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Supporting evidence-based decision-making: Capacity Building through Research

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ABSTRACT

Lack of data inhibits informed decision-making and is a critical challenge in developing countries, many of which are under-resourced in financial, technical and institutional capacity to collect and analyse the required data. This limits the countries' ability to achieve development goals and keeps them dependent on the provision of external resources. Development initiatives often treat capacity building and research as two separate tracks of development. While efforts have been made in the health sector to combine these through project-based learning, this approach is relatively unexplored in the water sector which by its inter-sectoral nature stands to benefit significantly from a more collaborative and solution-oriented development strategy. Capacity Building through Research (CBtR) facilitates data collection and analysis by local researchers, mentored by international experts, strengthening local capacity to produce credible evidence able to inform sustainability-related decision-making. Five case studies piloting CBtR are discussed here and evaluated through criteria of the Dutch Strategy Evaluation Protocol framework. CBtR is shown to be a long-term strategy that requires the strengthening of cross-disciplinary networks to enhance the capacity of water management institutions, which likely contributes to more efficient evidence collection and analysis suitable for decision-makers, leading to greater national resilience and reduced need for external support.

Key words: Capacity development, Developing countries, Research, Strategy evaluation, Sustainable development, Water management

HIGHLIGHTS

- Project-based Capacity Building through Research (CBtR) initiatives have been piloted in the water sector and assessed.
- In CBtR, both capacity building and research are integral components of project planning.
- CBtR enhances the knowledge base and evidence for sustainability-related decision-making.
- CBtR improves national resilience, while reliance on external development organisations is reduced.

INTRODUCTION

Sustainable management of finite natural resources such as water will be essential for protecting and improving the livelihoods of human populations that rely on them. Securing a safe water supply is one challenge as many people are still lacking access to a clean, safe and reliable water supply. Water insecurity is likely to increase due to both climate change and population growth (McKenzie *et al.*, 2015). Freshwater is critical to achieving many development goals, as it is a common-pool resource that connects societal needs; it is also important for health, the environment, food production, energy, industry and domestic use (Grigg, 2016).

Recognition of the cross-sectoral demands on water resources has led to the development of the Integrated Water Resource Management (IWRM) concept, which refers to the integration of technical (engineering) aspects with management (decision-making), and societal aspects such as gender and public participation, with the use and allocation of water across sectors and scales (Grigg, 2016). Biswas (2004) criticised IWRM as a 'nirvana' concept. Though it was to some extent complemented with the water security and nexus approaches (*e.g.* Benson *et al.*, 2015), around the world it has led to the recognition that decisions on water use and allocation must be linked to the decisions in the other water-dependent sectors.

Although water has such critical integrating role across multiple sectors of society, developing countries often lack the technical expertise, governance structures and financial resources to implement IWRM. This gap is underscored by the lack of reliable data and insight about the current state of water resources; inequitable access to scientific literature; shortage of competent institutional leaders caused by limited training opportunities and inadequate support for young researchers; and often a dis-enabling policy environment which undervalues the research profession resulting in poorly defined career perspectives and inadequate research infrastructure (Hyder *et al.* 2003 as cited in Lansang & Dennis, 2004). Moreover, until recently the 'success' of science was typically measured with quantitative indicators which fail to describe the quality of the research, the researchers' experience in their social contexts or their contribution to society (Schouten, 2019).

STRENGTHENING LOCAL RESEARCH CAPACITY

Capacity development and research in the water sector are essential for developing countries to meet their national sustainable development agendas as well as their international obligations such as the United Nations Sustainable Development Goals (SDGs). However, developing countries remain technically and financially under-resourced and are short on the evidential data and insight required to make informed decisions (McKenzie *et al.*, 2015; Almeshqab & Ustun, 2019). This exposes an implementation gap between the aspirations of the development goals and what is technically and financially feasible. International development organisations have often stepped in to fill gaps in research by importing expertise without considering enhancing the local capacity base in technical, institutional and financial sense on how to conduct, analyse and use the information collected; this base comprises the local researchers and the authorities and decision makers they are interacting with. Expertise, funding and ideas often flow from high-income countries which have less knowledge of the local, true needs (Beran *et al.*, 2017). In addition, the new expertise often stays within the international development organisation or its consultants/experts, having limited transfer to local researchers. Critically, the research for the evidence-based decision-making and the capacity development of local researchers are often treated as two independent tasks. The collection and analysis of evidence are conducted by the international experts, separate from any capacity development of local authorities and researchers (Wehn *et al.*, 2015). We propose that this need not be the case as alternative, better-integrated models exist in other disciplines, such as the health sector, which can be modified for the water sector. Research capacity building (RCB) is widely acknowledged in the health sector and has assisted in the career development of medical staff for more than 15 years (Lansang

