Environmental Science and Policy 176 (2026) 104316

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Driving impacts through science-practitioner partnership: Professionalising water service delivery in rural Bangladesh

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ARTICLE INFO

Keywords:
Research impact
Science-practitioner partnership
Rural water
Professional service delivery
SafePani
Institutional work

ABSTRACT

Academic research is under increasing pressure to demonstrate tangible societal, environmental, and economic impact, prompting increased engagement between scientists and practitioners. This paper investigates how such partnerships evolve, how science contributes across different phases of the policy process, and what conditions enable or constrain their effectiveness. It does so through the case of SafePani, a professional rural water service delivery model in Bangladesh. Conceptualised and piloted through UK-based research funding in schools and healthcare facilities, SafePani was later scaled under a six-year, results-based funding contract co-funded by the Government of Bangladesh. The study integrates the multi-level perspective, actor-centred institutionalism, and institutional work to analyse the micro-level activities that actors engaged in to build networks, shape dominant discourses and drive institutional change. Findings show that SafePani's success stemmed not only from technical innovation but from its strategic adaptability. This included evolving actor configurations from academic-led research to government-led implementation, mobilising financial, intellectual, and political capital, engaging credible boundary actors to build trust, and engaging bureaucratic champions. Crucially, institutional stamina of the government, the model's low cost and public value, and the funding flexibility enabled actors to overcome institutional inertia. SafePani offers a replicable example of how interdisciplinary science, sustained engagement, and contextual adaptation can drive institutional reform in complex policy environments.

1. Introduction

Academic research is under increasing pressure to demonstrate tangible benefits to society, the environment, and the economy (Bornmann, 2013; Boswell and Smith, 2017). Frameworks such as the UK's Research Excellence Framework and the 'pathways to impact' requirement in grant proposals exemplify institutional mechanisms designed to assess and incentivise research impact. Earlier impact models, which assumed a linear, supply-driven transfer of knowledge, have been increasingly challenged by scholars (Walter et al., 2005). Rather than focusing on autonomous streams of problems, policy, and politics that collide at key moments, recent scholarship emphasises the importance of what Huberman (1993) calls 'sustained interactivity'. Such shifts acknowledge the blurred boundaries between researchers, intermediaries, and users, prompting more interactive modes of engagement - particularly science-practitioner partnerships.

Decision-making in policy contexts is shaped by competing priorities, institutional inertia, and the diverse interests of stakeholders. Researchers must navigate these complex institutional landscapes while fostering trust and legitimacy (Georgalakis and Rose, 2019). Central to such collaboration is communication - not merely the transmission of information, but the shaping of discourses, interpretations, and the securing of political buy-in (Boswell and Smith, 2017, Wagner et al., 2023). Fuenfschilling and Truffer (2016), for example, demonstrated how the strategic framing of desalination technologies, in terms of entrenched values of supply driven water security, positioned it as an uncontroversial response to Australia's water scarcity during the Millennium Drought, marginalising sustainable alternatives like

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https://doi.org/10.1016/j.envsci.2026.104316
Received 4 March 2025; Received in revised form 9 July 2025; Accepted 13 January 2026
Available online 16 January 2026

wastewater recycling.

Ratner et al. (2022) refer to this as the 'social work' of engagement, which involves relationship-building, interest negotiation, and iterative dialogue. Within this space, knowledge brokers play an increasingly vital role. Whether embedded within government or operating through intermediary organisations, brokers translate and contextualise research for policy audiences (Cvitanovic et al., 2025). Studying the implementation of the Dutch Delta Approach in the in Bangladesh and Vietnam, Hasan et al. (2022) demonstrate that the success of policy transfer depends less on the technical strength of the model and more on the political work involved in framing, alliance-building, and navigating institutional landscapes.

Research-policy relationships are shaped by power. Control over funding and agenda-setting by institutions in the global North has historically influenced narratives around development policies and research collaborations with the global South - from a deficit narrative that highlights a lack of resources and capacity in less developed countries, to a sustainability narrative that emphasises transdisciplinary co-creation of solutions to complex environmental challenges (Tetley and Koch, 2024). Within countries, centrally formulated policies often encounter a reality gap when implemented locally. Jones (2015), in his analysis of rural water reform in Mali, found that national reforms resulted in symbolic compliance rather than functional change. Local actors engaged in what he terms 'institutional bricolage' - blending formal rules with customary practices to co-create context-specific governance arrangements.

To be effective, science-practitioner partnerships must operate across scales. This includes translating global evidence into locally relevant terms, while ensuring local insights inform higher-level policy agendas. Baniya and Aryal (2022) show how global frameworks like the Sustainable Development Goals (SDG) and the Paris Agreement shaped climate discourse in Nepal, but effective integration depended on collaborative practices among domestic actors and the ability to bridge sectoral silos. Likewise, in Uganda's water sector, where regulatory changes emphasise professional water service delivery, Cord et al. (2022) found that formal mandates alone were insufficient to secure support from local government; institutional uptake required alignment with normative and cultural-cognitive logics.

Key strategic questions in effective science-practitioner partnerships include whom to involve, when, and how. Research suggests that nurturing inclusive, multi-stakeholder coalitions can amplify impact, particularly if the right actors are engaged at the right time. Champions within organisations - senior civil servants, institutional entrepreneurs, or mid-level policy professionals - can promote uptake by mobilising networks and lending legitimacy to new ideas (Hinton et al., 2019). Timing is equally critical: policy engagement is most effective when aligned with political cycles, moments of disruption, or windows of opportunity, such as new appointments or reform agendas (Yeates et al., 2019).

Science can contribute to different phases of the policy cycle: providing evidence and framing problems during agenda-setting, offering options and analysis during policy formulation, supporting implementation through technical guidance and training, and informing evaluation and learning after policy rollout (Hope et al., 2024; Ratner et al., 2022). Effective partnerships demand agility and a deep understanding of bureaucratic processes and incentives to tailor their engagement strategies to these shifting roles. Even with political will and contextual alignment, impact cannot be sustained without adequate resources. Walter et al. (2005) found that the implementation of evidence-based innovations depends on financial, human, and technical resources, as well as leadership, motivation, and supportive infrastructure.

Despite extensive evaluations and theoretical developments regarding 'what works' at the science-policy interface (for example, Oliver et al., 2022; Wagner et al., 2023; Reed et al., 2018), much remains unknown about the everyday processes through which impact is achieved. There is a lack of detailed empirical studies on the micro-level actions and interactions that unfold through iteration, adaptation, and often serendipity. For academics in Western institutions seeking to promote impact - especially in the global South - there is a need to understand what science-practitioner partnerships look like in practice. This includes research activities, institutional collaborations, publications, events, resource mobilisation, and strategic alignment - all of which form part of the 'story of change'. This leads to the three research questions of this study:

- How do science–practitioner partnerships dynamically adapt to the shifting priorities and institutional constraints of policy environments?
- In what ways can science contribute effectively across different phases of the policy process?
- What factors determine the success or failure of these partnerships?

