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# Water as a guiding principle in transitions

## WUR researchers' vision on the theme of water

Water is pivotal for life on planet Earth, yet it is a scarce resource. Water also plays a major role in all strategic research themes of Wageningen University and Research (WUR). Water can be a connecting element and a guiding principle across all research themes. Putting water centre stage can provide new solutions, increase cooperation and synergy within WUR, and be a guiding force in the transitions needed to remain within planetary boundaries.

### Why water?

Astronomers explore the universe in search of planets where life could be possible. In this search, one thing is pivotal: the presence of liquid water. Water is an essential condition for any life form to exist.

On planet Earth, each life form consists predominantly of water, and all ecosystems and our food systems rely on it. But beyond being an essential factor for life, we depend on water for so much more: as a greenhouse gas, water vapour is an important climate regulator; water is essential to almost all industrial processes; and it is an important transport medium. Water shapes our landscape and is a key element for agriculture. It is therefore no surprise that all the UN Sustainable Development Goals rely on water (Fig. 1).

Group 1 targets:  
*strongly related to water*

Group 2 targets:  
*related to water*

Group 3 targets:  
*indirectly related to water*



### Water is critical for Sustainable Development Goals

Water is directly and indirectly linked to many of the Sustainable Development Goals (SDGs), with connections to human health and well-being, clean water and sanitation, food production, sustainable cities and communities, and the quality of ecosystems.

In our exploration, we evaluate the potential contribution of future pathways to the SDGs to inspire the development of High ambition pathways. These pathways integrate water- and ecosystem-based approaches across sectors and domains, and rebalance socio-economic and ecological values.

**Figure 1** Ligetvoet W. et al. (2023). The geography of future water challenges; bending the trend, The Hague: PBL Netherlands Environmental Assessment Agency

Viewed from space Earth looks like a blue marble, suggesting that water is abundantly present everywhere. However, the majority is salt water; only 2.6% of the water on our planet is freshwater, and only a tenth of that is freely available for human use. Of this freely available freshwater, about 70% is used for agriculture, and this scant amount is under great pressure worldwide. While water seems abundant, we need to ask whether we are handling this precious resource with sufficient care.

## Water-related challenges

The big challenges that humanity faces – climate change, increasing population and urbanisation, overexploitation of resources and increasing inequalities – make this scarcity even more urgent. The stakes are high: sustainable management and fair distribution of water are crucial to the health of our bodies (which are on average 65% water), our environment, and our planet.

Increasingly frequently, there will be too much, too little or too dirty water. Water-related disasters can be flooding and drought extremes becoming more frequent, sea level rise, soil subsidence and salinisation. These may lead to crop and biodiversity losses, competition or even conflicts over water. The availability of sufficient water will become less predictable for nature and agriculture. Proper (ground)water management will become even more crucial, for example to deal with sea level rise and land subsidence in sinking coastal and estuarine areas around the world. For sustainable development to take place, we need to prioritize the characteristics of natural water and soil systems.

Not only is our supply of water becoming less dependable; the quality of our fresh water is also decreasing, for example in terms of nutrients, pesticides, pathogens, microplastics and micropollutants. More specifically, in the Netherlands, there is a high risk that under the EU Water Framework Directive water quality standards will not be met by 2027. Freely available and clean freshwater will become an increasingly scarce and vulnerable resource. According to forecasts by the World Health Organisation (WHO), half of the world's population will be living in water-stressed areas by 2025.

An equitable distribution of the scarce water is vital if we are to improve the welfare and contribute to food and water security of the world's population. But water is also an essential part of nature. And here lies a fundamental source of tension: between the cost of water to fulfil

basic needs to meet the human right to a healthy, productive life, and the low cost of water as a driver of overconsumption of water. To address this requires an overarching view on water as the cornerstone for all life on earth.

## Why Water@WUR?

For thousands of employees and students at WUR, water lies at the core of their work. Within WUR resides a vast amount of knowledge on water, as well as the ability to tackle complex water-related challenges. But, WUR has not yet fully harnessed its potential when it comes to water. That's why WUR water researchers developed this vision – they see a golden opportunity for improving their connections and enhancing cooperation with each other. We refer to this cooperation as 'Water@WUR'.

So often we take water for granted, and yet it forms the basis of our agriculture, industries, households, spatial planning and natural ecosystems. By collaborating, we explicitly recognize that water is part of a complex system, where it competes with other functions, and therefore should not be worked on in isolation. Transition to a circular economy, mitigating climate change, sustainable water and soil focused management, as well as fair and safe water allocation and distribution, all require integrated approaches, in which water has a central position. This requires improved governance, increased collaboration and conflict management, in order to that we can build non-exclusive networks and consortia for new transdisciplinary research initiatives.

