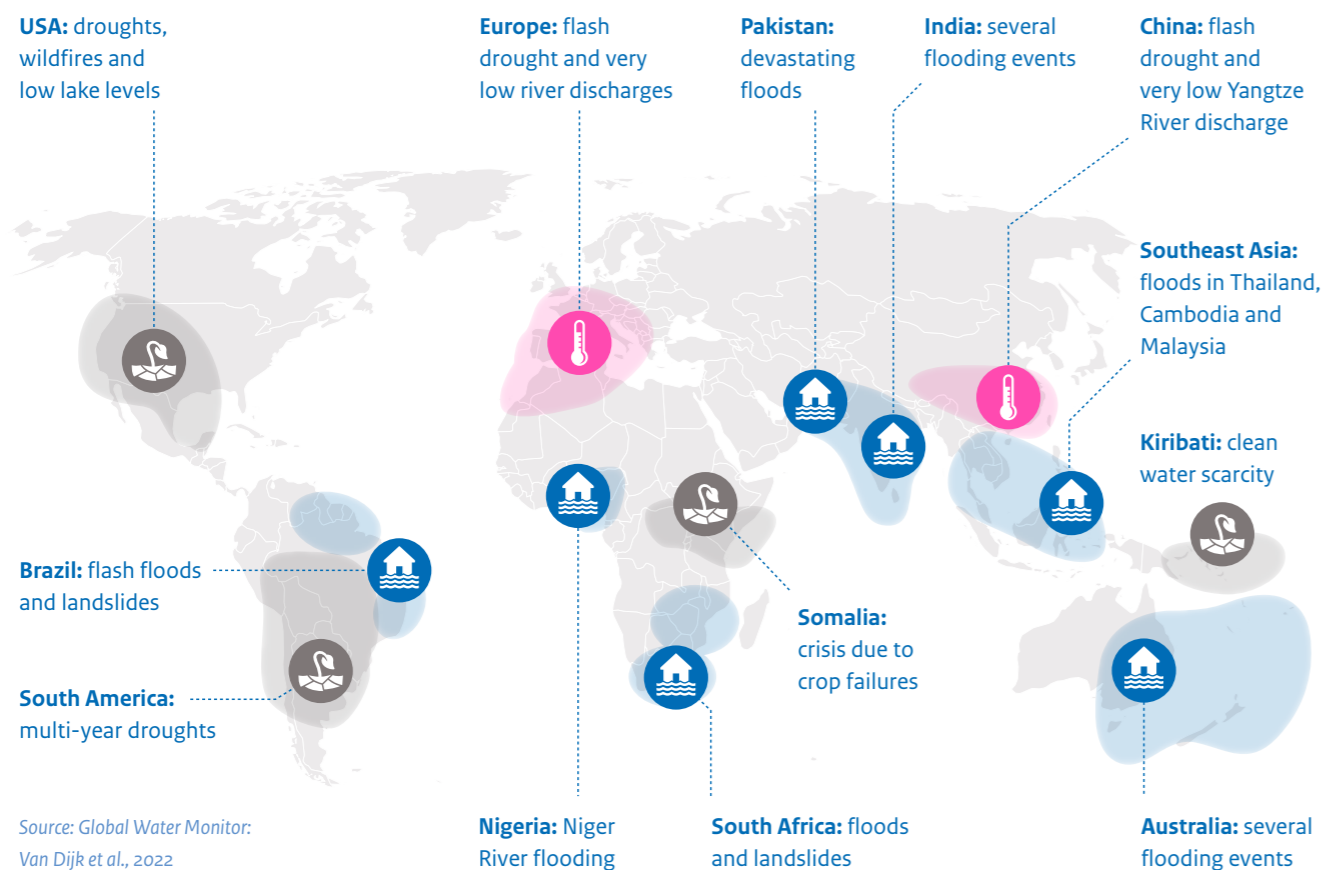
Bending the trend calls for a mission-driven approach to reduce water and climate risks which is integrated in the collective mission of the SDGs. Development of High ambition, long-term pathways requires the integration of water and climate adaptation agendas, coherent policies, supporting instruments and sufficient financing across sectors. As follow-up to the UN 2023 Water Conference, a structural UN process of strengthening global governance and financing systems will be critical in supporting and accelerating the required transition on all levels, from global to local, in River basins, Deltas and Coasts, Drylands, and Cities.
- **The water sector cannot do it alone: specific responsibilities for public authorities**

There is a high level of urgency to acknowledging the pivotal role and value of water in sustainable development and creating radically different incentives to bend the trend. National, provincial and local authorities have a specific responsibility, in this respect. They are in a position to change the rules of the game and develop transformative incentives across sectors. Bending the trend, however, also means that influential and powerful private companies, sectoral organisations, and financing organisations (public and private) need to take their responsibility and exercise leadership.

Failing to make the required changes and thus failing to structurally bend the trend will result in increased water- and climate-related disruptions, exacerbating the risk of being displaced for hundreds of millions of people.

Figure 2. Major water-related disasters in 2022

In 2022, weather extremes and impacts beyond expectation hit many regions of the world. 2023 shows a similar picture.



Source: Global Water Monitor: Van Dijk et al., 2022

Introduction

Water is critical to all life on Earth. Over the last years, it has become clear more than ever that water- and climate-related risks are a matter of life and death for the world: extreme events of flooding, drought, downpours, hailstorms, wildfires, heatwaves and tropical storms are increasingly disrupting societies and ecosystems across the world. Without effective responses, water- and climate-related disasters are projected to become more extreme and more frequent.

Wake-up call: extreme events beyond expectation

The recent ‘extremely extreme’ events of flooding, drought, wildfires and hurricanes, ocean acidification and warming, polar and glacial ice melts and heatwaves were beyond expectation and heavily affected societies and economies across the globe, illustrating the urgent need for robust solutions to water- and climate-related risks (Figure 2).

From challenges to solutions

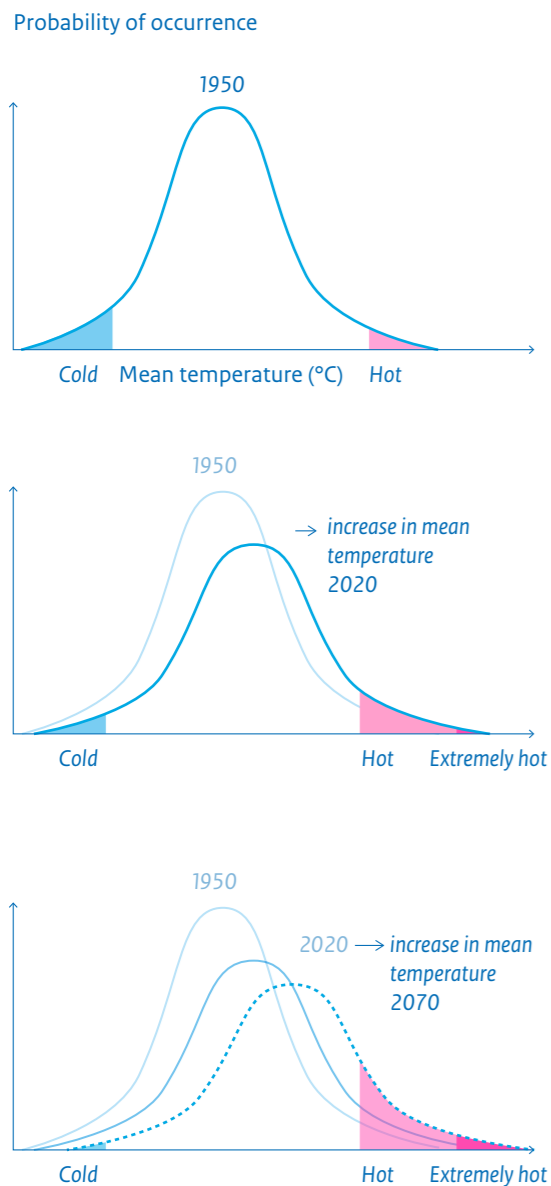
Just before the start of the UN 2023 Water Conference of 24–27 March, in New York, PBL Netherlands Environmental Assessment Agency published *The Geography of Future Water Challenges — Bending the Trend*¹.

Starting from a systems approach, this study explores solutions to reduce water- and climate-related risks across the world, up to 2070, and assesses the effects of potential measures for the four ‘hotspot landscapes’: River basins, Deltas and Coasts, Drylands, and Cities. Captured in infographics and focusing on High ambition pathways, this study shows that much can be achieved when following a transformative high-ambition approach. This comprehensive study, rich in narratives and explorations, is complemented with this Policy Summary, which highlights the study’s main findings, also in context of the results of the UN 2023 Water Conference. This Policy Summary includes two new summarising figures (Figures 8, p. 20 and 10, p. 23) and a short evaluation of the UN 2023 Water Conference (Section 6, p. 26; Section 7, p. 27).

Climate change, population growth and economic development will not wait, and the world is already facing strongly disrupted water resources and water systems. The urgency to take action and start the process of transformation is high. In the words of Secretary-General Antonio Guterres at the closure of the UN 2023 Water Conference: ‘Water needs to be at the centre of the global political agenda’. The coming decades will be critical for bending the trend. The approach and findings of *The Geography of Future Water Challenges — Bending the Trend*¹ reveal that, under a High ambition pathway and with strengthened governance, from global to local levels, there is a hopeful perspective on tackling the water crises and bending the trend.

