CSIRO LAND AND WATER
www.csiro.au

Bangladesh Integrated Water Resource Assessment

Enhancing Bangladesh's capacity to provide policy and management options for the equitable and efficient allocation and use of water into the future.

Australian Aid

WARPO
পানি সম্পদ পরিকল্পনা সংস্থা

INSTITUTE OF WATER MODELLING
IWM

CEGIS

The issue

Climate change, increasing population and economic growth are expected to increase the demand for water resources in Bangladesh. The quality and quantity of Bangladesh's surface water and ground water resources may be negatively affected with a risk of reduced access to safe drinking and irrigation water, and of induced contamination of ground water by saline intrusion and ingress of polluted surface waters.

Our approach

A collaborative, integrated, biophysical and socio-economic study was conducted to provide a national overview of water resources and to describe the impacts of development and climate change on both surface water and ground water. The study assessed how these impacts affect the poor and vulnerable, and how they affect the amount of water available for (and used by) different economic sectors such as agriculture, industry and households.

Key lessons for development

- Food security is achievable, though there will be challenges.
- Water is crucial to food security but land may be more limiting in the future.
- Ground water use is unsustainable in some areas.
- Climate change is a key concern, and for many water-related issues, coping with climate variability is likely to enable coping with climate change.
- Economic development overall is unlikely to be much affected by water-related climate change, but the structure of the economy may well be.
- Poverty-reduction policy should be directed towards accelerating growth in non-agricultural activities and education, as these are likely to yield the greatest improvements to household income.

Project partners

CSIRO, Bangladesh Water Development Board (BWDB), Water Resources Planning Organisation (WARPO), Institute of Water Modelling (IWM), Bangladesh Institute of Development Studies (BIDS), and the Centre for Environmental and Geographic Information Service (CEGIS), and the Australian Department of Foreign Affairs and Trade (DFAT).

DFAT-CSIRO Research for Development Alliance

This project was funded by the Research for Development Alliance, a strategic partnership tackling complex development challenges in the Asia Pacific region.

Key achievements

OUR STORY			
What did the project deliver?	**The provision of advice for future National Water Policy** including information on the ground water sustainability issue, as well as enabling better use of river modelling for the dry season. The assessment examined water resources from both biophysical and socio economic perspectives and exposed several key issues and knowledge gaps, including that sustainable levels of ground water use are generally not known. The project highlighted the fact that food security is achievable, in spite of the challenges of reduced land available for agriculture and a projected increase in flooding and salinity intrusion.	**Skills were strengthened** with the project building capacity of Bangladeshi organisations in integrated water resources assessment. This included the assessment of socio-economic impacts of climate change and future water demand due to population growth.	**The publication of journal papers and reports** with multiple in-country partner papers. This involved journal papers, two conference papers and a final 'big messages' report, which was presented at a workshop in Bangladesh, attended by the Minister for Water Resources.
How is it being used?	Policy change takes time, however it is expected that the Water Resources and Planning Organisation (WARPO) will incorporate the project outputs in their revision of the National Water Management Plan.	A good example of skill strengthening is how the project has assisted the Institute of Water Modelling (IWM) to make better use of their river modelling in the dry season. The project also enabled systems thinking and greater collaboration between the different research institutes in Bangladesh, such as enabling better integration of the biophysical and socio-economic data.	The new information, together with the capacity building, is helping to change the mindset of decision makers and grow the skills and capacity of the local research agencies.
What impact did the project have?	To date, impact has been achieved by providing advice for future policy at the request of senior WARPO officials. This has been demonstrated by the Bangladeshi Senior Secretary, Ministry of Water Resources, visiting Australia to show that there has, indeed, been ownership and interest in this work at high levels in Bangladesh.	Strengthening skills through the project has enabled the Bangladeshi research teams to undertake further systems research with other donors. The local research agencies also recognised that the collaborative partnership approach was a significant change to how they had previously operated and would enable them to be more effective in the future.	Key research gaps which could build on the work of the Bangladesh Integrated Water Resources project have been identified; however a lack of funding has meant that this future work is uncertain. Locally involved research agencies aim to continue this work, applying the new knowledge to subsequent projects.

