FROM SOURCE TO SEA

2013–2021

South Asia Water Initiative Completion Report

SAWI SOUTH ASIA WATER INITIATIVE

UKaid from the British people

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ABOUT SAWI

The South Asia Water Initiative (SAWI) was a multi-donor trust fund supported by the United Kingdom, Australia and Norway, and managed by the World Bank.

SAWI supported a rich portfolio of activities designed to increase regional cooperation in the management of the major Himalayan river systems in South Asia to deliver sustainable, fair and inclusive development and climate resilience. It did this through four complementary outcome areas: strengthening awareness and knowledge on regional water issues; enhancing technical and policy capacity across the region; facilitating dialogue and participatory decision processes to build trust and confidence; and scoping and informing investment designs. In the context of water resources planning and management, the program promoted poverty alleviation, economic development, gender inclusion and climate change adaptation.

Its work was structured across three river basins (Indus, Ganges and Brahmaputra Focus Areas) and one landscape (Sundarbans Focus Area), spanning seven countries (Afghanistan, Bangladesh, Bhutan, China, India, Nepal and Pakistan). These Focus Areas interfaced with a Regional Cross-Cutting Focus Area that both supported non-basin specific work and translated national and basin-specific work for wider dissemination or implementation.

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The International Bank for Reconstruction and Development /
The World Bank Group
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Acronyms and Abbreviations

AIRBMP	Assam Integrated River Basin Management Project
B	Billion (US Dollars)
BBIN	Bangladesh-Bhutan-India-Nepal
BBL	Brown Bag Lunch
BE	Bank-Executed Grant
BISRCI	Bangladesh-India Sundarbans Regional Cooperation Initiative
BMD	Bangladesh Meteorological Department
BRB	Brahmaputra River Basin
BWDB	Bangladesh Water Development Board
CMU	(World Bank) Country Management Unit
CoP26	26th Annual Conference of the Parties to UN Framework Convention on Climate Change
COVID-19	Coronavirus Disease
CSO	Civil Society Organization
CWC	(India) Central Water Commission
DFAT	(Australia) Department for Foreign Affairs and Trade
DFID	(UK) Department for International Development
DHPS	Department of Hydropower and Power Systems
DHM	Department of Hydrology and Meteorology (Nepal)
DRIP	Dam Rehabilitation and Improvement Projects
DSS	Decision Support System
DWRI	Department of Water Resources and Irrigations (Nepal)
FA	Focus Area
FCDO	United Kingdom's Foreign, Commonwealth and Development Office
FSPV	Floating Solar Photovoltaic
FY	Fiscal Year
GEE	Google Earth Engine
GESI	Gender and Social Inclusion
GHG	Greenhouse Gas
GoI	Government of India
GP	(World Bank) Global Practice
GRB	Ganges River Basin
GW	Gigawatt
HEP	Hydro Electric Power
HKH	Hindu Kush Himalaya
HUC	Himalayan University Consortium
IBKF	Indus Basin Knowledge Forum
IBRD	International Bank for Reconstruction and Development
ICIMOD	International Centre for Integrated Mountain Development
IIASA	Institute of Applied Systems Analysis
IRB	Indus River Basin
IT	Information Technology
IUCN	International Union for Conservation of Nature

IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
JWG	Joint Working Group
KU	Kathmandu University
KUSUM	Pradhan Mantri Kisan Urja Suraksha evem Utthan Mahabhiyan Scheme
M	Million (US Dollars)
MDTF	Multi-Donor Trust Fund
MoU	Memorandum of Understanding
MP	Madhya Pradesh (India)
MW	Megawatt
M&E	Monitoring and Evaluation
NEA	Nepal Electricity Authority
NER	North East Region (India)
NGO	Non-Governmental Organization
NHP	National Hydrology Project
NITI AAYOG	National Institution for Transforming India
PACT	Program for Asia Connectivity and Trade
PARCC	Program for Asia's Resilience to Climate Change
PRO	Program Management
PSU	Nepal Water Platform Support Unit
RACP	Rajasthan Agricultural Competitiveness Project
RAP	Resilient Asia Programme
RE	Recipient-Executed Grant
REG	Regional Focus Area
RGoB	The Royal Government of Bhutan
RICE	World Bank's South Asia Regional Integration, Cooperation, and Engagement Strategy
RIPC	Regional Integration Program Committee
SAR	South Asia Region
SARRE	South Asia Region's Regional Integration and Engagement
SARTFP	South Asia Regional Trade Facilitation Program
SAWGP	(DFID) South Asia Water Governance Programme
SAWI	South Asia Water Initiative
SDIP	(DFAT) Sustainable Development Investment Portfolio
SESA	Strategic Environmental and Social Assessment
SIIS	Shanghai Institute for International Studies
SUN	Sundarbans Landscape Area
TA	Technical Assistance
TF	Trust Fund
TTL	(World Bank) Task Team Leader
TU	Tribhuvan University of Nepal
VfM	Value for Money
WBG	World Bank Group
WECS	(Nepal) Water and Energy Commission Secretariat
WHU	Wuhan University
WQMS	Water Quality Monitoring System
WRM	Water Resources Management
WSS	Water and Sanitation Services