This paper addresses these questions by examining the design and scaling of the SafePani model for professional water service delivery. The SafePani model was conceptualised and piloted in schools and healthcare facilities in rural Bangladesh through UK-based research funding. Through sustained collaboration between academics, development practitioners, and government stakeholders, the model was scaled up to one of 64 districts under a six-year, results-based funding contract co-funded by the government.

To frame this analysis, we draw on two key theoretical perspectives. First, we adopt the multi-level perspective of socio-technical transition (Geels, 2005) to situate the institutional structures governing rural water services in Bangladesh and identify the actors and processes involved in implementing the professional service delivery model. Second, we employ an actor-centred approach to analyse the set of interactions between individual and collective actors and their institutional settings. We combine actor-centred institutionalism from economics (Scharpf, 1997) with the concept of institutional work from organisational studies (Lawrence and Suddaby, 2006) to integrate the strategic behaviour of actors with the specific practices that enact those strategies.

This paper makes two key contributions. First, by focusing on the micro-level processes that unfold throughout the life of a research programme, it advances empirical evidence on how researchers collaborate with practitioners and policymakers to translate knowledge into institutional change. It offers a practical pathway for researchers, across sectors and geographies, to build strategic networks, shape policy discourse, and align research outputs with decision-making processes.

Second, the paper illustrates the value of theoretical integration across disciplinary boundaries. By combining the multi-level perspective on socio-technical transitions, actor-centred institutionalism, and institutional work, we develop an analytical lens capable of explaining not only what institutional change occurred, but also why it was pursued and how it was enacted.

2. Theorising institutional change

2.1. Evolving perspectives on science-policy interface

The study of institutional change - particularly in relation to science-policy dynamics - has evolved through interdisciplinary contributions from political science, sociology, economics, and organisational studies. At the heart of these explorations lies institutionalism, a theoretical orientation that interrogates how formal and informal rules, norms, and structures govern collective behaviour, influence the use of evidence in decision-making, and shape the stability or transformation of governance arrangements.

Traditional institutionalist approaches have been foundational in establishing how institutions constrain or enable behaviour. Historical institutionalism underscores the path-dependent nature of institutions,

emphasising how early choices create enduring legacies that limit future options (Thelen, 1999). Rational choice institutionalism conceptualises institutions as incentive structures that actors strategically navigate to maximise utility (North, 1990). Sociological institutionalism, by contrast, stresses the symbolic and normative dimensions of institutions, demonstrating how actors conform to socially constructed norms and identities, often unconsciously (DiMaggio and Powell, 1983). However, these frameworks often struggle to explain gradual, endogenous, or actor-driven institutional change.

To address these limitations, more recent frameworks have shifted the analytical focus from structures to agency and discursive processes. Discursive institutionalism highlighted the power of ideas, communication, and discourse in reshaping institutions, recognising that institutional stability and change are deeply tied to how actors interpret and argue about norms (Schmidt, 2008). Meanwhile, actor-centred institutionalism introduced strategic negotiation as a driver of change, emphasising how actors leverage institutional settings to advance reform (Scharpf, 1997). This was complemented by the concept of institutional work, which examines the micro-level practices through which individuals and organisations create, maintain, or disrupt institutions (Lawrence and Suddaby, 2006).

Institutional change is not merely about adapting to new conditions; it involves contesting and consolidating meaning. In Bangladesh, the institutionalisation of Tidal River Management, which began as a grassroots innovation but was later reframed through Dutch delta expertise, privileged technocratic models over local knowledge, reinforcing top-down planning and exacerbating socio-spatial inequalities for marginalised land users (Hasan et al., 2022, Gain et al., 2017). Similarly, India's Swachh Bharat Mission reframed rural sanitation from infrastructure delivery to behaviour change, backed by strong political leadership (O'Reilly and Louis, 2014). While effective in mobilising resources, this approach often sidelined participatory models that emphasised inclusion and community empowerment.

Interdisciplinary approaches such as the multi-level perspective (Geels, 2002), co-production theories in Science and Technology Studies (Jasanoff, 2004), and polycentric governance (Ostrom, 2010) have significantly enriched the analytical frameworks for studying institutional change. These perspectives account for the complexity, diversity, and scale of socio-technical and environmental systems, emphasising that change emerges through dynamic interactions among actors, institutions, and structural conditions. The multi-level perspective highlights how innovations developed in protected niches can challenge dominant regimes when aligned with broader landscape-level pressures. Co-production theories foreground the reciprocal shaping of knowledge and governance, showing how scientific practices, policy norms, and institutional structures are co-constructed through negotiation and iteration. Polycentric governance introduces a multi-centred view of authority, in which decision-making is distributed across overlapping jurisdictions and actor networks, enhancing adaptability, experimentation, and inclusivity.

Together, these theoretical developments reflect a shift towards more pluralistic approaches of studying institutional change – ones that integrate structure and agency, while incorporating ideas, practices, power dynamics, and negotiation across multiple scales of analysis.

2.2. Theoretical integration of structure, agency and practices

Drawing on the above review, we adopt an integrated analytical framework that combines the multi-level perspective, actor-centred institutionalism, and institutional work to bridge process-oriented and actor-oriented perspectives. This synthesis brings together structural, strategic, and practice-based approaches, offering a more nuanced understanding of science–policy interfaces, where change emerges through iterative interactions among actors, discourses, and institutional structures.

2.2.1. Multi-level perspective

The multi-level perspective adopts a process-based orientation, viewing change as an interaction between three interconnected levels: the niche (innovation), the regime (dominant practices), and the landscape (external pressures) (Fuenfschilling and Truffer, 2016; Geels, 2005).

The landscape encompasses broader, external forces, such as economic growth and environmental challenges, that exert pressure on both the regime and niches. These factors are often perceived as stable and beyond immediate control, shaping the interactions between innovations and established systems. The regime is the semi-coherent rule sets carried by different social groups that stabilise a technological trajectory. Regimes are inherently resistant to change due to their path dependency, where established institutions, technologies, and practices create strong lock-in effects that reinforce the status quo. The niche is a locus for radical innovations geared towards problems of the existing regime. This is where new technologies, business models, and social practices are developed and tested, often within small-scale, protected environments like pilot projects or initiatives supported by external donors.

Rogers et al. (2015) further refines the concept of a niche by dividing it into three stages: pre-niche, niche, and niche-regime, to explain the progression of innovation in relation to mainstream practices. In the pre-niche stage, the innovation exists solely as an idea, plan, or undeveloped technology, without real-world implementation, typically involving initial scoping or early investigations. The niche stage involves trials and demonstrations by a small network of actors, who are shielded from the mainstream, such as through pilot projects or the development of guidelines. The niche-regime stage is characterised by the adoption of technologies and practices by regime actors, though they have not yet been fully integrated into the mainstream, as seen in large-scale trials or medium to long-term contracts. Once an innovation becomes widely accepted and embedded as a standard technology or practice, it is considered part of the regime, where it becomes a routine part of operations.

