Applying transdisciplinary approaches to collaborative groundwater research

What is transdisciplinary research?

Transdisciplinary research aims to address complex real-world problems. The concept emerged as far back as the 1970's, when scholars recognised the need to move beyond disciplinary boundaries towards greater integration across different forms of knowledge. This was particularly true for solving interconnected sustainability issues, or 'wicked problems' that don't have easy solutions.

Transdisciplinary approaches have an intent to improve a societal situation and therefore engage with stakeholders related to that situation. This requires collaboration between researchers and other stakeholders, and valuing of different types of knowledge. In this way, transdisciplinary research values scientific and academic knowledge as well as practical, local and personal knowledge. It can also support bridging between perspectives from the Global North and South by integrating diverse worldviews and knowledge systems.

Why is this relevant to groundwater research?

In the context of groundwater research, a transdisciplinary approach can support a holistic understanding of multiple facets of complex socio-hydrogeological systems. Groundwater management requires knowledge drawn from hydrogeology, environmental science, social sciences, engineering and other disciplines. Additionally, driving change in groundwater management requires collaboration across policy, practice and building from local knowledge.

In our RECHARGE research project, we adopted principles of transdisciplinary research to strengthen the evidence base on groundwater in the different contexts where we work.

By engaging researchers, policymakers, and community stakeholders, our transdisciplinary research approach sought to foster innovative solutions to groundwater sustainability challenges. This approach combined scientific insights with lived experiences, towards more effective and inclusive decision-making.

A transdisciplinary research approach not only guided the methodology but provided a way of thinking—one that values integration, participation, and transformative change in tackling complex issues like groundwater management.

How did we apply transdisciplinary research in the RECHARGE project?

New policy recommendations and a co-developed behaviour change campaign in Indonesia

In Indonesia, we brought together experts from environmental engineering, gender studies, communication, hydrology and public health. The Indonesia research component focused on three main objectives: risk mapping for city prioritisation based on contamination risk, expanding scientific knowledge of contamination pathways, and understanding community perceptions and motivations related to their water source choices.

The team drew on large secondary datasets, conducted field research with tracers linking sanitation and water-supply systems, and interviewed local communities in Jakarta. Collaboration was undertaken with water service providers, diverse government agencies, and public health organisations to develop clear policy recommendations that could improve groundwater management and to co-develop a behaviour change campaign to prompt households to transition from highly contaminated onsite water sources to piped water supplies.

To develop the behaviour change campaign, the team adopted the Behaviour Centred Design framework developed by the London School of Hygiene and Tropical Medicine. Collaborative workshops co-created communication concepts that emphasised the cost-effectiveness, health benefits, and the convenience of piped water. These concepts informed five outputs that constitute the behaviour change package. Outputs include four videos, a booklet to dispel common myths and facts around piped water, recommendations for local water utilities to increase piped connection, a poster for targeted public display and a journal article (currently under revision).

By deepening disciplinary scientific knowledge and integrating diverse disciplines and engaging stakeholders at multiple levels, the project aimed to be both scientifically rigorous and socially relevant, addressing local needs, shifting current behaviours and supporting sustainable groundwater water management practices.



Team conducting field research around Jakarta using tracers to link sanitation and water-supply systems (Safaa Aldirawi/UTS-ISF)



Co-design workshop held in Jakarta drawing on the Behaviour-Centred Design framework (Safaa Aldirawi/UTS-ISF)

Integrating diverse perspectives to strengthen water security in rural Vanuatu

In Vanuatu, water supply systems are sensitive to contamination and water shortages due to climatic variations. The RECHARGE project showcased a transdisciplinary

approach to addressing the potential impacts of climate change on rural water services. The team focused on groundwater development to combat water shortages and contamination, considering multiple perspectives for effective solutions.

The research integrated environmental science, social science, engineering, and local knowledge through a data collection framework that examined groundwater levels, quality, users' perceptions of water security, and customary beliefs around groundwater.



Research consultant, Lisa Faerua, interviewing the Area Council representative from one of the study sites (Diana Gonzalez/UTS-ISF)

The research emphasised the interconnections between these areas, ensuring collaboration from the outset. This included a focus on how the water supply, users, and service providers interact.



Group visit to a solar-powered groundwater scheme (UTS-ISF)

Additionally, we hosted a regional workshop with stakeholders from government, the private sector, NGOs, and the research community from different Melanesian countries to collaboratively understand groundwater in the broader Pacific region, share learnings, and start building a groundwater community of practice.



Group photo from the Pacific learning event in Port Vila, Vanuatu (UTS-ISF)

This holistic approach exemplifies the project's commitment to transdisciplinary practice and inclusive decision-making in water security.

Enhancing climate resilience of groundwater-based water services in the Mekong Delta through systems thinking and local knowledge

In Vietnam's Mekong Delta, groundwater use and management are characterised by uncertainty and complexity. Groundwater is used for multiple purposes (domestic, agriculture, aquaculture) with many unregistered wells and extraction practices beyond the view of government monitoring and regulation.