Figure 3. Shifts in extremes

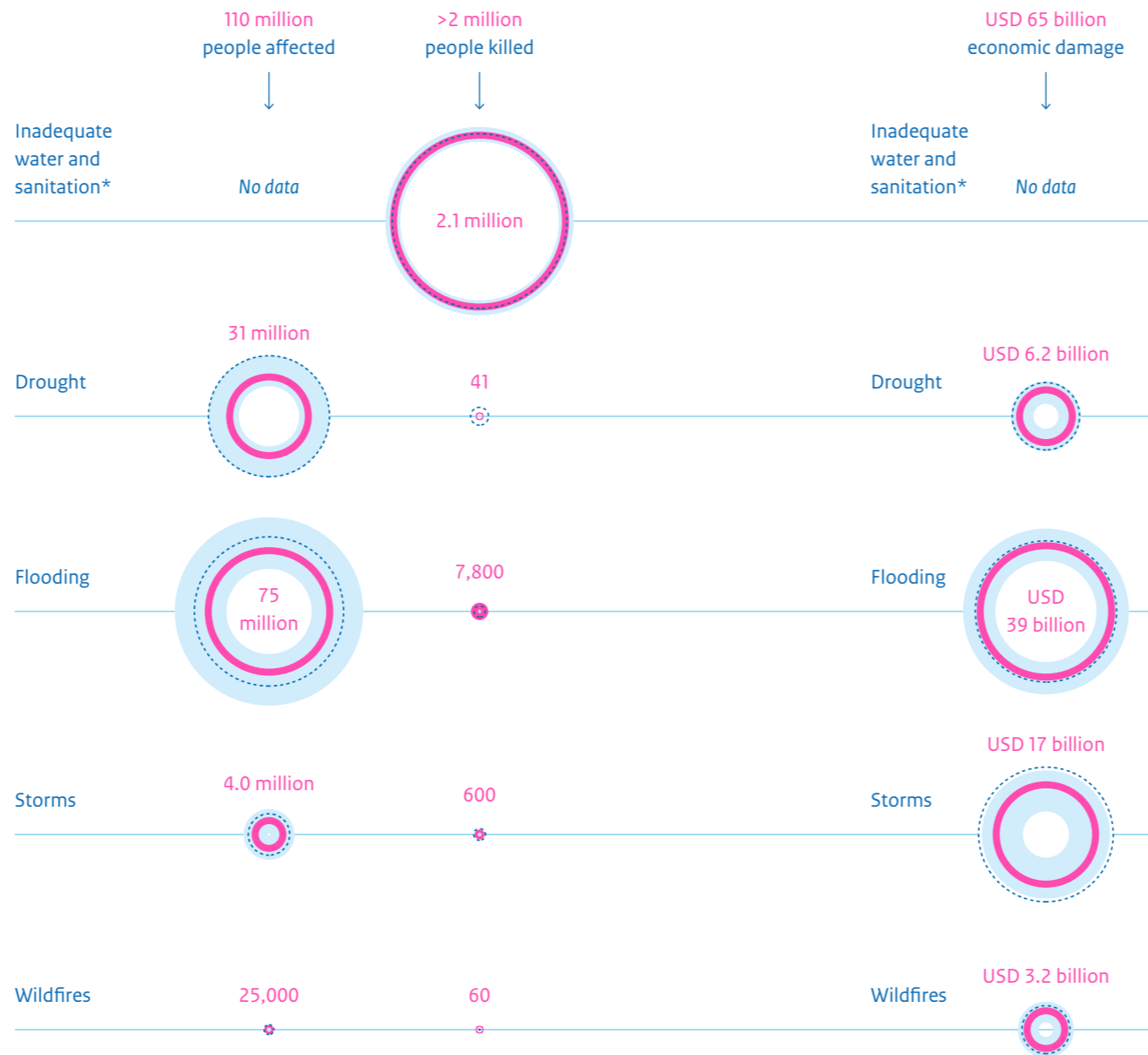
Shifts in the frequency distribution of global daily maximum temperatures between 1950 and 2020 (data NASA) and between 2020 and 2070 (estimate), showing strong shifts in extremes with increasing mean temperatures.



Source: PBL

Figure 4. Annual impact of water-related disasters and diseases

Between 1980 and 2020, globally, inadequate water and sanitation had a major impact on the number of people killed, while flooding in particular caused major economic damage.



○ Median value ● Average value ■ D25 and D75 (percentiles)

Source: CRED; data 1980–2020
*IHME, 2019; data 1990–2019

1 Water and water systems are essential to life, but under heavy pressure

Fresh water is a precious resource. Only 2.5% of the water on Earth is fresh water and almost all of this in the form of ice and groundwater; only 0.3% of this concerns the water in rivers and lakes. Globally, water resources and water systems are greatly under pressure due to the high levels of water use, in many regions leading to overexploitation of this resource and high levels of water pollution². At the same time, population growth and unsustainable land-use development across the globe increase the exposure of societies and their economies to climate hazards⁵. Recent overviews show that the biodiversity of freshwater systems has declined by over 80%, far more than that of any other type of ecosystem in the world³, and that in 2020 still 26% of the world population lack safely managed drinking water facilities and 46% lack safely sanitation services⁴.

Climate change: water-related risks increase

Global warming is the driver of many impacts on, amongst other things, water systems quality and the occurrence and intensity of water-related disasters. These impacts include changes in the melting level of glaciers and ice sheets, precipitation and evaporation patterns, river flows, soil moisture, sea level rise, as well as higher water temperatures that negatively affect water quality (i.e. lower oxygen levels, higher risk of toxic algal blooms) and the environmental conditions for freshwater species.

Observations over the 1950–2020 period show that the overall shape of the probability curve of daily maximum temperature has changed structurally. A gradual increase in mean values is accompanied by a strong shift in temperature extremes (Figure 3). These changes are projected to continue into the future. The increasing likelihood of extreme weather events, such as droughts, heat-waves, downpours, and extremely low and high river discharges, increase the risk of human casualties and societal, economic and ecological disruption.

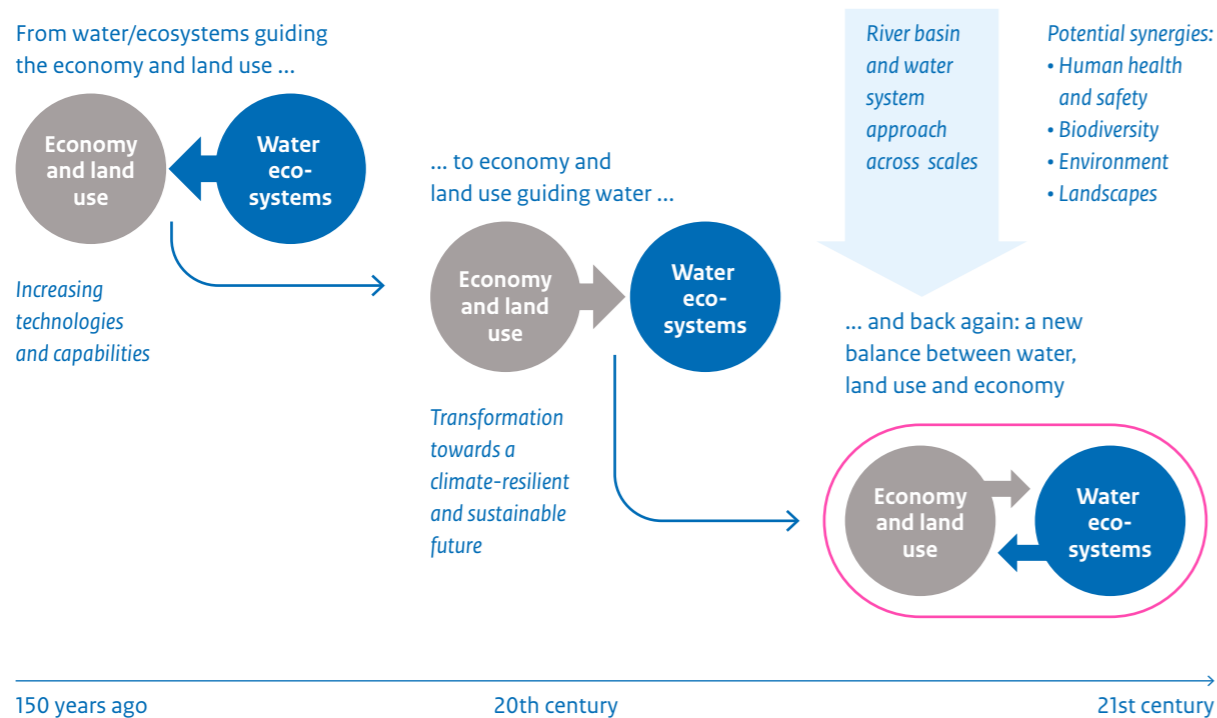
Hundreds of millions of people are facing increasing risks of too little, too dirty or too much water

Millions of people die every year because of polluted water and lack of adequate sanitation, and tens of millions are affected by water-related disasters, such as flooding, heavy rain, storms and drought (Figure 4). At the same time, humanity faces population growth in large parts of the world, a worsening of already heavily deteriorated water systems and related biodiversity, an increasingly disturbed water cycle, and a changing climate with unprecedented weather extremes.

The urgency for action is high and, more than ever, water and climate adaptation should be at the top of all agenda's — on all scales, from local to global, and from public to private.

Figure 5. Finding a new balance

While of old water system characteristics determined land use and economic growth, since the industrial revolution this dependence was reversed disrupting the qualities of water systems. Today rebalancing the interaction between the two is needed.



