Journal: Nature Water
https://www.nature.com/articles/s44221-024-00255-0
https://doi.org/10.1038/s44221-024-00255-0
Manuscript reference: NATWATER-24-0477A

Science-practitioner partnerships for sustainable development

Authors – Rob Hope[1], Katrina Jane Charles[2], Rupert Quentin Grafton[3], Daniel Olago[4], Mashfiqus Salehin[5], Mohammed Abed Hossain[5], Rebecca Peters[6], Ana Gren[7], Tassew Woldehanna[8], Muhammad Ibrahim[9], Emdadul Hoq Chowdhury[10], Mohammad Monirul Alam[11], Kitka Goyol[12], Rachael McDonnell[13] and Anna Nileshwar[14]

Corresponding author *– Rob Hope, Robert.hope@ouce.ox.ac.uk*

Affiliations
[1]Smith School of Enterprise and the Environment, University of Oxford, UK; Robert.hope@ouce.ox.ac.uk
[2]School of Geography and the Environment, University of Oxford, UK; katrina.charles@ouce.ox.ac.uk
[3] Crawford School of Public Policy, Australia National University; quentin.grafton@anu.edu.au
[4] Institute of Climate Change and Adaptation, University of Nairobi, Kenya; dolago@uonbi.ac.ke
[5] Institute of Water and Flood Management, Bangladesh University of Engineering and Technology; abed@iwfm.buet.ac.bd , mashfiqussalehin@iwfm.buet.ac.bd
[6] Georgetown University, USA, Rebecca.peters@georgetown.edu
[7] World Bank, Washington D.C., agren@worldbank.org
[8] Department of Economics, Addis Ababa University, Ethiopia, tassew.woldehanna@aau.edu.et
[9] Ministry of Local Government, Rural Development and Cooperatives, Government of Bangladesh, mibrahim@live.com
[10] Policy Support Branch, Local Government Division, Government of Bangladesh, emdadhoq@gmail.com
[11] UNICEF, Bangladesh, malam@unicef.org
[12] UNICEF, East and Southern Africa (ESARO), Kenya, kgoyol@unicef.org
[13] International Water Management Institute (IWMI), Italy, r.mcdonnell@cgiar.org
[14] Foreign Commonwealth and Development Office, UK, anna.nileshwar@fcdo.org.uk

Summary
Science funding can contribute more to sustain impacts for global development goals. Science-practitioner partnerships illustrate how a patient and outcome-based approach can improve water security for millions of vulnerable people.

Rethinking Partnerships
With unsatisfactory progress against most of the SDG targets, we reflect upon the role and performance of science in informing and accelerating development progress (1). Our focus is on science-practitioner partnerships which is a category of relationships and interactions between policy and strategy, scientific evidence, investment decisions, and operational execution to solve social, economic and development problems. This builds from the concept of a science policy interface (2) to accelerate sustainable development outcomes in dynamic, political and uncertain processes. Whereas an 'interface' provides a means for

science to 'predict and provide', such as the IPCC process (3), a partnership approach is a way to 'support and serve' to deliver results with impact.

Science-practitioner partnerships are characterized by a process of co-designing research priorities and locations, collaborative interdisciplinary data collection, and identification of investment priorities based on scientific evidence moderated by political feasibility. Such partnerships position science to serve rather than to direct. This can be a risky approach though one which engages with political priorities at the outset rather than hoping that future scientific findings will influence decision-makers later. While some government processes may be accused of opaque practices, scientists also face integrity challenges. Vested interests, knowledge boundaries and power dynamics can promote or ignore research leading to administrative capture (4). By design, a partnership negotiates an iterative understanding and commitment to build credibility, salience, and legitimacy (5). Here, we will focus on water security in the Global South as an example.

As the rhetoric and reality of global water insecurity escalates in the news, sustained local progress in most geographies has stalled or been found to be inadequate. Water security has evolved to better recognise trade-offs and priorities across sectors and user groups, and to respond more to the needs of the most vulnerable (6). Rather than water security being characterised as a tolerable level of risk, any conceptualisation must also consider equitable risk, as the distribution of harm falls unevenly on specific locations, groups, and individuals (7).

Partnerships to coordinate, catalyse and sustain science and policy impacts have long been promoted though rarely achieved or sustained. Understanding how to meaningfully engage science, policy and practice has remained elusive. What is the role of science in this changing global architecture? Where, how, and when can science engage, support, and inform better policy and investment decisions? What data is needed by which actors to make timely decisions to benefit the most vulnerable? How can inequalities be addressed from the river basin to the city, and from among villages to within households? What funding models are flexible and appropriate for science to deliver results?