& Dennis, 2004; Bates *et al.*, 2006). Although similar efforts have taken place in the water sector, they may be fewer or less generic and are less well documented. The RCB approach defines capacity development as a continuous process of empowering individuals, institutions and nations to (1) define and prioritise the problems they are facing in a systematic way; (2) scientifically evaluate appropriate solutions; and (3) apply and disseminate the generated knowledge (Lansang & Dennis, 2004).

This paper reviews a pilot on Capacity Building through Research (CBtR) on water. The pilot provides a platform to enhance scientific analytical skills, by facilitating leadership of local experts in the definition and implementation of projects, and including cross-sectoral collaboration where appropriate. This approach relies on a heightened level of critical thinking whereby local researchers are tasked with defining the objective and research questions, collecting and analysing the data, and supplying the resulting information to decision-makers. It adopts the concept that evidence provided by local experts who are, however, guided by international experts – who can also be perceived as impartial and knowledgeable – will benefit from better buy-in by local institutions and policymakers, which should result in solutions that are more sustainable and implementable than those supplied or imposed mostly by outsiders (Lansang & Dennis, 2004; Beran *et al.*, 2017).

Literature suggests that sustainable local knowledge systems are needed to support sustainable development. Hands-on learning through ongoing research programmes has been shown to be an effective learning mechanism which complements existing academic education (Lansang & Dennis, 2004). A CBtR approach enhances application skills, improving not only the ability to design and conduct research, but also to evaluate the results and use the results effectively (Bates *et al.*, 2006). Experiences from the health sector caution against 'bolting on' capacity development to existing research projects (Bates *et al.*, 2006), indicating that conscious design, planning and integration of the learning experience from the outset are important. Furthermore, Lansang & Dennis (2004) argue that key performance indicators should be agreed upon that go beyond superficial quantitative statistics to assess the research environment itself. This is especially relevant in water management, where capacity development and collaboration across sectors must be incorporated in programmes if they wish to contribute to sustainable solutions. Water management problems are multi-faceted and inter-disciplinary and implementation needs to be sensitive to this (Sheil *et al.*, 2016). For example, de Silva *et al.* (2017) report from the water (fisheries and agriculture) sector where local stakeholders were engaged across scales and sectors in order to define problems, research objectives and management options in line with wider local sustainable development goals; this very process was found to build consensus and capacity while reducing conflict. White *et al.* (2019) found that bringing together researchers, water managers and policy makers, amongst others, assists in the formation of research projects that are more appropriate, accepted and transformative in local contexts.

REVIEW OF CBTR PILOT PROJECTS

Building on work done in the health sector through RCB, the CBtR approach was piloted in several Dutch- and Australian-funded programmes and smaller individual projects, five of which are reviewed here, all located in Myanmar and taking place in 2015–2020. In these initiatives, the focus was on local practitioners and academics, and on building their technical skills through project-based research and training, in which international experts had only an assisting role. To assess the CBtR approach, the research question was formulated as to whether it enables local researchers to collect primary data for use in decision-making and increases their capacity to conduct their research and communicate results more effectively.

Study area

The pilot projects were located in Myanmar, a developing country in South East Asia. Myanmar's vast water resources are estimated to constitute up to 12% of the whole of Asia's freshwater resources and 16% of that of

the ASEAN nations (Myint *et al.*, 2020). They comprise numerous large lakes, eight main river basins, and the Ayeyarwady mega-delta (Anthony *et al.*, 2019). Water availability is critical to the 54 million inhabitants as 70% of the population is rural, engaged in agriculture and reliant on natural resources (FAO, 2019). Inland fisheries are economically, nutritionally and socially significant (Duncan *et al.*, 2021). However, increasing pressure from irrigation and hydropower (Emmerton *et al.*, 2015) supporting Myanmar's growing population will make effective water management an urgent and essential challenge in meeting sustainable development goal objectives and improving livelihoods.