Source: PBL

2 Current value systems and policies will not suffice to make the change

Environmental and development challenges are interlinked across thematic, institutional and geographic boundaries through social, cultural, policy and natural processes. The interrelated global water, climate change and biodiversity crises, and the increasing unequal distribution of impacts and risks across the world show that current value systems, policies and economic practices are not fit to make the changes that are needed to reduce vulnerabilities at the global scale. In line with the conclusions of the first report (*The Geography of Future Water Challenges*⁵), various studies point out that making a shift towards sustainable development calls for fundamental changes in approaches, valuation and the measuring of success^{6,27}. High ambition policies inspired by values and ambitions — including cultural and indigenous knowledge and capacities — that aim for sustainable development and a reduction in water and climate risks will be required to structurally bend the trend.

Bending the trend: radical change in balancing human development and water

The fundamental challenges regarding water and climate adaptation will be to rebalance human development and the quality and functioning of water systems. This asks for a radical change from today's paradigm 'the economy and land use determine how we use water' to 'water systems determine economic use and land-use development' (Figure 5). A critical instrument in rebalancing human development and water systems while adapting to climate change is the implementation of a river-basin and water system-based approach, underpinning coherent strategies for spatial development, water use, combating polluting emissions, and flood and drought risk management.

3 River-basin and water-systems approach in 4 hotspot landscapes

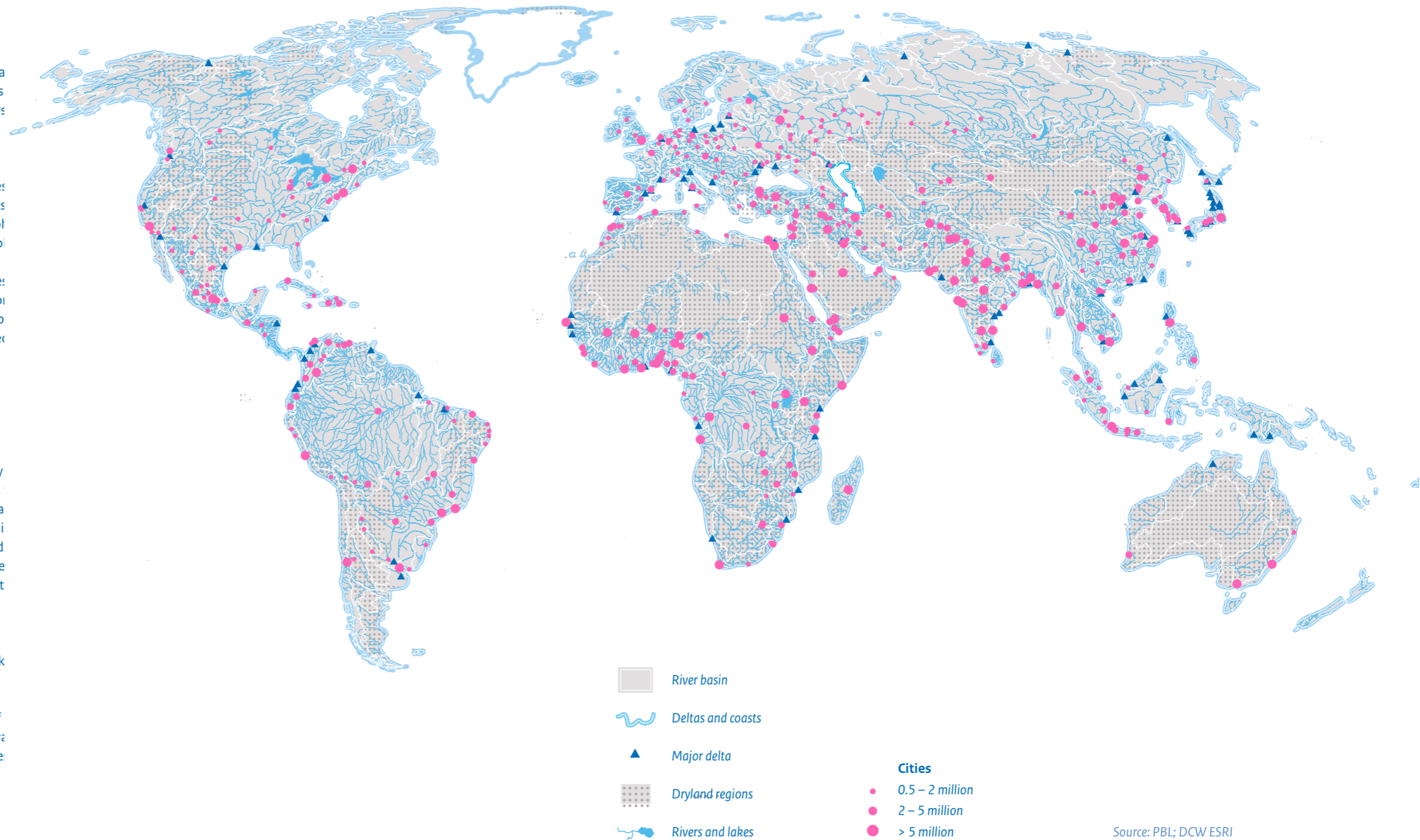
In *The Geography of Future Water Challenges*⁵ we identified four hotspot landscapes with specific clusters of water- and climate related challenges: River basins, Deltas and Coasts, Drylands and Cities (Figure 6). These hotspot landscapes are the levers for rebalancing human development and water, while increasing resilience to climate change.

River basins and river systems because rivers are the arteries of the Earth and important economic and socio-cultural axes in many countries, and river basins form the critical geographical landscape for long-term, climate-resilient and sustainable development across the globe. There are around 310 transboundary river basins, shared by 150 countries and territories. Together they cover 47.1% of the Earth's land surface and contain 52% of the world population⁸. Critical issues are the impact of hydropower dams, water withdrawal and pollution related to agriculture, households and industries, river flood risks, droughts, ecological quality, subsidence and transboundary conflict risks.

Deltas and Coasts, and Drylands because they are at the forefront of water- and climate-related vulnerabilities and already face severe threats. Without action, these areas may be confronted with serious limits to their ability to adapt to, for example, sea level rise, heat and drought in the coming decade. On average, population growth is taking place more rapidly in these highly vulnerable regions. Critical issues for Deltas and Coasts (including islands) are freshwater supply, groundwater withdrawal resulting in subsidence, the decline in biodiversity and wetlands, coastal flood risks, and pollution of coastal waters. For Drylands, critical objectives are to achieve an increase in local crop production in combination with more efficient water use, and reducing both migration and the risk of local water-related conflict.

Cities are projected to accommodate approximately 70% of the world population by 2070 and already are hotspots of water insecurity, exposure to climate change and weather extremes. Cities are found in each of the three other landscapes, and critical issues are freshwater supply, hygiene and sanitation, wastewater treatment, flood risk and heat stress. The large concentration of people and the autonomous investments in urban areas on less than 1% of the global land area offer a no-regret opportunity for effectively reducing water- and climate-related risks and improving human well-being.

Figure 6. River basins in integrated landscapes

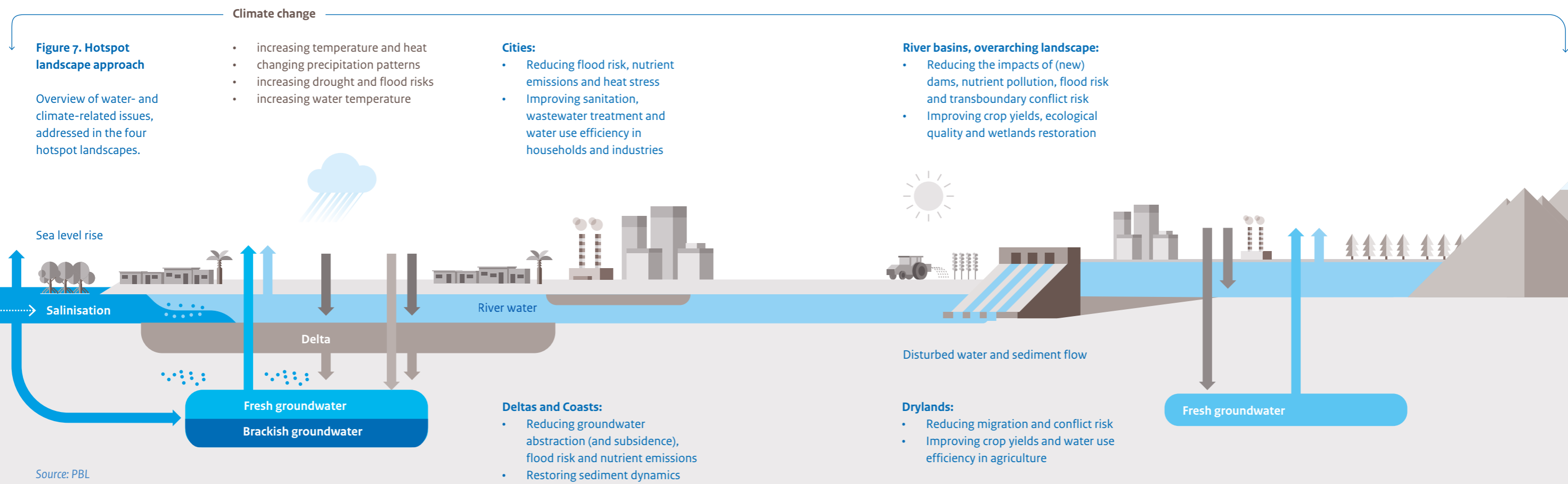


Source: PBL; DCW ESRI

Using the four hotspot landscapes, pathways of solutions to improve the quality of water systems and tackle water- and climate-related risks have been explored under different ambition levels (i.e. Low, Moderate, High). Twenty-eight indicators (see Appendix 1, p. 32) were selected to assess the effects of these pathways on reducing water- and climate-related challenges and risks (Figure 7). The analyses in this study are based on the second socio-economic pathway (SSP2), in combination with the the Representative Concentration Pathway (RCP) 6.0 climate change scenario (see text box).