SUMMARY OVERVIEW

Key Messages

This Completion Report summarizes cumulative results and outcomes for the South Asia Water Initiative (SAWI) Phase 2 (2013-2021). A short summary of SAWI Phase 1 (2009-2012) is presented in Annex 5. SAWI's objective was to increase regional cooperation in the management of the major Himalayan river systems in South Asia to deliver sustainable, fair and inclusive development and climate resilience.

Four interlinked pathways supported the outcomes: (i) building confidence and trust among the countries – mainly by convening regional technical dialogues; (ii) generating new technical knowledge, including in partnership with others, for national programs to use and to help shift stakeholder perceptions; (iii) building capacity of key institutions and stakeholders by exposing them to regional collaboration efforts elsewhere, and training them in the use of new tools and technologies to strengthen water resource management; and (iv) scoping and leveraging investments, most notably World Bank investments so that these new approaches could be embedded and taken to scale.

SAWI was structured around four geographic Focus Areas (FAs), namely, the Indus Basin, Ganges Basin, Brahmaputra Basin, and Sundarbans Landscape. The latter interfaced with a fifth FA, Regional Cross-Cutting Knowledge, Dialogue and Communications that supported non-basin-specific work and translated national or basin-specific work for wider dissemination. Each FA was framed around a high-level objective statement and strategy. The program was delivered as a Multi-Donor Trust Fund ($35.4M), with financial contributions from the governments of the United Kingdom, Australia and Norway and administered by the World Bank's South Asia Region's Regional Engagement (SARRE) team.[1] The World Bank's Water Global Practice provided technical leadership throughout, ensuring that SAWI was fully embedded within the World Bank's broader water agenda.

The first three years of SAWI Phase 2 focused primarily on setting the strategy, finding appropriate technical entry points, building new partnerships, and operationalizing activities. In Year 4 (FY18), SAWI widened its partnerships, seeded and leveraged new opportunities, and advanced regional and basin-level dialogue

1 SARRE was previously known as the South Asia Region's Regional Integration Program (SARRP) of the World Bank.

processes. In Years 5 (FY19) and 6 (FY20), SAWI solidified and built on emerging gains, most notably those emerging from the dialogue processes. SAWI also broadened networks and reach with other regional partners who helped take the agenda forward, and leveraged emerging regional opportunities by engaging with Bank investments in strategic sectors (e.g. inland waterways, energy, blue economy) that, taken together, could significantly impact regional growth and sustainable development. In its final year, SAWI consolidated its work amid delays from the COVID-19 pandemic and put in place sustainability mechanisms to the extent possible.

This Summary Overview section outlines cumulative results from Phase 2 and can serve as a stand-alone project completion document. It is followed by a more detailed report that includes a short Introduction (Section 1), individual assessments for each of the five FAs (Section 2), Program Management (Section 3), and Reflections and Recommendations (Section 4). SAWI's portfolio included over 67 activities and the main report highlights only illustrative examples. Details are in eight supporting annexes: Activity Performance (Annex 1); Activity Summaries (Annex 2); Knowledge Products (Annex 3); Program Management (Annex 4); SAWI Phase One (Annex 5); Country Mapping (Annex 6); Partnerships (Annex 7); and World Bank Investments and Operations Linked to SAWI (Annex 8).

SAWI was a critical building block for regional cooperation and integration in South Asia, particularly water resources management and challenges posed by climate change. The Trust Fund laid essential groundwork, initiated new opportunities, and advanced progress on key issues to deliver positive outcomes for people, the economy, and the environment. SAWI also succeeded in informing significant financial investments in South Asia related to water resources, climate change, and regional integration.

The recently concluded SAWI Phase 2 demonstrated the criticality of and the potential for collaborative approaches to govern three major transboundary river basins in South Asia. Aspirations of the SAWI program were high but grounded in and adapted to the contextual realities of South Asia. The work was buttressed by the World Bank's sectoral expertise, local presence, and relationships with the countries of South Asia. SAWI's achievements are associated first with carefully creating the groundwork for an enabling environment, followed by nudging critical processes forward and building momentum toward regional cooperation with transboundary rivers.