Project evaluation framework

The projects were analysed and assessed by adopting criteria from the recently issued Strategy Evaluation Protocol (SEP, 2020) which reflect the importance of institutional collaboration for institutional strengthening and development. The SEP acknowledges that until recently success criteria for scientific achievement were predominantly quantitative. However, these do not necessarily represent the main functions of science in society, which have historically been defined as the pursuit of knowledge with the highest standards of objectivity and the elimination of error through transparent, open and reproducible practices. Worldwide, organisations supporting research are adjusting their evaluation criteria by incorporating SEP to account for the capability of science for facilitating societal breakthroughs (Schouten, 2019). Notably, in the Dutch academic system, research quality and relevance to society are the two qualitative domains that are taken into consideration for assessing research. In the CBtR approach, this second qualitative domain is particularly pertinent for the evaluation of scientific achievement, and it was therefore selected as a key criterion in this study. For this domain, the SEP specifies the following sub-questions: (1) how the research product (such as guidelines, software and websites) is communicated and perceived by target societal groups or the general public (popular science); (2) how the research products are used by society, including the demonstrable uses of scientific results by social institutions, companies and governments, practitioners, teachers and media users, among others; and (3) how society recognises researchers, which includes the attribution of awards or means of support, important collaborative grants, public prizes and demonstrations of praise, and secondary appointments in civil-society organisations or policy-driven institutions. In this study, the CBtR pilot projects in Myanmar were analysed and evaluated for their contribution to evidence-based decision-making as well as for their inherent quality, based on the three SEP sub-questions: communication, uptake of research products and societal recognition of the research.

Pilot projects

In each of the five pilot projects described below, international experts from research institutes and/or small or medium enterprises would work with and mentor a local group (e.g. from government, NGO or an academic department) and/or an individual (e.g. researcher), and work together over a defined period on projects or academic curricula to define a series of research questions, develop research skills, conduct the research, analyse and share results with decision-makers, and incorporate the lessons into their professions or academic curricula.

(1) Water Land and Ecosystems (WLE) project (2015–2017) funded by CGIAR. The WLE project aimed to contribute to the sustainable and integrated development of Myanmar's water resources by enhancing capacities for inclusive governance and management of water and ecosystem services. A professional training and mentoring programme for a cross-sectoral group of mid-level water professionals was developed with three objectives: to create a common understanding of water, land and ecosystems in the Ayeyarwady river basin; to enhance personal research skills and to focus on active learning and coached project work. Between 2015 and 2017, a total of 37 Myanmar mid-level professionals participated in the respective programmes. Training was embedded in a policy engagement track focusing on the uptake of research and generating

understanding of the science–policy interface in the water governance and management arena. The policy engagement track further ensured a reflection on policy relevance during project implementation. In addition, in a separate track, institutional capacity was developed in key Myanmar organisations (universities but also the local river basin network) on water management and governance through discussions on IWRM certification and institutionalisation of the training. Special attention was given to communication of the research results, through pitch training, debating sessions and participation of fellows in national and international conferences. The WLE programme comprised a project development phase in which participants were tasked with developing a theory of change for a given project in their area of interest. The aim was to not only learn in class, but also to apply these concepts and methods on the ground in their current organisation. The objectives of the project phase were to better appreciate the need for the integration of concepts and challenges; to reflect on the project based on what was learned in class; and to make recommendations for their own organisation as well as for other organisations and the National Water Resources Committee. The project phase followed an eight-step approach which detailed the process from problem description to envisioned change in a number of clear monitorable steps. Discussion sessions and mentoring were carried out regarding the Myanmar National Water Policy as a framework and tool to be used in policy, planning and project development. Together, this would strongly encourage participants to connect societal and technical issues and identify pathways for change, but also build their capacity to articulate project proposals and plans and shift from 'safe' technical reports towards fundable and actionable plans for donors and institutions. An important component was the association with the three universities with a water-related curriculum, i.e. Yangon Technological University (YTU), Mandalay Technological University (MTU) and Myanmar Maritime University (MMU).