Underlying socio-economic pathway and climate change scenario
The scientific community has developed five shared socio-economic pathways (SSPs) to explore the future. The analyses in this study are based on the SSP2 pathway, in combination with the RCP 6.0 climate change scenario. Under the SSP2 pathway, which is generally considered a Business-as-usual or Middle-of-the-road scenario, the global population is projected to

grow from 7 billion people today to around 9 billion people by 2070 (30% increase) and the economic development is projected to triple global GDP by 2070. The RCP 6.0 climate change scenario projects a temperature increase of close to 3 °C by 2070 and 3.7 °C by 2100, reflecting a situation in which the Paris Agreement's target of a maximum global temperature increase of 1.5 °C or 2 °C will not be achieved.



Source: PBL

4 Much can be achieved under a High ambition pathway

Applying the water and adaptation measures under a Low, Moderate and High ambition level¹ shows a structural shift and improvement in reducing water- and climate-related risks compared to under the Business-as-usual scenario (Figure 8).

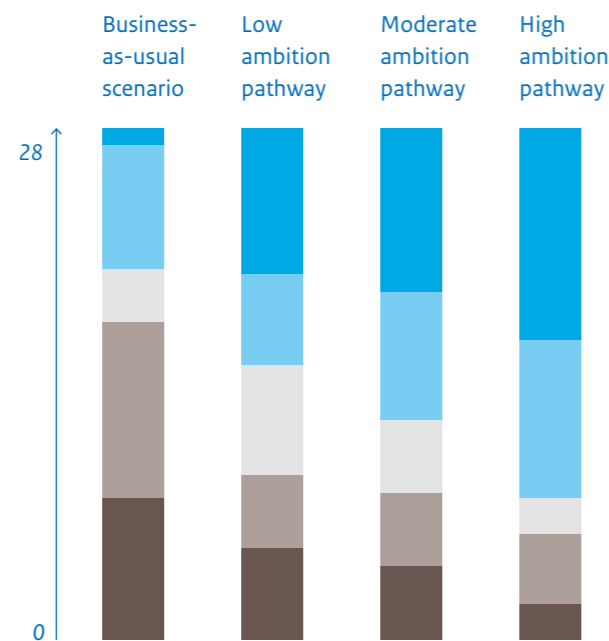
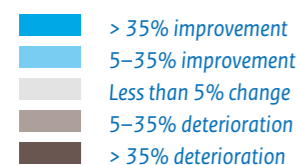
Under the Business-as-usual scenario, most indicators (around 60%) show a decline of more than 5% compared to 2020, and around 25% of the indicators (including total crop production, the number of people living in water-stressed conflict areas and those connected to a sewerage system) show an improvement of more than 5%.

An increase in ambition level for future pathways, from Low to Moderate and High, gradually increases the number of indicators that show substantial improvement compared with the situation in 2020. The percentage of addressed indicators that show more than 5% improvement increases from about 25% under the Business-as-usual scenario to about 75% under the High ambition pathway. Improvements are particularly strong for indicators related to *too little and too dirty water*. Clearly, under this high level of ambition, there is a great deal of perspective to improve water use efficiency and food production, and structurally improve the conditions for water, sanitation and hygiene (WASH). In addition, over-exploitation of water and groundwater resources, projected water stress and related conflict risk can be reduced, substantially.

Figure 8. Number of indicators that show improvement or deterioration

Number of the assessed indicators (28 in total) for the four hotspot landscapes (see Appendix 1) that will deteriorate or improve between 2020 and 2070.

Improvement or deterioration (2020–2070)



Source: PBL

Contribution to reducing the disruption of two of the nine critical planetary boundaries

Under the High ambition pathway a decoupling of population growth, economic growth and important pressures on the water systems can be achieved, which will contribute to reducing the disruption of two of the nine critical planetary boundaries: freshwater flow and the biochemical nutrient flow of phosphorus and nitrogen⁹. While the population is projected to grow by 30% and global GDP will triple (see text box, p. 19), global water withdrawal by 2070 under the High ambition pathway is 42% lower than under the Business-as-usual scenario by that year and 34% lower than in 2020. The polluting nutrient emissions are reduced by 36% and 10%, respectively (Figure 9, p. 22)¹. Globally averaged, and acknowledging the differences between high- and low-income countries, this means that total water withdrawal, per person, by 2070 will be reduced from around 519,000 litres/person/year under the Business-as-usual scenario to around 316,000 litres/person/year under the High ambition pathway. Nutrient emissions will be reduced from around 10 kg/person/year to around 7 kg/person/year.

However, not even the High ambition pathway will resolve all challenges. Although, compared to the Business-as-usual scenario, substantial gains will be achieved towards 2070, some indicators still show a decline compared to 2020. For instance, nutrient emissions from cities will still increase, as will projected river and coastal flood risks, driven by a strong urban development and GDP growth. The reduced impact of hydropower dams and restoration of the ecological quality of rivers and wetland areas will result in local improvements, but, on the global scale, will just compensate for the projected decline under a Business-as-usual scenario.

Large regional differences: Sub-Saharan Africa and South and Southeast Asia are lagging behind

Projected future global developments are not the same in every region. The Business-as-usual scenario shows a further deterioration for most indicators, between 2020 and 2070, in particular in Africa and Asia. For the global picture, a strong improvement under the High ambition pathway is reflected in all regions, but least of all in Sub-Saharan Africa, South Asia and Southeast Asia. In Asia, strong economic growth and the decline in population growth — expressed in GDP per capita in Figure 10 (p. 23) — create the conditions to significantly improve freshwater supply and sanitation, while, in Africa, strong population growth and economic development continue to put a great deal of stress on freshwater supply and sanitation.

Figure 9. Two examples of the projected trends under different pathways

Under the High ambition pathway, a decoupling of population growth, economic growth and important pressures on the water systems can be reached. Compared to the Business-as-usual development, the global water withdrawal by 2070 is projected to decrease by 42% (example one), and the nutrient emissions by 36% (example two).