SAWI did this in four ways. It convened and engaged stakeholders in semi-formal collaborative processes and helped shift entrenched positions through reframing discussions (Output 1). SAWI built institutional readiness through new knowledge and successful pilots that are being scaled up (Output 2). SAWI targeted capacity building (Output 3). And lastly, SAWI identified potential new opportunities aligned with larger World Bank investments (Output 4). The carefully calibrated and sequenced approaches were essential to build confidence, instill ownership, and establish legitimacy in the process.

Most significantly, SAWI created an enabling framework for cooperative action on the three South Asian transboundary rivers. The rivers are vital to the region's growth, security, and prosperity. Without donor resources and the World Bank's neutral role and technical approaches, it is unlikely that this would have happened at pace and scale.

Prospects for cooperation remain positive in the long term, with tacit on-going progress between countries on several initiatives, although concrete outcomes may not yet be visible. Establishing a new institutional framework of a transboundary nature – such as the proposed joint mechanism between Bangladesh and India for sustainable management of the Sundarbans – typically takes a long time. Similarly, it can take over a decade to fully realize the hydropower potential of a site or cascade.

SAWI successfully met and exceeded output goals outlined in the agreed results framework (see Annex 1).

The sub-regional dialogues in all four basin/landscape areas transitioned from general convenings (an achievement in itself) to vibrant forums with engaged participants who discussed ways to harness opportunities and tackle challenges at scale.

Most SAWI knowledge products and tools informed government action, improved operational efficiencies, and continue to be widely accessed as regional and global public goods — a notable accomplishment given the complex regional political economy that constrains knowledge sharing.

BOX 1: SAWI ADDED VALUE TO TRANSBOUNDARY WATER MANAGEMENT

SAWI brought additional value by:

Providing a neutral platform that brought together regional stakeholders from upper and lower riparian countries (similar joint regional encounters are rare). The neutral platform helped participants appreciate common hydrological, socioeconomic, technical, and environmental challenges, and enabled them to discuss ways to secure a sustainable future for the sub-region.

Conceptualizing problems at scale instead of piecemeal and tackling them holistically through a mix of activities.

Seeding ideas, broadening and shifting the discourse. For instance, some studies facilitated a move from national thinking to basin-wide and regional thinking and provided a climate change lens rather than focusing on intractable issues around water sharing.

Strengthening common understanding on climate change, and how it intersects with socio-economic issues affecting millions of people as disaster losses have greater negative impacts on less developed economies.

Facilitating knowledge exchange, educational or exposure visits, and research partnerships to incentivize collaboration and to support joint research that could provide usable information for policymakers.

Providing focused technical expertise on critical issues, such as plastics pollution and groundwater. For example, SAWI's groundwater work assisted decision makers to improve governance of groundwater in the Indus and the Ganges Basins.

- Knowledge enabled a paradigm shift from engineering-based technical solutions to more comprehensive and integrated solutions that considered social, environment, and economic aspects. These included developing nature-based solutions for watershed management, examining nutritional impacts of groundwater salination on mothers and children, and facilitating inland water transport while protecting Ganges River dolphins.
- Targeted capacity building events empowered stakeholders, showed them different ways of approaching intractable problems, and enabled water institutions to adopt more efficient and effective tools for planning and investments.
- Pilots and other highly technical work convincingly demonstrated the feasibility of approaches that are now being taken to scale.
- Innovative approaches spotlighted the potential of water as an integrator — not just a finite resource — and opened new avenues for cooperation in transport, clean energy, trade, and ecotourism.

As estimated 24 million people benefit from SAWI-supported improvements to flood forecasting in India's state of Bihar. Flood warnings are now provided 72 hours (3 days) in advance instead of only 24 hours in advance. The system improvement saves lives by giving people more time to respond and reach safety.

SAWI's strategic emphasis on contextualised basin-level work was successful. This deliberate design feature of Phase 2 was proposed by the United Kingdom's Foreign, Commonwealth, and Development Office (FCDO). It marked a shift from Phase 1's focus on regional-level dialogue and knowledge generation that delivered modest results. Although SAWI was primarily a regional program, it worked at multiple levels (regionally, nationally, locally) to engage diverse stakeholders and find entry points to tackle complex issues that constrain progress towards regional collaboration on transboundary water governance. SAWI's

portfolio of 67 grant activities was delivered within individualized FA strategies for each of the three river basins (Indus, Ganges, Brahmaputra), the Sundarbans wetlands, and a regional cross-cutting area for knowledge, dialogue and communications. The FAs focused on delivering four interlinked outputs in SAWI's results framework.