(2) NICHE Myanmar 250 project on Capacity Building for IWRM at two key universities, funded by the Dutch Organisation for Internationalisation of Education (NUFFIC). This project targeted the universities exclusively, however, the collaboration by WLE with this project further strengthened its relationship with the above universities. Apart from supporting universities in developing new curricula on IWRM, NICHE 250 had a dedicated component for staff development. This provided the space to develop a training-of-trainers programme for university staff participating in WLE with some additional coaching.

(3) S-MultiStor project (sustainable hydropower and multipurpose storage to meet water, food and energy development goals: a program for collaborative research and innovation), funded by the Netherlands Ministry of Foreign Affairs. This project aimed to strengthen local technical and scientific communities by jointly investigating and demonstrating approaches to render water storage more sustainable. Myanmar, specifically the Ayeyarwady Basin, was one of the three geographic focuses of this global project which also includes research in the Magdalena and Zambezi basins in Colombia and southern Africa, respectively. S-MultiStor was designed to support the engagement of partner universities in the global South in ongoing international initiatives related to sustainable hydropower and multi-purpose water storage, enriching those initiatives through research conducted by staff and students with support from international experts.

For Myanmar, two thematic areas included research development: to guide the implementation of the national Directive on environmental flows as affected by both hydropower and multi-purpose irrigation dams; and to improve fish migration through better management of multi-purpose dams and across river and wetland infrastructure. The project involved the collaboration of numerous partners including local scientific and technical partners and policy-makers (YTU, MMU and the Ministry of Agriculture, Livestock and Irrigation [MOALI], NGOs with local implementation experiences such as World Wildlife Fund (WWF) and Fauna and Flora International (FFI), international research institutes (IHE Delft, The Netherlands, and Charles Sturt University, Australia) and the International Finance Corporation (IFC, World Bank Group). Tangible outcomes of the project included the introduction of a new paradigm of system-scale planning

tools and of basin-scale approaches in the local practices and in the research and education programmes of the academic institutions. This necessitated cross-sectoral involvement in flow release scheduling from dams, irrespective of dam ownership.

(4) Delta Flows project (on the role that deltas play in sustaining basin-scale fisheries in the Mekong and Ayeyarwady rivers), funded by the Australian Government and the Australian Water Partnership. This project sought to investigate the river infrastructure's impact on fish migration. At present, very little is known about migratory fish in Myanmar and local capacity is lacking to conduct research able to inform infrastructure-related decision-making (Conallin *et al.*, 2019). The project aimed to generate key knowledge on migratory species; strengthen research capabilities and cross-sectoral collaboration; and facilitate the application of that knowledge in policy and management practice. Local fisheries staff at FFI Myanmar and the Myanmar Department of Fisheries (DOF) were taught how to remove the ear bones (otoliths) from different species of fish that were thought to be migratory. Otoliths from a specific economically important fish called Hilsa (*Tenualosa ilisha*) were sent for laboratory analysis to investigate their migration between the sea and freshwater as it was suspected that sluice gates in Myanmar's river deltas were impacting Hilsa populations. With this information, the DOF would be able to discuss the operation and refurbishment of existing sluice gates with the Irrigation Department which owns and constructs the sluices so that sluice infrastructure in the future might not impede Hilsa migration.

(5) Leapfrogging Delta Management project – Showcasing Smart Information Solutions in the Ayeyarwady Delta, funded under the Dutch Partners for Water programme. This project aimed at bypassing less efficient and more expensive technologies and moving directly to state-of-the-art applications in measurement and monitoring technology taking full advantage of ICT. Such innovation involves a long process and not seldom trial and error. It proved possible to integrate it with the other CBtR projects. This served several purposes, as it sparked scientific and technological curiosity and required critical thinking and deep understanding of the monitoring variables; it also imposed strategic thinking on data management as many innovative technologies make use of mobile phone and cloud data services. Lastly, bringing together innovation entrepreneurs, developers, university staff and students, and end-users would help the innovators to improve their products for the local market.