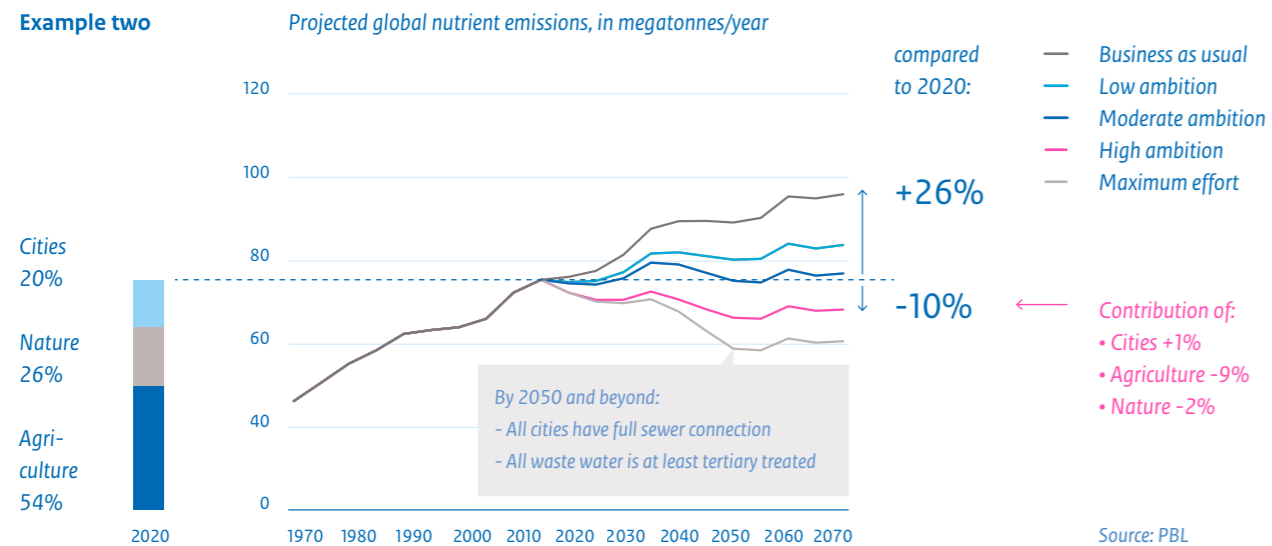
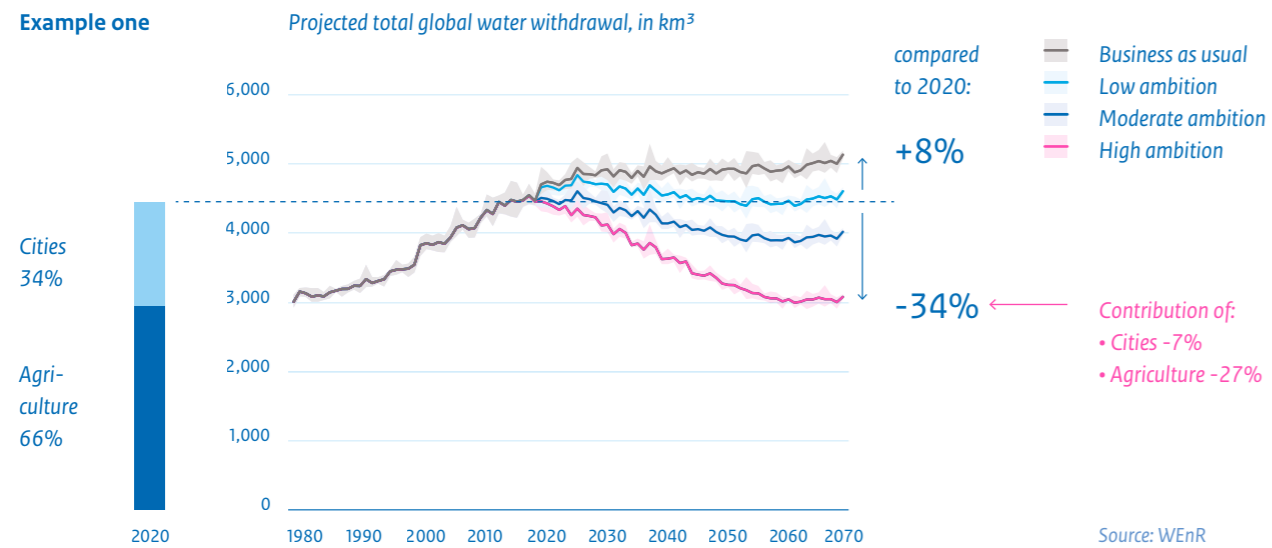
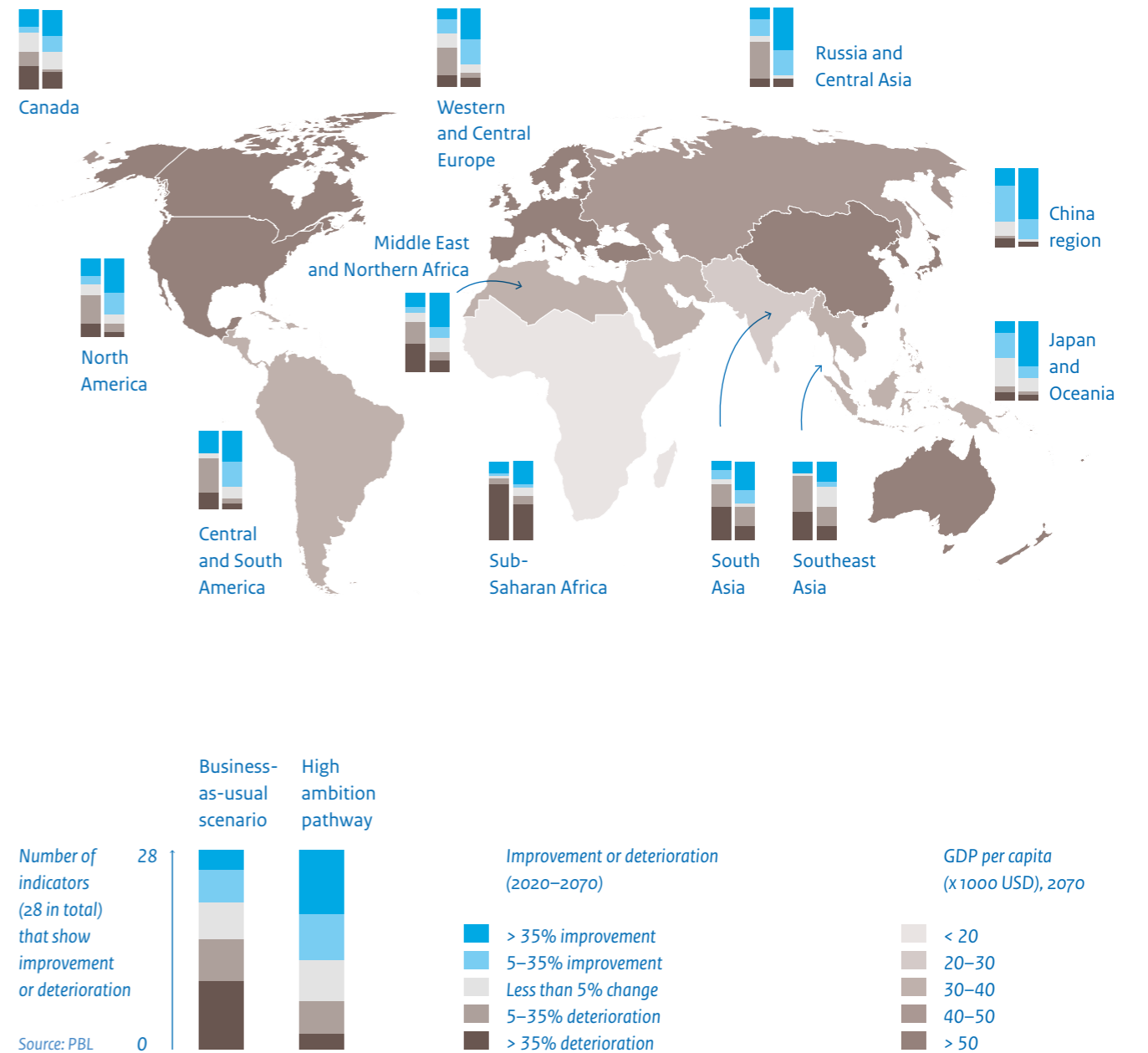


Figure 10. Projected changes for global regions, 2020–2070

Overview of projected changes in water- and climate-related impact indicators for 11 global regions under the Business-as-usual scenario and High ambition pathway.



5 Many co-benefits for the SDGs

Water is linked to all Sustainable Development Goals (SDGs)⁵. A high ambition approach of tackling the water- and climate-related challenges can contribute in many ways to achieving the SDGs and thus to sustainable development. The High ambition pathway shows substantially more co-benefits for the SDGs than is the case under the Business-as-usual scenario (Figure 11). As not all indicators are projected to improve compared to 2020 (Figure 8, p. 20), for some SDGs both positive and negative contributions are projected under the High ambition pathway.

Figure 11. Potential co-benefits for the SDGs

Quantitative- and qualitative-based appreciation of the potential co-benefits, by 2070, of measures and policies under the Business-as-usual scenario and the High ambition pathway. Conditional for the High ambition pathway is an effective operationalisation of SDG 16 (Strong institutions) and 17 (Partnerships for the Goals), on all levels, from global to local.

- Positive (qualitative/quantitative)
- Negative (qualitative/quantitative)
- Positive and negative (qualitative/quantitative)
- Conditional (not fulfilled / fulfilled)

Business-as-usual scenario



High ambition pathway



Source: PBL

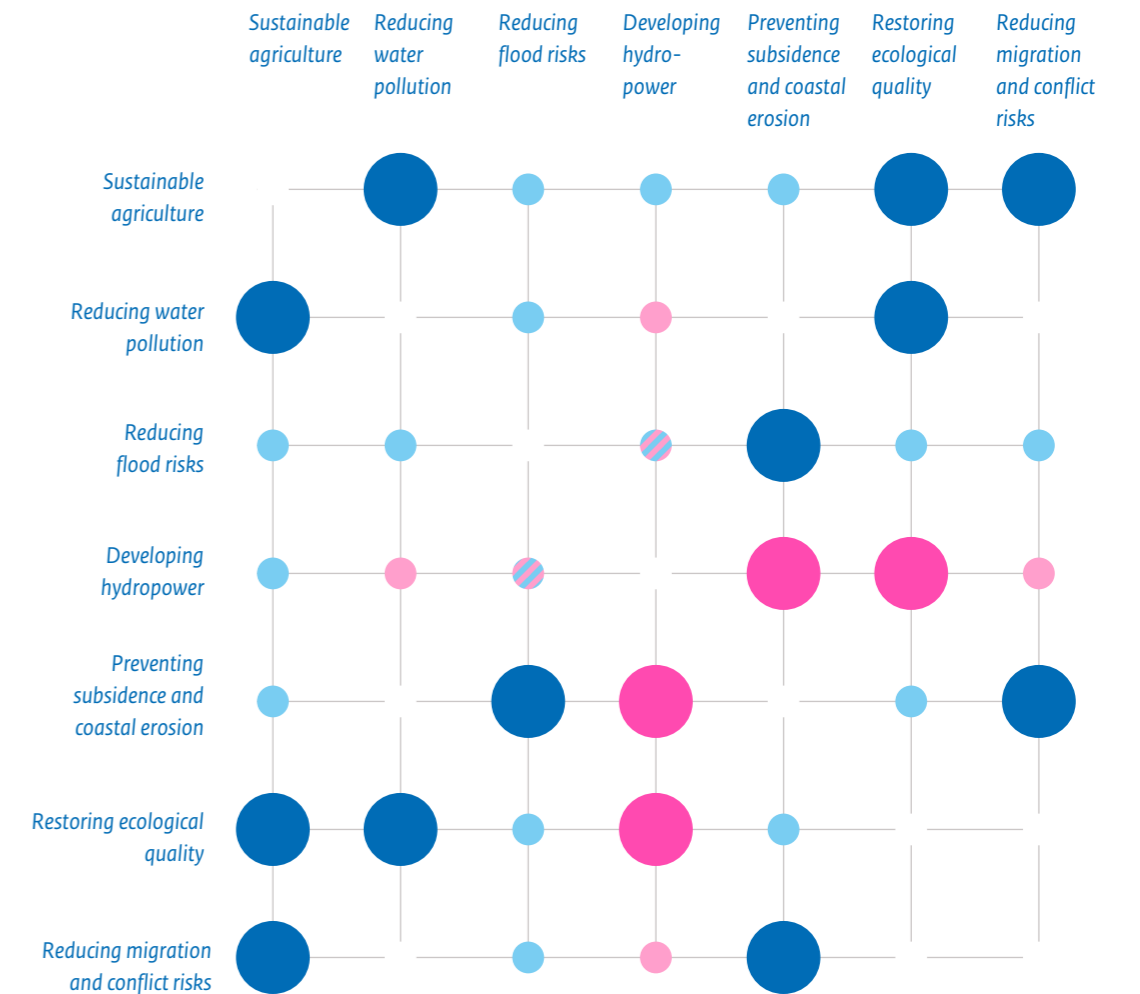
Figure 12. Synergies and trade-offs across domains

Under the High ambition pathway there are many synergies between various domains, but a wicked sustainability problem with hydropower development to increase the renewable energy production negatively affects the ecological quality of river systems and sediment flows to deltas and coasts.