Science-Practitioner Partnerships

The policy process involves the intent, decisions, and actions of multiple actors over time to deliver desired outcomes. Science-practitioner partnerships (from here, partnerships) aim to support the policy process by designing and executing collaborative work between academics, governments, communities, and the private sector to achieve a desired policy outcome. Partnerships for water security include, but are not limited to, the interactions between river health, groundwater resilience, water for agriculture, environmental pollution, and safe drinking water in the context of climate change, economic growth, and social inequalities.

Key attributes in the policy process are the phases of design, investment, and impact. Science can play a key role in building partnerships, designing strategy, executing plans, and evaluating impacts (Fig. 1). Science can offer policy contributions in different phases from foundational research, advisory analysis, operational insights, and reflexive learnings. However, it is unusual for science to be engaged in every step of this process. The mismatch between the potential value of continuous scientific engagement and short funding periods means the scale and scope of development impacts may be limited. As global science increasingly considers impact as a metric of public funding, an outcome-based framework can promote greater value for money. Outcome-based targets are unusual for research funding with FCDO's REACH program an example of a ten-year investment to improve water security for ten million vulnerable people in Africa and Asia.

We simplify a broader typology of research by characterising phases of foundational, advisory, operational, and reflexive science. Foundational science is the basis to build credibility and legitimacy with partners. Directing this work to design strategic priorities generates policy salience and the means to build an investment case. Often, scientists depart at this stage, but we argue that advisory science plays a complementary role to guide and support the interpretation and application of findings with decision-makers. Less common is for scientists to actively participate in operational work as programmes are executed. In contrast, the evaluation of programmes is familiar territory for reflexive science to feed back into the policy process. Clearly, reality does not follow a neat linear trajectory, though it does illustrate where and how sustained science engagement could retain institutional memory, strengthen relationships, and maintain policy salience.

Foundational science is a critical component in effective policy design from understanding climate risks across the Horn of Africa to reducing urban river pollution in South Asia. Forging effective and durable partnerships takes time, commitment, and luck due to rotation of key staff, election cycles, or political, public health or economic shocks. How can foundational science deliver in narrow political windows of opportunity? Place-based observatories offer one pathway to build and sustain political interest in defining an actionable and replicable water security challenge (8). The observatory model focuses collective attention and activity on a long-term, interdisciplinary, and instrumented field site which can be expanded, adapted, or closed as results dictate.

For example, cycles of drought and flood have amplified water insecurities for 25 million people in the Horn of Africa. Under-reported in the foundational science of climate models has been the biophysical process of low-level jets transporting vast quantities of water vapour over East Africa from the Indian Ocean to the Congo Basin (9). Instrumented field campaigns have complemented detailed groundwater analysis of an alluvial aquifer system that provides water to a small town typical of challenges in Africa's arid lands. Based on advisory and operational science led by the University of Nairobi with national and county governments, the aquifer has been characterised for the first time with plans for conservation. Measurements have been complemented by agreements to protect recharge zones, reduce contamination, and abstract sustainable yields (10). A key policy outcome is that the consequences of droughts that harm vulnerable pastoral, rural and urban communities, locally and regionally, are mitigated by a new environmental monitoring and management plan agreed with stakeholders.

Operational science creates new institutional models to adapt to established scientific approaches. For example, providing safe drinking water services for health centres and schools in coastal Bangladesh is hampered by high levels of groundwater salinity and bacteriological contamination influenced by cyclonic storms, monsoon flooding, inadequate regulation, and limited performance data. Following agreement on a shared policy approach targeting rural clinics and schools, a national steering committee with high-level national and district officials from local government, education, health, and engineering departments convened quarterly meetings to monitor the design of a professional water service delivery model. A critical operational partner has been the Policy Support Branch within Local Government Division which has facilitated the shift from teachers managing safe drinking water in schools to a professional service provider. Results show major improvements in water safety and reliability at a cost of less than USD1 per person per year. This progress has led to the government approving co-funding for a seven-year programme for one district from 2024 to 2030. If successful at scale, this model could be applied nationally to schools attended by 40 million pupils.

Advisory and operational partnerships are guided by a multi-stakeholder platform of government, industry and civil society to restore the quality and health of Dhaka's river ssystem. The government has a planned investment portfolio of USD20 billion over the next two decades to reduce ecosystem damage and public health hazards from urban expansion, untreated sewage, and industrial growth. Social inequalities are high with around one out of twenty residents living in a flood zone affected by heavily polluted water. Inputs from foundational science modelling river water quality is providing insights and evidence on how to sequence and prioritise investments within the wider political context of infrastructure planning, land use availability, and loan conditions (11,12).

One example of executing investments through scientific partnerships is results-based funding for drinking water services. Foundational science led by the University of Oxford provided evidence to develop a partnership with Uptime which operates in 16 countries guaranteeing reliable drinking water for 5 million rural people in 2024. Uptime designed a standardised contracting framework for service providers to qualify for funding based on outcome metrics (13). A water quality incentive is now being introduced to link metrics of monitoring and reporting outcomes with accountable responses by local and regulatory authorities. This model is attracting private sector funding due to a post-paid model with verifiable outcome metrics relevant to ESG and SDG commitments.

