Research Paper

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Water, Ecosystems and Energy in South Asia

Making Cross-Border Collaboration Work

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Contents

Preface

Chatham House research on South Asia has explored, *inter alia*, the prospects and challenges for greater regional integration in South Asia. Water is both a shared resource and one of the causes of tensions in the various bilateral relationships. Population growth, urbanization and industrialization are likely to lead to growing demand for water. Climate change may affect its supply.

Previous Chatham House research[1] highlighted the extent to which many policy-makers and opinion-formers from the region view water as a zero-sum resource, to be divided between South Asian countries on an arbitrary percentage basis. Yet given the challenges ahead, this zero-sum approach will only exacerbate tension. Instead, research and policy need to connect water to its uses, viewing it through a new lens so that it can be approached as a source of mutual benefit to all stakeholders.

This research paper, supported by the South Asia Water Initiative (SAWI) – a partnership between the World Bank and the governments of the United Kingdom, Australia and Norway – seeks to document instances of cross-border cooperation on water issues, to highlight the benefits that accrue from this cooperation, and to set out how cross-border collaboration was forged.

[1] Price, G. et al. (2014), *Attitudes to Water in South Asia*, Chatham House Report, London: Royal Institute of International Affairs, https://www.chathamhouse.org/publication/attitudes-water-south-asia.

Executive Summary

The countries of South Asia share several hydro-geological features and some of the world's major river basins – the Ganga (or Ganges), the Brahmaputra and the Indus. The Indus basin spans China, Afghanistan, Pakistan and India, while the Brahmaputra and the Ganga and their tributaries flow through China, Bhutan, India, Nepal and Bangladesh. These countries are also vulnerable to a wide range of natural disasters including earthquakes, tsunamis, cyclones, droughts and floods, which affect hundreds of millions of the region's inhabitants. Floods in particular are a pervasive and perennial problem, given the concentration of annual rainfall during the monsoon. As well as affecting people and property, they damage crops, presenting a further threat to livelihoods given that the majority of people in the region still depend on farming.

South Asia is home to a number of shared ecosystems. Successful ecosystem management requires cross-border collaboration. While joint management is frequently interpreted as a diminution of sovereignty, policy alignment has proven to be feasible when supported by dialogue. In addition, there is scope for shared learning across South Asia. The challenges faced across the region are similar, and solutions are readily transferable and replicable.

Despite its abundant hydropower potential, South Asia struggles with energy shortages. No country in the region is able to provide all of its population with guaranteed supplies of electricity. Cross-border hydropower, among other energy trading possibilities, therefore offers a partial solution to energy shortages in South Asia. Cooperation could provide economic benefits and allow for more amicable relationships in the region. It could also facilitate integrated planning for sustainable water-resource management.

Several categories of cross-border water cooperation have had success in the region, and could be expanded and developed to improve water-resource policy and resilience:

Early-warning systems

The development of cross-border early-warning systems is taking place at the official level and through non-governmental organizations (NGOs). South Asia has suffered a series of cross-border natural disasters in recent years. Floods, earthquakes and droughts are recurrent events throughout the region. Institutional structures and infrastructure for disaster responses, mitigation and building resilience are inadequate and cannot be dealt with unilaterally. The establishment of the South Asian Association for Regional Cooperation (SAARC) Disaster Management Centre demonstrates recognition of the need for cross-border collaboration.

To avert damage caused by flooding, close communication and a coordinated response strategy between upstream and downstream communities are imperative, in order to provide people with a window of opportunity to move with their most vital belongings to higher ground. One such project connects communities in Nepal and in India. It involves an Indian NGO, Poorvanchal Gramin Vikas Sansthan, along with Practical Action and Christian Aid, and has succeeded in significantly reducing the number of deaths from flooding. The project team had previous experience in establishing early-warning systems in Nepal, existing relationships with local government in India and proven

scientific expertise. The training programme succeeded by focusing on a small number of villages at first to demonstrate that the system worked. Thereafter, other villages were keen to take advantage of the project.

Ecosystem protection

The second category of cooperation involves ecosystem protection, putting the principle of ecosystem conservation and integrity at the centre of the management of land, water and forest resources. Several projects look at various Himalayan ecosystems. This approach attempts to find a holistic way to protect ecosystems and the people who live within them. Improving ecosystem management frequently necessitates improving or changing approaches towards water management.

The Ecosystems for Life project of the International Union for Conservation of Nature (IUCN) successfully brought together experts, policy-makers and other stakeholders from India and Bangladesh to discuss and carry out joint studies on common issues including water, fisheries, navigation, environmental flows and climate change. The project influenced policy-making on fisheries in the Indian state of West Bengal following joint research work by Indian and Bangladeshi experts and active networking by strategically selected Project Advisory Committee members. The project highlighted the importance of two main factors: the deliberate choice of expert advisers on the board, and targeted communication with the media to disseminate the knowledge produced in the most comprehensible and impactful manner. The project also demonstrated the limits of sovereignty in dealing with these issues. If ecosystems that straddle borders are to be protected, some form of policy alignment is likely to be necessary – divergent policies in different countries are less likely to succeed.

Shared learning

The third group of projects belongs to shared-learning models of cooperation. Similar conditions across South Asia present huge potential for peer-to-peer learning, but there are few concrete cases in which best practice in one country has been replicated in a neighbour. There are clear opportunities to spread success stories within and between countries. The renovation of Sikkim Springs attracted experts from Bhutan, Nepal and northeastern India to learn and deploy the lessons in their regions, given the similar hydro-geology and challenges. Principles of cooperation were simple and involved raising the visibility of the project and providing easy access to project details and procedures to enable cross-learning for other interested parties. The scope and influence of dynamic political leadership in fostering collective action was an important feature. Government engagement with the Sikkim Springs renovation process was highly positive; such engagement encourages longer-term sustainability.

The shared-learning approach comprises numerous dialogues. While few have produced tangible results, they act as confidence-building measures between countries, and ideas from them may have fed into policy-making (though it is difficult to prove a direct link). Perhaps the best example is the 1996 Ganges Water Treaty between India and Bangladesh, in which Track Two dialogues played a significant role prior to the treaty being signed.

Hydropower and regional power trading

The last category of cross-border cooperation is between India and Bhutan in hydropower. The development of Bhutan's hydropower has contributed to a trebling of its GDP per capita since 2000, rising from $780 to $2,611 in 2014. Economic growth has enabled an additional improvement in social indicators. At the same time, Bhutan's hydropower has helped to mitigate the energy deficit of states in northern India. This case highlights the relevance of mutual-benefit approaches to water use to meet basic developmental needs and threshold economic development, which in turn promotes greater environmental responsibility and unlocks economic resources for conservation. Political factors, compatible strategies of economic development and the sheer technical requirements of hydropower projects are crucial catalysts for cooperation.

Common themes

While there is no one-size-fits-all solution, the following common themes emerge from those approaches that have had the most success to date:

- **Support from the relevant government agency.** Frequently, implementing agencies have had long-standing relationships within government. Furthermore, the projects have demonstrated specific benefits and limited (or zero) costs to government.
- **Engagement at the community level.** Building trust and confidence in the intervention locally is time-intensive. The initial response to initiatives is often scepticism. Rather than spread resources thinly, a better approach may well be to concentrate on a smaller selection of villages to demonstrate that the concept works and then use this demonstration effect to garner support from neighbouring villages.
- **Alignment of policy and management practices across borders.** 'Joint management' has implications in terms of sovereignty and is likely to be difficult. Policy alignment is a more feasible goal.
- **Stakeholder consultation on needs and involvement in project design.** Projects that transparently develop solutions in coordination with relevant stakeholders are more successful than those that attempt to impose solutions from the outside.
- **Sufficient and sustained funding over the duration of the project.** Perhaps surprisingly, the most successful projects have been those that have incurred relatively high costs over relatively lengthy periods. Smaller projects have frequently failed to garner sufficient political traction.
- **Focus on the usage of water or the outcomes of cooperation on water, rather than on water *per se*.** Water is politically sensitive. Projects that focus directly on water or its management face more hurdles than those, such as species protection or ecosystem management, for which the headline purpose is not water.
- **A broader political environment conducive to cross-border engagement.** The scope for collaboration is contingent on domestic politics in the region. If bilateral relationships are poor, there is little evidence that enhanced cooperation on water is feasible. For instance, cooperation between India and Pakistan over water issues remains largely limited to those issues that fall under the 1960 Indus Waters Treaty.

1. Introduction

Cross-border river basins are complex and interlinked systems with social, economic, ecological and political aspects. Rivers that cross borders have been the source of competition and cooperation throughout history. Population growth and finite supplies of water have led to growing fears of conflict, but recent history suggests that there are many more examples of cooperation – in the form of treaties and agreements – than of conflict.[2]

South Asia's river systems include the Ganga (or Ganges), the Brahmaputra and the Indus. In total these rivers and their tributaries flow through seven countries, support more than 1 billion people, irrigate millions of hectares of land and have a cultural association for many of those who rely upon them. They are used for fishing, hydropower, industry and, in some cases, navigation.

River management presents common challenges across South Asia. Physical challenges include high inter- and intra-annual hydrologic variability, potentially exacerbated by climate change. Institutional capacity constraints can undermine efforts to implement policies, laws and regulations on management of river resources. Minority voices and traditional knowledge have generally been ignored, leading to increased conflict over rivers. These commonalities create opportunities for collaboration, yet with few exceptions this has not happened.

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Water is increasingly seen as a source of competition in the region. Population growth, industrialization and urbanization are adding to pressure on water resources, while climate change could challenge future supply. Potential scarcity is fuelling disputes over water rights within and between states. These tensions are exacerbated by a widespread tendency to conceive of water in zero-sum terms, whereby a proportion of the water in a river 'belongs' to either the upstream or the downstream riparian. In this thinking any agreement on water-sharing implies that as a result of it one country must be worse off than it was under the previous status quo.

Top-down approaches towards river management have been hindered by political differences and power disparities. This paper looks at examples of mutually beneficial cross-border cooperation on water-related issues across South Asia. It sets out the processes that have facilitated such cooperation, and it outlines the benefits that have accrued from adopting a regional approach to water issues.

Although South Asian examples of regional cooperation in general are limited, there is a clear positive trend. In areas such as disaster response and cross-border power trading, regional and bilateral engagement is beginning to take place. Multilateral official arrangements exist for

[2] UN-Water (2008), *Transboundary Waters: Sharing Benefits, Sharing Responsibilities*, Zaragoza: UN-Water, http://www.unwater.org/downloads/UNW_TRANSBOUNDARY.pdf (accessed 10 May 2016); and Wolf, A. T., Yoffe, S. B. and Giordano, M. (2003), 'International waters: identifying basins at risk', *Water Policy*, 5(1), pp. 29–60, http://www.transboundarywaters.orst.edu/publications/abst_docs/Wolf_et_al_Water_Policy_BAR.pdf (accessed 10 May 2016).

trade/other economic issues and connectivity (such as the 2015 BBIN[3] Motor Vehicle Agreement), but there is none on water or ecosystems. However, as the benefits from cooperation become proven, its desirability is likely to gradually enter mainstream policy thinking on water issues.

Several projects are currently seeking to engage two or more countries on cross-border water issues (see Appendix). Many of these are at a stage of preliminary research or in trial runs, as researchers and policy-makers seek to provide an evidence base for subsequent cooperation. Most of the examples of such cooperation are between India and one of Nepal, Bangladesh or Bhutan. There are fewer examples of water-related cooperation between India and Pakistan (aside from that governed by the Indus Waters Treaty) or between Afghanistan and Pakistan.

Projects addressing cross-border cooperation on water issues in South Asia generally either explore the challenges to cooperation or suggest hypothetical optimum water management plans that would only be feasible in the absence of political boundaries.

This project took a different approach to investigating models of water cooperation in South Asia, endeavouring to document examples of successful collaborative efforts across borders.

As well as conducting desk-based research, the project team reached out to numerous individuals working on water issues across South Asia to uncover examples of cooperation. Subsequently, through field investigations and interviews, we explored the long list of examples to assess which projects had been most successful.

As well as evaluating the outcomes, we looked into the factors that had enabled cooperation and the processes adopted in successful projects. Through this process of analysis and consultation we focused upon four broad categories of cooperation and highlighted a number of successful case studies in each. The four categories are:

- Development of early-warning systems for natural disasters, in particular floods;
- Protection of cross-border ecosystems;
- Sharing of learning, through the showcasing of innovative approaches in one country that can be adopted by others; and
- Power trading, in particular the development of hydropower in Bhutan and its export to India.

Our overall conclusion is that cooperation around water in South Asia is feasible despite political differences and economic asymmetries. Different forms of collective action, and common understanding of the threats and the shared benefits from cooperation, are required to foster more partnerships within the river basin states. The interplay between social networking among country experts, inclusive communication (especially with media groups), economic rationale, scientific rigour, defined rights and entitlements, and political leadership can facilitate effective and successful water cooperation. Policy instruments, methodical institutional arrangements and innovative models of cooperation are necessary to enable more cross-border cooperation over water issues in South Asia.

[3] BBIN = Bangladesh, Bhutan, India and Nepal.

2. Data-Sharing and Flood Early-Warning Systems

South Asia is vulnerable to a wide range of natural disasters, including earthquakes, tsunamis, cyclones, droughts and floods. Over the past decades, hundreds of millions of the region's inhabitants have been affected by such events, which until relatively recently were treated as unavoidable or as acts of God. Floods in particular are a pervasive and perennial problem, given the concentration of annual rainfall during the monsoon. As well as affecting people and property, they damage crops, presenting a further threat to livelihoods given that the majority of people in the region still depend on farming.

In recent years, there has been a policy shift towards reducing the impact of disasters. Studies have suggested that every $1 spent before a disaster can reap $5 in economic benefits. However, over the past two decades only a small fraction of overall aid spending has been allocated to disasters, and of that little more than 10 per cent has been spent on disaster risk reduction.[4]

The countries of South Asia increasingly share official data on flooding risks. Some major initiatives, such as the SAARC Satellite – which will play a role in weather forecasting as well as disaster response, and is scheduled for launch this year – are in the pipeline. However, 'last-mile connectivity' – i.e. ensuring that warnings reach threatened communities – is frequently absent. This has led some NGOs to try to facilitate communication between upstream and downstream communities, within and between countries, to provide sufficient time for people to move with their possessions to higher ground. Enhanced cross-border cooperation could provide at-risk communities with greater lead time to prepare for floods, enabling them to protect their possessions and also potentially, if the lead times are long enough, to harvest their crops.

Background

Despite the obvious human and economic benefits, it is only relatively recently that the countries of South Asia have begun taking an approach to natural disasters that goes beyond immediate response to encompass risk management and mitigation. In Bangladesh, although some cyclone shelters were built following the Bhola cyclone of 1970, which killed up to half a million people, this kind of planning for disasters was the exception rather than the rule until much later. Following devastating floods in 1988 and a cyclone in 1991, the Ministry of Disaster Management and Relief was established in 1993. In India, similarly, following the 1999 Orissa cyclone and the 2001 Gujarat earthquake, there were moves to set up a National Disaster Management Authority (NDMA). This was still in the process of being established when the 2004 Indian Ocean tsunami occurred. The NDMA was established in 2005 and the following year a National Disaster Response Force was set up. The 2005 Kashmir earthquake spurred Pakistan to adopt a similar approach, and in 2007 it too set up a National Disaster Management Authority.

[4] Kellett, J. and Caravani, A. (2013), *Financing disaster risk reduction: A 20 year story of international aid*, London: Overseas Development Institute and Washington, DC: Global Facility for Disaster Reduction and Recovery at the World Bank, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8574.pdf (accessed 10 May 2016).

The shift from response to management and mitigation has several components. In particular, it means a greater official focus on disaster preparedness and the development of early-warning systems for predictable disasters, such as floods and cyclones. It has also been enabled by technology – in particular mobile phones – that can be used to provide last-mile weather warnings.