A wicked sustainability problem with hydropower

A major wicked problem rises with respect to the construction of hydropower dams (Figure 12). These dams are obstructions to the continuity of water and sediment flows and to the migration of fish, and damage ecosystem sustainability and living conditions in rivers and deltas. Additional dams are being planned — partly because of the need to reduce the use of fossil fuels — which will put additional pressure on rivers and deltas. Adverse impacts will be strongest in the Southern Hemisphere, where the current number of river dams is relatively low but a catch-up in new dam construction is expected over the next 50 years. A strong increase in solar power may reduce the demand for hydropower, and building small-scale dams instead of large dams may reduce the impact of hydropower on rivers and deltas. Without adequate supportive social, economic and cultural processes, the construction of the large hydropower dams will also lead to the displacement and disruption of local communities⁵.

- Potential co-benefit**
- Large
- Small
- Potential trade-off**
- Large
- Small



Source: PBL

6 The UN 2023 Water Conference: will voluntary commitments bend the trend?

The UN 2023 Water Conference, which was held from 22 to 24 March in New York, was the first UN freshwater conference in nearly 50 years. It has raised a lot of attention and awareness, and yielded over 800 water-related action commitments from national governments, provinces and municipalities, businesses, NGOs, and others, as well as to the proposed assignment of a UN Water Envoy¹⁰. These 800+ voluntary pledges form an international Water Action Agenda that is designed to address the many water challenges the world currently faces — from floods and droughts to a lack of both clean drinking water and access to adequate sanitation. The World Resources Institute (WRI) analysed the 700+ commitments that were registered by the time the conference closed, and found that, while over one quarter of the commitments could be considered potential game changers, most were not considered strong enough to create substantial change in the world (Table 1)¹¹. This is due to the lack of dedicated financing and quantified targets, too little attention for climate change and transboundary cooperation, and the low number of commitments by national governments and multilateral organisations.

Table 1. Potential game changers and restrictions

These are the potential game changers and restrictions in the commitments to the UN's Water Action Agenda according to the WRI reflection on the 700+ commitments registered at the closure of the 2023 Water Conference.

Potential game-changers	Potential restrictions
Targets — clear metrics of success — and ways to monitor progress and adjust strategies as needed.	Only 22% of the 719 water action commitments submitted as of March 28, 2023 included quantified targets for outcomes.
Focus on biggest water users: agriculture, industry and energy.	Only 13% of the plans target agriculture, and 5% target industry.
Bring agendas of water management and building climate resilient together to create a water- and climate-resilient future.	Only 23% of commitments address climate change. Governments and others have treated water and climate change as siloed issues for too long.
Cooperation is needed across borders and sectors.	Only 12% of commitments include cooperation, either across national borders or economic sectors.
Envisioning the future: develop High ambition pathways.	We must adopt an outcomes-focused, mission-driven approach to water encompassing all the key roles it plays in human well-being.
More commitments are needed from governments and multilateral institutions.	Only 26% of commitments are from government and 11% are from multilateral institutions like the UN and development banks.

7 Rising to the challenge: changing gear and direction

Strategies for governing water and addressing climate change in tandem must be higher on the political agenda¹². The High ambition pathway illustrates that much could be achieved (Figure 8, p. 20 and Figure 11, p. 24) by strengthening governance on all levels, coupled with the implementation of steering instruments, such as spatial planning that is focused on protecting and restoring water systems functioning and reducing the exposure to flooding, adequate pricing of water use, and ambitious regulating standards to reduce water pollution. To accomplish implementation of these instruments, fundamental and transformative choices need to be made that reach further than the voluntary commitments resulting from the UN 2023 Water Conference. There is no silver bullet to solve all challenges. Rebalancing human development and water, while tackling the challenges of too little, too dirty or too much water, will require multiple cohesive steps to

- A** increase of the level of urgency in society to act now,
- B** innovate and transform our approaches to water challenges, and
- C** improve governance on all levels, from local to global.

A higher level of urgency (A) means that we need to acknowledge the pivotal role of water in sustainable development; appreciate its value for the economy, society and ecosystems and ensure that water is leading in all decisions we take; and start now to change gear and direction while also planning beyond 2030.

Innovating our approaches to address water challenges (B) includes implementing river-basin and systems approaches, developing and implementing High ambition pathways, creating adequate incentives, and collaborating on policies across the various scales and sectors.

Improvement of governance on a local to global scale (C) should focus on increasing political awareness of what is at stake and improving worldwide abilities to act; scaling up funding for water and climate adaptation; and building a shared water agenda and process for concerted decisions on strategies, actions, and financing, on all levels, from local to global (Figure 13, p. 28).

The conclusion and message from the Global Commission on the Economics of Water (GCEW) during the UN 2023 Water Conference point in the same direction: 'A sustainable and just water future can be achieved. It requires transforming the economics and restructuring the governance of water. We must take actions that are bolder, more integrated, across sectors and more networked at national, regional and global levels'¹³. Also, in many respects, their call for collective action is coherent (Appendix 2, p. 33). But while the GCEW actions primarily focus on water availability, water use and water pollution, our study additionally addresses flood risks, hydropower challenges, river-basin and ecosystem-based approaches, and spatial planning as critical instruments to bend the trend towards sustainable management of water systems.

Figure 13. No silver bullet

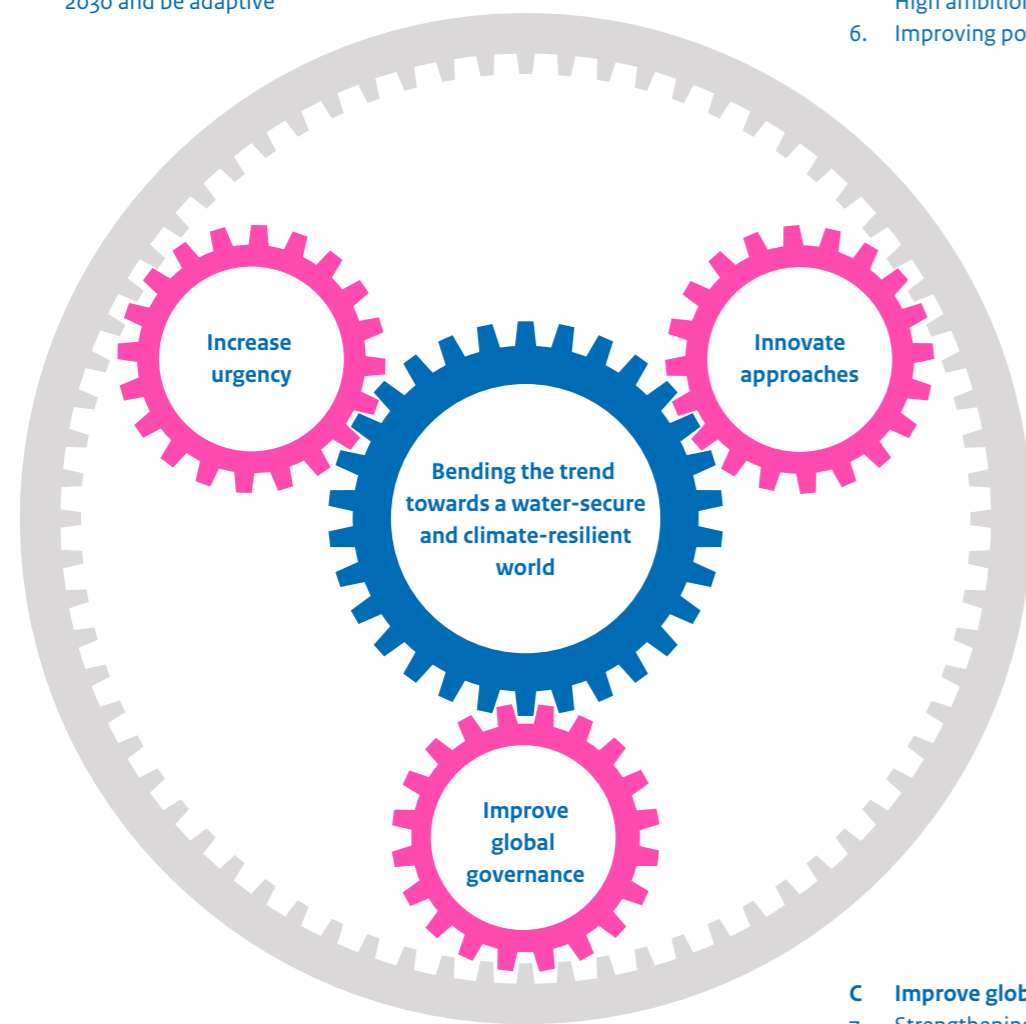
There is no ‘silver bullet’ to solve the complex water- and climate-related challenges. Multiple cohesive actions from local to global will be needed to break away from vested interests and business-as-usual developments.