Reflexive evaluation is important in every phase of partnerships. What we have learnt from our collective experience is the value of evaluating 'equality' in all aspects of water security. This includes the participation of women, men and children in policy and research engagement; to transform equality in water management from cities to river basins, and rural villages to service providers; and, to understand how gender and status affect individual water security. Sharing knowledge, increasing participation, and establishing global networks are intermediate steps to evaluate structural change and progress. However, the capacity of governments and donors to change cultural norms to reduce gendered inequalities remains a challenging but important question.

Policy Insights

We identify four policy insights for science funding bodies, governments, and donors promoting effective partnerships for sustainable development. First, the opportunities for academics to engage in partnerships with practitioners need new funding models, incentive structures and measures of value. Academic careers are shaped more by journal outputs than investing in partnerships. Universities in the Global South have intensive teaching loads with few incentives, or time, to publish or build partnerships. Poor infrastructure, limited resources, and precarious contracts compound challenges. Women face additional dilemmas as taking parental leave can place a burden on future career choices and progress. We recommend outcome-based funding to recruit and retain senior and junior academics with the skills and mindset to work with policy makers to improve outcomes from existing and new policy.

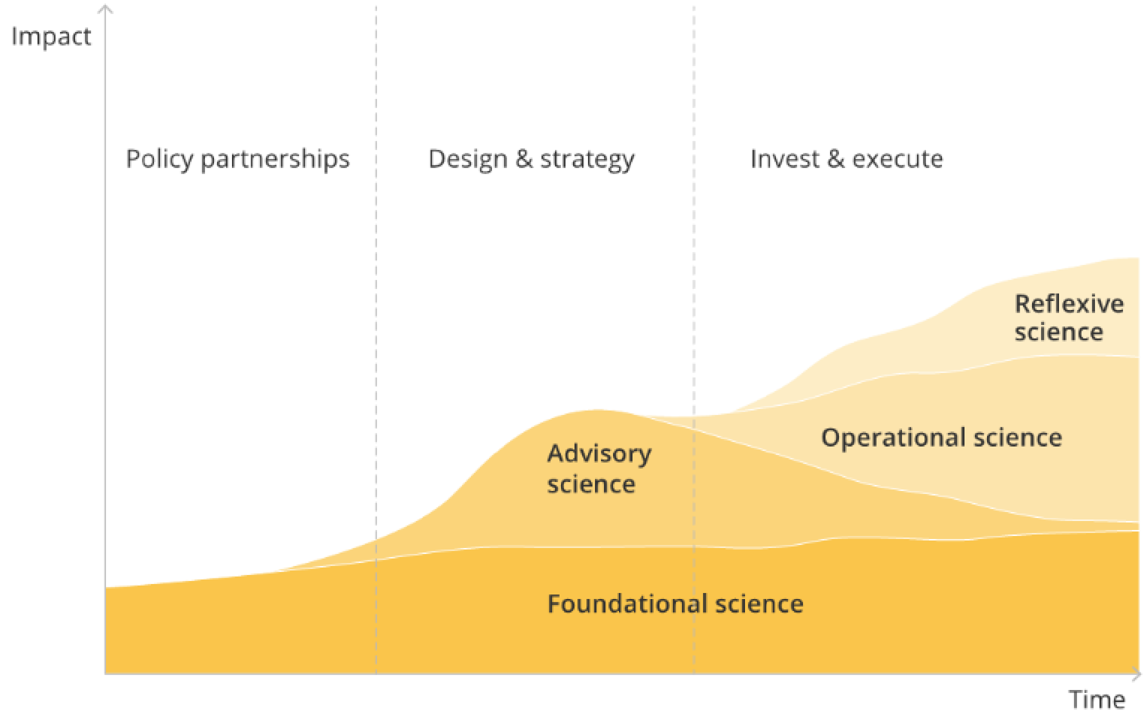
Second, a new funding architecture for international development needs to transition from ‘science directs’ to ‘science serves’ with partnerships adapted to policy priorities in dialogue with local concerns. The design phase of partnerships is critical because vested interests and institutional structures often promote marginal changes to under-performing practices. Transparent and ambitious impact targets with outcome-based resources provide a means and the motivation for partners to invest the necessary time to build trust and to deliver mutually defined progress for the public good.

Third, science-practitioner observatories are a key mechanism for government, scientists, and local stakeholders to design, execute and evaluate key development challenges. Global examples would include iccdr,b’s work on demography and public health in Asia (14), the Young Lives’ global programs tracking population cohorts (15), and REACH’s water security observatories. Patient funding over decades has yielded considerable insights to influence policy and investment benefiting tens of millions of people, the majority of whom live outside the observatories.