More exchange, networking and internal collaboration on water will create novel insights into existing problems, and help to identify key knowledge gaps and overlaps, support methodological innovation and contribute to a joint research agenda. Subsequently it will also create more links between research and education and a better alignment of research done by Wageningen University and the Wageningen Research institutes and facilities. This will lead to better research results, make research more efficient, and contribute to our research having greater impact.

## Our water mission

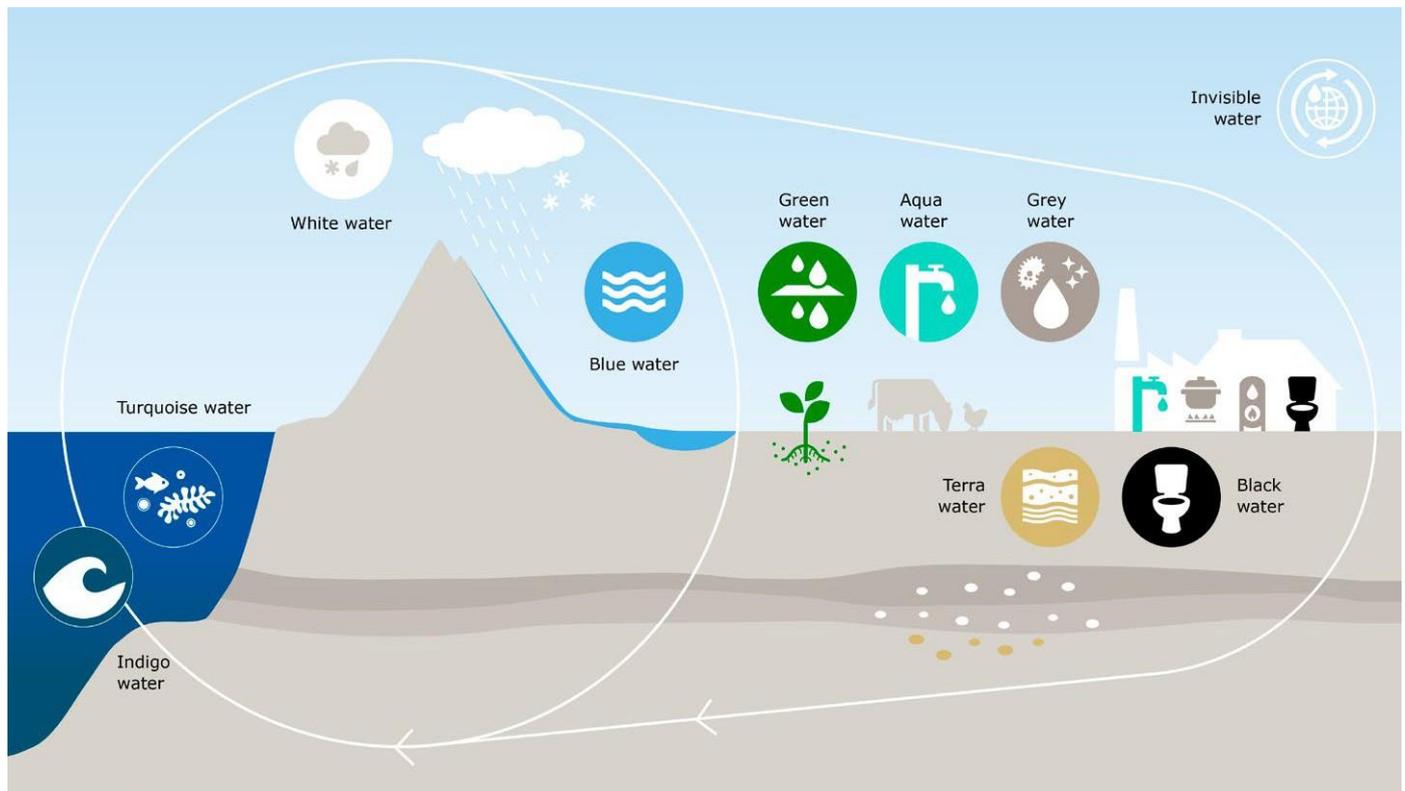
Given the importance of water, it is no surprise that water research has a prominent place within all strategic research themes of WUR. However, with the exception of the theme on sustainable water and land use, this is not always very visible.

For all these themes, we need to transition towards sustainable systems that keep us within planetary boundaries, taking into account geographical and social dynamics. We water researchers at WUR see a unique possibility for connecting across all the research themes within WUR. Research on water, in its many aspects and appearances, will not only provide us with novel insights; it can also be a guiding principle in these transitions and systems. Water, as part of a system that includes soil and landscape, should be leading in the design of nature-based solutions. Seeing water as a guiding principle can be a driver for change towards sustainable systems.