A Increase the level of urgency

1. Acknowledge the importance and pivotal role of water
2. Valuing water: broaden the scope
3. Start now, but plan way beyond 2030 and be adaptive

B Innovate approaches

4. Let water be leading: adopt a river-basin and ecosystem-based approach
5. Envisioning the future: develop High ambition pathways
6. Improving policy coherence



C Improve global governance

7. Strengthening global water governance and capacity
8. Scaling up funding for water and climate adaptation
9. Building a shared water agenda and process to create perspective

Source: PBL

Water problems and the consequences of climate change are unevenly distributed around the world, with low-income countries in particular being hit the hardest, facing rapidly growing populations and limited economic and adaptive capacities. Without additional attention and resources for these countries, developments over the coming decades will lead to further inequalities, both between and within countries. While there are various water-related processes within the United Nations, an overarching UN water agreement or process, comparable with the Conference of the Parties (COPs) on Climate Change, the Global Convention on Biological Diversity and the UN Sustainable Development Agenda, is currently lacking. Water has neither an institutional home, nor a political position at the United Nations.

This conclusion is in line with that of the Global Commission on the Economics of Water (2023) ('We must adopt an outcomes-focused, mission-driven approach to water encompassing all the key roles it plays in human well-being.') and the WRI (2023) evaluating the voluntary commitments of the UN 2023 Water Conference ('We need a Paris Agreement-like treaty for water to address water resource management, sanitation, adaptation and mitigation, and transboundary cooperation globally and regionally.').

Therefore, structural attention is urgently needed at UN level to deal with water- and climate-related issues in the world in a fair manner and to organise adequate supporting financing. Developed countries have agreed to make USD 100 billion a year available to developing countries so that they can take measures to mitigate global warming and adapt to the impacts of climate change. In 2020, the rich countries had not fully fulfilled that agreement. Accounting for inflation, the estimated annual funding needed to meet adaptation needs is USD 160 to 340 billion by 2030 and USD 315 to 565 billion by 2050 (Figure 14).

Figure 14 Climate financing

Annual climate financing that is agreed and made available by 2020, and that is needed by 2030 and 2050.

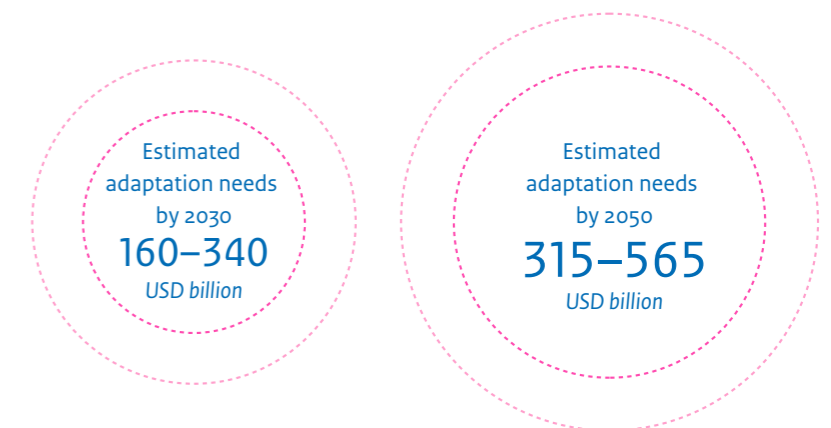
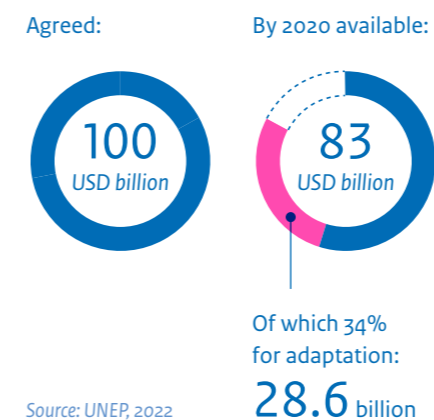
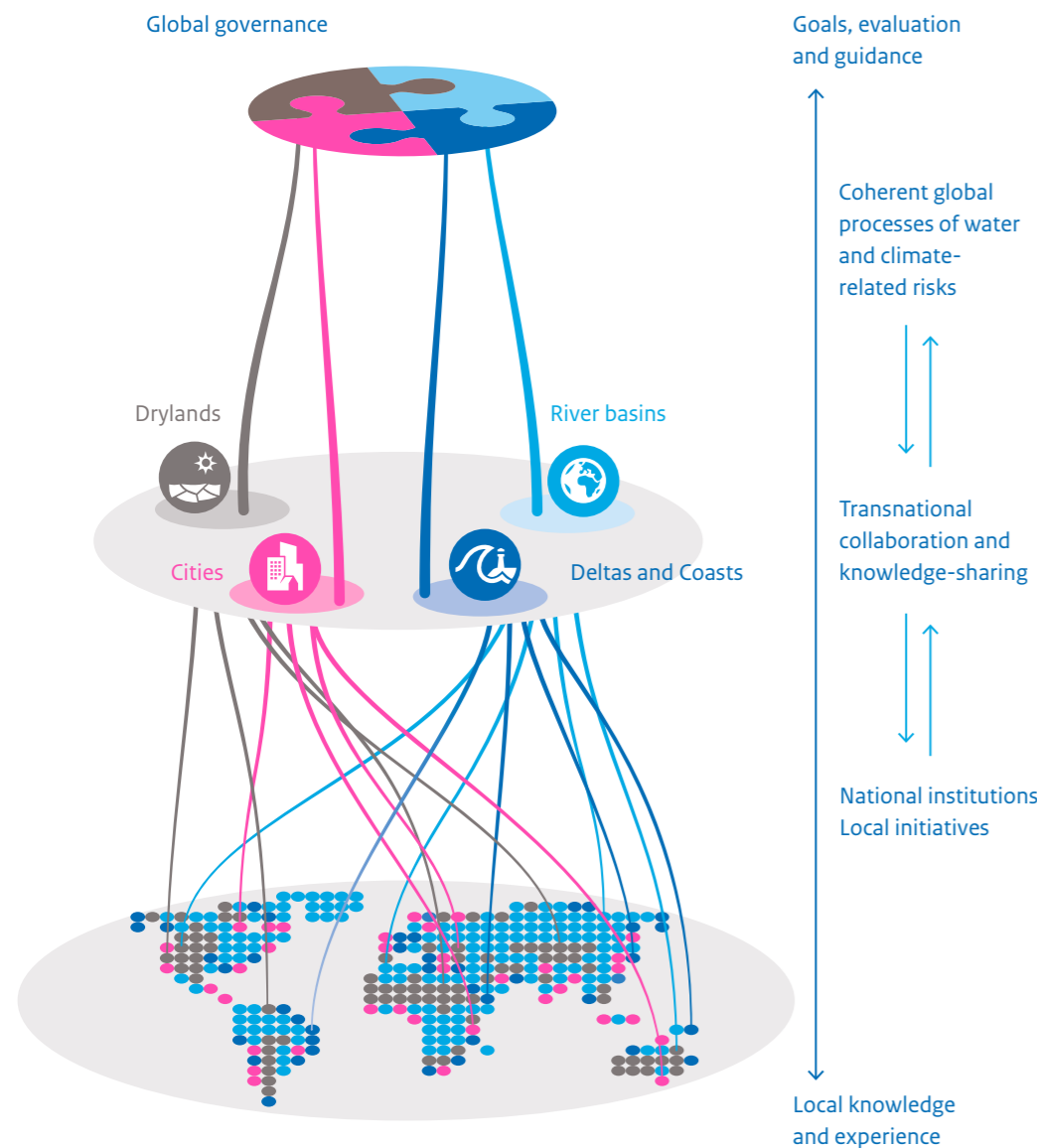


Figure 15. Global governance

Strengthening global governance and building a shared water agenda and process.



Although bending the trend is everyone's responsibility, the importance of global recognition and a global process cannot be overstated. Mainstreaming water throughout the UN system, supported by a mandate, sufficient capacity and leadership, will contribute to unifying water governance approaches, on all scales.

Source: PBL

The estimated amount needed for adaptation in the period up to 2030 is roughly between 5 and 10 times higher than current international financial support. Without a structural increase in financing flows, the financial gap will widen, and low-income countries will fall further behind with regard to water and climate issues.

In contrast to the mitigation domain, water security, the quality of water ecosystems and climate adaptation still lack clear global goals and targets, which is hampering collaboration and funding. Guiding goals and global collaborative strategies and pathways for river basins, deltas and coastal areas, including the small ocean islands, drylands and cities, will be essential building blocks to address the various challenges (Figure 15). Our future exploration of what may be achieved under various levels of ambition for a wide variety of relevant water- and climate-related indicators may be used as an inspiration for exploring future pathways and developing guiding goals and targets on all scales.