Impact Pathway

The project's objective was to '*provide an overview of integrated water resources assessment for Bangladesh, and present information in a useable format for updating the National Water Management Plan*'. To achieve this, the research team developed an Impact Pathway consisting of three linked phases (Fig. 1a). Phase 1 focused on 'capacity building'. This enabled the allocation of resources and the development of plans, agreements and new projects through Phase 2 'policy and program development'. Following on from Phase 2, Phase 3 'implementation, adoption and scaling out' would occur. These phases would cumulatively build the adaptive capacity of the project stakeholders. However, while Phase 1 encompassed the project's activities (solid line), Phases 2 and 3 were out of the project team's direct control (dashed line). Consequently, the Impact Pathway was clear for Phase 1, but less so for Phases 2 and 3.

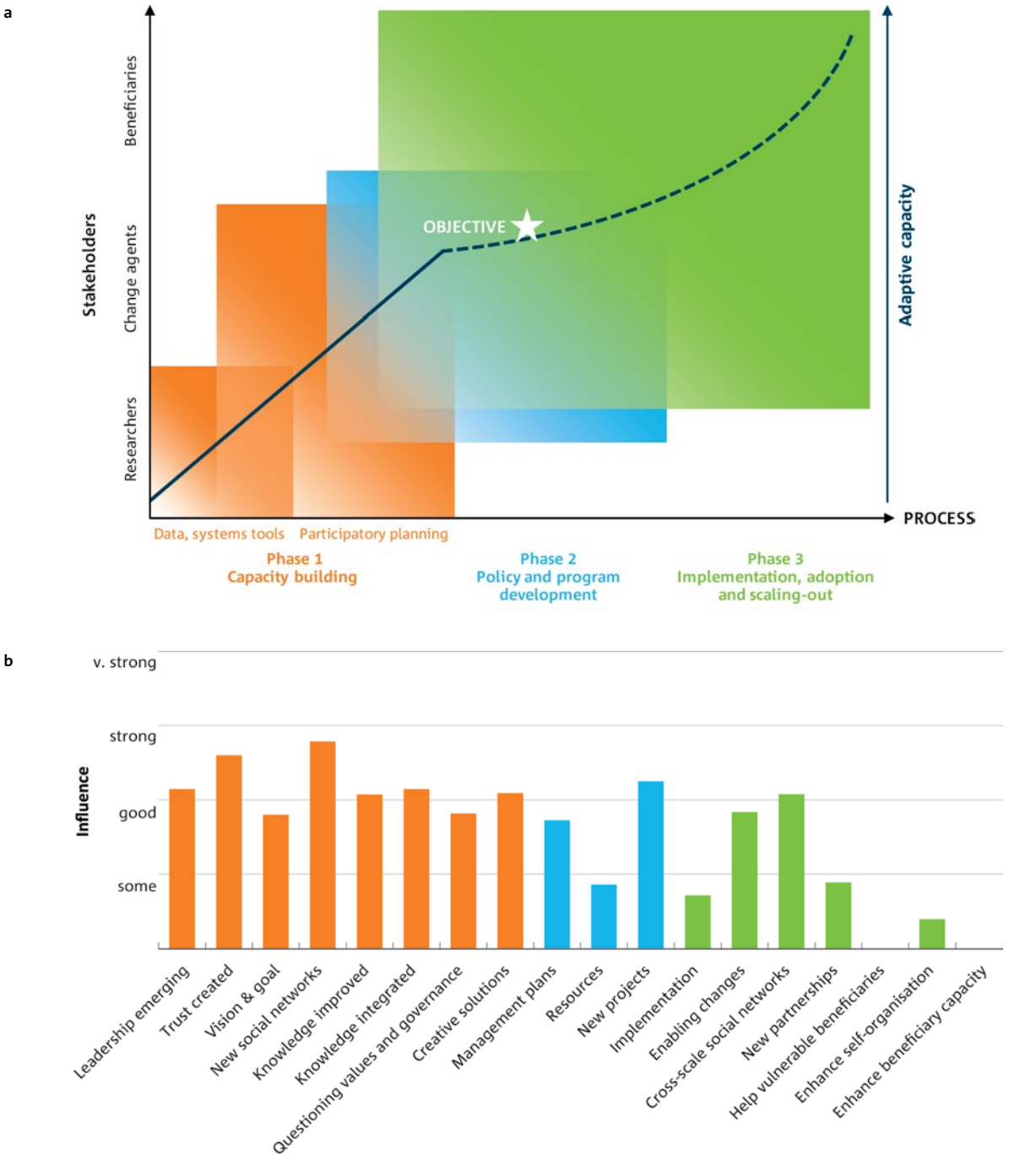

Figure 1. The project's (a) Impact Pathway and (b) influence on adaptive capacity within the Impact Pathway's three phases

Evaluating impact

To track the influence of the project on stakeholders' adaptive capacity, and to enable comparisons between all Alliance projects, a standardised set of 18 indicators was developed. According to the project's Impact Pathway, each phase encompassed a progressively wider group of stakeholders, and the indicators were designed to assess change amongst them. Fifteen researchers and change agents involved in Phase 1 were interviewed at project completion, and asked to give their assessment of change by scoring each indicator, providing evidence for their scores. Results showed that there had been a positive influence for all indicators in all phases (Fig. 1b).