Fourth, partnerships are strengthened by targeted investments. Missed opportunities between academic studies influencing the allocation of bilateral and multilateral funding is common. Governments have a challenging role to play in coordinating academic partners and institutional investors. Providing targeted resources, training and an effective framework for government engagement would strengthen established research agencies or policy units within ministries that links science with sustainable development goals.

The mantra of partnerships in international development is increasingly popular. However, the well-intentioned approach will be strengthened through a significant rethink of existing science funding models. Many scientists are currently limited by governments wary of investing in partnerships that end with changing funding priorities. There remains a narrow but valuable window to 2030 when bolder and more innovative investments in science-practitioner partnerships could achieve significant impacts for many hundreds of millions of vulnerable people.

Figure 1. A framework for Science-Practitioner Partnerships (source: authors)



References

1. C. Kőrösi, J. Cullmann, Science needed now, for action. *Science*. **381**, 1136–1136 (2023).
2. S. van den Hove, A rationale for science–policy interfaces. *Futures*. **39**, 807–826 (2007).
3. S. Dessai, M. Hulme, R. Lempert, R. Pielke Jr, "Climate prediction: A limit to adaptation?" in *Adapting to climate change: Thresholds, values, governance*, W. N. Adger, I. Lorenzoni, K. L. O'Brien, Eds. (Cambridge Univ. Press, Cambridge, 2009), pp. 64-78.
4. M. J. Colloff, R. Q. Grafton, J. Williams, Scientific integrity, public policy and water governance in the Murray-Darling Basin, Australia. *Australasian Journal of Water Resources*. **25**, 121–140 (2021).
5. D. W. Cash, W. Clark, F. Alcock, N. M. Dickson, N. Eckley, J. Jaeger, "Salience, Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision-making" (KSG Working Paper Series RWP02-046, Harvard University, 2003). http://nrs.harvard.edu/urn-3:HUL.InstRepos:32067415
6. A. K. Gain, C. Giupponi, Y. Wada, Measuring global water security towards sustainable development goals. *Environmental Research Letters*. **11**, 124015 (2016).
7. F. Sultana, Water justice: Why it matters and how to achieve it. Water International. **43**, 483–493 (2018).
8. J. Koehler *et al.*, Water policy, politics, and practice: The case of Kitui County, Kenya. *Frontiers in Water*. **4** (2022).
9. C. Munday, N. Savage, R. G. Jones, R. Washington, Valley Formation aridifies East Africa and elevates Congo Basin rainfall. *Nature*. **615**, 276–279 (2023).
10. F. Tanui, D. Olago, G. Ouma, Z. Kuria, Hydrochemical and isotopic characteristics of the lodwar alluvial aquifer system (LAAS) in northwestern Kenya and implications for

sustainable groundwater use in dryland urban areas. *Journal of African Earth Sciences*. **206**, 105043 (2023).
11. G. Bussi, S. Shawal, M. A. Hossain, P. G. Whitehead, L. Jin, Multibranch modelling of flow and water quality in the Dhaka River system, Bangladesh: Impacts of future development plans and climate change. *Water*. **15**, 3027 (2023).
12. S. F. Hoque, R. Peters, P. Whitehead, R. Hope, M. A. Hossain, River pollution and social inequalities in Dhaka, Bangladesh. *Environmental Research Communications*. **3**, 095003 (2021).
13. D. McNicholl, R. Hope, A. Money, A. Lane, A. Armstrong, M. Dupuis, P. Harvey, C. Nyaga, S. Womble, J. Allen, J. Katuva, T. Barbotte, L. Lambert, M. Staub, P. Thomson, J. Koehler, "Delivering Global Rural Water Services through Results-Based Contracts". (Working Paper 3. Uptime consortium, 2021).
14. J. Holmgren, Modern history of cholera vaccines and the pivotal role of icddr,b. *The Journal of Infectious Diseases*. **224**, S742-S748 (2021).
15. I. Barnett, P. Ariana, S. Petrou, M. E. Penny, L. T. Duc, S. Galab, T. Woldehanna, J. A. Escobal, E. Plugge, J. Boyden, Cohort profile: The young lives study. *International Journal of Epidemiology*. **42**, 701–708 (2012).

The authors declare no competing interests.

Acknowledgements This article is an output from the REACH programme, funded by UK Aid from the UK Foreign, Commonwealth and Development Office (FCDO) for the benefit of developing countries (Programme Code 201880). However, the views expressed and information contained in it are not necessarily those of or endorsed by FCDO, which can accept no responsibility for such views or information or for any reliance placed on them. For more information on the REACH programme: www.reachwater.uk. Funding from the Australian Research Council Laureate Fellowship grant FL190100164 'Water Justice: Indigenous Water valuation and Resilient Decision-making' supported this work.