In the region, disaster mitigation is largely seen as a national rather than international issue. However, major disasters – in particular cross-border ones – have sparked moves towards better regional cooperation. In 2006, following the Kashmir earthquake and the Indian Ocean tsunami, the South Asian Association for Regional Cooperation (SAARC) set up the SAARC Disaster Management Centre in New Delhi. India had provided some support to Pakistan following the Kashmir earthquake and helped Nepal following the 2015 earthquake there. The latter event prompted India and Pakistan to agree that SAARC should play a greater role in disaster response.

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Multilateral groupings and NGOs are also increasingly active in various aspects of disaster risk reduction. At a multilateral level, the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES) was the first intergovernmental agency to provide weather forecasts to countries in the two regions. Bangladesh, India, the Maldives and Sri Lanka are member states, but each country in SAARC collaborates with the organization. RIMES was set up by the UN in collaboration with the Asia Disaster Preparedness Centre following the Indian Ocean tsunami. It has worked with bilateral agencies and NGOs to strengthen flood warning systems in Bangladesh, providing longer lead times of up to 10 days.

The UN Economic and Social Commission for Asia and the Pacific (ESCAP), a multisectoral intergovernmental platform, was also mandated in 2015 by its members, including those from South Asia, to strengthen regional cooperation for flood forecasting in cross-border river basins. ESCAP promotes intergovernmental, multi-stakeholder cooperation, such as through the Mekong River Commission and the ESCAP-WMO Panel of Tropical Cyclones,[5] which bring together stakeholders that share risks across common rivers and oceans.

NGOs have been increasingly involved in disaster risk reduction in recent years, particularly since the 2005 UN World Conference on Disaster Reduction in Kobe, Japan. This led to the approval of the Hyogo Framework for Action (2005–15), which has been succeeded by the Sendai Framework. Both treat disasters as events requiring a collective response, creating space for NGOs to work alongside government agencies and other actors.

In the South Asian context, the International Centre for Integrated Mountain Development (ICIMOD) is a key non-governmental actor. It has set up a Regional Flood Information System in the Hindu Kush Himalayan region. This enables the exchange of real-time data on river levels across the Himalayas (excluding India).

[5] WMO = World Meteorological Organization.

Floods

Of all the countries in the world, those of South Asia are among the most affected by flooding. A 2004 UN Development Programme (UNDP) report calculating exposure to floods places India as most affected, followed by China and Bangladesh.[6] Pakistan is in fifth place, Afghanistan eighth and Nepal 10th. Adjusted for population, Bhutan is most at risk, with Nepal fifth and Bangladesh and Pakistan 12th and 13th respectively.

In recent years, millions of people across the region have been affected (see Table 1). During the monsoon season, the various tributaries of the Ganga regularly cause flooding in Nepal and in the contiguous states of India, while the Brahmaputra causes floods in northeastern India. Events such as landslides in Nepal also contribute to flooding in India.

According to India's Central Water Commission, on average 72,000 sq km of the country are flooded each year, affecting more than 30 million people. Pakistan faces similar problems. The 2010 floods left vast swathes of the country underwater after record rainfall led the Indus to burst its banks, causing damage to land and affecting millions of people. Large parts of low-lying Bangladesh are frequently flooded during the monsoon, and catastrophic events during which up to 75 per cent of the country has been inundated have occurred frequently over the past few decades. In Afghanistan, flash floods are the greatest risk, while degradation of land and deforestation have exacerbated the impact of floods and increased the risk of associated landslides.

There is a widespread sense that variable monsoons are increasing the intensity of flood-related events (with increasing climate change threatening to exacerbate this variability). Accelerating glacial melt is increasing the risk of glacial-lake outburst floods. Rising populations have led to growing encroachment of settlements on flood plains and riverbanks, increasing the number of people severely affected by flooding and decreasing the net capacity for drainage.

There is a considerable economic cost for the countries of the region as a result of floods. According to a 2015 report by the UN Office for Disaster Risk Reduction, economic losses in India resulting from floods amount to more than $7 billion annually.[7] In 2015, the World Resources Institute estimated that India has the highest GDP at risk of flooding, followed by Bangladesh; and that within 15 years India's GDP at risk could rise more than tenfold to $154 billion, equivalent to more than 2 per cent of its projected GDP.[8]

[6] United Nations Development Programme (2004), *Reducing Disaster Risk: A Challenge for Development*, New York, NY: United Nations Development Programme, http://www.undp.org/content/undp/en/home/librarypage/crisis-prevention-and-recovery/reducing-disaster-risk--a-challenge-for-development.html (accessed 10 May 2016).
[7] UNISDR (2015), *Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction*, Geneva: United Nations Office for Disaster Risk Reduction (UNISDR).
[8] Winsemius, H. and Ward, P. (2015), 'World's 15 Countries with the Most People Exposed to River Floods', http://www.wri.org/blog/2015/03/world%E2%80%99s-15-countries-most-people-exposed-river-floods (accessed 20 Sep. 2015).

Table 1: Worst floods in South Asia, 2000–15

Country	Year	Month	Number of people killed	Number of people affected (million)	Economic loss ($ billion)*	Area affected (million hectares)**	Location
India	2000	August–October	2,606	46.60	1.36	5.38	Gujarat, Andhra Pradesh, Assam, Arunachal Pradesh, Bihar, Himachal Pradesh, Kerala, Madhya Pradesh, Punjab, Uttar Pradesh, West Bengal
India	2004	June–August	3,000	40.00	0.59	8.47	Bihar, Tripura, Assam, Bangladesh
Bangladesh	2004	June–August	638	33.75	2.20	3.08	Central Bangladesh, Greater Dhaka
India	2005	July–August	150	22.92	1.53	12.30	Gujarat, Madhya Pradesh, Maharashtra, Goa, Orissa, Karnataka, Himachal Pradesh, Jammu and Kashmir
India	2007	July–September	1,103	18.70	0.05	7.14	Bihar, Uttar Pradesh, West Bengal, Orissa, Assam
India	2008	June–July	1,063	7.90	0.30	3.84	West Bengal, Orissa, Assam, Gujarat, Arunachal Pradesh, Goa, Bihar, Haryana, Kerala, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Orissa, Rajasthan, Uttar Pradesh, Tamil Nadu, Uttarakhand, West Bengal, Jharkhand
Pakistan	2010	July–August	1,985	18.00	16.00	2.20	Khyber Pakhtunkhwa, South Punjab, Baluchistan, Sindh
India	2013	June	6,054	0.50	2.92	9.50	Uttarakhand, Himachal Pradesh, Bihar, Karnataka, Kerala, Gujarat, West Bengal, Uttar Pradesh

Sources: Central Water Commission (2005), *Water and related statistics,* http://cwc.gov.in/main/downloads/Water_Data_Complete_Book_2005.pdf (accessed 3 Mar. 2016); Central Water Commission (2013), *Water and related statistics,* http://www.cwc.nic.in/main/downloads/Water%20and%20Related%20Statistics-2013.pdf (accessed 3 Mar. 2016); Majumder, S. (2013), *The Economics of Early Response and Resilience: Bangladesh Country Study*, Dhaka: Government of Bangladesh, pp. 1–29; Madhurkar, U. (2005), 'Flood of misery', *India Today*, http://indiatoday.intoday.in/story/devastating-rains-and-floods-hit-gujarat-govt-inadequate-response-worsens-crisis/1/193683.html (accessed 3 Mar. 2016); Flood Management Information Cell (2007), *Flood Report 2007*, Bihar: Government of Bihar, pp. 2–45; UNDP (2009), *Kosi Floods 2008: How we coped! What we need?*, India: UNDP, pp. 5–58; Ahmad, N. (2011), *Pakistan National Briefing: Economic losses from disasters*, LEAD Pakistan, http://www.lead.org.pk/lead/attachments/briefings/LPNB3.pdf (accessed 10 Mar. 2016); Disasters Emergency Committee (2015), 'Pakistan Floods Facts and Figures', http://www.dec.org.uk/articles/pakistan-floods-facts-and-figures (accessed 10 Mar. 2016); PHD Chamber of Commerce and Industry (2013), *Life ahead for Uttarakhand: Rebuilding Infrastructure & Reviving Economy,* http://phdcci.in/file/state%20profie_pdf/Uttarakhand-Study-Final-August2013.pdf (accessed 10 Mar. 2016).

* The methodology for calculation varies and therefore the mentioned value should be taken as the closest approximation to the real figures. Values for economic losses have been taken from different available sources and converted into US dollars.
** The methodology for calculating the affected area differs from case to case. The figures may also include cropped areas and agricultural land affected by floods.

Official cross-border engagement on floods

Despite the shared risks, examples of cross-border cooperation on floods are relatively rare in the region. The absence of effective warning mechanisms exacerbates a trust deficit. There is scepticism among experts in Nepal and Pakistan, for instance, over India's dam-building and sharing of data and information on shared rivers. Pakistan and Afghanistan do not share or exchange hydrological data even though the Kabul river (which originates in Pakistan, crosses into Afghanistan and then flows back into

Pakistan) presents a flood risk for both countries. Nepal used to fax water data to Bangladesh, but in recent years the data shared are said to have been reduced because of staffing constraints.[9]

India provides Bangladesh with information from eight monitoring stations: four on the Brahmaputra, two on the Ganga, and one each on the Teesta and Barak. These allow Bangladesh to provide flood warnings five days in advance. Since 2015, with additional data from the Brahmaputra in China, Bangladesh has been developing a 10-day warning system.

In 2015, China agreed to provide Bangladesh with daily data from three measuring stations in Tibet as well as rainfall data between June and October each year. This follows an agreement by China to give India hydrological data for the Brahmaputra (known in China as the Yarlung Tsangpo) during the monsoon. Under the Indus Waters Treaty, India provides limited flood warning data to Pakistan in relation to the Ravi, Sutlej, Beas, Chenab and Jhelum rivers during the monsoon, informing the Indus Water Commission when the water flow reaches a certain level – but this provides insufficient time for effective early warning.

Even when data are shared, the official exchange between countries can be too slow to provide warnings to threatened communities as last-mile connectivity is frequently lacking. This leaves them to rely on their traditional coping strategies. Data are frequently used for longer-term planning rather than for flagging specific flood risks. In many countries in South Asia there are widespread concerns over resource cutbacks in some government ministries, as well as over the quality and frequency of data collection. Some local officials appear to focus primarily on post-flood relief.

The current situation is clearly suboptimal, but the trend is towards greater engagement. There is a growing acceptance that cross-border cooperation is imperative for effective flood forecasting.

While Pakistan has criticized India for not passing on warnings in recent years, during the 2014 flooding in Indian Kashmir it became clear that there are no effective systems in place to provide warnings there, let alone downstream.[10] As well as a lack of information, obstacles include disputes over water between several Indian states and Pakistani provinces, further fuelling secrecy over water data.

Table 2: Summary of flood warning frameworks in South Asia

Country	Institution for flood forecasting	Observation network (no. of real-time stations)	Flood forecasting model	Numerical weather prediction	Operational flood forecasting in place
Bangladesh	Flood Forecasting and Warning Centre	84 water-level	Mike 11	NOAA Global Forecast System, WRF	Yes
Bhutan	Department of Hydro-Meteorological Service	21 hydrological, 22 meteorological	IIFAS, HEC-RAS	HBV, WRF	No
China	Ministry of Water Resources	n/a	Xinjiang	T639	Yes
India	Central Water Commission	n/a	Mike 11	WRF	Yes
Nepal	Department of Hydrology and Meteorology	32 hydrological, 46 meteorological	Mike 11	WRF	No
Pakistan	Public Works Department	24 hydro-met	FEWS, Indus-IFAS, CLS	WRF	Yes

Source: Singh Shrestha, M., Grabs, W. E. and Khadgi, V. R. (2015), 'Establishment of a regional flood information system in the Hindu Kush Himalayas: challenges and opportunities', *International Journal of Water Resources Development*, 31(2), http://dx.doi.org/10.1080/07900627.2015.1023891.

[9] Khadka, N. S. (2013), 'South Asia disunity "hampers flood warnings"', BBC News, 19 July 2013, http://www.bbc.co.uk/news/science-environment-23358255 (accessed 10 May 2016).
[10] Khadka, N. S. (2014), '"No flood warning for Indian Kashmir" admits Indian official', The Third Pole, 23 September 2014, http://www.thethirdpole.net/no-flood-warning-system-for-indian-kashmir-admit-indian-officials/ (accessed 10 May 2016).

Non-governmental engagement on floods

While there is a clear trend towards disaster mitigation and risk reduction, progress on the ground is slow and floods continue to afflict millions of people across South Asia. In contrast to governments, NGOs can be more flexible and, in some cases, are more trusted by communities. This has provided scope for them to fill gaps left by governments.

New technologies also help to facilitate better early-warning systems and to bypass traditional approaches. For instance, mobile phones and the internet can allow previously isolated communities to communicate and receive information in ways previously unimaginable. Satellite images can be used to predict which riverbanks are likely to overflow, while solar power can supplement traditional energy sources to prevent monitoring equipment becoming obsolete once batteries have run out.

There is clear scope for greater cross-border engagement, though, which would provide for longer lead times before the onset of flooding sparked by rainfall or melting ice upstream. Some organizations are starting to use data collected in one country as a means of informing potentially affected downstream communities in other countries. Whether within or between countries, successful flood early-warning systems require four elements:

- Collation of accurate data;
- Interpretation of these data to ascertain the risk downstream;
- Timely dissemination of warnings to potentially affected communities; and
- Awareness within communities of the action they should take.

The longer the lead time for a flood warning, the more affected communities are able to prepare by, for example, harvesting crops and moving possessions to higher ground. Many NGOs have worked on disaster risk reduction, and some are establishing systems to expedite data exchange and supply flood early warnings to at-risk communities. This mostly takes place within countries. In India, for instance, ICIMOD and Aaranyak (another NGO) have established a community-based flood early-warning system for 45 communities in Assam. When water reaches a certain level, a flood sensor is triggered and a signal transmitted to a receiver, which in turn disseminates the warning through mobile phones to agencies and communities.

Another project, funded by the UN Adaptation Fund and implemented by the UNDP and Pakistan's environment ministry, provides mountain communities with warnings about outburst floods from glacial lakes. Through the project, a hazard watch group monitors the lakes and constructs mitigation measures such as small dams and retention walls. In May 2014, the project alerted local villagers that a glacial lake was likely to burst, allowing them to move to higher ground with their livestock hours before the flood hit.

At present, flood warnings are generally based on river levels upstream; in the future meteorological data could provide longer lead times by working out the time taken between rainfall upstream and flooding downstream. Such a process will require cross-border cooperation.

Steps to forecast droughts on a regional basis are also under way. The Global Water Partnership South Asia and the International Water Management Institute (part of the World Meteorological Organization) are setting up a South Asian Drought Monitoring System in partnership with the relevant government departments and other interested parties in Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka, and also involving the SAARC Disaster Management Centre.[11]

[11] WMO, Global Water Partnership and International Water Management Institute (2014), 'South Asian Drought Monitoring System (SA DMS)', http://www.droughtmanagement.info/idmp-activities/south_asia/ (accessed 25 July 2015).

ICIMOD and the World Meteorological Organization are also establishing a regional flood information system in the Hindu Kush Himalayan region under a project initiated in 2001. This has facilitated a cross-border information system covering Nepal, Bangladesh, Bhutan, India and Pakistan, bringing institutions together and encouraging the countries to share their data. The project uses satellites as well as community-based monitoring. It has successfully modernized hydro-meteorological data in the region by upgrading networks to provide real-time data. Data are now being transmitted from 38 hydro-meteorological stations across four countries and then sent to partner agencies (i.e. hydro-meteorological departments) in each one; the data can then be used to generate flood outlook forecasts and warn communities.

Using an in-house monitoring system, the project provides regional forecasts that can give a one- to two-week flood warning. The monitoring stations use SIM cards to relay information to ICIMOD and the partner agencies. These regional flood outlook data are intended to support national meteorological departments in preparing timely flood warnings.

Most current flood warning systems are based on river gauges. This approach does not account for additional water flows into a river between gauges. Additional information necessary for effective flood management, such as the area likely to be submerged and the depth and duration of submergence, is frequently unavailable.

Systems based on rainfall would provide longer warning times. Steps are being taken by a number of global weather centres, such as the US National Oceanic and Atmospheric Administration, the India Meteorological Department and the European Centre for Medium Range Weather Forecast, to provide short- to medium-range rainfall forecasts.