2.2.2. Actor-centred institutionalism

Actor-centred institutionalism is a theoretical framework for analysing public policy and political economy that connects two key perspectives: the influence of formal institutional arrangements and their constraining effects on political outcomes, and approaches that highlight the role of boundedly rational actors and their strategic motivations in shaping those outcomes. Building on Scharpf (1997)'s work, actor-centred institutionalism offers conceptual tools for interaction-focused policy research by theorising how individual and collective actors, along with their orientations and capabilities, shape policy decisions and outcomes.

Actors' orientations encompass their preferences and perceptions, which are relatively stable but changeable through learning and persuasion. Preferences reflect actors' interests, representing their calculated responses to policy issues and the costs and benefits of potential actions. Perceptions, on the other hand, are cognitive orientations, shaped by subjective interpretations of phenomena based on actors' beliefs and values. Capabilities refer to the action resources, for example, financial capital, technical skills, political network, and reputation, that actors can leverage to achieve their objectives within the institutional framework. Leadership and entrepreneurship are key, as they can shape agendas, frame issues, and mobilise support for change. Coalition-building is often crucial, as actors with overlapping interests form alliances to achieve their goals and influence institutional transformations.

2.2.3. Institutional work

While actor-centred institutionalism explains the strategic behaviour of actors and macro-level mechanisms driving institutional change, institutional work focuses on how this behaviour is enacted through

specific practices and everyday actions within organisations. In essence, actor-centred institutionalism explains 'why' actors pursue change, while institutional work reveals 'how' they actively engage in it. Introduced by Lawrence and Suddaby (2006), institutional work refers to the purposive action of actors aimed at creating, maintaining, and disrupting institutions.

One key category of institutional work is shaping policy discourses. Discourses provide a framework for actors to construct meanings, influence perceptions, and define problems, as well as assign responsibilities. Shaped by actors' beliefs, interests, and visions, discourses legitimate innovations by articulating collective visions and expectations, which influence the development and diffusion of technologies. Examples of specific types of institutional work shaping discourses are theorising (i.e. offering narratives to rationalise the new institution), changing assumptions and beliefs (i.e. shifting how broader societal problems or opportunities are understood), and constructing identities (i.e. shaping how participants see themselves and their responsibilities) (Duygan et al., 2019).

Another critical category is developing social networks, as success in transitions relies on distributing competence and connecting actors. The concept of distributed agency suggests that multiple agents, rather than a single inventor, work together to influence change. Due to their limited power, actors form ties to build trust, legitimacy, and access resources like knowledge. Networks facilitate cooperation, resource control, and alliance-building, supporting innovation and creating expectations. Examples of institutional work relying on networks include normative network construction (i.e. building alliances of individuals or groups sharing similar goals), advocacy (i.e. promoting new ideas by lobbying and raising awareness), and vesting (i.e. granting the new institution power, authority, or resources for sustainability and rule enforcement) (Duygan et al., 2019).

3. Transitions in rural water service delivery

The multi-level perspective provides an analytical lens to review global paradigm shifts in rural water services, focusing on the interactions between landscape and regime that drive transitions in institutional and financing ideologies, as well as the emergence of professional service delivery in niches. This section contextualises the rural water sector in Bangladesh within the global policy discourse, introducing the SafePani model as the case study.

3.1. Landscape-regime interactions

The rural water regime in low-income countries of Asia and Africa has been profoundly influenced by landscape pressures from international donor organisations, shaping national policies through bilateral or multilateral aid (Wit et al., 2024). A focus on infrastructure development has dominated global policy discourse, as articulated in the Millennium Development Goal (MDG) Target 7c, relying largely on concessional financing through grants, loans, and charitable aid from NGOs and faith-based groups for initial capital investments. This dependence on external funding has contributed to a partial abdication of government responsibility, reflecting the low priority rural populations often receive from national decision-makers. Underpinned by the principles of participation and ownership, community-based management models were promoted through a series of conferences, and statements and included in many national sector policies (Chowns, 2015). In contrast to urban areas, where subsidised piped services are managed by utilities, rural users are left to navigate their own water management challenges, often having to gather funds and spare parts for repairing pumps and pipes.

For the vast majority of Bangladesh's 116 million rural population, the main source of drinking water is tubewells. The government's Department of Health and Engineering (DPHE) is mandated to provide water supply infrastructure, the operation and maintenance of which are delegated to users represented by voluntary committees. For public institutions like schools and healthcare facilities, these responsibilities are borne by the individual administrators without any dedicated funding or technical support (Fischer et al., 2021). Bangladesh has vibrant local markets of tubewell spare parts and trained technicians, which has both driven and benefited from the growth of private tubewells, now numbering an estimated 16 million across the country compared to only 2 million public ones (Fischer et al., 2020).

Population growth, economic development, and climate-related hazards have created new landscape pressures on the rural water regime. With the adoption of SDG 6.1, global policy discourse has shifted from a focus on 'provision' to a 'risk mitigation' approach, emphasising the delivery of safe, reliable, and equitable water services (Bradley and Bartram, 2013). The limitations of community-based management in ensuring functionality have become increasingly apparent (Harvey and Reed, 2007). Seasonal fluctuations in user payments, driven by cultural preferences for rainfed sources, pose significant financial challenges for the operation and maintenance of rural water points (Armstrong et al., 2022, Foster and Hope, 2017). Additionally, variations in hydroclimatic contexts have led to the adoption of different water supply technologies, each with unique maintenance requirements, often exceeding community capacities. This is observed in coastal Bangladesh, where high groundwater salinity has led to uncoordinated donor investments in alternative sources and technologies, including pond sand filters, rainwater harvesting, small-piped schemes, and reverse osmosis systems (Hoque et al., 2019).

The original perception of groundwater as a safe resource is increasingly being questioned due to chemical and bacteriological contamination from both natural and anthropogenic sources (Nowicki et al., 2023). In Bangladesh, other than a one-off testing of public tubewells post-installation, there are no provisions for monitoring water quality, resulting in uncertain risks particularly given the high prevalence of unregulated private and donor-funded waterpoints. Evidence from BBS/UNICEF (2021) shows that when arsenic and *E.coli* are taken into account, the MDG success story of 97 % of rural populations having access to improved sources fades to 43 % having safely-managed services under the SDG criteria.

3.2. Professional service delivery emerging in niches

There is growing demand for a shift in financing strategies, moving away from aid reliance and expanding the use of subsidies and diverse funding sources, alongside increased private sector involvement in operation and maintenance services. The professional service delivery model has emerged as a as a niche model in recent years, where a public entity, such as a utility or local government, or a private entity, such as for-profit or social enterprises, takes contractual responsibility for delivering a guaranteed service level to users, with regular monitoring and penalties for non-compliance (Nilsson et al., 2021). This approach offers a mechanism to deliver subsidies to providers, with evidence from Kenya showing that tariff revenue covers only about one-third of local operational costs (Chintalapati et al., 2022). While subsidies have traditionally come from donor funding, the goal is to eventually source them from a mix of development partners, public budgets, and private funding. Advances in smart technologies, including remote sensors, data storage, and cashless payment systems, are supporting new financing strategies and enhancing transparency, particularly for performance-based funding (McNicholl et al., 2021).