A twin-track approach of development and hydro-diplomacy framed SAWI's strategy across all activities. The development of technical solutions became an entry point to convene stakeholders in basin-level dialogues on issues of common interest — something unlikely to otherwise happen given the regional political economy constraints. Exposure visits, educational tours, and capacity building became avenues to transfer this knowledge to inform decision makers. For instance, transboundary water resources are already a contentious issue between countries and concerns of water quality deterioration and pollution are likely to further exacerbate these tensions. Data is limited, hampering effective decision making. By using remote sensing satellite data, SAWI helped gather reliable data on local hydrology and water quality models. This was an essential first step to monitor water quality, understand levels and sources of pollution, and ultimately inform bilateral discussions between countries.

> The sequencing of SAWI activities was paramount for stakeholder buy-in and engagement. For example, analysis of the basin context was a fundamental starting point to build on the weak knowledge base. SAWI's analysis brought an interconnectedness by including economic, social and environmental dimensions. SAWI then used emerging findings as an opportunity to frame dialogues and discussions at national, state, and regional levels.

New knowledge on climate change impacts and threats to water, food and energy security was central to SAWI's Focus Area strategies and activities. In the Indus and Brahmaputra basins, climate change was selected as a neutral topic of shared interest for scientific collaboration. This enabled SAWI to successfully frame dialogues around a common unifying theme, raised regional and international attention about glacier melt, and promoted knowledge exchange, including responses to cross-border water hazards. SAWI helped address capacity gaps at national levels by providing technical options that took account of the wider ecosystem and emergent climate and weather risks such as in the Sundarbans. SAWI offered technical solutions to help countries adapt, reduce vulnerability, and increase resilience of communities to climate and weather disasters. For example, SAWI's technical work helped forecasters in Bihar (India) prepare earlier alerts about impending floods and early warning systems in Bhutan and Bangladesh were linked to larger World Bank hydromet investments in the region.

SAWI Phase 2 developed more than 50 collaborative partnerships with South Asian institutions that helped promote wider impact and sustainability (see Annex 7 for details). Notably, these institutions continue to advocate for cooperation on transboundary water issues, inform policy and decision makers, and provide capacity support and some convening functions.

Gender was mainstreamed across all activities, in line with the World Bank's gender strategy since 2016. Over the years, SAWI's activities encouraged more participation of women stakeholders, brought fresh insights through analytical work on the impacts of water and climate on women, and helped bring deeper appreciation of the importance of integrating gender issues into water governance, plans and investments.

SAWI delivered strong value for money. The trust fund was linked to 43 World Bank-supported investments in South Asia, valued at $9.5 billion, and drew on the Bank's larger networks and country presence. SAWI aligned its work with other World Bank trust funds managed by the SARRE team for an integrated approach. For example, SAWI's work in hydromet, weather, and climate services aligned with the Program for Asia's

Resilience to Climate Change supported by UK. SAWI's activities with inland waterways and hydropower resonated with the Program for Asia Connectivity and Trade and the South Asia Regional Trade Facilitation program, supported by UK and Australia, respectively.

South Asia faced several challenges during the last two years of SAWI's implementation that brought water security into sharp focus. The COVID-19 pandemic was a major disruptor in the region along with extreme weather events with devastating loss of lives and economic consequences. While there is some risk that momentum will slow on transboundary water issues, opportunities exist for collaboration as South Asia works to recover and build resilience — and SAWI laid important groundwork for that.

Future external financing will play an important role to sustain momentum or else there is a risk that some gains might stall. Looking ahead, the World Bank will work with donor partners to transition SAWI-related work to a new Resilient Asia Program (RAP) in a way that ensures continued momentum and responsiveness to post-pandemic realities and priorities.

The political situation in Afghanistan and COVID-19 restrictions introduced uncertainty about the sustainability of work in the Indus Basin. Any follow-on activity will need to factor in the shifting geopolitics of the region, including the situation in Afghanistan, and adjust the approach to engaging with policy makers at national, subnational, and regional levels. At the time this report was written, the situation in Afghanistan was still evolving and not enough information was available to make a full assessment.

A. Strategic Relevance of SAWI to Regional Cooperation on Transboundary Waters in the Context of South Asia

SAWI remains highly relevant to South Asia's growth, stability, and prosperity. Transboundary rivers in South Asia are critical to sustainable growth, development, peace, and shared prosperity in South Asia. However, population growth, urbanization, unsustainable agricultural practices and waste management, and over-extraction and depletion of groundwater are stressing the quality and availability of water. SAWI was strategically designed and implemented to address the unique context, characteristics, and urgent need to manage water resources critical to the lives and livelihoods of more than one billion South Asians.