ANALYSIS AND EVALUATION OF CBTR PILOT PROJECTS

To assess the five pilot projects regarding their effectiveness in strengthening local capacity for the collection and analysis of basic data relevant for decision-making, they were analysed, and a brief survey was conducted, applying criteria from the SEP. The different approaches in the above pilot projects yielded complementary information that, taken together, generated insight into both the learning process of Myanmar participants and the functioning of CBtR.

The S-MultiStor project allowed the CBtR approach to be applied systematically, especially through the collaboration with the academic partners. The concepts of multi-objective planning and system-scale planning are novel to Myanmar, and several PhD and Master-level study projects were supported to help introduce these concepts; they also contributed to updating the post-graduate curricula. Updates concerned training on the development and application of tools for system-scale and multi-objective planning, environmental flows assessment and recommendations, and the importance of connectivity in river basins for sustainable development. MSc and PhD fellows experimented with devising environmental flow recommendations for various river systems downstream of large multi-purpose dams to address ecosystem degradation caused by dam construction. Hydrology-based environmental flow models were piloted and adjusted by the students to suit local conditions and data availability

(Hlaing *et al.*, 2020). In addition to these modelling exercises, several field trips were conducted by YTU and MMU to collect hydrological, water quality and social data from the studied systems, and for tool refinement. Besides the completion of several MSc theses, a PhD study was recently defended, supported by S-MultiStor, on the hydropower potential in the Myitnge River basin which introduced hydropower investment sustainability as an impact analysis criterion; such analysis had not yet been considered in similar studies in Myanmar. In the framework of this research, the student took an internship at IHE Delft, The Netherlands, for collaborative work with this and other Dutch research institutions. The topics of river basin connectivity and environmental flows are also now embedded in the local curricula and in student projects.

In parallel, an environmental flows group was established in civil society to investigate the release of environmental flows from both hydropower and multi-purpose irrigation dams. This involved a core group of university researchers (YTU, MTU and MMU), NGOs (WWF) and the IFC. This group focused on three points to strengthen institutionalisation and implementation of environmental flows: policy and legislation; data and research; and institutional roles and capacity. The workshop Exploring the Science and Policy for Developing a National Environmental Flows (eflows) Framework for Myanmar was held in Yangon in 2018, and the Symposium and Technical Workshop on Environmental Flows in Myanmar in 2019 was co-organised by IHE Delft, Charles Sturt University, YTU, the Australian Government, Badu, Riversfutures, WWF Myanmar and the Australian company Alluvium. Both initiatives were attended by over 100 experts from academic institutions, engineering companies, various stakeholders and government agencies. In 2018, a technical workshop with 60 local and international experts on environmental flows helped set a baseline for devising a national framework. A state-of-knowledge review on environmental flows within Myanmar was also published.

A second civil-society focus group discussed migratory fish and multi-purpose dams, and the impact of river and wetland infrastructure on fish migration. This group has collaborated with MOALI and DOF on the options for improving fish migration through infrastructure improvement. Since 2018, cross-institutional World Fish Migration Day events have been held in Myanmar and the Netherlands, which included outreach initiatives in both countries, a 'wicked debate' in the Netherlands and panel discussions in Myanmar (in Yangon, Lake Indawgyi and online). These events debated improving awareness of the impact of water infrastructure on fish migration and the resulting challenges for biodiversity, wetland ecosystems and food security.

A simplified CBtR approach was applied successfully in the Delta Flows project. Key fisheries and NGO staff were trained. They accurately and systematically collected and processed a sufficient number of otoliths for investigating migration. Results demonstrated migration patterns for the Hilsa between the sea and the rivers. The DOF and FFI shared this information within their own institutions and also in universities to improve knowledge of the critical importance of fish migration. DOF discussed with the Irrigation Department on how Hilsa and other fish species are being affected by sluices and other water infrastructures. The information on Hilsa migration routes is also being utilised by another (on-going) donor-funded project aimed at increasing fish passage and migration at key barriers.

The introduction of innovative water management measurement and monitoring technology within a CBtR framework was broadly perceived as successful from both an economic and a capacity development perspective. The universities have incorporated the innovations into the curricula and practical assignments. The novel monitoring and measurement technology is now being used routinely in MSc and PhD research. Staff was trained in the techniques to instruct local users who have now gained independence from external experts. As an example, water quality assessment, river bathymetry, wave monitoring and suspended sediment transport in rivers have become standard elements in YTU and MMU curricula. Finally, a local engineering company specialised in IWRM and water management has been established by trainees of the programme.