Professional service providers vary widely in their scope, ranging from repair and maintenance to water safety services, their legal arrangements, through formal contracts or memorandum of understanding, their monitoring frameworks, involving smart technologies, and performance reporting, and their financing models, including revenues from user fees or reliance on external funding (Nilsson et al., 2021). For example, FundiFix in Kenya operate on a guaranteed service model where local service providers establish performance-based contracts

with communities, ensuring that repairs are completed within a few days, or the community receives free service for the next month (www.fundifix.org). In Mali, Uduma works through long-term concession contracts, and incentivises maintenance by paying mechanics based on the revenue from water sales (www.uduma.net).

A global diagnostic study identified a group of 77 service providers delivering water services for about 5 million people in 28 countries, who report operational metrics consistent with a results-based contracting approach (Nilsson et al., 2021). Other estimates suggest that 20–95 million people in sub-Saharan Africa are currently served by professional entities, compared to the 540–627 million people served by community-managed waterpoints (Carter, 2023). Scaling up professional service delivery from fixed-term niche initiatives supported by development practitioners and impact investors to government integrated sustainable models requires fundamental shifts in cultural-cognitive, regulatory and normative institutional environments (Cord et al., 2022).

3.3. SafePani model as a case study

SafePani is a professional water service delivery model for rural Bangladesh, developed under the REACH programme led by the University of Oxford and funded by the UK's Foreign, Commonwealth & Development Office (FCDO). The initiative emerged in 2018 from collaborations between Oxford and UNICEF, aiming to address water safety and reliability challenges by shifting from community-based management to professionalised service delivery.

Between 2021 and 2023, the model was piloted in 204 schools and healthcare facilities in eight unions (Tier 4 administrative boundary) of Khulna district through research funding, with HYSAWA as the selected service provider. The operations included three components: first, minor rehabilitation of existing water supply infrastructure where needed, such as raising tubewell platforms, installing soak wells, and repairing pipelines; second, water safety management through quarterly sanitary inspections, baseline chemical tests (arsenic, manganese and chloride) at DPHE laboratory and bi-annual or quarterly *E.coli* tests at a purpose-built microbiological laboratory. Managed actions involved shock chlorination of *E.coli* contaminated sites, reporting results to users and government steering committee, and follow-up testing to confirm decontamination.

In 2024, the model was scaled up to the entire district, involved 1174 schools and healthcare facilities. In 2025, the Government of Bangladesh collaborated with UK-based Uptime Catalyst Facility to co-fund a results-based contract for six years till 2030. Under the contract, the service provider will be paid quarterly upon verification of performance metrics on water safety and reliability.

4. Methodology

This study adopts the learning history method to examine the evolution of the SafePani model - from its early conceptualisation within a global research initiative to its pilot implementation and eventual scale-up with government co-funding. The learning history approach, rooted in Senge (1990)'s work on the 'learning organisation' and developed further by Roth and Kleiner (1998), (1995), is designed to capture and analyse organisational experiences during periods of significant change. It facilitates organisational learning by constructing shared narratives based on the reflections of stakeholders, enabling the identification of strategic decisions, lessons learned, and turning points that shaped the trajectory of change.

4.1. Data sources

4.1.1. Project archives

To support this approach, the study drew upon a comprehensive set of data sources accumulated over several years. These included formal records such as the minutes of National Steering Committee and District Working Group meetings, memoranda of understanding, contractual agreements (including the HYSAWA service contract), and concept notes submitted to government. Additional materials included project documentation such as budgets, workplans, deliverables, internal correspondence and bilateral meeting notes, email exchanges, and informal observations. Academic outputs- policy briefs, survey datasets, and working papers - were also incorporated, alongside event documentation including workshop presentations, photographs, participant lists, and field visit records. These sources, archived in a shared project repository, provided a robust foundation for reconstructing the SafePani process across different phases and institutional settings.

4.1.2. Internal workshop

To deepen the analysis, an internal workshop was convened in September 2024 with SafePani actors (n = 20) who had been involved in the pilot and scale-up process. Participants included members of the core Khulna team - engineers (n = 2), community liaison officers (n = 8), government liaison officer (n = 1), performance manager (n = 1), water quality manager (n = 1), lab technician (n = 1) and IT specialist (n = 1) - as well as senior representatives from UNICEF (n = 1), HYSAWA (n = 1), and the University of Oxford (n = 3).

The discussions focused on field experiences, evolving roles, inter-agency interactions, and reflections on informal or undocumented moments that influenced strategic decisions. While government actors did not participate in the workshop, the narrative and analytical findings were reviewed and validated through co-authorship and follow-up consultations with government officials who played key roles in SafePani's development. These workshop discussions were audio recorded and transcribed by the lead author.

4.2. Data analysis

4.2.1. Narrative construction

A detailed chronological narrative of the SafePani initiative was constructed by synthesising this material with the archival data. This timeline served as the basis for identifying critical events, shifting actor alignments, and the evolving structure of institutional relationships. It also facilitated the subsequent thematic analysis, which sought to explain how institutional change unfolded across different phases of the initiative.

4.2.2. Thematic analysis

Thematic coding was conducted in NVivo using a deductive coding frame derived from three theoretical frameworks. The multi-level perspective was used to categorise the SafePani process across landscape, regime, and niche levels, with particular attention to the three innovation stages of pre-niche, niche, and niche-regime. Actor-centred institutionalism helped capture the orientations and capabilities of key actors, including their preferences, perceptions, and resources. Institutional work enabled the identification of specific actions that actors undertook to construct and maintain institutional arrangements, such as deploying resources, shaping discourse, and building networks.

To operationalise this analysis, two matrices were developed. The first matrix (see Table S1 in Supplementary materials) classified SafePani activities according to their associated types of institutional work. Activities were categorised as forms of theorising, defining, constructing normative networks, changing normative associations, constructing identities, educating, vesting, or advocacy. This enabled a structured interpretation of how institutional change was enacted through discursive, normative, and resource-based strategies. The second matrix (see Table S2) mapped actor strategies across the three policy phases. It identified the orientations and capabilities of key organisations, including research institutions, donor agencies, government departments, and service providers, and tracked their purposive actions in the conceptualisation, piloting, and scaling of the SafePani model.

Together, the matrices provided a coherent analytical structure for examining how institutional change occurred over time through the interaction of actor agency, evolving networks, and broader systemic pressures.

5. Results

The development and implementation of the SafePani model unfolded in three phases, as framed by the multi-level perspective. These included (1) the pre-niche phase comprising the research and partnerships leading to its conceptualisation; (2) the niche phase involving the design and pilot through donor-funded research; and (3) the niche-regime phase of scaling up the model through a results-based contract with co-funding from the government. Actor-centred institutionalism provided an analytical lens to identify the evolving configuration of actors and their strategic behaviour, shaped by their orientations and capabilities. Institutional work further elucidated the micro-level purposive activities and interactions through which actors shaped the trajectory of institutional change (Fig. 1). The timeline of events is outlined in Fig. 2.