We also see that WUR is uniquely positioned to play a key role in these water-related challenges. The Netherlands is known internationally for its water

knowledge. Wageningen water researchers have a clear global playing field. Focussing on the water user, they always see water in connection with agriculture, aquaculture and food production, with nature and biodiversity, and with sustainable business. This integrated approach fits well with WUR's 'trademark' systems approach and is a unique complement to other water knowledge in the Netherlands and worldwide. An integrated approach avoids the risks of water-centricity, as it recognises the inextricable interlinkage between water and food systems or, even more broadly, the Water-Energy-Food- Ecosystems (WEFE) nexus.

Over the years, WUR has developed a unique interdisciplinary and transdisciplinary systems approach, supported by investments in explicitly interdisciplinary research instruments such as its Knowledge Base, Investment Themes, student challenges and the Wageningen Global Sustainability Programme (formerly INREF). More than at other research and education institutions, the social, ecological and technical scientists at WUR are invited and encouraged to look beyond their own silos, and to work together on complex contemporary challenges.



**Figure 2** The nature of water is circular as evaporation from surface water (different shades of blue) will resupply soil water (green) and surface water (blue) through precipitation (white). On its route towards the sea, (blue) surface may turn into brackish (turquoise) and saline sea and ocean water (indigo). The blue and green systems resupply subterranean reservoirs (terra). Tapwater is used for drinking water (aqua), and water is disposed after domestic or industrial use (grey) or specifically for disposal of animal and human excreta (black). The grey and black wastewater also flow back into the water cycle via various routes. In addition to that, production of commodities, crops and other goods require water, which is not always present (anymore) in these products. This is referred to as invisible water. From Antonis A. et al. (2022) <https://doi.org/10.18174/566902>



## 'Wageningen water goggles'

Without losing disciplinary depth, researchers are able to zoom in on details and zoom out to see the bigger picture. Being able to look across disciplines and easily seek cooperation with other disciplines and practitioners in the field are typical hallmarks of the WUR approach, and this quality is reflected above all in WUR's water research. WUR has strong expertise in both environmental and aqua-/agricultural research, and linking these is central to tackling water-related questions.

These 'Wageningen water goggles' are particularly suitable for tackling many of the local and global challenges we currently face.

The systems thinking that WUR embodies allows for flexible self-organisation in interdisciplinary teams. This facilitates working within multi-stakeholder projects and processes in the 'Dutch diamond', made up of the public sector, the private sector, civil society and knowledge institutions. It also means Wageningen researchers are capable of linking up with local initiatives and working on participatory bottom-up solutions. A promising first start was the Water@WUR day (March 19, 2024), where WUR researchers working on water met and discussed the challenges of the future.

Increasing collaboration between WUR water researchers will also increase our critical mass and improve the internal and external visibility of WUR water research. This in turn will enable us to formulate stronger research proposals (PPS, NWO, EU) and gain better access to funding sources. Clients such as the Dutch government (agencies) could also benefit from a central point of contact on water-related issues at WUR. To further enhance this, follow-up events will be organized for the Water@WUR community and others interested.

## Conclusion

For over a century, WUR has been at the forefront of tackling the world's most pressing water challenges, fostering a legacy of groundbreaking research and practical solutions that have transformed the way we manage this precious resource. However, water has often been considered so obvious that its presence and the need to do novel research on it have been taken for granted.

There used to be a strong belief that environments can be shaped according to human needs. However, we are currently encountering the boundaries of what is engineerable, even exceeding our planetary boundaries. Respecting these boundaries will become crucial: we need to shift our world view from an unlimited and exploitative growth model towards a cyclic system. As the nature of the water cycle itself is circular, taking water as a guiding principle is essential. This can be done in spatial planning, in the Netherlands and elsewhere, making clear where natural boundaries lie and enabling new opportunities to arise. Moreover, water can also be a connecting element and guiding principle in the transition to sustainable food systems, the restoration of our biodiversity, human and animal health, mitigation of and adaptation to climate change, and a biobased and circular society.

Knowledge of and solutions regarding water – an integral part of these transitions – will become essential to addressing the challenges mentioned above. This represents a great opportunity for WUR's water research, as this is our niche and where we have the leading edge compared to other water knowledge institutions worldwide. Water as part of food- and ecosystems has always been at the heart of our interdisciplinary and transdisciplinary way of thinking. By joining forces within Water@WUR we can make our unique knowledge proposition more visible to the outside world and thus be able to further collaborate on this fascinating and crucial topic.

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## WUR vision on water

Water is an integral part of ecosystems, food systems and human society and therefore should be considered a guiding principle in a transition towards sustainable systems that keep us within planetary boundaries.



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The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,600 employees (6,700 fte) and 13,100 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.