Early-warning systems on the Karnali/Ghaghara river

A few examples exist of cross-border early-warning systems, notably involving cooperation between Nepal and India, in which NGOs warn communities in India based on data collated in Nepal. There is considerable scope for these arrangements to be expanded.

Since 1979 a UK-based NGO, Practical Action, has undertaken a range of technical and community-based programmes for the most vulnerable in Nepal. In 2001, with support from the European Commission's humanitarian aid department (DIPECHO), it set up its first early-warning system for flood-affected communities in Chitwan, constructing watchtowers and using handheld sirens to transmit flood warnings. Since then, with support from DIPECHO and subsequently from the Zurich Foundation, Practical Action has worked with local organizations in Nepal to improve flood resilience.

In 1987, Nepal's Department of Hydrology and Meteorology (DHM) established a monitoring system on the country's major rivers. The data were largely used for long-term planning rather than for flood warning. As Practical Action expanded its focus to the Karnali river, known in India as the Ghaghara, it made use of these existing river gauges for the purpose of issuing flood warnings. From the start, the work engaged district government and a local company that produced appropriate technologies for river gauges.

Several districts in the Indian states of Uttar Pradesh and Bihar are susceptible to flooding from rivers originating in Nepal. In 2008, the Koshi river altered course after breaching an embankment in Nepal, affecting 2.3 million people in Bihar. The flooding demonstrated the need for greater disaster preparedness on the Indian side of the border.

As Practical Action expanded its work in Nepal, it became clear that information gathered there could be of use to downstream communities in India. Following the model it had adopted in Nepal, Practical Action provided technical skills downstream in India for mapping and using computer modelling to assess the time taken between high-water levels upstream and flooding downstream.

Practical Action coordinated and established communication with Nepal's DHM to facilitate the flow of river-discharge data from Nepal to the affected villages in India. Officially, the DHM sends these data to Uttar Pradesh's irrigation department. Annual meetings also take place every June or July between the officials from the irrigation department and district administration in Uttar Pradesh and the development officers and the office chief of the DHM in Nepal. These meetings discuss management of infrastructure for disaster reduction, flood forecasting, inundation problems and management of embankments. However, they do not focus specifically on flood prevention or action.

This case of official data-sharing has several limitations. The data released by Nepal are not circulated directly to the communities in India. Instead, the Uttar Pradesh irrigation department circulates data on daily discharge from barrages (such as '10,000 cusecs of water discharged from barrage on 10 July, 2014'), but these data cannot be used for flood forecasting. The delivery times are too slow, with data taking more than 24 hours to reach local officials, and in their raw form cannot be interpreted to predict floods.

These limitations prompted Practical Action, along with the Indian NGO Poorvanchal Gramin Vikas Sansthan (PGVS)[12] and Christian Aid, to try to develop direct linkages between Nepal's DHM and the flood-affected communities in Uttar Pradesh. The approach and outcome are discussed below.

Technical approach

PGVS, Practical Action and Christian Aid conducted a project to establish an early-warning system linking districts in Nepal and India. In 2012, PGVS carried out a pilot project in 15 villages in the Bahraich district of Uttar Pradesh, which borders Nepal. By 2014 the project had been extended to 45 villages; it is to be further expanded into 95 villages in the Bahraich and Gonda districts.

Initial conversations about the project were started by Christian Aid, the common partner of PGVS and Practical Action. The founder and chairman of PGVS discussed with Practical Action the feasibility of a cross-border early-warning system that could provide more lead time to downstream communities and help build their resilience against floods. PGVS had already worked on disaster risk reduction among communities in India. Practical Action undertook the role of technical expert, conducting preliminary assessments and hydrological modelling to ascertain the time taken for water to flow from Nepal into bordering districts in India. It encountered challenges in accessing the official data from the Uttar Pradesh irrigation department, and doubts were raised regarding the data's authenticity and reliability. On the other hand, Nepal's DHM was cooperative and open to sharing river-flow data.

Practical Action studied and mapped real-time data, changes in river flow and discharge rates in the Ghaghara basin in India and at Chisapani on the Karnali river in Nepal. Its maps were, in turn, verified and improved through engagement with the local communities facilitated by PGVS. The assessment included analysis of the Girjapuri barrage and its operation, which affects the characteristics of floods in the region. Based on these evaluations and mapping exercises, early-warning sets were

[12] PGVS was established in 1986 and had been working in Uttar Pradesh and Bihar on issues such as water, sanitation and healthcare.

placed in chosen villages for the pilot project, which focused on villages bordering the junction of the Saryu river. Ghaghara and Sarda were selected for the pilot run. Later, other villages were selected based on their vulnerability, proximity to the border and connectivity to surrounding villages.

The early-warning set comprises a display machine connected to a solar panel, storage batteries and CDMA (Code Division Multiple Access) technology to transmit data. The river levels are displayed constantly on the machine during the flood season. As a back-up, poles with mark-ups of different threat levels were also constructed in various locations on the Ghaghara river for manual monitoring of the flows by local groups. In the event that the river flow exceeds the normal levels, disaster task forces set up in each village can activate evacuation programmes.

The project's impact was assessed based on whether the number of casualties from floods was reduced. For instance, in the 2014 floods in Mihipurwa block, no deaths were recorded. This was attributed to the early-warning system and the training that communities had received.

Community engagement

PGVS undertook risk assessment and community engagement in the downstream communities and provided information on how to interpret the data. (Red Cross Nepal performs similar work in Nepal.) Trained 'Gram Task Forces' were set up through a democratic process in each village. These comprise three teams: an early-information team, a search and rescue team, and a disaster relief team. PGVS conducted extensive training for these teams to interpret the data and strategize evacuation plans for each village. Each task force is responsible for analysing the data received at its river monitoring station, alerting villagers and activating the village's disaster management plan. PGVS also introduced disaster mitigation strategies, based on villagers' traditional knowledge. These included storage solutions for possessions and crops, information on flotation devices and information relating to the nearest areas of high ground, which are frequently roads or railway tracks. In some villages that are distant from roads, brick houses were constructed so that villagers could climb on to roofs to escape floods.

The process of getting community buy-in was initially difficult.[13] However, bringing a local villager into the PGVS team helped the communication process. The demonstration of the benefits that accrued from the pilot project facilitated conversations around warning systems in other villages. No economic incentives were provided to encourage villagers to participate in the project.

Another attitudinal challenge during project uptake was the trust deficit in communities of India towards Nepal. Some communities affected by the Ghaghara believed that their fields were flooded because Nepal had released water into the river. However, during the river-monitoring exercises and interaction with communities on the other side of the border, they realized that Nepalese villages also get flooded and that Nepal was not responsible for the devastation caused by floods. However, some other village communities – situated further from the border – were unaware that floods stemmed from events in Nepal.

In Maikupurva, Dallipurva and Daraiyakutti the task forces had participation from women and men. These members also belonged to other groups such as women's self-help groups or village-level administrators such as *Tehsildars* and *Lekhpals*. Deep divisions between Hindus and Muslims and between castes in these regions may explain earlier uncoordinated responses to disasters. In the absence of communication between members of different castes and religions, no uniform

[13] Interviews, PGVS staff, June 2015.

or united strategy could be made to avert disasters or respond to them. Demonstrating the need for a coordinated village-level response and increasing village cohesion was vital for the project.

Government engagement

The close relationship between the chairman of PGVS and local government officials ensured official support for the project. The revenue officer in Nanpara (in Bahraich district) had prior involvement with other PGVS projects (which had focused on water, sanitation and health) when he had been posted to Gonda district. On being transferred to the project site of the early-warning system, he extended all the support he could. On a personal level, he had a great deal of respect for civil society work and had previously founded an NGO that worked on education in the region.

Had the early-warning system been established by the local government, the process would have been slower because of the need for local officials to get approval from various ministries. Therefore, it made more sense for local government officials to facilitate work by NGOs that can be more flexible and often have a better reputation among the affected communities. While local government officials approved of the project, they did not offer other support and no costs were imposed on the government.

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The main challenges for the project in its early stages related to the preliminary survey, assessment and data collection, which were affected by the geology of the region and administrative lapses. It took six months to collect, verify and assess the data. At first, the Uttar Pradesh irrigation department refused to share the data, and it required multiple requests before it would do so. The available river discharge data then had to be verified for authenticity, which further delayed the process.

More intensive and cross-learning sessions and workshops are now conducted between Nepal and India. PGVS has also acquired membership of the Asian Disaster Reduction and Response Network and the Credibility Alliance, as well as being associated with India's NDMA.

Early-warning systems in the Koshi basin

India's Central Water Commission has been issuing flood forecasts for the Koshi river system since 1970. At present there are three forecasting stations on the river – at Basua, Baltara and Kursela – and two base stations at Barahkshetra and Birpur. Each site is equipped with a wireless system for communication. While the gauges provide effective warnings, the lead time would be lengthened if more were set up in the upper reaches of the river in Nepal.

Despite the technological advances and sophisticated flood monitoring systems, timely communication of the relevant information to vulnerable communities is sometimes inadequate, leading to loss of lives and livelihoods. Furthermore, the fact that different departments and agencies are responsible for various elements of disaster management creates vulnerabilities, as does a failure to interpret data.

Lutheran World Relief (LWR) coordinates a cross-border project on resilience on the Koshi and Gandak rivers, building on an earlier successful pilot project involving Grameen Development Services (an Indian NGO) and BIKALPA (an NGO operating in Nepal). This project focuses on 53 communities in Nepal (Saptari, Udayapur and Nawalparasi) and India (Bihar and Uttar Pradesh). Working with local disaster management committees, the project involves capacity-building; the introduction of safety nets through insurance; advocacy work; and developing livelihoods, for example by introducing flood-resistant crops.

The project also involves the development of early-warning systems whereby details of water releases from dams or high water levels are communicated to downstream communities in Nepal and India. This has shortened the time for this information to reach communities from two days to just one day. Attempts are currently under way to reduce this time to six hours.

In 2013, the Narayani and Koshi river basins flooded all the border regions. NGOs realized that the upstream communities were much better equipped with information on floods, while the downstream communities faced difficulties in accessing such information. There were multiple reasons for this, including an official protocol that had to be followed. Earlier work by LWR in the region on livelihood issues and the flooding situation triggered the conception of the project on early-warning systems. LWR's presence on the ground and its extensive social network eliminated any resistance from the communities.

Based on immediate needs, a six-month pilot project to set up early-warning systems was started in 23 villages. The key area of focus was to establish an interaction between border communities through a Citizens' Forum. This included members of local assemblies (*panchayats)*, health workers and teachers. The target population was more than 100,000 people living in six districts in Uttar Pradesh and Bihar, in India, and in two districts in Nepal.

Indigenous knowledge was reclaimed and supported in these areas. Safety nets, sandbags and other traditional methods used for flood protection were improved as part of the project. Communities participated in data collection and other decision-making processes related to the project. To enhance communication among communities and sustain project activities, district-level forums were created. Alternative livelihoods and other support infrastructure such as grain banks and flood-resilient crops were introduced to enhance resilience. Conflict between upstream and downstream communities was avoided, and they seemed happy to work together for purely humanitarian reasons.

The project aimed to build resilience rather than solely approaching flooding through the lens of mitigation. Therefore, the focus was on the long-term adaptability of communities living in flood-prone areas. Background research was intensive and was supplemented by local knowledge. Resilience-tool design, economic indicators for human capital, behavioural-change measurements and other novel techniques were used to design the interventions. Many different ideas were experimented with before the design was settled on. For instance, the project took an asset-based approach – focusing on the strengths of a community rather than its needs – to add flexibility to existing tools and to allow effective implementation on the ground. Real-time information was collected and monitoring mechanisms were set up. The project used existing institutional frameworks and modified them to build adaptive capacities. Localization in this sense was imperative for success.

While the local government in India was appreciative of the project's outcomes, it remained distant during its implementation. Later, an interface was established between local government and communities. The project raised awareness among donors that building adaptation and resilience is a long, drawn-out process that required in this case at least two years' presence on the ground by the implementing NGO. Solutions that do not take such time to secure community buy-in are less likely to succeed. The current focus of the project is on building resilience against extreme climatic events, referred to as 'sustainability resilience perspectives'.

Lessons learned

The success of the projects described here was dependent on a combination of factors. While every project needs to be contextualized with regard to the specific local political economy and socio-ecological realities, a number of broad lessons can be learned:

- Early-warning projects need to be suitable for local conditions, which may require an innovative approach, and have a clear goal. In some cases, approaching the project through the lens of building resilience rather than solely mitigating floods might work.
- In order to establish the early-warning system, primary geological and hydrological assessments are necessary, along with innovative tools and techniques, to first understand the complex interlinkages between the hydrology, geology, ecology and social structures of the region. Collaboration with scientific and technical bodies must be established to produce research and data on floods, including baseline assessment of flood cycles and situation analysis.
- The utility of data produced by technical bodies should be strengthened through inclusive interaction with local communities. This may also act as a confidence-building measure, besides allowing verification of ground realities *vis-à-vis* modelling studies on the hydrology and flood cycles of the region in focus.
- Providing employment in the project to a member of each of the villages concerned can build further trust and confidence among communities. This facilitates communication with the locals and helps build local networks faster and more effectively. But the processes are time- and labour-intensive. Ensuring community buy-in can require projects to go beyond the simple provision of a flood warning.
- Social networking and connections aid in establishing collaborative projects across different organizations. For instance, in the case of the Karnali river the informal connections of the chairman of PGVS assisted in getting approvals from local government departments and securing funding from international organizations. It is unclear whether the project could have been successful without these connections.
- A robust training and monitoring component is necessary to sustain the success of the project. The training programme should enable understanding of the early-warning systems in the simplest way. It should also include basic skill development and livelihood strategies to provide communities with the knowledge and capacity to withstand disaster shocks, improvise responses, and adapt to the changing climate rather just mitigate its effects.
- Modelling is complicated by the tendency for rivers to change their course. Heavy rainfall and subsequent rises in river levels mean that gauges are frequently washed away, necessitating

continued investment in infrastructure. Ideally, governments would take over running such projects when their effectiveness has been proven. But formalizing this transfer is complicated. While the running costs of such projects are relatively low (certainly relative to the compensation paid to the families of flood victims), governance in some of the regions affected by flooding is poor.

- In areas in which governance is poor, monitoring stations are more likely to be subject to theft (of solar panels, for instance), rendering the early-warning systems inoperative. Community-owned systems suffer fewer instances of theft but require continued third-party funding and maintenance. The main challenges to these projects include maintenance of the infrastructure, the accessibility of the affected areas and the cost of international mobile communications.

3. Ecosystem-Based Approaches

Ecosystems are vital for human life, providing a range of fundamental services from food, water and clean air to carbon sequestration. Protecting biodiversity is a means of protecting ecosystems, and – because ecosystems are directly linked to people – this has become an important approach to conservation. Ecosystem protection requires the inclusive management of natural resources to ensure their sustainability.

South Asia has several cross-border ecosystems. Each is characterized by competing demands for water, food and energy, and by competing pressures on and/or from fisheries, livelihoods, navigation and ecology. Complex interlinkages exist between these factors, which necessitate careful assessment and comprehensive management strategies as well as cross-border cooperation.

Water is a politically emotive subject in South Asia, and agreements over it have been more contingent on politics than on social, economic or ecological concerns. The ecosystem approach – of which water is a key component – has the potential to bring about shared understanding of challenges to create shared solutions. Its overarching objective of sustainability allows for discussion and research into more sensitive areas. The approach is forward-looking. This is paramount given the potential impact of climate change on water resources, and provides a template for increased cross-border discussions and policy alignment in water management.

Protecting ecosystems involves an integrated approach that aims to ensure sustainable and equitable resource management as well as meeting people's needs. The approach is flexible and involves decentralized decision-making.

Strong scientific elements underpin the ecosystem approach. It incorporates understanding and principles of relevant disciplines such as hydrology, ecology, geology, and even anthropology and sociology. The theoretical conception combines technological solutions with sensitivity to history, culture and the politics of resource management. Cross-border ecosystem projects in South Asia are evolving and have the potential to forge a new approach towards water.