5.1. Pre-niche phase: research to conceptualisation

The pre-niche phase marked the conceptual foundation of SafePani in response to systemic challenges in water safety and service reliability under Bangladesh's prevailing infrastructure-driven regime. Among the key actors involved in this phase were academic institutions, including the University of Oxford, International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b), and Bangladesh University of Engineering and Technology (BUET). These institutions collaborated under the REACH programme, which aimed to improve water security for 10 million people in Asia and Africa.

The **orientations** of these actors significantly shaped the early development of the SafePani niche. Guided by REACH's theory of change, academic partners undertook interdisciplinary studies to investigate the distribution and drivers of water insecurity. In Matlab (Chandpur district), household-level investments in self-supply infrastructure revealed a marked shift in responsibility for financing, operation, and water quality assurance from public to private actors. (see Fischer et al., 2020, Fischer et al., 2021). In Khulna district, where groundwater salinity exhibited high spatial heterogeneity, research found uncoordinated investments by government agencies, NGOs, and private entrepreneurs, exacerbating social, economic, and gendered inequalities in access (see Hoque and Hope, 2020, Hoque et al., 2019).

The SafePani model was initially informed by the reliability-centred maintenance approach developed by the Oxford team through their work in Kenya, where chronic handpump failures were being addressed using real-time monitoring technologies (Thomson et al., 2012) and performance-based maintenance contracts. The adaptation of this model to Bangladesh was led by a team of economists and engineers whose orientation centred on service reliability and system accountability. However, Bangladesh's rural water landscape, characterised by

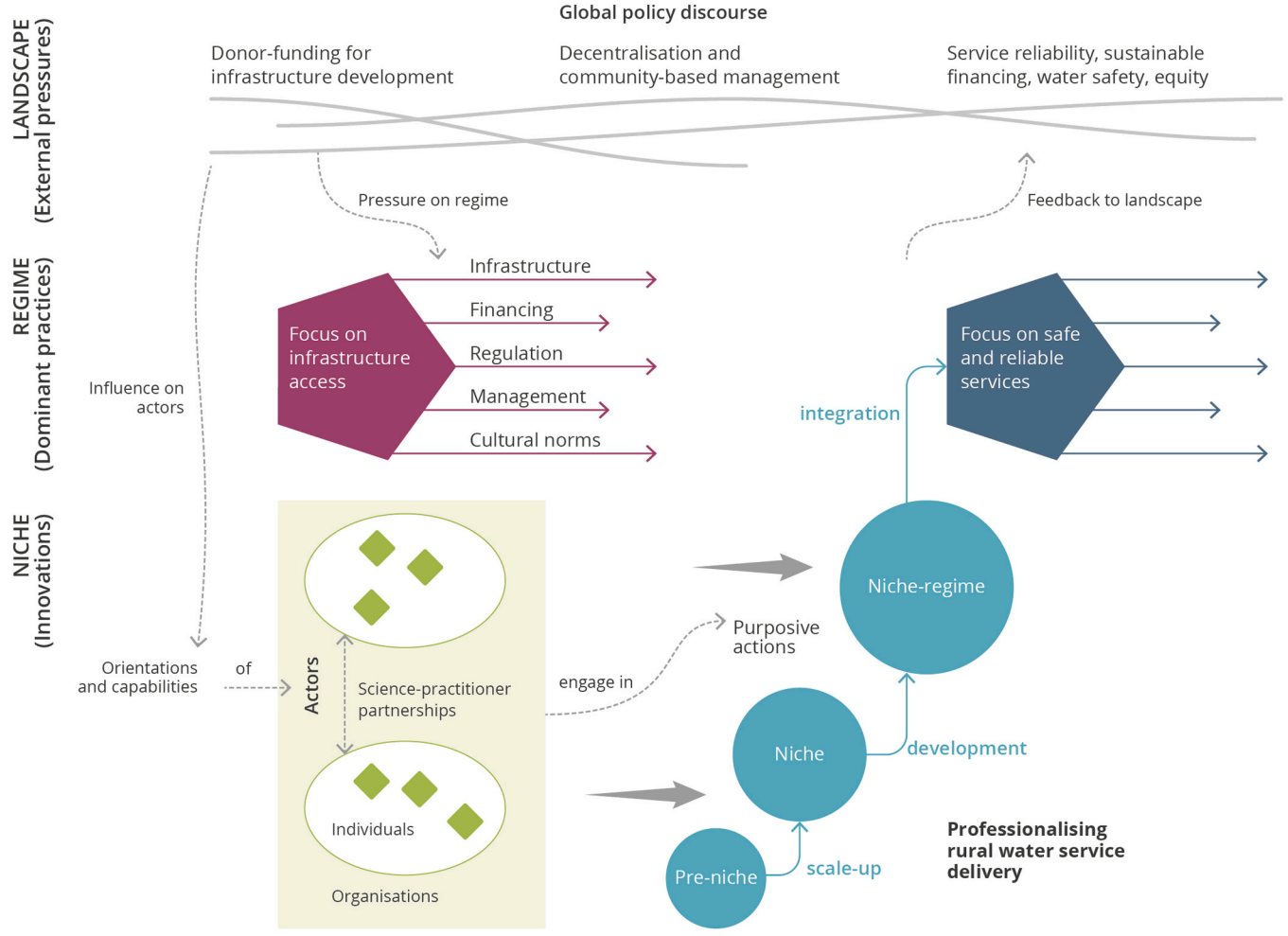

Fig. 1. Theorising institutional change in rural water service delivery combining the multi-level perspective with actor-oriented institutionalism and institutional work.