PHASE 1: Building capacity had the highest-scoring indicators, which was to be expected since this was the focus of project activities. The project had strongly participatory engagement processes, capability development and the provision of new information for decision making. Overall, the project improved the confidence and capacity of individuals and institutions participating in the project. Individuals appreciated the training, with several interviewed staff revealing that their confidence and skills, and the skills of their colleagues, had grown during the project, principally through sharing information, formal training and having contact with other institutions and new ways of thinking.

The project improved the trust and cooperation between individuals and institutions participating in the project. In particular, the strengthened connection between the different Bangladeshi researchers and change agents now means that there is greater capacity to fill the knowledge gaps for decision makers. In some cases, this project was the first opportunity that Bangladeshi agencies had to work with their local colleagues, sharing knowledge and information.

The project grew the social networks between institutions and government agencies participating in the project. In addition to this, the project team interviewed stakeholders at the beginning of the project to ensure that the research goals were appropriate for Bangladesh. As part of the ongoing communication and engagement strategy, there were two workshops to present project ideas and materials. Almost all water sector agencies / NGOs were invited to the workshop which provided participants with the opportunity to establish further relationships. The main groups missing from these workshops, however, were organisations that directly interacted with rural groups. It was felt that future workshops could perhaps include dialogue with communities.

The new information is helping to change the mindset of decision makers and to grow the skills and capacity of the local research agencies. Though the project team and connected stakeholders have developed a greater understanding of the complexity of water resources in Bangladesh, changing National Water Policy takes time and is driven by the Ministry.

PHASE 2: Policy and program development had weaker indicator scores. While it is too early for a change in the National Water Management Plan to occur, outputs from this project will inform future revisions. This is expected soon. Stakeholders indicated that the revision (which is several years overdue) has been delayed due to funding and a lack of government commitment. In addition, the project's results will be useful for other water resources planning in Bangladesh including working with other key donors in the region.

Key research gaps which could build on the work of the Bangladesh Integrated Water Resources project have been identified. However, a lack of funding has meant that this future work is uncertain. Concerns have also been raised about the short term effectiveness of this project and the capacity of local researchers and change agents to implement the recommendations following the completion of the project, without ongoing funds. The local research agencies involved aim to continue this work and apply their new skills in subsequent projects.

PHASE 3: Implementation, adoption and scaling-out local research agencies identified that the project improved their collaborative partnership approach, with this being a significant change which will make them more effective. In-country partners felt that their understanding and capacity improved, particularly around international collaboration, data management, and integrated thinking. This, in turn, led to the development of new ideas and concepts, and has also flagged gaps for further improvement. An interesting aspect of this work included the transfer of skills as regards how to use existing data in new ways, for example using remote sensing satellite data for the estimation of evapotranspiration. While this work is common for Australia and CSIRO, it serves to demonstrate the importance of collaborative research with a capacity building element. In-country teams are keen to explore how this technology / data can be used in other sectors such as soil, water and climate analysis, and yield forecasting. This project was focused at the national policy and institutional level, and therefore wasn't focused on assisting vulnerable beneficiaries. However, if future national water plans and policies are improved as a result of this project, then it will have a beneficial impact on vulnerable communities.

SNAPSHOT: Water in Bangladesh

In Bangladesh, water is predominantly linked with agricultural production, with 86% of water services used by the agriculture sector, followed by domestic use (12%) and industrial use (2%). Agriculture is also the single most important source of employment in rural areas, with two-thirds of the labour force either directly or indirectly involved in agriculture.

As Bangladesh's economy diversifies, non-agricultural sectors are gaining importance. The demand on the supply of household water (mostly sourced from ground water) is increasing with population growth, economic development and urbanisation. Bangladesh is frequently affected by major floods and droughts, which can be damaging to both the economy and society. The poor are more vulnerable to water hazards such as flood and drought, with flood losses having cumulative effects on the most vulnerable, leaving some subsequently uprooted. These impacts are compounded by a fall in real wages and food price hikes, the latter exacerbating malnutrition and existing poor health.