To gauge how WLE project participants had experienced the CBtR approach and to what extent they would apply the new knowledge in their future career, a brief survey was conducted among the participants featuring questions derived from the SEP evaluation criteria as outlined above. Table 1 provides a set of qualitative but representative responses by respondents; the limitations in participant sub-group numbers and the diversity in their background rendered a more rigorous statistical analysis less meaningful however.

The results show that, generally, participants were able to value and articulate the benefits of the projects' focus on CBtR from design to evaluation and communication. On the other hand, when asked to reflect on the impact of the training on their future professional career, few responses were volunteered. Similarly, it appeared that the most difficult question to respond to concerned the advice they would give to seniors in their organisation, and their policy recommendation for the river basin in general. This restraint was likely due to the hierarchical interpersonal relationships in Myanmar (which discourages juniors to directly advise seniors) as the projects involved primarily mid-level professionals. Nonetheless, some participants demonstrated knowledge on how they would apply the acquired capacity in their job, either by training other professionals and creating a multiplier effect (which was more obvious for the university participants as they develop curricula) or by furthering the prepared project proposals in their respective organisations.

DISCUSSION

The CBtR pilot projects demonstrate the importance of institutional capacity both to ensure proper implementation of the projects themselves and to lay the foundation for further replication of the capacity development. CBtR encouraged effective project definition and implementation, because its research expanded scarce information

Table 1 | Evaluation of the WLE project, typical representative responses.

Question posed	Response
What is the most significant knowledge you gained during the training program?	IWRM, governance, interconnection of problems, need to collaborate, proposal writing
What is the most useful skill you acquired during the training?	Debating, presentation skills (5-min pitch), listening, proposal writing
How has your network grown during the training and how have you used it in your research/proposal development and further work?	Network of friends from different disciplines, organisations, exchange of data to make proposal, also skills, international network and training opportunities (one fellow presented proposal to RD and wants to do a project)
What is the key message you had for your senior/colleagues after completing the training?	No response
How do you think positive change can be achieved in water management in Ayeyarwady? What would be your advice/policy recommendation after completing your research/proposal?	No response
How were you able to use in your job the knowledge and connections that you acquired in the training?	Staff who participated in training-of-trainers programme now use the skills and content in their teaching (multiplier effect), knowledge immediately translated in viable project (YCDC)

in a data-poor environment which in addition was designed so as to generate information which would be directly useful for decision-making on pending questions. In addition, attention to developing capacity in communication by skills training such as pitching, debating and presenting remains important. In one example, data collected as part of S-MultiStor and presented by local university researchers helped inform WWF to allocate funding for project continuation. Taking into account the current pressure in the country to build new hydropower facilities, the sharing of knowledge and collaboration are essential to strengthen local governance and assist agencies in making more sustainable choices for water management. Each of the cases demonstrates the pertinence of the second criterion of the SEP's qualitative evaluation criteria, namely, to what extent the research outputs support their *use* by society. The WLE targeted technical staff at Myanmar's water sector organisations, many of whom were educated at YTU, MTU or MMU, making collaboration with those universities a logical starting point for developing capacity. The more academically oriented S-MultiStor programme translated this criterion into renewal of academic curricula at the post-graduate level. This will in turn contribute to achieving the first SEP criterion which pertains to the way scientific information is received by or communicated to (local) society. The inclusion of the new concepts of multi-objective and system-scale planning in water management training confirms the value of this information to Myanmar's local context; it was incorporated in national course materials to become available for further development to address local and national questions and be useful to actors across academic, professional and governance spheres. Interestingly, the environmental flows focus group brings together members from academic, policy, financing and civil society groups, encouraging collaboration and enabling each of them to utilise the enhanced capacity for identifying and addressing water management challenges.