Environmental degradation and climate change will profoundly impact South Asia and its transboundary rivers, putting millions of lives at risk. Warming temperatures are expected to increase the frequency and intensity of glacial melt, monsoon rainfall, flooding, cyclones, and droughts. These disruptions cause loss of lives and livelihoods, cost billions of dollars in economic damage, damage ecosystems, and threaten food and water security. The three river basins have different hydrology, topography and climate impacts, requiring a whole-of-river-basin systemwide approach that can address current and future needs regardless of national boundaries. SAWI's knowledge products and tools were designed to strengthen technical capacity. They included models to aid weather and climate prediction, and specific activities to improve flood forecasting, environmental flow assessments, ecosystems, and community resilience.

By 2050 between 1.5 to 1.7 billion people in South Asia are projected to be exposed to water scarcity.

Source: Gosling and Arnell, 2016.

Complex regional politics and persistent tensions constrain meaningful cooperation. South Asia's asymmetric relationships and trust deficit historically translated into competition for shared resources and little sharing of vital hydrological data. Although the three river basins span multiple countries, India and China are key stakeholders. India, as a middle riparian, shares all three rivers with its neighbours Bangladesh, Bhutan, China, Nepal and Pakistan. China has advantages of being an upper riparian – the Indus and Brahmaputra rivers originate in the Tibetan Plateau in Southwestern China. While transboundary rivers create interdependencies among countries, water conflicts arise over inequitable access to water, water quality, competing uses by sectors, and dam construction. Water discourse among countries traditionally was part of broader regional and bilateral political tensions and sovereign diplomatic considerations, and approached through bilateral water sharing agreements (Box 2).

BOX 2: STRATEGIC INCENTIVES PREVAIL, FRAMED BY TREATIES ON WATER DISTRIBUTION

- The Indus Water Treaty (1960) frames the terms for sharing waters of six transboundary rivers between India and Pakistan.
- The Ganges Treaty (1996) was key to resolving a long-standing conflict between India and Bangladesh.
- The Joint Rivers Commission (1972), a bilateral working group, was established between Bangladesh and India to address issues of water sharing, irrigation, and extreme weather such as floods and cyclones.
- The Mahakali Treaty (1996) is the most recent of several treaties for water sharing and project development between India and Nepal for the Kosi, Gandaki and Mahakali rivers.
- A Memorandum of Understanding (2013) between China and India recognizes the importance of transboundary rivers for all riparians. China agreed to provide hydrological information to India during the flood season.

Limited technical knowledge, misinformation and myths remain barriers to effective cooperation of shared water resources. The lack of a formal regional institution also limits collective efforts. Domestic politics, national policy priorities and geopolitical objectives have tended to dominate collaborative action on regional water issues. Limited institutional capacity, poor quality data and weak systems also constrain potential cooperative action.

In recent years there were encouraging signs, albeit limited, of countries cooperating on specific aspects of regional water issues. The eastern subregion of Bangladesh, Bhutan, India and Nepal continues to make progress toward cooperation, with several cross-border opportunities emerging on transport connectivity, rejuvenation of inland waterways, and electricity trade. India's stated Act East policy continues to extend economic and strategic relations with South East Asian countries. In the western subregion, political relations are complex and determined by a host of factors that go beyond the scope of SAWI.

Encouraging signs of cooperation include China's decision to restart sharing flood forecasting data with India, and an arrangement by Nepal and India for sharing flood data. Emerging platforms such as Google Earth Engine, which has satellite images and geospatial datasets, provide water managers with necessary data for water resource planning and management.

While keeping the four outputs central to its delivery, SAWI flexibly tailored its five Focus Area (FA) strategies to reflect realities on the ground. National entry points became an important tactical means for SAWI to engage on issues of regional relevance. This enabled SAWI to convene stakeholders with asymmetric capabilities and diverse interests, align work with national priorities while bringing a regional lens, and demonstrate the feasibility of a model so it could be taken to scale. For example, the Ganges FA used its technical engagement and links with large national investments to gain greater ownership and buy-in. The Indus FA invested in building capacity through training visits and promoted joint technical work around climate change. The Brahmaputra FA drew in institutions from the four riparian countries

(Bangladesh, Bhutan, China, and India) by focusing on issues of common interest such as hydromet services, disaster risk reduction, hydropower development and trade, and inland water transport. Activities in the Sundarbans leveraged opportunities arising from the Bangladesh and India plan to operationalize an agreement for joint management of the Sundarbans, outlined in a 2011 Memorandum of Understanding. This included supporting the Bangladesh-India Sundarbans Regional Cooperation Initiative (BISRCI), which found traction in both countries.