A shared water agenda, based on shared goals and targets, on all scales, will allow concerted decisions on strategies, actions and financing and realising a water-secure world for all. A shared water agenda needs to address short-term urgencies as well as organise a process to optimise long-term High ambition pathways, reducing water- and climate-related risks — not as a blueprint, but rather as a mission statement and a promising perspective across cities, landscapes, regions and countries.

Steps towards a global UN-based water process

On 1 September 2023, the UN General Assembly adopted resolution A/77/L.106: 'Follow-up to the United Nations Conference on the Midterm Comprehensive Review of the Implementation of the Objectives of the International Decade for Action, "Water for Sustainable Development", 2018–2028'. According to this resolution, the United Nations agree to organise at least two follow-up UN water conferences, one in 2026 and one at the end of the Water Action Decade, in Tajikistan, in 2028. The resolution also 'requests the Secretary-General to present a United Nations system-wide water and sanitation strategy in consultation with Member States before the end of the 78th session of the General Assembly, in order to enhance the coordination and delivery of water priorities across the United Nations system', and asks for a stocktaking of the Water Action Decade before its ending in 2028.

The anchoring of water as a theme at the United Nations with at least two more conferences, combined with the call for a systems-wide UN approach holds the promise to strengthen a science- and practice-based water approach, connected to consolidated action and learning and capacity building. In combination with the Water Action Agenda and its over 800 commitments, this resolution, thus, may be the first step towards a structural UN-based water process. Opportunities to strengthen this process must be created at the UN Climate Change Conference (COP28), which will be held from 30 November to 12 December 2023, in Dubai.

APPENDIX

1 Overview of the 28 water- and climate-related indicators used to assess changes between 2020 and 2070

Related to River basins

- Number of new large dams (height > 20 m)
- Water withdrawal from rivers and lakes (km³/yr)
- Water withdrawal from groundwater reservoirs (km³/yr)
- Water withdrawal from water reservoirs (km³/year)
- Water withdrawal for irrigation (km³/yr)
- Water withdrawal for households and industries (km³/yr)
- Agriculture — total crop production (Mt dry matter/yr)
- Agriculture — nutrient emissions (Mt/yr)
(Nutrient emissions from households and industry (Mt/yr) see **Cities**)
- Total nutrient emissions to rivers (Mt/yr)
- People living in water-stressed river basins (million people)
- Population annually exposed to river flooding (million people/yr)
(Annual urban damage from river flooding (% of GDP/yr) see **Cities**)
- Area with high aquatic biodiversity (x 1000 km²)
- Area with harmful algal blooms (km²)

Related to Drylands

- Agriculture — total crop production (Mt dry matter/yr)
- Agriculture — drop per crop irrigated agriculture (l/kg dry matter)
- People living in water-stressed, conflict-risk areas (million people)
- People living in water-stressed, migration-risk areas (million people)
- Groundwater depletion (km³/yr)

Related to Deltas and Coasts

- Population annually exposed to coastal flooding (million people/yr)
(Annual urban damage from coastal flooding (% of GDP/yr) see **Cities**)
- Total nutrient loads to coastal seas (Mt/yr)
- Coastal groundwater abstraction resulting in subsidence (km³)
- Sand used for building/infrastructure (million tonnes)

Related to Cities

- People with unimproved sanitation (million people)
- Population with a connection to the sewerage system (million people)
- People with untreated waste water (million people)
- Nutrient emissions from households and industry (Mt/yr)
- Annual urban damage from river flooding (% of GDP/yr)
- Annual urban damage from coastal flooding (% of GDP/yr)

2 Comparison of suggested fundamental changes in water-related approaches, politics and economics in ‘Bending the Trend’ (our report) and ‘Turning the tide’ (GCEW, 2023)

<i>The Geography of Future Water Challenges — Bending the Trend (PBL, 2023)</i>	<i>Turning the Tide — A Call to Collective Action (GCEW, 2023)</i>
<ul style="list-style-type: none"> • Acknowledge the importance and pivotal role of water 	<ul style="list-style-type: none"> • Manage the global water cycle as a global common good
<ul style="list-style-type: none"> • Valuing water: broaden the scope 	<ul style="list-style-type: none"> • Deliver on the human right to safe water, act collectively to stabilise the global water cycle, and ensure that the value that is created collectively gets shared widely • Cease under-pricing water
<ul style="list-style-type: none"> • Start now, but plan way beyond 2030 and be adaptive 	<ul style="list-style-type: none"> • Phase out some USD 700 billion of subsidies; reduce leakages; disclose water footprints • Move ahead on current opportunities to fortify natural freshwater storage systems (wetlands, groundwater), develop the urban circular water economy (recycling industrial and urban waste water), reduce water footprints in manufacturing, and shift agriculture to precision irrigation, less water-intensive crops and drought-resilient farming that can also raise incomes
<ul style="list-style-type: none"> • Let water be leading: adopt a river-basin and ecosystem-based approach 	<ul style="list-style-type: none"> • We must adopt an outcomes-focused, mission-driven approach to water encompassing all the key roles it plays in human well-being
<ul style="list-style-type: none"> • Envisioning the future: develop High ambition pathways 	<ul style="list-style-type: none"> • We must adopt an outcomes-focused, mission-driven approach to water encompassing all the key roles it plays in human well-being
<ul style="list-style-type: none"> • Improving policy coherence 	<ul style="list-style-type: none"> • Reshape multilateral governance by using trade policy as a tool for more sustainable use of water, and by supporting capacity building for all (gender equality, empowering farmers, women, youth, Indigenous Peoples and local communities)
<ul style="list-style-type: none"> • Strengthening global water governance and capacity 	<ul style="list-style-type: none"> • Reshape multilateral governance by using trade policy as a tool for more sustainable use of water, and by supporting capacity building for all (gender equality, empowering farmers, women, youth, Indigenous Peoples and local communities)
<ul style="list-style-type: none"> • Scaling up funding for water and climate adaptation 	<ul style="list-style-type: none"> • Establish Just Water Partnerships to enable investments in water access, resilience and sustainability in low- and middle-income countries, using approaches that contribute to both national development goals and the global common good
<ul style="list-style-type: none"> • Building a shared water agenda and process to create perspective 	<ul style="list-style-type: none"> • Establish Just Water Partnerships to enable investments in water access, resilience and sustainability in low- and middle-income countries, using approaches that contribute to both national development goals and the global common good

REFERENCES

1. Ligtoet, W. et al. (2023). *The Geography of Future Water Challenges; Bending the Trend*. The Hague: PBL Netherlands Environmental Assessment Agency.
2. IPCC (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*. Cambridge University Press. doi:10.1017/9781009325844.
3. WWF (2022). *Living Planet Report 2022 – Building a nature-positive society*. WWF, Gland, Switzerland.
4. UN (2022). *The Sustainable Development Goals Report 2022*.
5. Ligtoet, W. et al. (2018). *The Geography of Future Water Challenges*. The Hague: PBL Netherlands Environmental Assessment Agency.
6. Dasgupta, P. et al. (2021). *The Economics of Biodiversity: The Dasgupta Review*. London: HM Treasury.
7. Mazzucato, M. (2021). *Mission Economy. A moonshot guide to changing capitalism*. Penguin Books UK.
8. McCracken, M., & Wolf, A. (2019). Updated register international river basins in the world. *International Journal of Water Resources Development*, 35(5), 732-782. doi:10.1080/07900627.2019.1572497.
9. Richardson, K. et al. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37). doi:10.1126/sciadv.adh2458.
10. UN (2023). Closing UN 2023 Water Conference. Interactive Dialogue reporting back.
11. WRI (2023). UN Water Conference 2023: Not enough game-changing commitments. Report World Resources Institute.
12. Rahman, M.F. et al. (2023). As the UN meets, make water central to climate action. *Nature*, 615(7953), 582-585. doi:10.1038/d41586-023-00793-9.
13. Mazzucato, M. et al. (2023). *Turning the Tide: A Call to Collective Action*. Global Commission on the Economics of Water. France. Retrieved from <https://policycommons.net/artifacts/3496281/turning-the-tide-report-web/4296871/> on 26 Sep 2023.

COLOPHON

The Geography of Future Water Challenges – Bending the Trend
Policy Summary in the Context of the UN 2023 Water Conference

© PBL Netherlands Environmental Assessment Agency, The Hague, 2023

PBL publication number 5251

Contact

Arno Bouwman (arno.bouwman@pbl.nl)

PBL Netherlands Environmental Assessment Agency

Willem Ligtoet

Arno Bouwman

In collaboration with

Wilfried ten Brinke (Blueland Consultancy)

English-language editing

Annemieke Righart,

PBL Publishers

Production coordination

PBL publishers

Art direction

Karin Schwandt

Graphic design

Suzanne Bakkum

Printer

Xerox/Koninklijke Van der Most

This publication can be downloaded from: www.pbl.nl/en.
Parts of this publication may be reproduced, providing the source is stated, in the form: Ligtvoet W. et al. (2023). *The Geography of Future Water Challenges – Bending the Trend – Policy Summary*. The Hague: PBL Netherlands Environmental Assessment Agency.

PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all our studies. We conduct solicited and unsolicited research that is always independent and scientifically sound.

Accessibility

PBL attaches great importance to the accessibility of its products. Should you encounter any access-related problems when reading them, please contact us at info@pbl.nl, stating the title of the publication and the issue you are experiencing.



Online publication
Part I: The Geography
of Future Water Challenges



Online publication
Part II: The Geography
of Future Water Challenges
– Bending the Trend



Website
The Geography of
Future Water Challenges



Website
River Basin Delta Tool