Background

Discussions about ecosystem management began in North America in the late 1980s. In the United States attempts were made to streamline approaches to natural resource management. The Interagency Ecosystem Management Task Force, comprising a wide range of US federal agencies, was established in 1993 and conducted several case studies to examine national experience in ecosystem management. Based on these, the task force recommended strategies for improving coordination between federal agencies and other stakeholders in order to protect ecosystems and raise public awareness.

The Canadian Task Group on Ecosystem Approach and Ecosystem Science, set up in 1996, highlighted key concepts of an ecosystem approach to management. These included the recognition of the interrelationship of natural systems and the need for their preservation through a holistic approach, ensuring stakeholder cooperation at all stages of decision-making processes. In addition, the task group conducted case studies in Canada and concluded that there was a need to broaden the perspectives of traditional and non-traditional partners to find long-term solutions to complex environmental problems.

While these initiatives were not completely connected to the debates held in relation to biological diversity, they played an important role in providing basic inputs for the development of the approach.

At its first meeting in 1995, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the Convention on Biological Diversity (CBD) stressed the need to address the issue of conservation of biological diversity in a more comprehensive manner. These discussions were instrumental in the adoption of the ecosystem approach. According to the SBSTTA:

> The conservation and sustainable use of biological diversity and its components should be addressed in a holistic manner, taking into account the three levels of biological diversity and fully considering socio-economic and cultural factors. However, the ecosystem approach should be the primary framework of action to be taken under the Convention.[14]

However, at that stage there was no concrete definition of the approach. Subsequently, efforts were made to debate the terminology and delineate the scope of the approach. The International Union for Conservation of Nature (IUCN) and the World Wildlife Fund (WWF) played leading roles in drawing up the principles underlying ecosystem management.

Currently, the ecosystem approach within the framework of the CBD is described as 'a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way'.[15] By taking into account ecological, social and economic considerations, this approach seeks to balance the three objectives of the convention: biodiversity conservation, sustainable use and equitable benefit-sharing from the use of natural resources.

The approach also takes into account the fact that humans and cultural diversity are integral elements of most ecosystems. It applies appropriate methodologies in conjunction with existing practices and approaches. Finally, it does not specify any particular spatial unit or scale,[16] and hence can refer to any functioning unit at any scale (which could be a pond, a catchment area, a biome or the biosphere). In that sense, the ecosystem approach is a comprehensive and flexible framework that can be adapted to the situation being addressed. The 12 principles that form the basis for it are listed below (reproduced, in adapted form, from CBD definitions):

1. Objectives for management of land, water and living resources are a matter of societal choice.
2. Management should be decentralized to the lowest appropriate level.
3. Ecosystem managers should consider the effects of their activities on adjacent and other ecosystems.
4. Recognizing potential gains from management, there is a need to understand the ecosystem in an economic context. Programmes should reduce market distortions, align incentives to promote sustainable use, and internalize costs and benefits.
5. A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning.
6. Ecosystems must be managed within the limits of their functioning.
7. The ecosystem approach should be undertaken at the appropriate scale.
8. Recognizing the varying temporal scales and lag effects which characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

[14] Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) (2007), 'Recommendations 1/3: Recommendation on the *modus operandi* of the Subsidiary Body on Scientific, Technical and Technological Advice', https://www.cbd.int/recommendation/sbstta/default.shtml?id=6983 (accessed 20 Sep. 2015).
[15] CBD Secretariat (1994), 'Convention on Biological Diversity. Article 2: Use of Terms', in *Convention on Biological Diversity*, Kyoto.
[16] According to the Convention on Biological Diversity, the term 'ecosystem' means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. This definition does not specify any particular spatial unit or scale.

9. Management must recognize that change is inevitable.
10. The ecosystem approach should seek the appropriate balance between conservation and use of biodiversity.
11. The ecosystem approach should consider all forms of relevant information, including scientific, indigenous and local knowledge, innovations and practices.
12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.[17]

At its heart, the ecosystem approach can be seen as a social process that recognizes that several stakeholders must be involved in decision-making and the management of ecosystems, and that this requires the development of effective channels and processes. For this reason the approach can be applied to a whole array of ecosystems (marine, wetlands, forests, grasslands and others) rather than just to areas marked for biodiversity conservation.[18]

The ecosystem approach in South Asia

The application of an ecosystem approach is still in its nascent stages in South Asia. Across the region policy-making is informed by integrated water-resource management, which promotes the management of water and related resources such as land and biodiversity on a watershed basis to ensure sustainable ecosystems, while maximizing social and economic benefits.

South Asia is home to a number of cross-border ecosystems. At different scales, these include:

- the Hindu Kush-Karakoram-Himalaya region (Afghanistan, Pakistan, India, Nepal, China, Bhutan)
- the Terai ecosystems such as the Shiwalik range (India and Nepal)
- the Sundarbans mangrove forest (India and Bangladesh)
- the Manas subtropical forest (India and Bhutan)
- the Rann of Kutch (India and Pakistan)

Several projects are under way – many at an early stage of preparation – to seek strategies to balance ecosystem protection with human needs and developmental aspirations. While the concept is straightforward, putting it into practice is complex, even more so when it involves working across countries rather than within a single country. South Asia has many economic and political asymmetries, along with different rights and fragmented institutional and legal frameworks. Furthermore, the need to stress sovereignty makes joint management too aspirational. Policy alignment, however, is politically feasible if it can be proven to provide mutual benefits.

Political differences and conflicting national strategic interests are a further impediment to effective cross-border resource management. While there have been notable successes between India, Nepal, Bhutan and Bangladesh, political differences (for example, between India and Pakistan) and conflict (for example, in the border regions of Pakistan and Afghanistan) have thwarted some attempts at joint management. For instance, while Pakistan protects the Rann of Kutch under the Ramsar Convention, India does not apply the convention on its side of the border.

IUCN and the WWF are the lead actors working on ecosystems in South Asia. IUCN's 'Ecosystems for Life' initiative (see below) facilitated a series of joint scientific studies conducted by Bangladeshi and Indian researchers.

[17] Convention on Biological Diversity, 'Principles of the ecosystem approach', https://www.cbd.int/ecosystem/principles.shtml (accessed 10 May 2016).
[18] Smith, R. D. and Maltby, E. (2003), *Using the ecosystem approach to implement the Convention on Biological Diversity*, Gland and Cambridge: International Union for Conservation of Nature, https://portals.iucn.org/library/efiles/edocs/CEM-002.pdf (accessed 10 May 2016).

IUCN's persistent research work through Ecosystems for Life and other projects to strengthen knowledge on the Sundarbans in Bangladesh has gained the support of state governments in India, and in 2015 members of the national parliaments of Bangladesh and India agreed to set up a joint platform to preserve the Sundarbans.[19] IUCN's involvement in conservation in the Sundarbans further extends its 'Mangroves for the Future' project (see below). Research collaboration that seeks to fill widespread knowledge deficits is less politically sensitive and more feasible than projects that focus directly on water.

In addition, IUCN Bangladesh, in association with three local NGOs – the Bangladesh Centre for Advanced Studies, the Centre for Natural Resource Studies, and Nature Conservation Management – has been implementing community-based resource-management projects in five sites of the *haor* (wetland) and floodplain areas of Bangladesh since 1998 to enhance conservation efforts and boost the livelihoods of local people.[20]

'Ecosystems for Life': a Bangladesh–India initiative

In 2008, IUCN and the embassy of the Netherlands in Dhaka deliberated upon the possibility of a cross-border water project. The idea was to promote better understanding of river systems shared between Bangladesh and India and to ensure the sustainability of the region's ecosystems. This resulted in Ecosystems for Life (E4L), a five-year project funded by the Netherlands, at a cost of $6.8 million.

The project had first been conceived with a focus on cross-border water management, but due to the political sensitivities around the issue it was refocused on ecosystems. After one year of conceptualization, it was decided that the project would concentrate on action-oriented research and policy, dialogue and knowledge management.

As well as contributing to scientific data sets for India and Bangladesh, the project brought into the mainstream the idea of cross-border dialogue and policy alignment between fisheries departments in Bangladesh and contiguous Indian states. For instance, stocks of the *hilsa* fish, seen as a delicacy in West Bengal and Bangladesh, were falling because of overfishing. Bangladesh had introduced a moratorium on fishing, but its effectiveness was limited by the fact that fish swam upstream into India. The IUCN-led dialogue led West Bengal to introduce a similar ban on fishing. Such challenges require cross-border dialogue and engagement.

Strategic selection of the committees

National Advisory Committees comprising leading economists, environmentalists and development thinkers were formed in India and Bangladesh. These then set up two project advisory committees (PACs) to advise, monitor and guide project implementation in each country. Members were carefully selected with the aim of bridging the gap between civil society and government, accommodating each country's views, and allowing a free flow of innovative ideas and suggestions.

The process of gathering experts was largely facilitated by the established contacts and networks of IUCN members. The breadth of the project's objectives helped to encourage wider participation and allowed for peer-to-peer learning. Some Indian experts were inspired to learn more about how

[19] Chowdhury, K. R. (2015), 'India and Bangladesh agree joint initiative for Sundarbans', The Third Pole, 8 April 2015, http://www.thethirdpole.net/2015/04/08/india-and-bangladesh-mps-agree-joint-initiative-for-sundarbans/ (accessed 10 May 2016).
[20] Steele, P., Oviedo, G. and McCauley, D. (eds) (2007), *Poverty, Health and Ecosystems: Experience from Asia*, Gland and Cambridge: International Union for Conservation of Nature and Manila: Asian Development Bank, https://www.k4health.org/sites/default/files/PHEAsia.pdf (accessed 10 May 2015).

Bangladesh dealt with disaster management. One well-known oceanographer from West Bengal was motivated to learn about Bangladesh's policies on fisheries. Other experts became interested in disaster management in other countries.

Research topics of common interest

The next stage was to choose the best topics for joint research. The idea was to select fields in which policy could deliver a substantial impact and benefit both countries. A list of 12 possible research topics was narrowed to six by the PACs:

- Food security
- Water and poverty
- Impacts of climate change
- Inland navigation
- Environmental security
- Biodiversity conservation

Thereafter, research and situation analysis were conducted for the selected themes. Separate research teams (comprising Indians and Bangladeshis) were set up for each theme and joint reports were produced. These reports were then discussed and disseminated to a larger audience including government officials. Some projects, such as the community-based flood early-warning system, implemented by ActionAid, fed into government policy.

While some of the results were not published, the process of joint research was in itself deemed to have been useful. Some topics, such as inland navigation, were sidelined because of political sensitivities (although more recently India and Bangladesh have made significant progress in using rivers for transportation to foster connectivity with northeastern India). Other topics, such as wetland connectivity, climate change and environmental flow, suffered for similar reasons.

Action-oriented research

The third stage was the research itself. This was based on outcomes rather than outputs. PAC members noted that research needed to be action-oriented, grounded in reality and have policy implications. Instead of focusing purely on academic or scientific studies, E4L sought to 'demystify the science' and to interact with other stakeholders, including governments and communities. In addition, field visits constituted an important component of the research process.

In relation to the issue of the *hilsa* fish, for example, E4L brought together the Indian and Bangladeshi research teams to discuss a common methodology at an initial meeting. Subsequently, the teams conducted research on both sides of the border into river ecology. As well as fieldwork, face-to-face meetings were conducted. Multiple discussions were held regarding subsequent research findings. This constant communication allowed findings to be synthesized in a single report. Policy-makers from the region were presented with a 'joint vision and understanding' of the *hilsa* fish in 2012. The final report was published in 2014 and gained traction among academics, practitioners and civil society in both countries.[21]

[21] Ahsan, D. A., Naser, M. N., Bhaumik, U., Hazra, S. and Bhattacharya, S. B. (2014), *Migration, spawning patterns and conservation of Hilsa Shad* (Tenualosa ilisha) *in Bangladesh and India*, New Delhi: Academic Foundation, http://cmsdata.iucn.org/downloads/iucn_hilsa_study.pdf (accessed 10 May 2016).

A direct impact of the joint study was reflected in the West Bengal government issuing a notification for *hilsa* conservation in 2013.[22] This was informed by the policies of Bangladesh, which in the early 2000s had taken stringent steps to ban fishing during the breeding season and had created protection zones (sanctuaries) to conserve the fish. The West Bengal state government adopted the same approach, and its notification set out the instruments to be used during the breeding season in the service of conservation efforts. According to a PAC member, the prompt government response was commendable and justified E4L's collaborative approach.

Awareness-raising

Initial outreach meetings were held under the Chatham House Rule, preventing attribution.[23] This, along with language barriers and lack of understanding of technical aspects/research, hindered engagement with the media. Following the first PAC meeting it was decided to simplify research outputs to facilitate wider engagement. As a result, the team provided targeted media persons with resource packs containing key information and research findings, written in accessible language. Training sessions were also held for members of the media to enhance their involvement in the research process and to provide them with a better understanding of the subject. Targeted media engagement was seen as a critical factor for success.

In addition, E4L used modern communication tools and technology to produce knowledge products and disseminate them to a wider audience. A video entitled 'Hilsa and the lives in between' was produced using the findings from the joint study. The film was released during the 7th CMS Vatavaran Environment and Wildlife Film Festival and Forum in New Delhi. It depicted challenges associated with *hilsa*, livelihoods, policies and practices. The use of a content-management platform to channel research findings brought further attention to the subject and to the E4L project.

In addition, E4L collaborated with the Earthcare Outreach Trust to conduct a training session on basic film-making and self-reflection in Delhi in 2014 for young adults from India and Bangladesh.[24] According to an IUCN team member, 'The process was enriching, insightful and created future capacities for cross-learning.' IUCN's experience in creating similar participatory videos in Africa and South America also fed into its application of this approach in the Indian/Bangladeshi context.

Reputation for political neutrality

The lead role in the conceptualization and implementation of the E4L project was IUCN Bangladesh. IUCN's global reputation, political neutrality and experience in cross-border water management significantly helped the project gain traction in both India and Bangladesh.

IUCN was also instrumental in bringing together experts from both countries and building trust among participants. It provided a conducive and non-partisan environment for engagement and open dialogue to explore potential areas of cooperation. This process provided the impetus to break through initial resistance and to transform ideas into concrete actions.

[22] West Bengal Government – Notification: No.7I8 Fish/C-1/9R-3/2012 (parr-I) and No. 719 Fish/C-1/9R- 3/2012 (Part-I), both dated 4 April 2013, available at Dakshinbanga Matsyajibi Forum, 'West Bengal: six months' fishing ban & other restrictions for Hilsa conservation', 24 August 2014, http://dc.icsf.net/en/component/dcnews/articledetail/1295-West-Bengal--Si.html (accessed 10 May 2016).
[23] When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.
[24] International Union for Conservation of Nature (2014), 'Participatory video: learning beyond borders', 27 March 2014, http://www.iucn.org/news_homepage/news_by_date/?14701/Participatory-Video-Learning-beyond-borders (accessed 10 May 2016).

Besides supplying the project with trust and space, IUCN used its experience in cross-border water management to create a basic conceptual framework for E4L within which most of the project activities were undertaken. While this provided a structured approach, IUCN was flexible enough to enable more radical, innovative and practical ideas that helped meet the project's objectives.

This balance between structure and flexibility, along with the freedom provided for conceptualization of the project, was a key element to its success. For instance, Professor Imtiaz Ahmed from the University of Dhaka proposed the idea of training and sharing knowledge among young scholars from India and Bangladesh belonging to different fields of studies and professions. As a result, the event 'Water Futures: A Dialogue for Young Scholars and Professionals' was jointly organized by Jamia Milia Islamia university in India and the University of Dhaka with support from E4L in 2013.

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The success of the event led to a second round of dialogue ('Water Futures II') in 2014, which focused on cross-border water management. Although this did not directly involve policy-makers or government officials, their support was deemed necessary for it to succeed. Participation was also restricted by the timeline. 'None of the official rank officers could attend a two-week workshop without going through tedious approval processes,' mentioned a senior member of the project team.