A farmer irrigating crops using groundwater (Diana Gonzalez/UTS-ISF)

To build collective awareness of the situation with a view to improved management, the research took a systems thinking approach to understand groundwater-based water services in all its complexity. Data collection was multifaceted, involving technical monitoring of groundwater quality, as well as social science research on community perceptions and lived experiences.



Researcher Phan Thi Thuy Duy measuring groundwater salinity at an onion farm (Diana Gonzalez/UTS-ISF)



Researchers Diana Gonzalez and Nguyen Anh Minh interviewing a community member (Nguyen Le Man/CTU)

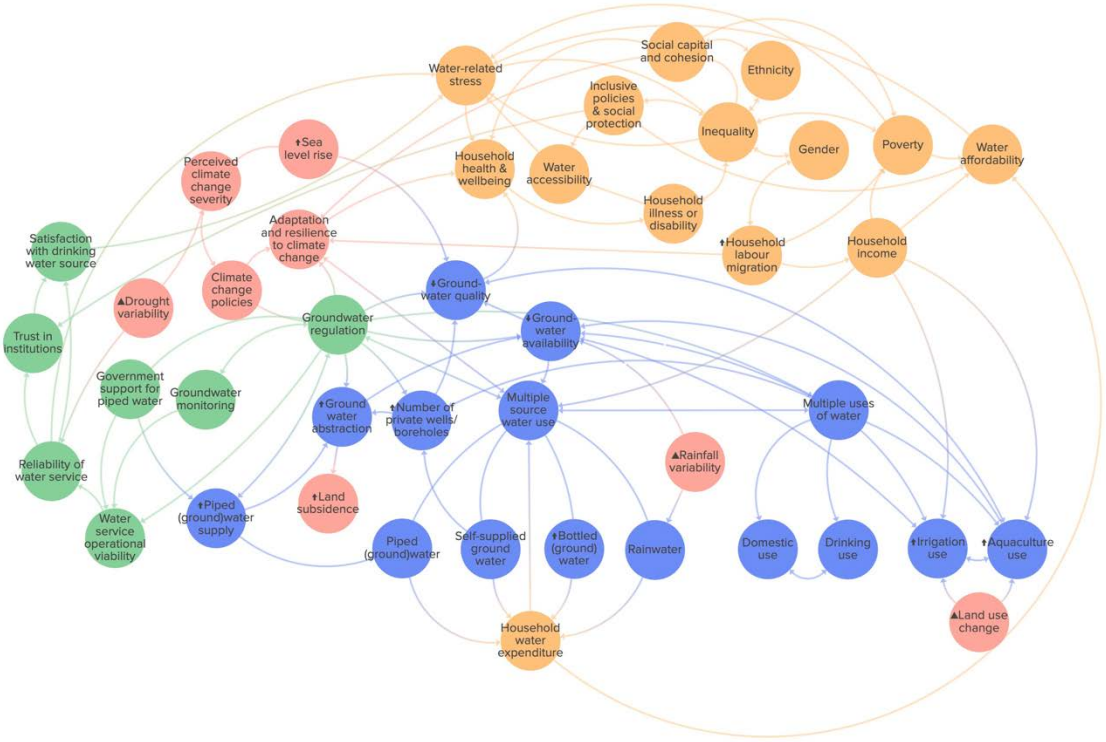
One example that highlighted the importance of local values was the story of Mr Day, who lives with his extended family in an urban area of the Mekong Delta. Mr Day shared the significance of the well at his household, built by his late father-in-law. Despite Mr Day's concerns about the declining quality of the groundwater, his household continues to use it for everyday needs, though he prefers other sources like piped or bottled water for drinking. His family continues to use the well out of respect for his mother-in-law, who insisted on maintaining the well to preserve the memory and legacy of her late husband. Mr Day expressed that if it weren't for his mother-in-law's wishes, they would no longer use the well water at all.



Mr Day lifting water from the well built by his late father-in-law (Diana Gonzalez/UTS-ISF)

This story highlights the complex relationship people have with groundwater, where the practical use of the resource intersects with cultural values, family traditions, and emotional connections to the land. It is a reminder of the deep, sometimes intangible, knowledge and values that play a crucial role in water security and management.

The research team applied systems thinking methods to synthesise these diverse data points to engage stakeholders in a shared understanding of the complex groundwater system. The system map we co-developed was foundational for identifying shared goals and intervention points for sustainable water management in the region.



Systems map of the complex socio-hydrogeological systems in Vietnam's Mekong Delta (Carrard et al. 2025, *under review*).

Breaking down disciplinary boundaries

The RECHARGE research across Indonesia, Vanuatu, and Vietnam highlights the value of a transdisciplinary approach for addressing the challenges of resilient and inclusive groundwater-based water and sanitation services in diverse contexts.

Whether through monitoring groundwater levels, engaging with local communities, or using collaborative workshops, the research underscored the value of transdisciplinary collaboration in tackling complex, real-world issues.

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