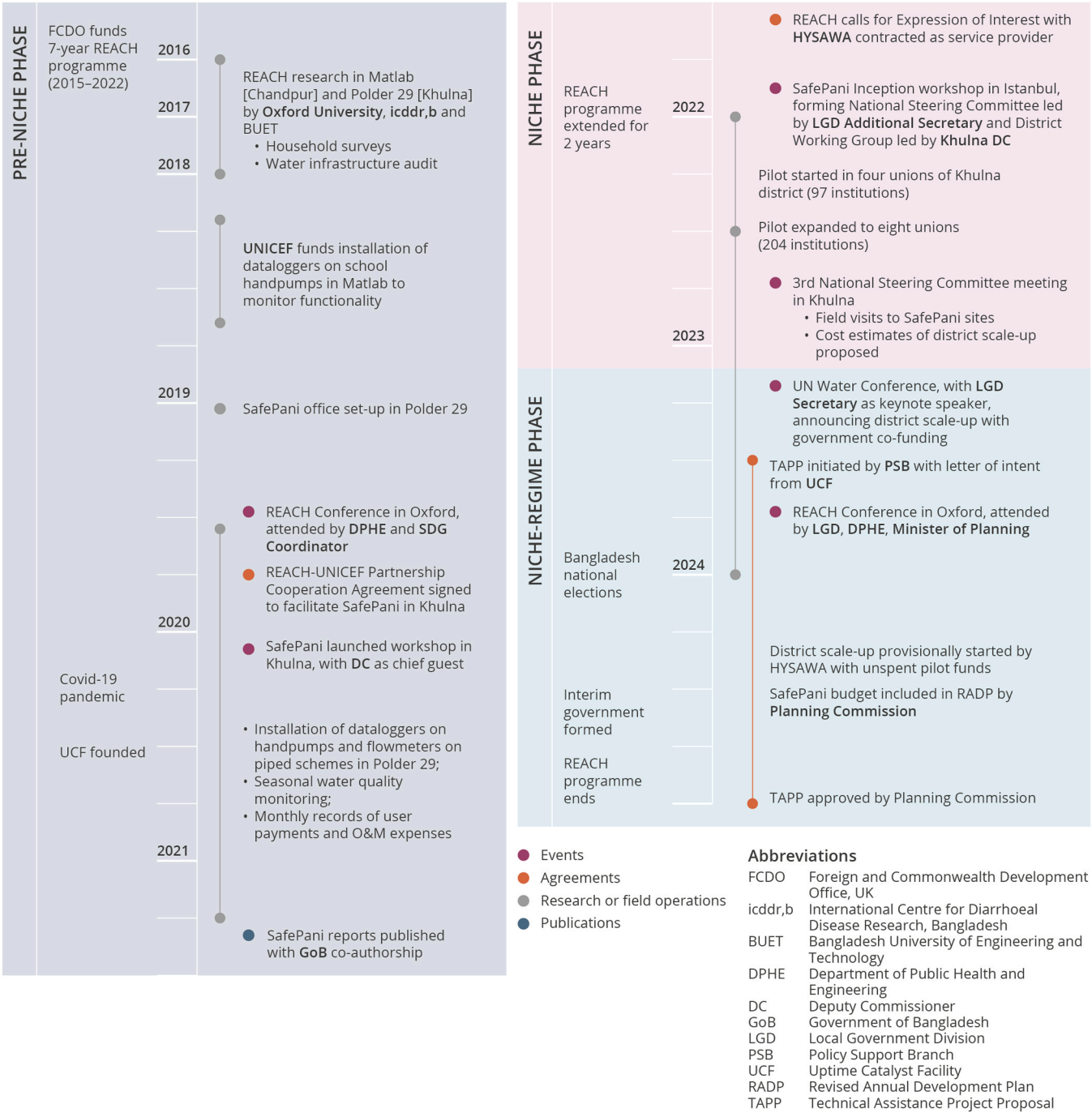

Fig. 2. Evolution of the SafePani model from conceptualisation and piloting with donor-funding to scale-up through result-based contract with government co-funding.

household self-supply and diverse infrastructure types, required a broader framing that also accounted for water quality risks such as arsenic and salinity contamination.

This early conceptual development involved extensive institutional work, particularly the **construction of normative networks** to forge collaborations and legitimise a new governance model. UNICEF, with its longstanding engagement in WASH policy and programme delivery in Bangladesh, was enlisted as the 'research into action' partner. Motivated by interest in scalable delivery models, UNICEF facilitated funding for pilot-testing dataloggers - technologies used to monitor handpump usage - in schools. These efforts aimed to replicate lessons from Kenya's FundiFix model, though early trials in Matlab faced technical limitations such as poor mobile signal reception, battery failures, and vandalism.

Following a Partnership Cooperation Agreement between Oxford/REACH and UNICEF in 2019, a dedicated SafePani office was established in Khulna. A stakeholder consultation in Polder 29 brought together local officials, school headteachers, and DPHE engineers to discuss the planned deployment of monitoring technologies. The Directorate of Primary Education (DPE) granted formal approval for the model's introduction in schools. A national workshop in 2020 launched the SafePani model officially, bringing together the Local Government Division (LGD), DPHE, DPE, Directorate of Secondary and Higher Education (DSHE), and UNICEF, marking a broader coalition around reliability-centred rural water governance.

As the model evolved, its scope expanded in response to Bangladesh's institutional and hydrological context. Recognising that reliability alone was insufficient, the Oxford and icddr,b teams began incorporating environmental health considerations into the model. A seasonal water quality study was initiated across different water supply technologies in Khulna to monitor microbial and chemical contamination. This expanded framing helped link SafePani to public health objectives and reinforced its relevance for donors and government stakeholders.

Government engagement in this phase was initially channelled through DPHE, with BUET's technical credibility facilitating access to key decision-makers and UNICEF's institutional familiarity with bureaucratic processes enabling policy dialogue. However, with the launch of SafePani, engagement expanded to include LGD and the Deputy Commissioner of Khulna, integrating public administration stakeholders into the initiative for the first time. The partnership was further strengthened when a high-level delegation, including DPHE engineers and the government's SDG Coordinator, attended the 2019 REACH Conference in Oxford.

In parallel, institutional work focused on **changing normative associations** - reframing rural water services from an infrastructure-driven model under the MDGs to a service-focused, risk-based approach under the SDGs. REACH published reports, policy briefs, and working papers advocating institutional reforms in sustainable finance, service delivery, and monitoring systems (see Fischer et al., 2021, Hope et al., 2021, Hoque et al., 2021). Many of these were co-authored by government officials, lending legitimacy and signalling alignment with national priorities. The SafePani model was further reinforced through its connection to the National Strategy for Operations and Maintenance, co-developed by LGD, BUET, UNICEF and Oxford, anchoring the model in existing regulatory frameworks.

5.2. Niche phase: piloting with donor funds

In the niche phase, the SafePani initiative transitioned from conceptualisation to implementation. Researchers, who had previously shaped the model through empirical studies and theoretical framing, assumed advisory roles focused on enabling operationalisation. This marked a notable shift in actor orientations - from knowledge generation to strategic engagement in governance reform. The model now required a demonstration of feasibility under real-world conditions, necessitating new actor configurations and institutional adjustments.

In 2021, HYSAWA, a Bangladesh-registered social enterprise with close ties to LGD, was contracted to pilot SafePani in Khulna district. HYSAWA's orientation as a government-facing service provider made it a suitable intermediary to navigate both operational and political terrain. Institutional work at this stage focused on developing protocols, aligning global best practices with local needs, and establishing frameworks for contracting, monitoring, and regulation.

The construction of **normative networks** continued with a high-level inception workshop held in Istanbul, convening senior officials from LGD, DPE, Directorate General of Health Services (DGHS), DPHE, and Khulna district administration. The workshop led to the signing of a memorandum of understanding between Oxford, UNICEF, HYSAWA, and government counterparts. The presence of senior LGD leadership was pivotal in securing cross-agency participation. It was agreed that the pilot would focus on schools and healthcare facilities - institutions with clearer administrative hierarchies - rather than community waterpoints, where fragmented ownership and responsibility complicated implementation.