In addition, IUCN's experience in conducting major conferences and dialogues, its informal networks and its involvement with well-connected individuals (able to facilitate visa clearances, for instance) helped in the implementation of the project. But given that the success of the process stemmed, in part, from its ad hoc nature, it is difficult to set out a prescriptive formula for dialogues of this type.

E4L aspired to promote understanding of the interconnectedness and sensitivity of ecosystems in the region by integrating discrete, yet related, themes. For instance, the joint research study on environmental security sought to link cross-border water management and environmental security.[25]

E4L applied the principles of the ecosystem approach in three ways. It utilized appropriate scientific methodologies encompassing different disciplines to study regional ecosystem services. It emphasized the fact that people form an integral component of ecosystems. And it highlighted the significance of the complex links between economics, institutions and natural resource use.

The Sundarbans and 'Mangroves for the Future'

Situation analysis of environmental security in the Ganga basin also explored the status of the Sundarbans, the world's largest area of mangrove forest. Mangrove forests are highly productive ecosystems. They are important in terms of socio-economic development, environmental vulnerability, disasters and climate change. Mangrove forests spread across different landscapes along the eastern, western and southern coasts of India. The eastern mangrove forests – the Sundarbans, found in West Bengal and adjacent areas of Bangladesh – are the richest and densest.

[25] Ghosh, N. and Khan, S. E. (2012), *Situation Analysis on Environmental Security*, Bangkok: International Union for Conservation of Nature, http://cmsdata.iucn.org/downloads/03envseca.pdf (accessed 10 May 2016).

The history and patterns of usage and conservation of mangroves suggest that they offer abundant potential for socio-economic development and building climate and disaster resilience. Furthermore, these are severely vulnerable areas. Unplanned and unilateral decisions on development, population displacement and climate change can irreversibly damage their ecosystems. In addition, mangroves are unique ecological zones that often extend across political boundaries. The conservation and optimization of ecological services, therefore, requires cross-border and even multilateral collaboration.

The Sundarbans were initially inhabited by a marginalized tribal population. However, population growth and consequent rising demand for resources led to increasing conversion of forests into agricultural lands and settlements. Within India various legal measures were introduced to protect forests. These included the 1980 Forest Conservation Act, the 1986 Environment Protection Act and the 1991 Coastal Regulation Zone Notification. In 1987 the Sundarbans were designated as a UNESCO World Heritage Site and a biosphere reserve, which gave the area special protection. India has also established the National Mangrove Committee (part of the Ministry of Environment and Forestry) and launched the Man and Biosphere Initiative to improve mangrove protection, especially in the Sundarbans.

This focus on conserving mangroves was strengthened after the 2004 Indian Ocean earthquake and tsunami, which highlighted the potential of these regions to absorb the impact from such phenomena. Increased international attention was demonstrated in 2006, when the former US president, Bill Clinton, in his capacity as the UN secretary-general's special envoy for tsunami recovery, launched the IUCN/UNDP 'Mangroves for the Future' (MFF) initiative. The initiative covered countries affected by the tsunami and aimed to strengthen ecosystems in coastal areas as well as to provide alternative livelihoods for local populations.

MFF grants funds to regional projects of all sizes in member countries, with the aim of improving the livelihood strategies of coastal communities, strengthening resilience, protecting ecosystems and enhancing natural resource management. MFF also conducts national and regional meetings and conferences, at which participants discuss ways to improve mangrove conservation and develop more effective implementation strategies.

This ongoing process has led to an acceptance of the benefits of joint research and potential policy alignment in at-risk shared ecosystems. In 2013, multi-stakeholder discussions were conducted in India and Bangladesh on the development of joint methodologies to determine environmental flows in the Sundarbans. The resulting study combined multiple disciplines to evaluate ecological, economic and institutional requirements, and highlighted gaps in existing knowledge and research.

In 2014, IUCN released its *Bangladesh Sundarban Delta Vision 2050*.[26] The organization's persistent research work and its role in strengthening knowledge on the Sundarbans in Bangladesh have gained the attention of state governments in India. In 2015, members of the national parliaments in Bangladesh and India agreed to establish a joint platform to preserve the Sundarbans.[27] Although direct causation is difficult to prove, this political response may have been related to IUCN's strategy for joint research and dissemination, and to its engagement with trusted ex-officials on both sides of the border.

[26] Hussain, M. Z. (2014), *Bangladesh Sundarban Delta Vision 2050: A first step in its formulation*, Dhaka: International Union for Conservation of Nature, https://portals.iucn.org/library/sites/library/files/documents/2014-065-doc.2.pdf (accessed 10 May 2016).
[27] Chowdhury (2015), 'India and Bangladesh agree joint initiative for Sundarbans'.

Lessons learned

The ecosystem approach is flexible and applicable at various scales. From the successful approaches used in South Asia, the following contributing factors can be identified:

- An advisory committee or board of members with relevant experience, expertise and contacts in government, academia and the media is needed to build a project's critical mass, and to set realistic goals. The existence of such a group facilitates participation across borders, and strengthens networks and channels of communication between different stakeholders.
- Selecting a topic of common interest for each country is critical to the success of cross-border ecosystem management projects. This requires a participatory decision-making process. The choice of an appropriate theme can build trust and facilitate the creation of a pilot project to demonstrate the benefits and potential of the broader ecosystem management approach.
- Joint research should be based on outcomes rather than on outputs. An action-oriented or applied research-based intervention, with the goal of achieving impact on the ground, should be undertaken. This reduces the gap between policy and practice, and provides impetus for government to formalize the joint research process in the long term.
- The production of knowledge during interactions, joint research and dialogues should be accompanied by a proper dissemination strategy. This must target audience groups and create media packages to deliver key messages to relevant stakeholders. Innovation is required to develop media platforms for continual interaction, and for sharing experiences and expertise on ecosystems.
- The platform for discussing, conceptualizing and implementing ecosystem projects should be flexible. It should be conducive to the development of innovative ideas, tools and techniques for assessing cross-border ecosystem management.
- A politically neutral facilitator can be useful for initiating ecosystem-based projects – for example, by providing financial support and technical expertise, and persuading stakeholders to overcome biases.
- Ecosystem-based projects might provide a means to overcome the controversies that often hinder joint management of cross-border rivers. They rely on a long-term approach to handling natural resources, which provides broader context and significance to efforts to manage water.
- Joint management efforts frequently falter because of concerns over sovereignty. A realistic approach should encourage dialogue, share best practice and aim for policy alignment.
- Governments could facilitate regional cooperation by streamlining visa clearances for the workers and consultants involved, and by easing the internal clearances that government officials require when facilitating cross-border dialogues.

4. Shared Learning

The countries of South Asia share similarities in history, culture, consumption patterns and institutional arrangements for water-resource management. This provides significant scope for mutual learning to enable better resource management.

There are also convergences on issues of water management, quality and quantity, biodiversity degradation and climate change. Competing demands for water from domestic consumers, industry and agriculture demonstrate the complexity of resource management and highlight regional commonalities. In addition, each country in the region faces some degree of water crisis. The potential scope for collective action to resolve water challenges is therefore very significant.

However, despite the logical basis for cooperation (on water and a range of other issues), South Asia is one of the least integrated regions of the world. Water-sharing is frequently conceived of in terms of river volumes – a zero-sum approach that reinforces trust deficits between countries. Cooperation over water is often stymied by mutual suspicion at the governmental level, with the result that, while promoting more joint research projects should be the aim, even basic data are shared reluctantly.[28]

Efforts to share information, collaborative studies, capacity-building and technology exchange are undertaken at the Track Two[29] level by NGOs, academic institutions and think-tanks. But translating the lessons they draw into policy and practice requires political willingness, ingenuity and leadership, as demonstrated by IUCN's Ecosystems for Life project. Shared learning offers a means of disseminating best practice and experience to facilitate policy alignment, while recognizing the difficulties of joint management discussed above.

Background

This section highlights some cases of successful shared learning in South Asia that have supported improvements in water management and conservation practices. These sit under three broad headings:

- *Data-sharing initiatives*, whereby knowledge platforms are established to ease access to data on water resources;
- *Dialogue platforms*, whereby technical, political and social understanding of resource management is shared between countries; and
- *Action research projects*, whereby projects that have benefited one country are replicated in another.

[28] Michel, D. and Pandya, A. (eds) (2009), *Troubled Waters: Climate Change, Hydropolitics and Transboundary Resources*, Washington, DC: The Henry L. Stimson Center, http://www.stimson.org/images/uploads/research-pdfs/Troubled_Waters-Chapter_2_Jaitly.pdf (accessed 10 May 2016).

[29] 'Track Two' diplomacy refers to a process between non-state actors, NGOs, professionals, academics and former policy-makers that aims to inform official dialogues, negotiations and discussions between countries.

Data-sharing initiatives

Sharing of data on cross-border rivers is contentious. The Ganga and Brahmaputra are categorized as 'classified' rivers in India, and for national security reasons data on their flows are not in the public domain. While much effort has been put into declassifying these data, improving transparency is a slow process. However, given the significance of data on discharge and flows, bilateral arrangements have been made between India, China, Bangladesh and Pakistan to share information through official channels. The interpretation and use of these data, nevertheless, is problematic. Information frequently does not reach at-risk communities in time (as seen above).

However, there is a clear shift in thinking towards allowing data-sharing on classified rivers. In 2008 India launched a web-based data and information project: 'Generation of Database and Implementation of Web Enabled Water Resources Information System in the Country' (WRIS). This is a joint venture of the Central Water Commission, the Ministry of Water Resources and the Indian Space Research Organization. The India-WRIS Web GIS[30] (geographic information systems) is intended to be a 'single window' solution. It provides comprehensive, authoritative and consistent data and information on India's water and related natural resources in a standardized national framework enabling use of the data for assessment, monitoring, planning and development. Despite the fact that these data are only for non-classified rivers, the portal is intended to eventually provide information on integrated water-resources management.

Several NGOs, such as The Third Pole, have created open-source databases of water-related data sets. The World Resources Institute has similarly compiled a series of data sets, including the India Water Tool, which are intended to help companies and other users to understand 'their water-related risks and prioritize actions toward sustainable water management'. The intergovernmental knowledge centre ICIMOD provides data on the Hindu Kush Himalayan region. Its Mountain GeoPortal provides information on geology, hydrology and glaciology for this region.[31]

The International Water Management Institute, with its South Asia centre in Sri Lanka, also publishes data series to inform decision-making for water management.[32] It releases global, regional and national knowledge products on a range of environment- and water-related topics: environmental flows, climate, floods, droughts, irrigation, glaciers and snow. While it has released multiple data sets on Nepal, Myanmar and other South Asian countries, it has not yet compiled comprehensive data on India and Pakistan.

While these data-sharing initiatives are growing, their impact on cross-border water management is difficult to assess. As with any other knowledge platform, the availability of comprehensive data sets on rivers improves technical understanding and facilitates modelling exercises that allow for better understanding of water-related issues across the region. These data-sharing portals have also increased the availability of innovative tools for risk assessment, water security and management to be used by experts across South Asia, and have removed the secrecy historically associated with water data.

[30] See India-WRIS, http://www.india-wris.nrsc.gov.in/ (accessed 10 May 2016).
[31] See International Centre for Integrated Mountain Development, 'Datasets', http://geoportal.icimod.org/Home/DataSets (accessed 10 May 2016).
[32] See International Water Management Institute, 'Water Data Portal', http://waterdata.iwmi.org/pages/Products.php (accessed 10 May 2016).

Dialogue platforms

Numerous NGOs, think-tanks and academic institutions have been involved in organizing Track Two dialogues among South Asian countries to share experiences and practices around water (see Appendix). Since 2000, these have gained importance in facilitating knowledge-sharing on water issues. Typically, the dialogues involve former diplomats and government officials, academics and members of the media, and solicit ideas across different disciplines and fields to find solutions to common challenges. While some initiatives are widely publicized, others are more private.

Some such dialogues have supported official negotiations – for example, discussions between the Centre for Policy Research in India and the Centre for Policy Dialogue in Bangladesh helped lay the groundwork for the 1996 Ganges Water Treaty. The synergy between India's foreign policy and Bangladesh's domestic politics was important. At the time, India was following the Gujral Doctrine of non-reciprocity in dealings with its smaller neighbours, and the relatively pro-Indian Awami League was in power in Bangladesh.

Dialogues have also forged relationships and facilitated knowledge production by bringing together experts from different countries to share ideas and conduct research. These have supported consensus-building on areas of common concern among riparian nations, and continue to be used to promote common understanding of risks and build momentum towards cooperation.

Shared learning is an essential component and objective of Track Two diplomacy. For instance, the annual Thimphu Seminars, conducted by the Ananta Aspen Centre in India and the Royal Institute of Governance and Strategic Studies in Bhutan, focus on hydro-development.[33] They aim to increase stakeholder interaction between India and Bhutan on issues such as hydropower, education, IT and skill-building, as well as supporting regional cooperation. The seminars place special significance on the exchange of knowledge between young professionals to build capacity and relationships for long-term cooperation.

The Centre for Dialogue and Reconciliation has been associated with India–Pakistan dialogues on various subjects including water. Moving towards a consensus between Indian and Pakistani stakeholders on issues related to resource scarcity and climate change is one of the primary objectives of this initiative, which seeks to build interaction beyond official levels and engage with wider communities in the two countries. Another Indo-Pakistani joint working group was gathered by the Stimson Center and the Observer Research Foundation to build mutual understanding among decision-makers of the two countries to resolve common challenges of water management in the Indus basin.

Similarly, the Blue Peace Initiative between India and Bangladesh, run by the India-based Strategic Foresight Group, aims to address relations between the two countries and advocates joint management of shared waters as an instrument of peace rather than conflict. Other think-tanks in the region are also deconstructing the securitization debate about water in order to facilitate cooperation. The Asia Foundation, the World Resources Institute, CUTS,[34] the Observer Research Foundation, the Centre for Policy Research and, more recently, the Institute of Defence and Analysis, among others, advocate the cooperation narrative in opposition to the 'neo-Malthusian' notion that resource scarcity will lead to conflict.

[33] See Centre for Escalation of Peace, 'Track II Dialogues', http://www.cepeace.org/track-ii-dialogues (accessed 10 May 2016).
[34] Consumer Unity and Trust Society.

A common feature of most of these dialogues is that they are bilateral. Perhaps due to the scale of operation involved and the contextual nature of the problem areas, the dialogues focus on the specifics of negotiations between two countries and the possibility of improving existing formal arrangements.

However, some efforts have been made, or are under way, to construct multilateral dialogues involving all riparian countries, or to engage with stakeholders in other basins to understand their approaches. One example was the Abu Dhabi Dialogue, a major consultative initiative involving Afghanistan, Bhutan, Bangladesh, China, India, Nepal and Pakistan, as well as international experts. It emerged as a means of addressing complex regional challenges through collective action.

The Abu Dhabi Dialogue meetings between 2006 and 2012 created an increased sense of responsibility, awareness and capacity to take informed decisions on areas of common concern with respect to water management. The iterative and inclusive dialogue platform mobilized attention towards the importance of collective action in managing shared rivers and in water-governance strategies in South Asia. In 2009 the South Asia Water Initiative took this understanding further and, supported by several countries and institutions, scaled up efforts to improve regional cooperation. There is clearly now greater interest in exploring opportunities for water cooperation on water-related issues such as livelihoods and economic development.

The Mekong-Ganga Dialogue, conducted by the Observer Research Foundation in collaboration with the Mekong Program on Water, Environment and Resilience, is another multilateral forum for discussion and shared learning. It is intended to build knowledge linkages with actors in the Mekong basin, where the challenges are similar to those in the Ganga basin but regional institutional cooperation has advanced much further. More than 100 policy-makers and experts have participated in the three annual conferences held between the Ganga and Mekong countries since 2012, focusing on the nexus between water, food and energy.

There are also several official dialogues among South Asian countries on water security, climate change, food security and ecological conservation, mainly under the broader banner of SAARC. Given the scale of cooperation and geographical variance, further bifurcation within the regional grouping has given way to other sub-regional initiatives such as BIMSTEC,[35] BCIM[36] and BBIN,[37] which discuss water/energy cooperation more inclusively and are considered to be more effective.