To enhance the effectiveness of CBtR and project-based learning, the presence of trainers on the ground and local fieldwork were found to be crucial. Participants responded best to coaching on topics that were of clear mutual interest. Admittedly, this format is resource-intensive, but the potential for remote coaching proved limited even when relationships had been already established. Locally active organisations such as NGOs can be crucial partners in facilitating a CBtR approach when international experts are temporarily absent, avoiding discontinuous project implementation (Brown, 1991). Such bridging organisations can be effective in linking international actors with local practitioners and communities (Sapsed *et al.*, 2007). They strengthen project legitimacy by building on their existing rapport with the community; working from existing social networks also tends to be less time-consuming and expensive than starting a top-down initiative from scratch. These factors help conduct relationship-based, long-term and outcome-focused capacity development, which generally requires a commitment beyond the usual government cycles (Prager, 2015).

Feeding back acquired new capacity into the participants' organisations posed specific challenges. This was to some extent related to an equivocal commitment from their superiors and organisations to put the new capacity into practice. Although this commitment was explicitly or implicitly requested at the start of the pilot projects, the communication and selection procedure of candidates did not sufficiently emphasise this to ensure that the organisations would be prepared to incorporate the acquired capacity. This reluctance is likely also a reflection of the academic and organisational cultures in the country with their strong hierarchical behaviour that tends to discourage independent contributions from younger or lower-level staff. Champions in senior staff and trust-building can be instrumental to make new ideas enter into existing workflows; typically, this is a process that exceeds the typical lifespan of a CBtR project. Finally, networks surrounding the CBtR help establish a community of users in the country. Here, this was achieved by involving representatives of universities and key water agencies such as the National Water Resources Committee in the training programmes and by helping participants develop their local and international networks through participation in water events and social networks.

To assure the continued success of CBtR requires a long-term commitment from both government and donor agencies to ensure that an effective knowledge base and adequate research capacity are built and that pathways are established for the application of the generated data and knowledge. Support programmes should be aware that building local capacity demands substantial investment and resources and that it should include an assessment of the potential and commitment of local partners to facilitate learning through project implementation. Indeed, the pilot projects suggest that the full benefits of CBtR can be captured only over a time span that is generally much longer than the programme's duration or its funding or political cycles; this requires broad-based and cross-sectoral support.

CONCLUSIONS

This paper reports the initial observations of five pilot projects in Myanmar applying an approach which combines data collection and research implementation, with the structural strengthening of institutional capacity to conduct research (CBtR). As the overview shows, a major weakness in current international development is that projects often are comparatively small, have a short duration and are poorly connected to similar local and international initiatives. While some projects do aim at developing research capacity, they tend to have modest ambition and short-time horizons; many other projects, however, tend to aim solely at quick, practical results in terms of data and information collection to address isolated solutions. Projects are often driven by the specific technical interests and budget situation of the funding agency rather than by broader systemic interest in institutional capacity development. The observations suggest that knowledge that is developed locally through project-oriented research in which local and international experts work, explore and learn together leads to better informed and more evidence-based decision-making. As a first benefit, participants from different levels of government demonstrated greater awareness and understanding of the issues they are facing and which need to be addressed in order to meet sustainability goals. In Myanmar, such action can be taken within the National Water Policy Framework which lends it a greater legitimacy. The proper design of projects allows to effectively combine research implementation and research capacity development, instead of approaching these as two separate goals along different avenues. Still, several challenges exist to the implementation of CBtR in developing countries, in part because project impacts are cumulative. To allow long-term change to take root, a critical combination of influencing factors and decisions is needed. This requires considerable and sustained investment in time and funding; however, such long-term commitments may be less compatible with the short-term nature of many international development approaches, and starting new initiatives with different objectives overlaying old ones can be confusing and counterproductive. Therefore, projects are preferably designed with clear short- and long-term goals. These will allow to keep generating deliverables and benefits that can persuade funding and oversight institutions, but at the same time develop the endogenous (research) and local institutional capacity which will mitigate the risk of discontinuation due to changes in institutional or other structural support. A key conclusion of the study is that CBtR does strengthen the role of local universities as knowledge institutes capable of initiating and conducting research more autonomously and producing evidence for informed decision-making by sector agencies and communities. In line with the SEP criteria, this is likely to lead to better sharing and use of scientific information which in turn will fundamentally contribute to the capability of developing countries to understand and manage their sustainable development challenges.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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