Institutional work also involved **'constructing identities,'** defining roles for key actors at both local and national levels. At the service provider level, HYSAWA's team was structured to include personnel for water safety management, government liaison, community mobilisation, and engineering works. At the national level, the model advocated for a shift in the government's role from direct service provision to contracting, monitoring, and regulation, reshaping the institutional landscape. A National Steering Committee was established under LGD's leadership, alongside a District Working Group chaired by the Deputy Commissioner of Khulna. This shift required civil servants to adopt oversight and coordination roles that diverged from traditional infrastructure delivery mandates.

Operationally, institutional work moved to **defining**, establishing formal rule systems and compliance categories. A comprehensive water safety plan was developed, outlining protocols for sanitary inspections, routine testing for bacteriological and chemical contaminants, and responsive management actions. Performance monitoring frameworks were introduced, including a digital dashboard and a mobile application for real-time reporting and verification of repairs. These tools formalised the standards against which service reliability and safety would be assessed.

Capacity building or **educating** became a core focus. Community liaison officers were trained in water sample collection, while school headteachers and clinic staff were taught to report system failures using the app. These efforts aimed to embed a culture of maintenance and accountability among frontline stakeholders. Regular district and national meetings were used to share progress, troubleshoot operational issues, and keep government actors engaged.

Yet, despite institutional innovations, challenges persisted. Frequent staff rotations, especially at LGD, undermined continuity. The departure of senior officials who had championed the model led to reduced institutional memory and weaker political support. In response, the third Steering Committee meeting in September 2022 was held in Khulna, enabling national officials to directly observe operations and interact with local actors. During the visit, REACH presented a scale-up proposal to extend SafePani to 1700 schools and 300 healthcare facilities, covering 300,000 students and demonstrating that services could be delivered at an annual per capita cost of USD 1 (REACH, 2023).

Despite the compelling evidence, the government response remained lukewarm, underscoring the challenges of securing political and financial buy-in at scale. DPHE officials, in particular, were defensive - disputing survey findings on infrastructure gaps and redirecting attention to hydrogeological feasibility for new installations. Senior bureaucrats demanded accountability from junior engineers during field visits. Questions were also raised about the programme's impact on diarrhoeal disease outcomes, revealing the ongoing struggle to shift institutional logics from infrastructure provision to service quality and public health.

5.3. Niche-regime phase: scale-up with government co-funding

In the niche-regime phase, actor orientations aligned around scaling SafePani as a national solution for rural water services, leveraging political advocacy to secure government co-funding and navigating complex political and administrative landscapes. This marked a critical stage where a well-developed niche began interacting strategically with elements of the incumbent regime, aiming for institutional integration.

The return of key government actors to LGD in 2022, now occupying senior roles as Secretary and Joint Secretary, significantly altered the political opportunity structure. These key government champions, with their increased authority and access to empirical results from the pilot, were instrumental in advocating for SafePani's expansion. The Secretary proposed a co-funding arrangement with a 50–50 cost-sharing model between the government and donors, a notable departure from the typical 30–70 split in government projects. Institutional work during this phase shifted into **advocacy**, as high-level officials leveraged their networks to build political capital and mobilise financial commitments for scale-up.

In 2023, the costed estimates for district-level scaling were published as a brief, co-authored by the Secretary and the National Steering Committee, providing legitimacy and signalling strong government support. The UN Water Conference in New York in March 2023 offered a critical moment for **advocacy and agenda setting**. At this international

forum, the LGD Secretary publicly announced the government's readiness to co-finance SafePani, citing its alignment with results-based funding principles. Around this time, the Uptime Catalyst Facility and its affiliate, Uptime Global Ltd. - organisations with expertise in results-based rural water contracting—joined the initiative. Their involvement introduced global credibility and technical capacity in performance verification, donor engagement, and contractual design.

These engagements culminated in the co-development of a Technical Assistance Project Proposal (TAPP) between LGD's Policy Support Branch and HYSAWA. With a proposed budget of BDT 220 million (USD 2.1 million) for the period 2024–2030, the TAPP required approval from the Planning Commission due to its size. This marked an important transition in institutional work from advocacy to **theorising**: SafePani was deliberately conceptualised as a scalable 'model' capable of ushering in macro-level reforms, rather than a short-term 'project' with a predetermined endpoint. This shift was critical in positioning the model within the broader global discourse on WASH financing. The model's emphasis on results-based funding, where professional service providers were remunerated based on measurable outcomes, aligned with international best practices and increased its appeal to donors and policymakers.

While bureaucratic alignment appeared strong, administrative and political disruptions soon followed. Although SafePani was showcased at the September 2023 REACH global water security conference in Oxford - attended by the Minister of Planning, LGD officials, and DPHE engineers - the TAPP approval process stalled due to national elections and procedural errors. The proposal was initially routed through the wrong division of the Planning Commission, delaying endorsement. Further complications arose in mid-2024 following the fall of the Awami League government, triggering a suspension of all pending projects for political review.

Despite this volatility, SafePani ultimately secured endorsement from the Planning Adviser of the interim government in September 2024. This decision was influenced by the model's low financial footprint, strong institutional consortium (Oxford, UNICEF, HYSAWA, BUET), and alignment with core governance priorities such as accountability and efficiency. Institutional work during this stage involved **defining** - finalising performance indicators, developing payment triggers, and refining reporting systems in line with results-based principles. Templates for disbursement schedules, verification procedures, and compliance reporting were iterated jointly by Uptime, LGD, and HYSAWA, creating a robust administrative framework for scale-up.

6. Discussion

The SafePani initiative provides a compelling case for analysing how science-practitioner partnerships navigate and shape policy environments. The discussion is organised in two parts. The first part explores how the composite theoretical framework advanced understanding of the study's core research questions - how such partnerships evolve, how science contributes across the policy process, and what conditions enable or constrain their effectiveness. The second part situates these findings within the broader context of rural water governance, drawing out the implications of the SafePani experience for institutional reform and service delivery in Bangladesh and beyond.

6.1. Driving research impacts through science-practitioner partnerships

The success of SafePani stemmed from its ability to adapt to shifting institutional contexts, align science with dominant policy logics, mobilise diverse actor capabilities, and strategically embed research within government systems through iterative collaboration, targeted political engagement, and sustained resource mobilisation.

The actor configuration evolved as the initiative matured. Initial efforts in Matlab, despite strong facilitation by icddr,b, failed to gain traction due to limited government involvement. The partnership expanded from academic institutions (Oxford, BUET, icddr,b) to include service delivery actors (HYSAWA, Uptime) and senior government stakeholders from LGD, DPE, and the Planning Commission. This shift mirrored the transition from research to implementation. Actor-centred institutionalism offers a useful lens to understand how actors' orientations (e.g. Oxford's emphasis on evidence, UNICEF's bureaucratic navigation, HYSAWA's delivery focus) and capabilities (e.g. funding, networks, political access) enabled them to influence the evolving agenda. Agency was distributed but coordinated, and agendas were iteratively negotiated through collaboration.