The information-sharing dialogues and regional and sub-regional initiatives have convened experts from different disciplines and fields, but their impact is less clear cut. They generally aim to inform policy-making and facilitate better-informed decision-making. Learning from ground-level practices and experiences has great potential in South Asia and represents a different type of shared learning. Projects adopting this approach can include capacity-building among a broader set of stakeholders – indirectly influencing ground-level practices and creating a community based on shared knowledge.

[35] The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, comprising Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan and Nepal.
[36] The Bangladesh–China–India–Myanmar Forum for Regional Cooperation.
[37] The Bangladesh, Bhutan, India, Nepal Initiative.

Action research projects

Action research projects are typically innovative practices developed on the ground to improve water management, conservation and sustainability. Within the countries of South Asia, there is frequently a lack of awareness of successful case studies. Showcasing innovative approaches in neighbouring countries is relatively rare.

Several successful processes have been adopted or showcased by, for instance, the World Bank or the Asian Development Bank. One is the Orangi Pilot Project (launched in 1980), which offered innovative solutions for sewerage and sanitation that have formed the template for an approach adopted in different cities. The project demonstrated that communities have the ability to fund and run facilities such as sewerage, provided that government complements local work with larger infrastructure. The process was not a prescriptive one; instead it focused on engaging with communities and ensuring that they had ownership of decision-making.

Another example is the Karachi Water Partnership (KWP), one of the most effective instances of collective action between stakeholders to produce knowledge and improve efficiency and accountability in water management. Launched in 2007, the KWP was a response to deteriorating water quality and sanitation and to the absence of wastewater treatment and conservation strategies in Karachi. With the intention of providing safe and sufficient water to residents, the Hisaar Foundation, an NGO working on water, food and livelihood issues, adopted the concept of a city-based water partnership. Consequently, different water-related institutions, civil society actors, the private sector, the media, water professionals and citizens (including women) entered into a partnership to manage the city's water resources sustainably. The project also employed innovative models of cost synergy and mutual accountability.

The project demonstrated that communities have the ability to fund and run facilities such as sewerage, provided that government complements local work with larger infrastructure. The process was not a prescriptive one; instead it focused on engaging with communities and ensuring that they had ownership of decision-making.

Cost synergies were intended to reduce the financial burden for any one institution. This allowed stakeholders with different financial capacities to become involved in the project. Mutual accountability was imperative to sustain progress on providing safe drinking water and creating a sense of responsibility among users and service providers. The project targeted long-term behavioural change in relation to water management. These ideas were cultivated and implemented over a period of time through conferences, stakeholder dialogues, training workshops and awareness campaigns.

Several interesting lessons can be drawn from the project. It brought together individuals and institutions with a genuine stake in managing water resources, and gave equal importance to direct and indirect beneficiaries and users. The intensive consultative processes guaranteed consensus and accountability in order to implement ideas smoothly and effectively. The involvement of city institutions and government agencies ensured further sustainability and had the potential to reform obsolete and redundant institutional structures. The innovative economic models gained private-sector support and strengthened project design.

The KWP approach has the potential to be replicated elsewhere in fast-urbanizing South Asia, where cities face similar pressures of balancing water scarcity with rising demand. However, so far experience-sharing from the project has been limited to dialogues and discussions rather than on-the-ground replication.

Sikkim Springs

Sikkim, a state in northeastern India, borders Bhutan, China and Nepal. It is heavily dependent on water from springs to meet rural drinking-water and agricultural needs. Nearly 65,000 of the 80,000 rural households in the state depend on springs as a source of drinking water.[38] However, the impacts from population growth, grazing and trampling by livestock, erosion of topsoil, erratic rainfall patterns, deforestation, forest fires, and development activities such as road and house construction have degraded the springs. This has been exacerbated by urbanization, which has meant that many of those who used to be responsible for maintaining springs in rural areas no longer live there.

The impact of this degradation, especially in the southern and most drought-prone parts of the state, has became more pronounced over the years. The state government, following consultation with farmers, realized the intensity of the problem and its impact on livelihoods, sanitation and hygiene, health and other developmental factors. The lack of documentation on the springs magnified the challenge of finding a solution.

The state government, in collaboration with WWF-India and the Dehradun-based People's Science Institute (PSI), commissioned a scientific study to investigate recharge patterns and the scale and level of spring degradation in Sikkim. PSI had experience in renovating springs in two other mountainous states, Himachal Pradesh and Uttarakhand. Vulnerability assessments were conducted in southern and western districts of Sikkim. Based on these, it was understood that the challenge was to increase discharge from the springs.

WWF-India attempted to raise $1.8 million for an 18–20-month project to restore the springs. But by working with the government of Sikkim, the cost of the project was lowered to $180,000. Through the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA),[39] the state government provided labour for the project to enable spring-sheds to be developed in Sikkim. With the state government's involvement, the spring-shed development initiative became known as Dhara Vikas ('Development of the flow of the springs').

In 2010, with support from the MNREGA, pilot projects to recharge the springs began to build trenches and ponds above the recharge areas. These were conducted on private land and targeted 10–15 hectares of recharge areas. Landowners and villages upstream were encouraged to participate through the offer of seeds for planting oranges. The pilot projects drew on principles of geohydrology and watershed management. A system was developed to allow the rehabilitation of 50 springs and four lakes, mainly in drought-prone areas.

Scientific studies by PSI were supplemented by traditional knowledge and understanding of the local population, fed in by WWF's local team. Planning for spring-shed development was more practical and effective as a result of triangulating the data and information from models and groundwork. The

[38] Tambe, S., Arrawatia, M. L., Kumar, R., Bharti, H. and Shrestha, P. (2009), *Conceptualizing strategies to enhance rural water security in Sikkim, Eastern Himalaya, India*.
[39] MNREGA is a central government initiative that provides at least 100 days of paid employment each year for unskilled manual workers.

balance between traditional knowledge, pure science and existing policies was one positive aspect of the project.

In 2011, after a major earthquake, the location of the spring recharge areas changed. This created an additional challenge for the project – new trenches had to be built and additional financial and administrative support was needed. A different approach was adopted, in which 100–150 hectares in the upper reaches of the forests were used for spring recharge. This reduced the cost of incentives and implementation, and was more sustainable. In 2012, with the help of Babha Atomic Research Centres, environmental isotopes were used to identify the flow and recharge areas. As a result of the 'landscape approach', more than 100,000 million litres of groundwater were recharged per year, including 20 per cent more recharge during the dry season. Along with the spring recharge, storage infrastructure was built to achieve water security.

Despite the earlier work of WWF-India in the region on lake and biodiversity conservation, building trust among upstream communities was challenging. Downstream users directly benefited from the project, and took less time to understand and support its implementation. Upstream communities were more sceptical. Constant communication and multiple discussions were required to convince upstream users of the benefits of soil restoration and spring-shed development. The project managers from WWF-India explained the links between their activities and the downstream impact to help sensitize the upstream communities. The converging point among both communities was the religious significance of the springs and cultural values. Further trust was built by explaining the additional livelihood-generation opportunities to upstream users. As a result, both communities went beyond their expected responsibilities and areas of work to contribute to the project's success.

Capacity-building and training programmes were conducted by ACWADAM,[40] PSI and WWF under the initiative to build the skills of young professionals in the field of hydrology, hydro-geology and other relevant fields. This ensured the project continued even after WWF ended its support.

Cross-learning efforts

Springs are an important source of water in areas with similar topographies, many of which share the same challenges of spring depletion as Sikkim. WWF teams from Nepal, Bhutan, India's Arunachal Pradesh state and elsewhere have visited Sikkim to learn about the spring revival initiative so that they can implement similar programmes.

The UNDP supports several community-based organizations in protecting and sustainably managing water sources in Bhutan, through the Global Environment Facility (GEF) Small Grants Program. These organizations expressed interest in learning from the spring-shed development experience in Sikkim. In 2014 14 participants, including representatives from the GEF-Small Grants Program, community-based organizations, and agriculture and forest extension officers, visited Sikkim. Besides the field visits, the group attended a one-day workshop on 'Experience Sharing on Reviving [the] Himalayan Springs', with broader participation with officials from Nagaland and Meghalaya. Lessons were later integrated into ongoing projects on protection and management of community water resources. Three knowledge-sharing workshops were organized, and pilot initiatives at two sites have been initiated.

[40] The Advanced Center for Water Resouces Development and Management.

Lessons learned

- Dynamic political leadership is vital to the success of shared-learning approaches. While this is not easily replicable, it highlights the need to build capacity among local leaders and to develop a comprehensive strategy to convince them of the benefits of shared learning. It also implies the need to publicize successes as a means of building public demand for the introduction of best practices.
- A balance between traditional knowledge and pure science must be carefully sought to ensure the effectiveness of a project's design and sustainability.
- Use of existing institutions, policies and programmes – and the exploitation of synergies with a project's design – can play a role in ensuring the sustainability of a project in the long term and gaining government support.
- Different developmental needs, income-growth strategies and infrastructure plans must be balanced with environmental conservation efforts so as to improve project outcomes.
- Publicizing project outcomes through live media platforms and other forms of communication can allow other regions facing similar challenges to access the knowledge and experience generated.

5. Hydropower and Regional Power Trading

Despite its abundant hydropower potential, South Asia struggles with energy shortages. None of the region's countries provides all of its population with guaranteed supplies of electricity. South Asia's total hydropower potential is estimated to be around 300 GW,[41] of which only a fraction has been exploited. This potential, like energy demand, varies between countries. Energy requirements in India, Pakistan and Bangladesh exceed their economically viable hydropower potential. Conversely, the hydropower potential in Nepal and Bhutan is such that – if it were more fully exploited – both countries would have power surpluses after meeting domestic energy demand.

Cross-border hydropower, among other energy trading possibilities, therefore offers a partial solution to energy shortages in South Asia. Achieving energy security is just one of the reasons why the region's countries must cooperate to harness their hydropower potential. Cooperation could also provide economic benefits and allow for more amicable relationships in the region. It could even facilitate integrated planning for sustainable water-resource management.

However, instances of cross-border hydropower cooperation are rare in South Asia. Examples differ in their context and success. While hydropower has been a contentious issue between Pakistan and India, the latter has agreements with Nepal and Bhutan to develop joint projects. The case of India and Bhutan is the most significant example. Bhutan exports power to India for most of the year, and imports power from India between January and March. This section looks at the motivations, feasibility, process and replicability of the two countries' power trading as a guide to the possibilities for wider cross-border hydropower cooperation in South Asia.

The development of hydropower in Bhutan is the most clear-cut example of bilateral cooperation over water resources providing mutual benefits. While the specific political relationship between the two countries cannot be replicated elsewhere in the region, the processes by which Bhutan developed its hydropower are pertinent to other countries, such as Nepal. At the same time, the benefits that have accrued to Bhutan from exporting power and to India from meeting its energy demands, especially during the peak summer months, demonstrate the outcome of cooperation over water resources.

Energy interdependency stems from and contributes to the positive relationship between India and Bhutan. India continues to be the largest power trade and development partner of Bhutan. Bhutan planned its hydropower development as an important aspect of its economic and social growth agenda. Consequently, its export earnings from hydropower increased and, through coordinated policy-making, its per capita GDP increased fivefold between 1992 and 2013.[42]

[41] Trembath, A. (2015), 'Assessing Demand and Opportunities in Asia: The 2015 World Hydropower Congress', http://www.hydroworld.com/articles/print/volume-23/issue-2/features/assessing-demand-and-opportunities-in-asia-the-2015-world-hydropower-congress.html (accessed 10 Mar. 2016).
[42] World Bank (2014), 'Bhutan: Country Snapshot', http://www.worldbank.org/content/dam/Worldbank/document/SAR/bhutan-country-snapshot-spring-2014.pdf (accessed 10 May 2016).

Background

South Asia's hydropower potential is largely untapped, and cross-border power trading is in its nascent stages. India offers a huge energy market for neighbouring countries. It is energy-poor, with an average energy deficit of 3–4 per cent a year and massive unmet demand.[43] As mentioned, only a fraction of the region's total generation potential of around 300 GW has been realized. Moreover, for environmental reasons not all of this potential is likely to be realizable.[44]

Table 3: Hydropower potential and capacity in South Asia

Country	Hydropower potential (GW)	Installed capacity (GW)
India	150.0	29.5
Bhutan	30.0	1.5
Nepal	42.0	0.6
Bangladesh	0.3	0.2
Pakistan	45.0	6.5
Afghanistan	25.0	0.3

Source: SAARC Secretariat (2010), *SAARC Regional Energy Trade Study (SRETS)*, Kathmandu: SAARC Secretariat, http://www.sasec.asia/uploads/publications/srets_a.pdf (accessed 21 Jun. 2016).

Nepal has huge potential for hydropower development. Only 600 MW has been developed out of potential capacity of 42 GW.[45] India is the obvious potential market for Nepal's hydropower.[46] Water cooperation between the two countries dates back to the 1920s, when plans for the Sharda barrage and the Koshi and Gandak hydroprojects were first mooted. India provided assistance for some of the early hydropower projects implemented in Nepal, such as the Kataiya power house and the Trishuli, Devighat and Phewa hydropower projects.

India has offered grant-aid programmes to facilitate the development of multipurpose hydropower projects in border areas in Nepal. It has also assisted in joint technical studies, and promoted development both by the private sector and through public–private partnerships. However, for political and technical reasons they have not been accompanied by the active development of hydropower projects in Nepal. For instance, the 5.6 GW Pancheswar project is a multipurpose dam for irrigation, hydropower, storage and recreation, which would be economically beneficial for both countries.[47] It was delayed by protests from environmental groups, anti-dam activists and Maoists in Nepal, as well as by concerns that not enough emphasis had been placed on meeting Nepal's domestic electricity requirements. There is a widespread tendency in Nepal to blame India (and perceived 'unfair' agreements) for energy shortages. In contrast, in India delayed projects are generally blamed on political instability in Nepal and delays in environmental approvals.

[43] Ministry of Power (2015), 'Executive Summary of the Power Sector', Central Electricity Authority, Government of India, http://cea.nic.in/reports/monthly/executivesummary/2015/exe_summary-03.pdf (accessed 3 Dec. 2015).
[44] World Hydropower Congress (2015), 'World Hydropower Congress Programme: 2015 Handbook', Beijing, https://www.hydropower.org/sites/default/files/2015%20World%20Hydropower%20Congress%20Handbook.pdf (accessed 2 Jan. 2016).
[45] Srivastava, L. and Misra, N. (2007), 'Promoting regional energy co-operation in South Asia', *Energy Policy*, *35*(6), pp. 3360–3368.
[46] South Asia Regional Initiative for Energy Cooperation and Development (2005), *Hydropower in South Asia—Potential Resource for Energy Exports,* http://www.sari-energy.org/successdocs/IStudy_SouthAsianHydroResources.pdf. (accessed 23 Jul. 2015).
[47] Upadhyay, K. (2014), 'Environmentalists oppose Pancheswar dam', *The Hindu*, 25 August 2014, http://www.thehindu.com/news/national/environmentalists-oppose-pancheshwar-dam/article6347305.ece (accessed 23 Jul. 2015).

India has helped to construct several major hydropower projects in Bhutan, which in turn exports to India the power produced. So far Bhutan has identified and assessed as technically feasible some 23.76 GW out of an estimated potential of 30 GW. Total installed capacity is currently 1.488 GW.[48] This is generated by four large hydropower projects. A further four large projects are in various stages of construction. Twenty-four smaller projects jointly generate around 4 MW. Hydropower is Bhutan's largest source of export revenue and has contributed much to the economic growth and development of the country. Despite being the smallest country in South Asia, it has seen its GDP per capita triple since 2000, reaching $2,611 in 2014, the highest in continental South Asia.[49]

Regional power trading

Hydropower cooperation cannot be divorced from broader power-trading arrangements among South Asian countries. No regional agreement exists on inter-grid connectivity or energy trading, despite attempts by SAARC to establish such a framework. The creation of an effective power-trading regime would have the potential to foster greater hydropower cooperation in the region, by providing the necessary infrastructure to meet energy demand.