Alignment: SAWI was closely aligned with, and strongly contributed to, the World Bank's South Asia Regional Integration Cooperation and Engagement strategy. SAWI was an integral part of the World Bank's growing regional portfolio and strategic approach for regional integration and engagement in South Asia. By design, SAWI's activities were linked to other World Bank investments that were delivered at scale over a longer term. The strategy of linking SAWI activities with national priorities and with Bank-financed investments enabled SAWI to extend its reach beyond its immediate activities. SAWI supported the World Bank's water strategy and its three thematic priorities of sustaining water resources, delivering services, and building resilience. SAWI was closely aligned with the World Bank Group's Action Plan on Climate Change Adaptation and Resilience[2] to support country efforts to systematically manage climate risks in policy planning, investment design, and implementation.

Portfolio: SAWI supported a rich portfolio of 67 activities over its lifetime. In the final year FY22, SAWI completed 19 remaining activities, most of which fell under the Regional, Brahmaputra and Ganges Focus Areas. Over the years, and as part of adaptive program management, the portfolio pivoted to take up activities that were highly topical and relevant. Such activities offered new thematic entry points to deepen the regional water discourse, build technical knowledge and capacity in water management and responses to climate change, and to offer policy advice on issues related to building resilience.

B. Effectiveness

The program successfully delivered its objective of increasing regional cooperation in the management of the major Himalayan river systems in South Asia.

BOX 3: SAWI MET AND EXCEEDED ITS TARGETS

Output 1: Four basin-level dialogue processes were convened, and 29 participatory processes that supported knowledge sharing were implemented.

Output 2: Some 205 technical products were completed, giving stakeholders new knowledge and tools to plan water resource management.

Output 3: A total of 1,983 professionals — including **260** women — and 124 water management organizations benefitted from a range of **capacity building** support.

Output 4: SAWI activities were **linked to 43 World Bank investments and operations worth approximately $9.5 billion**.

With more than **50** development partners and **60** country-level partnerships, SAWI's **network** continues to grow and is essential to long-term sustainability.

2 The World Bank plan aimed to ramp up adaptation climate finance to reach $50 billion over FY21-25, an average of $10 billion a year. See https://www.worldbank.org/en/news/press-release/2019/01/15/world-bank-group-announces-50-billion-over-five-years-for-climate-adaptation-and-resilience

Strong results emerged during the lifetime of the program, including the following:

(i) **SAWI helped to advance processes along the continuum from transboundary conflict to collaboration Basin-level dialogue became critical mechanisms to engage stakeholders and build trust**. SAWI started from a low base of no regional dialogues on water, and some hesitancy from riparian countries.[3] India did not engage officially in the SAWI program but permitted "individual academicians" to be involved in dialogues. China's academic community became active participants in dialogue in the latter years of the program. Sub-regional dialogue forums gained momentum over years, enabling stakeholder participation in these apolitical forums at scale – a measure of success in itself, given the complex regional dynamics that limit meetings of this kind. At the end of SAWI's Phase 2, the engagement matured to Track 1.5 level – unofficial, technical dialogue between official representatives across all basins. For example, the Indus Basin dialogue grew from Track 3 to Track 1.5 with over 100 participants from Afghanistan, Pakistan, India and China in its regional knowledge forum. The Brahmaputra Dialogue was taken up by institutions from Bangladesh, Bhutan, China and India. The Sundarbans dialogue helped to firmly establish a Bangladesh-India Sundarbans Regional Cooperation Initiative as an interim process toward a more formal institutional cooperation mechanism between the two countries.

(ii) **SAWI's differentiated approach in each basin proved to be an effective strategy in creating an enabling environment toward cooperation**. Although each basin progressed in different ways, overall shifts are becoming evident (details in Chapter 2), as follows:

Indus Basin

Regional dialogues were established and, although incremental progress was made, the convening of stakeholders was a huge achievement in itself. The Indus Forum succeeded in bringing together key stakeholders from the region including relevant government agencies, development practitioners and civil society groups to improve understanding of climate change impacts in the region and plausible solutions. This would not otherwise have been possible in the region due to existing geopolitical sensitivities among the countries. However, continuation of the dialogue process is subject to shifting sub-regional dynamics and sustained funding becoming available. Another significant achievement was the development of a joint research proposal to understand and assess the impacts of climate change in the Indus Basin by researchers from the four countries. The joint research proposal has been submitted to several calls for proposals from entities such as the Coca Cola Foundation and International Shared Waters Cooperation, US.

Ganges Basin

Alignment with national priorities in Bangladesh, Bhutan, India and Nepal provided the most traction in convening, engaging and convincing stakeholders of the need to adopt a basin-wide lens to planning and investments. Demonstration of pilots, transfer of new user-friendly tools, and capacity building led to scale up through national programmes.