For science to influence policy, it must align with dominant institutional logics. SafePani strategically focused on government primary schools and healthcare facilities rather than community-managed waterpoints, which often involve unclear mandates and governance challenges. By focusing on facilities where DPHE had a clear service mandate, the initiative enhanced feasibility and ensured government accountability. This approach secured a stable political constituency through DPE, DSHE, and local administration. The model's durability stemmed from shared commitment to resolving a widely recognised problem, for which previous interventions, such as the School Learning Improvement Plan (SLIP) fund, had failed to offer a viable institutional solution.

Science played multiple roles across the policy cycle. In the pre-niche phase, science played a foundational role in shaping the discourse on water safety and reliability. In the niche phase, science took on an advisory role, guiding implementation strategies, informing water quality protocols, and shaping performance metrics. By the niche–regime phase, science became reflexive, using empirical evidence to demonstrate cost-effectiveness and secure co-funding.

Institutional work was central to enabling this evolution. Regular bilateral meetings, steering committee interactions, and events such as the Istanbul workshop created spaces for aligning diverse interests. Participation in international conferences incentivised bureaucratic engagement and enhanced legitimacy. Boundary work played a critical role. SafePani actors translated scientific findings into co-authored reports and policy briefs tailored for government audiences. These outputs helped embed the initiative into planning and budgeting processes. Reputation also mattered: Oxford's international standing opened doors, but legitimacy was sustained through partnerships with local actors like UNICEF and BUET, who could engage effectively with national bureaucracies.

Nonetheless, SafePani's evolution was shaped by underlying power asymmetries. Oxford's control over funding and technical expertise meant that decisions often reflected the Oxford–UNICEF vision. While government actors were cordial and offered support, participation was often passive. Similarly, while local users were not harmed in any way, there was little scope to incorporate their preferences. Alternative suggestions, such as renovating non-functional piped schemes or developing infrastructure aligned with hydrogeological realities, were excluded from scope, on the grounds that infrastructure provision remained a government responsibility.

The divergence between SafePani and its precursor, FundiFix, underscores the importance of political and institutional context. While FundiFix struggled to gain government traction in Kenya, SafePani achieved partial institutionalisation within five years. This contrast reflects not only the receptiveness of Bangladesh's policy environment but also the capacity of actors to identify and leverage political opportunities. Bangladesh's centralised bureaucracy, with its hierarchical structure and clearly defined incentive and reward systems, facilitated the brokering of district-level support and vertical alignment. In contrast, Kenya's devolution has fragmented authority between national and county governments, often resulting in misaligned interests and weak convergence. Many counties lack the institutional maturity and administrative capacity required to absorb or sustain externally driven innovations.

The ability to mobilise financial, intellectual, and political resources

was equally crucial. FCDO funding enabled long-term embedded research through REACH. UNICEF's institutional presence facilitated navigation of bureaucratic processes while BUET offered strong technical and political support. Political capital was strategically leveraged; for instance, the return of a supportive Additional Secretary to LGD was capitalised on to reignite high-level support. In case of FundiFix, the absence of a politically connected boundary organisation, coupled with low UNICEF engagement, further weakened its institutional foothold. Additional enablers included the low cost and public value of the model, its ability to scale affordably, and the flexibility of the Uptime, which responded rapidly to opportunities for matched funding. The project was also deliberately kept outside the DPP process and avoided being owned by DPHE, reducing institutional friction and maintaining reform autonomy.

6.2. *Driving institutional change in rural water service delivery*

Reforms in rural water service delivery across the global South have historically been influenced by institutions and ideologies originating in the global North (Wit et al., 2024). In the post-independence era, conditional development aid shaped national policy frameworks, while global discourses, particularly around community-based management, emerged as dominant paradigms (Harvey and Reed, 2007). However, as funding landscapes and economic contexts evolve, new discourses are emerging, once again predominantly from western institutions, with funding from research councils, charitable foundations or corporates. Unlike earlier reform efforts driven by landscape-level pressures that influenced high-level sectoral policy, current ideologies, such as professional service delivery, are emerging within protected niches through small-scale, experimental projects that are gradually expanding their geographical reach.

Nonetheless, efforts to integrate these niche innovations into dominant regimes continue to face resistance. Path dependency in actor orientations and institutional lock-in inhibit change. In Bangladesh, decades of tubewell-based self-supply have entrenched an institutional logic equating service delivery with infrastructure installation. The arsenic crisis heightened awareness of chemical contamination, yet other hazards like manganese and lead remain under-acknowledged. Bacteriological risks are still largely framed in terms of diarrhoeal disease, despite growing evidence of broader health impacts.

Professional service delivery may appear to be a novel concept within the rural water sector, yet it closely mirrors the principles already established in urban contexts, where subsidised piped water systems are managed by utilities or municipalities. In contrast, rural households, with relatively lower incomes, are expected to finance their own water infrastructure and manage it voluntarily, often without technical or institutional support. The global push towards safely managed water services underscores the need to move beyond basic access and towards more complex delivery models, particularly piped water systems capable of reaching areas with poor local water availability. As rural systems grow in technical and operational complexity, the case for professional management becomes stronger.

SafePani offers a proof of concept that professional service delivery in rural contexts is not only institutionally feasible but also financially viable. Crucially, it does so without abandoning local governance structures but instead by redefining roles and establishing clear performance metrics and accountability systems. By tying payments to outputs, results-based funding offers a promising architecture for combining government and donor funding. As this discourse matures and begins to influence the orientations of regime actors - such as government ministries, international donors, and financing institutions - opportunities for broader regime integration increase.

7. Conclusion

This paper has examined the SafePani initiative to explore how science-practitioner partnerships can drive institutional change in rural water governance. The study contributes to growing literature on research impact by highlighting the importance of aligning scientific knowledge with dominant institutional logics, building multi-actor coalitions, and navigating political and bureaucratic systems. SafePani's success lay not only in technical innovation but in its ability to adapt strategically - mobilising financial, intellectual, and political capital; engaging champions across government; and embedding scientific evidence within planning and budgeting systems.

The integration of the multi-level perspective, actor-centred institutionalism, and institutional work provides a robust analytical lens for understanding how change occurs through iterative negotiation and adaptive agency. SafePani illustrates how science contributes across the policy cycle - from framing problems and designing interventions to legitimising scale-up and securing co-funding. Its comparative success, especially relative to FundiFix in Kenya, underscores the significance of political context, institutional architecture, and credible boundary actors. SafePani offers a replicable model for professionalising rural water services and a broader template for science-policy collaboration in complex governance settings.

CRediT authorship contribution statement

Sonia Ferdous Hoque: Writing – original draft, Visualization, Methodology, Conceptualization. **Rob Hope:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Charles Katrina:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Mohammad Monirul Alam:** Supervision, Project administration. **Md Nurul Osman:** Project administration, Investigation. **Mohammad Saiful Islam Mazomder:** Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

This document 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.

Declaration

During the preparation of this work the author(s) used ChatGPT in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2026.104316.

Data availability

No data was used for the research described in the article.

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