In 1971, India and Nepal signed an agreement which led to the development of 12 interconnections between Nepal and the Indian states of Bihar and Uttar Pradesh. In 2014, the two countries signed a benchmark agreement allowing greater grid interconnectivity.

Power trading between India and Bangladesh is a recent phenomenon. Bangladesh imports power from India to reduce its dependency on gas resources. Official bilateral cooperation was established between the two countries in 2010 in the areas of power generation, transmission and energy efficiency. Consequently, steering committees and working groups were established to pursue these objectives. Currently India supplies 500 MW of power to meet Bangladesh's base load power requirements, via a 400-kilovolt transmission grid between Baharampur in India and Bheramara in Bangladesh.[50] Connectivity is still regarded as a major stumbling block for smooth power trading between the two countries. Steps are being taken to increase the power supplied through the grid to 1,000 MW.[51]

Agreement has been reached on CASA-1000 – a project linking Afghanistan, Pakistan, Kyrgyzstan and Tajikistan.[52] The Central Asian countries generate surplus hydroelectricity during the summer, when Afghanistan and Pakistan suffer chronic power shortages. The project involves the construction of a grid linking the four countries to allow the hydroelectricity to be exported. A similar arrangement between India, Nepal, Bhutan and Bangladesh would offer huge potential to increase energy security. Cooperation between India and Bhutan could provide a basis for such broader multilateral cooperation.

[48] International Rivers (2015), 'Status of hydropower dams in Bhutan', https://www.internationalrivers.org/resources/8703 (accessed 7 Jul. 2015).
[49] National Statistics Bureau (2016), 'Key indicators', Royal Government of Bhutan, http://www.nsb.gov.bt/nsbweb/main/main.php#&slider1=4 (accessed 7 Jul. 2015).
[50] Wijayatunga, P., Chattopadhyay, D. and Fernando, P. N. (2015), *Cross-Border Power Trading in South Asia: A Techno Economic Rationale*, ADB South Asia Working Paper Series.
[51] Asian Development Bank (2015), 'ADB to Help Scale Up India-Bangladesh Cross-Border Power Exchanges', news release, 1 October 2015, http://www.adb.org/news/adb-help-scale-india-bangladesh-cross-border-power-exchanges (accessed 3 Dec. 2015).
[52] Laruelle, M., Peyrouse, S. and Axyonova, V. (2013), *The Afghanistan-Central Asia relationship: What role for the EU?*, Brussels: EUCAM/FRIDE.

The development of Bhutan's hydropower

The political relationship between India and Bhutan was a key factor enabling the development of hydropower in the latter. Cordial relations date back to the colonial era. Following India's independence, mutual trust was strengthened, as was India's political and military support for Bhutan. The possibility of a threat from China further united the two countries and 'continued the British legacy of treating the Himalayas as the sentinel of India's security'.[53]

In 2007, the 1949 Treaty of Friendship between India and Bhutan was reassessed and Article 2 of the treaty, which had obliged Bhutan to be guided by the advice of India, was dropped. In the revised treaty the new article states that 'both countries shall cooperate closely with each other on issues relating to their national interest. Neither Government shall allow the use of its territory for activities harmful to the national security and interest of the other'. The revised treaty recognizes Bhutan's and India's 'sovereignty and territorial integrity', which previous treaties did not. From an Indian perspective, Bhutan offered a stable political system and a positive investment environment. While it has recently transitioned from monarchy to democracy, Bhutan has remained stable, certainly in contrast to India's other neighbours.

Bhutan crafted its development plan strategically, focusing on infrastructure development. This, in turn, helped Bhutan to exploit its hydropower potential. Revenues from hydropower exports were eventually diverted to other sectors such as health and education, and to electrification. India provided substantial support to Bhutan, though this support has gradually declined in percentage terms as Bhutan has been able to use its own resources. This increasing self-reliance can be linked to the development of hydropower.

Bhutan's first hydropower plant was commissioned in 1967 to supply electricity to the capital, Thimphu. Subsequently five more plants were built to supply power to district headquarters.[54] Discussions with India about hydropower development began in the early 1970s, and the agreement for the Chhukha project was signed in 1974. In parallel, Bhutan focused on developing other parts of its economy: agriculture, services, mining and manufacturing. Work on the Chhukha project did not start until the late 1980s, when construction activity caused real GDP growth to increase rapidly. In 1986–87, GDP grew by 18 per cent, and it averaged 8 per cent a year in the 1980s.[55]

India fully funded the Chhukha project with a 60 per cent grant and 40 per cent loan, the latter repayable over 15 years.[56] Subsequently, funding shifted to a 70:30 debt-to-equity model. India also provided technical expertise and administrative support through organizations that included the Central Water Commission, the Central Water and Power Research Station, the Central Soil and Materials Research Station, and the Geological Survey of India.

Successful institutional working arrangements ensured the project was completed on time. It was inaugurated in 1988. High-level political engagement in both countries was seen to endorse further cooperation. The fact that the project was deemed a success created a demonstration effect that facilitated further projects.

[53] Ghosh, S. (2014), 'Understanding India-Bhutan relations', OneIndia, 18 June 2014, http://www.oneindia.com/feature/understanding-india-bhutan-relations-1467521.html (accessed 10 May 2016).
[54] Tshering, S. and Tamang, B. (undated), *Hydropower – key to sustainable, socio-economic development of Bhutan*, http://www.un.org/esa/sustdev/sdissues/energy/op/hydro_tsheringbhutan.pdf (accessed10 May 2016).
[55] Dhakal, D. N. S. and Jenkins, G. P. (1991), *International Trade in Energy: The Chukha Hydroelectric Project in Bhutan*, Harvard Institute for International Development.
[56] For more information, see Druk Green 'Chhukha Hydropower Plant', http://www.drukgreen.bt/index.php/chp-menu/about-chp (accessed 10 May 2016).

The next project was the much larger Tala project, downstream from Chhukha and with a capacity of 1,020 MW. Unlike Chhukha, Tala included a storage reservoir. The commissioning of the final units did not happen until 2007. In turn, Tala was followed by the Kurichhu and Basochhu projects. As these became operational, hydropower became the country's main export.

Effective Bhutanese institutions were established to facilitate hydropower development. The Chhukha Hydel Project Authority was formed in 1975 to oversee the construction and commissioning of the project, and to ensure that the project was completed on schedule. Because Bhutan had never constructed a project on this scale, the first few years focused on infrastructure development for the construction – roads, schools, hospitals and housing. The first unit of the project was commissioned seven years after it started, and was completed within a further two years.

As the hydropower sector developed, institutional arrangements evolved. The energy sector was restructured following the passing of the Bhutan Electricity Act in 2001. The Bhutan Electricity Authority, set up in 2001 following the act, is responsible for licensing, setting tariffs and monitoring. Overarching strategy is the responsibility of the Ministry of Economic Affairs. Clearly laid-out responsibilities have been crucial in hydropower development. The Bhutan Power Corporation was set up in 2002. It has responsibility for transmission (to India and within Bhutan) and distribution. In 2008 Druk Green Power Corporation (DGPC) was established through an amalgamation of the Chhukha, Kurichhu and Basochhu hydropower corporations.

DGPC provided 15 per cent of the electricity from hydropower plants to the government in the form of a royalty, and it cross-subsidized electricity for local consumers by exporting power to power-deficit states in northern and northeastern India. Bhutan's competitive advantage allowed it to set comparatively low tariffs. Successful power trading with India contributed to a reduction in dependence on external aid, and produced surpluses for investment in social and industrial development.

India has assisted Bhutan in building almost 96 per cent of the country's current hydropower capacity. Electricity production now provides around one-fifth of Bhutan's GDP. In 2011, India bought more than 5.4 billion kWh of power from Bhutan, meeting roughly 1 per cent of its electricity needs. While this is small, Bhutan's hydropower has helped India meet its peak-power needs. For instance, during a major blackout in July 2015 (when the Northern Grid failed), Bhutan was approached to release additional power from its hydroelectric plants. Meeting such demand instantly enabled the grid collapse to be repaired. Thus, despite the fact that Bhutan only has one-fifth of India's hydropower potential, it offers a crucial support system for India's energy security.

The majority of Bhutan's hydropower plants (either operational or under construction) are run-of-the-river in nature, which makes them comparatively benign environmentally. The upcoming hydropower plants have even incorporated climate mitigation, risk reduction and ecological conservation in their designs. For instance, the Kurichhu Hydropower Plant, a 60-MW run-of-the-river project, features a 'fish ladder' for uninterrupted migration of fish. Population displacement was limited because of the low population density in the area.

The 2008 Sustainable Hydropower Development Policy and the 2013 Alternative Renewable Energy Policy ensured adequate planning infrastructure for hydropower projects so as to reduce the negative environmental impacts and allow maximum benefits to the population. These institutional and legal arrangements have facilitated further development of the sector in Bhutan.

Hydropower projects have demonstrated the strong linkage effects of investment, causing simultaneous growth in manufacturing, trade and other sectors.[57] Hydropower has contributed as much as 20 per cent of Bhutan's GDP in some years, allowing for economic and social development. The rural population now has increased access to health services, reduced incidents of diseases and lower child mortality. There has been an increase in the number of high-quality regional hospitals with specialized healthcare programmes. Improved vocational centres and educational institutes are contributing to an increase in the number of highly skilled workers and are supporting improvements in quality of life. Improved roads and transport infrastructure have also enhanced accessibility and overall development.

While the development of hydropower has boosted GDP, there have been two additional benefits for Bhutan. First, rather than relying on donors for development projects, Bhutan has much greater capacity to set its own development agenda. This freedom has enabled innovative thinking – the development of the notion of 'gross national happiness', for instance. And this local ownership of development has been accompanied by significant improvement in social indices.

Second, hydropower development has facilitated a significant increase in access to electricity for the population. As one study puts it:

> Socio-economic impact study of rural electrification projects has shown that the electricity lighting has particularly improved the quality of lives of students, housewives (women) and the rural households and improved conditions in the quality of services of basic health units as well as other services like telephones. Once electricity service is made available to a rural home, it enhances their rural income activities. They find more productive time under better light. Rice cookers and water boilers have become very handy for mothers in the kitchen and overall exposure to health hazards from smoke created by fuel wood has been reduced. The quality of social life has also greatly improved once electricity is made available.[58]

According to the government's 2020 Vision Document, hydropower will remain an integral part of Bhutan's development. However, the deadlines for these projects are being scaled back.

Table 4: Forthcoming hydropower projects in Bhutan

Name of project	Tentative installed capacity (MW)	Status
Punatsangchhu	1,200	Under construction
Punatsangchhu-II	1,020	
Mangdechhu	720	
Wangchhu	570	Construction approved
Kholongchhu	600	
Bunakha	180	
Chamkarchhu	770	
Sunkosh	2,560	Detailed project reports being prepared
Amochhu	540	
Kuri Gongri	2,640	
Total	**10,800**	

Sources: Ministry of External Affairs (2014), 'Inter-Governmental Agreement between Bhutan and India on development of Joint Venture Hydropower Projects', press briefing, 22 April 2014, http://www.mea.gov.in/press-releases.htm?dtl/23230/InterGovernmental+Agreement+between+Bhutan+and+India+on+development+of+Joint+Venture+Hydropower+Projects (accessed 10 Dec. 2015); International Rivers (2015), 'Status of hydropower dams in Bhutan', https://www.internationalrivers.org/resources/8703 (accessed 10 Dec. 2015).

[57] Ministry of Economic Affairs, Bhutan (2006), *Investment Opportunity Study – 2006*, Thimphu: Ministry of Economic Affairs, http://www.moea.gov.bt/documents/files/pub10qb8368ff.pdf (accessed 10 May 2015).
[58] Tshering and Tamang (undated), *Hydropower – key to sustainable, socio-economic development of Bhutan*.

In 2009, India and Bhutan signed a protocol to develop 10,000 MW of hydropower, wherein the surplus electricity will be exported to India. Out of the 10 mega projects, three are already under construction, another four were approved for construction in 2014 during Prime Minister Narendra Modi's visit to Bhutan, and the remaining three are under different stages of evaluation. Modi also assured continued cooperation between the two countries to make the idea of B2B – 'Bharat to Bhutan' – real and effective.

Lessons learned

- Competitive advantage is critical in setting tariffs and building an effective revenue model. For instance, Bhutan's tariffs were set so as to provide competitive advantage over other South Asian countries and to ensure a continued market. Strong policy signals and agreements might be required to reduce investment risks.
- Given the cross-border nature of the resource, strategic alliances between countries will play an important role in facilitating hydropower cooperation. Increased interaction across borders, dialogues, discussions on benefit-sharing models and demonstration of a successful project will be important for convincing political leaders and building consensus to support cooperation.
- Exporting electricity is feasible even when domestic needs are not fully met, provided that increased domestic coverage is developed in tandem with exports.
- Cross-subsidization or rationalization of tariffs and revenue generated from hydropower must be planned to have high spin-off effects to boost other critical sectors of the economy and to provide indirect benefits – such as infrastructure development, healthcare, education, skill development and rural electrification.
- Hydropower development in Bhutan has not involved significant displacement of populations. Moreover, public support has been ensured by the fact that the revenue generated from hydropower has been used to provide social and economic benefits. In addition, local populations have often benefited from infrastructure development prior to the development of hydropower.
- Hydropower cooperation must also focus on local technical capacity, job creation and human resource development. Building the capacity of local professionals to study, construct, operate and maintain hydropower projects is important.
- The roles and responsibilities of existing and new institutions involved should be clearly laid out and well defined, removing any overlaps in their jurisdictions. Their capacities should be enhanced and strengthened to deal with risks and shocks, and they should be able to resist political pressures.
- Cooperative arrangements covering hydropower must be strongly supported by policies that emphasize sustainable development and socio-economic growth. A balanced approach towards economic growth, social development and environmental conservation is vital in sustaining the growth and success of hydropower development.

6. Recommendations

The case studies explored in this paper reflect different approaches to the issue of cross-border cooperation. This in turn reflects variations in the size of operations, as well as divergent political, social and economic contexts. None the less, some general recommendations emerge from the approaches detailed in this paper:

- **Successful cross-border projects require champions.** Most of the successful projects needed stakeholders to be convinced of the benefits before they were willing to engage with the process. Frequently, a key individual pushed through the idea of introducing change rather than continuing the status quo. For instance, the renovation of Sikkim Springs used labour provided through the Mahatma Gandhi National Rural Employment Guarantee Act. Attempts to facilitate similar models in other areas failed because of a lack of similarly committed local officials. Successful ecosystem projects rely on the space provided by individuals who are politically well connected and personally committed. However, this implies that what is successful in one area may not necessarily be replicable in another, given different political and governance situations.
- **Government engagement should be sought at an early stage in any project.** Successful cross-border projects generally engaged with government from the conception stage. In several other instances officials were engaged at a later stage, making them sceptical or suspicious of the motivations of those advocating the projects. This often undermined the projects.
- **The appropriate level of official engagement is likely to vary according to the project.** In the case of providing early-warning systems for floods, the project team engaged with local district officials who were already known to it. In the case of cross-border ecosystems, the project was enabled by the fact that many senior central government officials and diplomats were engaged in various capacities. In other cases, courts or parliamentarians may be the relevant state interlocutors.
- **NGOs should seek to capitalize on prior relationships with government officials.** NGOs should be able to provide officials with a synthesis of their proposal and the likely outcomes. If there are likely economic benefits, these should be emphasized.
- **Consultation with communities, critical to ensuring project support, needs to be focused.** Successful projects working at community level are time-intensive. Organizations should focus on a limited number of communities in the first instance rather than spread their resources thinly. In some communities there is widespread scepticism about the motivation of outsiders. In one instance, initial support for a flood early-warning system was gained by employing a person from a target village. Neighbouring villages subsequently became more interested in the project after witnessing the success of the project during the monsoon season.
- **Sensitivities over cross-border water issues remain a challenge for cooperation.** To reduce sensitivities, it is important for project advocates and planners to adopt a transparent approach. Those initiatives that sought to develop solutions internally were less successful than those that developed solutions in coordination with all relevant stakeholders, whether through formal or informal approaches.