Whilst floods can be damaging to both the economy and society, it is important to note that not all floods are damaging. Some seasonal floods are essential for enhancing agricultural productivity.

Future improvements related to general economic development, especially growth in non-agricultural employment and improved education are likely to be the greatest and most positive influences on Bangladeshi household income.

The components of the composite index are: resource availability; access to water and sanitation; excess water (flooding); water shortages; water use for irrigation; capacity to use water (number of tube wells); and environmental factors (largely water quality). Red districts are the most vulnerable; the green are the least.

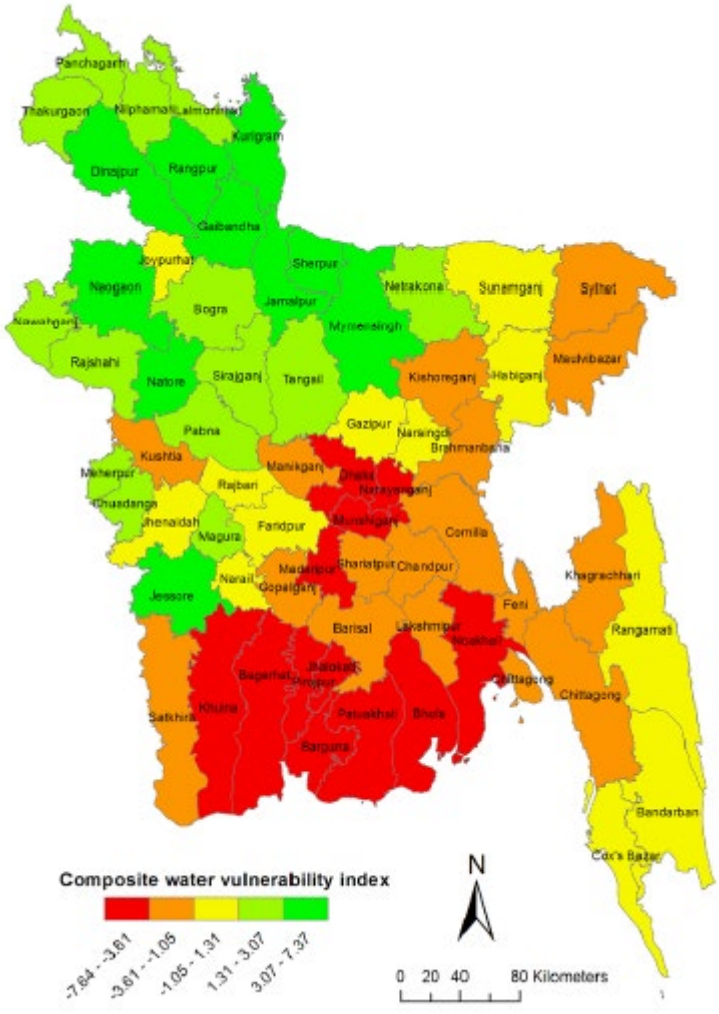

Figure 2. Composite Water Vulnerability Index by district

Alliance wide lessons

Designing investments to assist vulnerable communities in developing countries adapt to global change (e.g. globalised markets, population growth and climate) is typically complex. This is particularly true for the Alliance where our portfolio of multi-year projects focused on global development challenges related to climate, water resources, sustainable cities, and food security. Each of the projects involved multiple actors (e.g. planning, emergency services, and primary industries) at multiple scales (local, provincial, national and global) and over time, reflecting the broad domain of R4D.

Our experience is that the context-specific nature of these investments is best served by a well-informed approach to project structure and design. Practical learning from these projects can support the development of guidance to improve aid investment outcomes. Key findings included:

- **Strong partnerships and collaboration lead to better outcomes:** Partnerships can be developed or evolve in a number of ways, all of which can be effective. Our projects included partnerships where we led, where we worked with our in-country partners to build demand, and those where we responded to demand. These partnerships were formed and evolved around relationships and purpose. A general observation is that 'pull' type projects appear to have the most clearly articulated impact pathway at the national policy level and provide the least scope for expansion; whereas co-developed or evolutionary type projects provide greater flexibility and also more opportunities to broaden partnerships over the life of projects, which can significantly improve impact. In all cases, it takes time to build appropriate, effective communication processes and trust; especially when there are cultural and institutional differences. This can be expedited through ongoing in-country presence and two-way exchanges of personnel, which provides high strategic value but carries a high operational cost.
- **Capacity building and engagement:** Engagement early on (i.e. pre-project) provides a valuable platform for co-development of projects that are then shaped by and can be responsive to local context. This has the added value of building trust between partners, which can be increased over time through capacity building initiatives. Traditional develop-deliver skillsets such as two-way mentoring, use of trusted advisors and local champions to facilitate engagement, improved project management and engagement skills, remain important; however, our experience is that conjointly developed knowledge, products and services are more context-specific and tractable.
- **Participatory approaches:** Partner institutions have high levels of connectedness with government institutions and other boundary partners – giving the research a stronger pathway to impact and increasing its relevance. Participatory approaches can improve the status of research partners and encourage buy-in from key decision-makers, which is important for longer-term support. Participatory planning approaches also strengthen formal and informal networks amongst decision-maker communities and between decision-makers and researchers, building capacity of all participants.
- **Creation of and access to data:** Datasets that are well-structured and accessible will have ongoing value. Where mandates or jurisdictions are unclear and there is a limited history of data curation and sharing, a trusted relationship between parties needs to be developed in order to overcome such procedural and institutional challenges. A trusted third party can play an important role in these situations.
- **Scenario planning:** Scenario planning provides a structured and powerful tool to think about the future and challenges, especially where there are large uncertainties such as changes to natural systems (e.g. water and climate), changes in rules or an adjustment of goals (e.g. livelihood goals); and can be based on existing data, modelled, or a combination of both. Scenarios work best when elicited from in-country partners or developed in conjunction with in-country partners rather than imposed.
- **Systems thinking and approaches:** Systems approaches to better integrate biophysical with social and economic information are highly valued by project partners, from design through all stages of the project lifecycle to decision making. Systems approaches also promote participation from a broader range of stakeholders. In general most local research teams had limited experience of these approaches, including scenario planning, and Alliance activities significantly enhanced their capacity to understand and apply such systems tools.
- **Evaluation methods:** Assessments often take place in complex policy settings and systems where there are multiple actors. Accurately defining, measuring and attributing impacts is vital to describing and communicating the success of investments. The use of mixed methods approaches, and better understanding of which approaches work best under certain conditions, will improve the quality of impact evaluation studies and the articulation of impact. Also, the timely return of results to project research teams and partners is important to maintain the salience of results.

Steps required to maintain the Impact Pathway

Researchers identified key issues and challenges for Bangladesh in future water use and management, as well as potential hotspots for future detailed local assessments. Hotspots included where there is high risk of contamination by saline intrusion or polluted surface waters, and where there is high risk of lack of access to safe drinking water and irrigation water in rural areas.

The most pressing water-related issues differ from region to region.

- In the north-west and north central region the most pressing water-related issue is the overuse of the ground water due to the role of Boro rice production for food security. The sustainable level of ground water use has not yet been quantified, nor has the exchange of water between aquifers and the surface, including rivers. Developing analyses and models of ground water to surface water exchanges, exploring the impact of changed irrigation water use, and assessing the costs and benefits (including social) of alternatives could assist decision makers to better understand the issues.
- The coastal zone has the greatest exposure to arsenic, salinity and storm surges, as well as the poorest quality ground water, coupled with the least opportunity to store surface water. The vulnerability of the coastal cities and infrastructure to sea level rise and water-related problems make the region a priority for further research. In this zone additional research and improved irrigation management techniques has the potential to aid food production and ease water overuse elsewhere.
- Dhaka urban ground water use for households and industry is unsustainable. Surface water pollution by industrial wastes and other pollutants is emerging as a major issue. The rivers surrounding Dhaka are so polluted that the water cannot be used. Developing alternative strategies is a priority, and will likely include solving surface-water and recycled water-quality problems, and developing artificial aquifer recharge from urban storm water.

CONTACT US
t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

AT CSIRO WE SHAPE THE FUTURE
We do this by using science and technology to solve real issues. Our research makes a difference to industry, people and the planet.
WE ASK, WE SEEK AND WE SOLVE

DFAT-CSIRO RESEARCH FOR DEVELOPMENT ALLIANCE
This project was funded by the Research for Development Alliance, a strategic partnership tackling complex development challenges in the Asia Pacific region.

FOR FURTHER INFORMATION
CSIRO Land and Water
Mac Kirby
t +61 2 6246 5921
e mac.kirby@csiro.au
w www.csiro.au/LWF

B&M | 15-00227