BOX 4: GANGES STRATEGIC BASIN PLANNING DELIVERED SIGNIFICANT RESULTS

» **Tools**: SAWI gave central and state governments access to a sophisticated basin planning suite that can objectively assess different scenarios and interventions to improve the health of the Ganges system.

3 SAWI Phase 1 supported the regional Abu Dhabi Dialogues.

- **Participatory Approach**: SAWI convened government and nongovernment stakeholders in more than 30 state-level events, with strongly divergent views emerging from 11 Indian basin states. The process shifted perceptions and built confidence in basin-scale water management. Without SAWI it is unlikely this type of neutral process would have happened.
- **Knowledge**: New analysis showed that uncoordinated and increased economic activity and socio-economic development were likely to have serious water consequences for the Ganges, with climate change also a threat. This has implications for how future investments are planned.

Brahmaputra Basin

Evolution of the Brahmaputra dialogue from a Track 3 to a Track 1.5 process, the growing involvement of China and India in addition to Bangladesh and Bhutan, and the improved quality of discourse over the years are considered by regional stakeholders to be game-changers in a subregion fraught with geopolitical tensions. There is evidence that institutional partnerships built up through the Brahmaputra Dialogue activity will leverage resources from other sources and take forward local activities while remaining in contact with each other to share knowledge. However, without external facilitation, these are likely to be at the Track 2 or 3 levels and unlikely to reach the same regional scale that SAWI enabled.

Highly technical work on basin dynamics in the landscape, and innovative studies on weather and climate services were appreciated and taken on board by governments in Bangladesh and Bhutan. In India, SAWI built a comprehensive and much-needed knowledge base on the dynamics of the Brahmaputra Basin in India's North-East Region (NER) for policy and decision makers. SAWI provided analytical work in response to the Prime Minister's initiative on water in NER and it was taken up by a high level committee. SAWI's technical assistance also fostered collaboration between Assam and Bangladesh (see Box 5).

"SAWI broke the ice. The Brahmaputra Dialogue was able to bring together representatives from all four riparian countries – a first for the sub-region.

This neutral forum helped us to take a fresh perspective and to learn from the past which helped to sustain a positive attitude among all participants".

- Brahmaputra Dialogue participant (July 2021)

BOX 5: GOING BEYOND 'BUSINESS AS USUAL' IN INDIA'S STRATEGIC NORTH EAST

India's northeastern state of Assam lies in the Brahmaputra Basin and faces major water-related risks such as routine flooding and rampant erosion. To date, responses have largely been piecemeal, reactive, and inflexible in dealing with the dynamic nature of the Brahmaputra Basin and in adapting to climate change. Investments have not been conceived within the context of the entire river basin and its transboundary dimension. Many basin investments were in so-called grey infrastructure that is often expensive and can actually increase risk because it was not designed for the basin's inherent complexity.

SAWI's activity, **Improving Water Resources Management in North-East India and Assam**, marked a significant change from "business as usual" in the area. SAWI introduced new approaches for integrated water management and disaster risk management such as nature-based green infrastructure and non-structural measures. SAWI also helped advance discussions on issues of joint concern between India (Assam) and Bangladesh, as follows:

- Technical analysis on flood and erosion management brought deeper recognition and awareness among government agencies in Assam and Bangladesh of the need to consider issues beyond their own borders. The challenges facing Assam cannot solely be addressed by the state without coordinated action.
- An early start was made to translate the change in mindset into action. SAWI's work to improve the design of Assam Integrated River Basin Management Program or AIRBMP ($500 million) is a steppingstone to broader cooperation in India's North-East and other riparian countries. AIRBMP and associated projects in Bangladesh and Bhutan provide a vehicle for the World Bank to engaged on these issues. SAWI added value by ensuring that transboundary issues were front and center in the project design. The first phase of the program creates a solid foundation for improving water resources management in Assam and better coordination across the other North-East states and riparian countries sharing the Brahmaputra River Basin.

SAWI laid the groundwork for a planned regional network of water resource practitioners across the North-East and with other riparian countries. The network members will share experience, build on the platform established in the Brahmaputra Dialogue, and link closely with related projects, such as the Jamuna River Economic Corridor Development Program in Bangladesh and other World Bank-supported activities in Bhutan to strengthen hydromet services.

Sundarbans Landscape

SAWI's most significant contribution in its Sundarbans work was raising the visibility and profile of the fragile wetlands as a key area of cooperation between Bangladesh and India. The trust fund's work brought the two countries together in dialogue and joint research, paving the way for deeper and broader joint management of the Sundarbans and its inland water transport links, ecosystem conservation, and livelihoods.