- **Questions should be framed appropriately.** Organizations should focus on outcomes, rather than outputs or even water. Framing projects as being about water is likely to raise concern. Focusing on the uses or benefits of water-related projects is more likely to result in proposals gaining traction, particularly among government constituencies.
- **Data access and analysis need to improve.** While there are concerns over data secrecy, a substantial pool of data is available from governmental and non-governmental sources. On the government side, there is a reluctance to utilize data from non-official sources. And overall, there is a lack of capacity to interpret the data in a timely and effective manner so as to benefit the intended communities. Greater access to data, and new data points, will serve, over time, to de-securitize water data.
- **Successful cross-border solutions tend to be costly and relatively large-scale.** The approaches that worked were time-consuming and costly. While smaller projects – such as facilitating interactions between farmers in neighbouring countries – are feasible, these frequently fail to generate the necessary political traction to enable tangible outcomes.
- **International politics cannot be avoided. Bilateral relations self-evidently affect the feasibility of cross-border cooperation.** While the impact of a successful project between countries with poor relations is potentially high, the likelihood of success is generally low. Developing functional and replicable models of cooperation between countries that enjoy better bilateral relations would seem to be a more effective use of resources, given generally low levels of cooperation in the region at present.
- **Where cross-border relations are poor, there is a strong argument for creating a community around dialogues over water issues.** Such dialogues could develop approaches that could be implemented if the overarching political atmosphere improves. Windows of opportunity for cross-border cooperation open and close depending on the vagaries of domestic politics. When windows are closed, aspirations should be tempered.
- **Improving visa clearances would aid official cooperation.** Involving government officials in cross-border dialogues is complicated by the need for them to obtain clearance from their departments, in addition to the regular difficulties in acquiring visas. The ease with which travel is feasible is frequently contingent on the broader political relationship.
- **The media need to play an informed and responsible role in communicating policy issues and successes.** Several projects are under way attempting to sensitize journalists to water-related issues. There is clearly widespread scope for the media across South Asia to report successful cases of water management. However, notable hurdles include a lack of understanding of scientific issues and a preference for sensationalism that leads to a greater focus on failure than success. Furthermore, work on water issues frequently becomes categorized as environmental news, reaching a particular expert community and not necessarily the broader policy-making one.
- **Cross-border cooperation needs to be demonstrably beneficial to both sides.** The benefits may be financial but are not necessarily so. In the case of flood warnings, for instance, the benefit for the upstream community could be its awareness that it is helping to avert a disaster that would afflict another community.

Appendix: Cross-Border Cooperation in South Asia

Official bilateral cooperation

India and Pakistan

The commission established under the 1960 Indus Waters Treaty (IWT) is intended to distribute waters of the Indus river system between India and Pakistan. The IWT allows India exclusive development on the Ravi, Beas and Sutlej rivers, and Pakistan largely exclusive use of the Jhelum, Chenab and Indus rivers. The treaty asks the countries to notify each other of plans to carry out engineering works on the rivers that could affect the other party. It also informs the process of dispute resolution over the use of waters on the six shared rivers. The Permanent Indus Commission provides a mechanism for consultation and conflict resolution through inspection, data exchange and visits. Article VII of the treaty provides for future cooperation for 'optimum development' of the shared rivers.

India and Bangladesh

Since 1972, India has given Bangladesh data twice daily on rainfall and river discharge at Farakka on the Ganga and Pandu on the Brahmaputra during the monsoon season (from 15 June to 15 October). India also provides data on water levels at Goalpara and Dhubri on the Brahmaputra, Silchar on the Barak river and Teesta on the Damohani river. In the flood season, data are also provided three times a day on the Manu, Teesta, Dharla and Ghughumari rivers. This information is provided for free by India. The 1996 Ganges Water Treaty allocates dry-season flows between India and Bangladesh, based on water availability at the Farakka barrage, ensuring Bangladesh a minimum flow.

The Joint Rivers Commission (JRC) between India and Bangladesh, set up in 1972, has a range of functions. It is intended to ensure the most effective joint efforts in maximizing benefits from common river systems, to formulate flood-control works, to allow for advance flood warnings and forecasting, and to study flood-control and irrigation projects.

So far 37 meetings have been held between India and Bangladesh to discuss shared waters. The JRC also consists of sub-groups that deliberate upon specific issues such as the Tipaimukh hydroelectric project, the exchange of flood data, the sharing of the Teesta and Feni rivers, and the exchange of research. These meetings have increased the exchange of information and interactions between the two groups, and have served to build trust through official statements, reassurances and reiterations.

In 2015, members of parliament from Bangladesh and India agreed for the first time to set up a joint platform to preserve the Sundarbans. The following agreements are also in place in the Sundarbans:

- **Memorandum of Understanding (MoU) between India and Bangladesh on Conservation of the Sundarbans (2011).** This seeks to facilitate cooperation in the areas of conservation of biodiversity, joint management of resources, livelihood generation for poverty alleviation and

development, cataloguing of local flora and fauna, and study of the impacts of climate change. The MoU is valid for an initial period of five years, which can be extended further through mutual consent.

- **Protocol on Conservation of the Royal Bengal Tiger of the Sundarbans (2011).** This provides for bilateral cooperation in scientific research; knowledge-sharing and patrolling of the Sundarbans waterways to prevent poaching or smuggling of derivatives from wildlife; and bilateral initiatives to ensure survival and conservation of the Royal Bengal tiger in the area's unique ecosystem. The protocol also provides for cooperation to promote understanding and knowledge of Royal Bengal tigers, as well as for the exchange of personnel for training and promotion of education.
- **Memorandum of Understanding (MoU) on Cooperation in the field of Fisheries (2011).** This seeks to promote development of cooperation in fisheries, aquaculture and allied activities through joint activities, programmes and exchange of scientific materials, information and personnel. India's Ministry of Agriculture and Bangladesh's Ministry of Fisheries and Livestock coordinate implementation of the MoU. The MoU is valid for an initial period of five years and can be extended further through mutual consent.

India and China

In 2014, China agreed to provide India with data from observation stations at Nugesha, Yangcun and Nuxia on the Yarlung Tsangpo (the Chinese name for the Brahmaputra river) between 15 May and 15 October. Previously data were shared from 1 June to 15 October. China also provides hydrological information if water levels at observation stations are at, or approaching, warning levels in the non-flood season. India pays China Rs 8.2 million ($122,400) per year,[59] which China uses to maintain the observation stations. Both countries have agreed to exchange hydrologists (although China does not allow Indian citizens into Tibet, and India does not allow Chinese citizens into the state of Arunachal Pradesh).

In 2014, Indian and Chinese officials shared hydrological data on the Brahmaputra river at the annual expert-level mechanism meeting in New Delhi. This was set up in 2006 to discuss interaction and cooperation on provision of flood-season hydrological data, emergency management and other issues regarding cross-border rivers.

An MoU was signed between India and China to supply flood-season hydrological information on the Sutlej river in 2010. However, the frequency of data-sharing is considered to be insufficient. The Indian sources rely on the National Remote Sensing Agency to get everyday data on the river.

India and Nepal

Nepal and India have signed three treaties. The agreement on the Koshi project (signed in 1954 and revised in 1966) and the 1964 Gandak treaty were widely perceived as providing disproportionate benefits to India. The 1996 Mahakali River Treaty concerns the integrated development of the Mahakali with projects such as the Sharada barrage, the Tanakpur barrage and the Pancheswar project. In addition, Nepal shares flood warning data with India, and publicizes rainfall and river levels on a

[59] At an exchange rate of Rs66.99:US$1 on 3 June 2106. See Reuters (2016), 'Currencies Quote', http://www.reuters.com/finance/currencies/quote?srcAmt=1.00&srcCurr=USD&destAmt=&destCurr=INR (accessed 3 Jun. 2016).

government website. Cooperation on joint hydropower development has been slow, but has picked up since 2014, with India agreeing to expedite the Pancheswar project and to develop the Arun III and Upper Karnali projects.

India and Bhutan

Along with the development of Bhutan's hydropower detailed in this paper, India and Bhutan established in 1992 a Comprehensive Scheme for Establishment of Hydro-meteorological and Flood Forecasting Network on rivers common to them. This has 35 stations in Bhutan, funded by India. A Joint Group of Experts on Flood Management was set up in 2004 to discuss the causes and effects of recurring floods and erosion in southern Bhutan and adjoining areas of India.

Official multilateral cooperation

Nepal, India and Bangladesh, and Bangladesh, India and Bhutan have strengthened cooperation in water management initiatives for the Ganga and Brahmaputra river basins respectively. These initiatives focus on hydropower generation and irrigation, and include the joint development and financing of projects. The governments of Bhutan, Bangladesh, India and Nepal also met for the Climate Summit for a Living Himalayas, held in Bhutan in 2011. The four governments agreed to implement a framework of cooperation.[60]

Table 5: Other cross-border water projects

Name of project	Implemented by	Website	Type of project
Aqueduct	World Resources Institute	http://www.wri.org/our-work/project/aqueduct	Data provision
Hudiara Drain	World Wildlife Fund (WWF)	http://wwf.panda.org/who_we_are/wwf_offices/pakistan/projects/index.cfm?uProjectID=IN0920	Tackling pollution
Blue Peace Initiative	Strategic Foresight Group	http://www.strategicforesight.com/focus.php?id=2#.VlSVq14vs3A	Water diplomacy
Connecting the Drops between India and Pakistan	Stimson Center, Observer Research Foundation	http://www.stimson.org/research-pages/connecting-the-drops/	Track Two dialogue and research project
De-securitizing Transboundary Water in South Asia	Asia Foundation, World Resources Institute	http://asiafoundation.org/in-asia/2014/09/17/desecuritizing-transboundary-water-in-south-asia/	Research project
Drought Monitoring System in South Asia	Global Water Partnership, International Water Management Institute, SAARC Disaster Management Centre	http://www.GWP.org/en/GWP-in-action/South-Asia/News-and-Activities-GWP-South-Asia/Drought-Monitoring-System-in-South-Asia/	Action research project
Ecosystems for Life	International Union for Conservation of Nature (IUCN) and others	http://www.iucn.org/about/union/secretariat/offices/asia/what_we_do/ecosystems_for_life/	Action research project and Track Two dialogue
Effective water governance in Asian highlands	Helvetas; International Development Research Centre, Centre for Mountain Ecosystem Studies, Institute of Botany, Kunming University	http://asianhighlands.org/	Applied research project

[60] See http://www.bhutanclimatesummit.org.bt/main/index.php.

Name of project	Implemented by	Website	Type of project
Establishment of a Regional Flood Information System	Bangladesh Water Development Board, Bangladesh Meteorological Department, Department of Hydromet Services; China Meteorological Administration and Bureau of Hydrology; Central Water Commission, India, India Meteorological Department; Department of Hydrology and Meteorology, Bhutan; Pakistan Meteorological Department, Water and Power Development Authority, Federal Flood Commission	http://www.icimod.org/hycos	Applied research project; regional cooperation
'From Water to Wellbeing' – Clean Water Project	UN Habitat, Coca-Cola	http://www.unwac.org/pdf/From%20Water%20to%20Well-being%20-%20UN-Habitat%20&%20Coca-Cola.pdf	Collaborative action project
Himalaya-Third Pole Circle	Indian Institute of Science, Bangalore; Wadia Institute of Himalayan Geology, Dehradun; International Centre for Integrated Mountain Development (ICIMOD), Kathmandu; Institute of Tibetan Plateau Research, part of the Chinese Academy of Sciences, Beijing	http://www.icimod.org/?q=17399	Policy dialogue and regional collaboration
India–Pakistan Track II Water Dialogue	Atlantic Council	http://www.atlanticcouncil.org/programs/south-asia-center/india-pakistan-track-ii-water-dialogue	Track Two dialogue
India–Pakistan Water Dialogue	Centre for Dialogue and Reconciliation	http://www.cdr-india.org/pdf's/March-2014/India-Pakistan-Water-Dialogue.pdf	Track Two dialogue
Karachi Water Partnership	Global Water Partnership, Karachi Water Partnership, Karachi Water and Sewerage Board	http://www.GWP.org/en/ToolBox/CASE-STUDIES/Asia/Pakistan-A-Successful-Model-of-the-Urban-Water-Partnership-in-Karachi-440/	Urban water management
Koshi Basin Programme	ICIMOD, Commonwealth Scientific and Industrial Research Organisation, International Water Management Institute, Water and Energy Commission Secretariat, Nepal; National Institute of Disaster Management, India; Helvetas; University of Beijing	http://www.icimod.org/kbp	Collaborative action research project
The Kurichhu Project	National Hydroelectric Power Corporation Limited and Druk Green Power Corporation, Bhutan	http://www.drukgreen.bt/index.php/khp-menu/about-khp/20-plants/khp	Collaborative hydropower project
Living Himalayas	WWF (India, Bhutan and Nepal)	http://wwf.panda.org/what_we_do/where_we_work/eastern_himalaya/	Ecosystems
Mangroves for the Future	IUCN, UNDP	https://www.mangrovesforthefuture.org/	Ecosystems
Mekong-Ganga Dialogue (2012–14)	Observer Research Foundation; Mekong Program on Water, Environment and Resilience	http://www.orfonline.org/cms/export/orfonline/modules/issuebrief/attachments/MGD-Report_1426508951886.pdf	Track Two dialogue
Nepal–India Cross-Border Early Warning System	Lutheran World Relief; Grameen Development Services; BIKALPA	http://programs.lwr.org/asia/india/warningsystem	Flood early-warning system

Name of project	Implemented by	Website	Type of project
Nepal–India Early Warning Systems	Christian Aid; Cordaid; Practical Action; Poorvanchal Gramin Vikas Sansthan; Red Cross Nepal	https://www.cordaid.org/fr/projects/trans-border-early-warning-systems/109753/	Flood early-warning system
Re-imagining the Indus: Mapping Media Reportage in India and Pakistan	Observer Research Foundation; Lahore University of Management Studies	http://www.orfonline.org/cms/sites/orfonline/modules/book/BookDetail.html?cmaid=29679&mmacmaid=29680	Track Two dialogue and collaborative research project
River Basin Programme – Disaster Mitigation at Regional Level	Oxfam and local partners	http://www.oxfam.org.uk/search-results?i=1;q=river+basin+programme;q1=Publications;show_all=ogb_mixed;x1=page_type	Disaster resilience – action/applied research project
Sikkim Springs	Sikkim government; WWF; People's Science Institute, Dehradun	http://www.sikkimsprings.org/	Spring renovation – shared learning
Storm Water Harvesting using 'Bhungroo', Gujarat	Naireeta Services, India	http://unfccc.int/secretariat/momentum_for_change/items/8694.php	Technological innovation – shared learning
Sustainable Integrated Farming Systems	Welthungerhilfe, India	http://welthungerhilfesouthasia.org/our-programmes/initiatives/sifs/	Action and applied research project
Thimphu Seminars	Ananta Aspen Centre, India; Royal Institute of Governance and Strategic Studies, Bhutan	http://thimphuseminars.org/about-us	Track Two dialogue
The Third Pole	Partners across the Hindu Kush Himalaya region	http://data.thethirdpole.net/	Data provision
Towards Kabul Water Policy – Afghanistan–Pakistan Dialogue	EastWest Institute, IUCN	https://cmsdata.iucn.org/downloads/pk_ulr_d3_1.pdf	Track Two dialogue
Transboundary Landscapes Project, including the Kailash Sacred Landscape Conservation and Development Initiative	ICIMOD	http://www.icimod.org/?q=9121 and http://www.icimod.org/?q=9456	Ecosystems
Waging Peace: India–Pakistan Water Issues	Observer Research Foundation, Atlantic Council		Track Two dialogue
Water and Climate Resilience Programme	Global Water Partnership South Asia	http://www.GWP.org/GWP-south-asia/WACREP/	Climate resilience
Water Beyond Borders	Asia Foundation; Legal Initiative for Forest and Environment; Environics Trust	http://www.waterbeyondborders.net/	Civil society engagement
Web Enabled Water Resources Information System in the Country	WRIS, India	http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=Main_Page	Data provision
Work on Draft Legal Framework for Conservation and Protection of Inland Wetlands in South Asia	Centre for Science and Environment, India	http://cseindia.org/node/5263	Legal protection of wetlands

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