BOX 6: JOINT TECHNICAL WORK IN THE SUNDARBANS BUILT TRUST

Before SAWI, efforts to understand the Sundarbans were piecemeal and available literature focused on either the Bangladesh side or the India side of the shared wetlands that is home to the world's largest mangrove forest.

The SAWI-funded **Sundarbans Joint Landscape Narrative** report described for the first time the defining characteristics of the entire Sundarbans across both Bangladesh and India. The report created a holistic understanding of the ecological, socioeconomic, and cultural variables of the Sundarbans, increased scientific and economic knowledge, and identified options for effective planning and management. The seminal work brought an integrated approach encompassing the need for conservation and habitat protection and needs of the local, poor population that depends on the mangrove forest and fishing for survival.

The process to create the report was as important as the report. A joint team of experts from Bangladesh and India prepared the report following several multi-stakeholder consultations over more than a year. The process built trust and stakeholder opinions helped to inform and shape the final product, ensuring greater acceptance. As part of the data collation and research process, SAWI engaged with several hundred stakeholders in both countries including policymakers, government officials, academics, scientists, economists, and community members and focused on including women and development partners.

The landmark report resulted in better working relationships between Bangladesh and India at multiple stakeholder levels. It also laid the groundwork for moving toward operationalization of non-binding agreements for joint management of the Sundarbans.

Regional: The Regional Focus Area's most significant results included development, testing, and sharing of innovative knowledge with the potential to deliver regional benefits; capacity building; and forging regional partnerships.

BOX 7: REGIONAL PLATFORMS FOSTERED COLLABORATION

"Without a functioning and sustainable regional platform that facilitates science, policy and practice interfaces, water resource management in the Hindu Kush Himalaya region would remain at risk of fragmented and disconcerted efforts by local communities, practitioners, policy makers and scientists. The platform and network generated through this SAWI's grant to the Himalayan University Consortium established a strong foundation for regional coordination and collaboration."

SAWI Partner

(iii) **Climate change was a key area addressed by SAWI activities in different ways.**

- COP 21 presence: Through BISCRI, SAWI indirectly helped facilitate a joint India-Bangladesh side event on the Sundarbans at the UN Framework Convention on Climate Change Conference of Parties meeting in December 2015. Environment ministers from both countries issued coordinated statements supporting increased cooperation in the Sundarbans and in climate adaptation and mitigation.

"*Sundarbans may be in two countries but tigers know no boundary. This hotspot has to be preserved together. We have already agreed that we will have a joint management plan to preserve Sundarbans.*"
- Mr Prakash Javadekar, Minister of Environment, Forest and Climate Change, GoI

"*We will try to work out how the climate vulnerability of the Sundarban can be raised on a global platform jointly and much more strongly.*"
- Mr Anwar Hossain Manju, Minister for Environment, Forest and Climate Change, GoB

Figure 1: The Ministers of Environment, Forest and Climate Change from Bangladesh and India at a Sundarbans event on the sidelines of the UN's COP21 meeting in Paris in December 2015. Prakash Javadekar of India (left) and Anwar Hossain Manju of Bangladesh (right).

- BISRCI drew on the findings of SAWI's Targeted Environmental Studies in Sundarbans (the delta area into which the rivers drain) in discussions with a joint working group. The studies highlighted critical issues about the impacts of sea level rise on drinking water salination. The work was highly relevant as climate-induced phenomenon continues to damage the landscape and affect the health of local communities, imposing huge economic and ecological costs.
- New knowledge and systems helped countries adapt and build resilience to climate change. For instance, hydromet support in the Brahmaputra Basin (Bhutan, Bangladesh), the Ganges Basin (India), and in the Sundarbans Landscape addressed capacity gaps at national levels, promoted knowledge exchange cross-border water-related hazards, and informed the design of larger World Bank hydromet investments in the region.
- Climate change was an important unifying theme that brought riparians together in dialogue in the Indus and Brahmaputra basins, and resulted in collaborative research efforts and partnerships between the countries being taken forward.

- A regional flagship study[4] on the impacts of climate change and black carbon on glacial and snow melt and its impacts on water resources led to regional stakeholders calling for greater regional cooperation on the issue of glacier melting. Stakeholders acknowledged the importance of this issue which will impact future water resources and the lives of 1.5 billion people who depend on these rivers. This work was endorsed by the Hindu Kush Himalaya Glacier and Mountain Economy Platform, and a draft declaration to champion this cooperation was formally announced at COP 24 in Katowice, Poland in December 2018.

(iv) **A total of 1,983 professionals, including 260 women, benefitted from SAWI capacity building events. They acquired new skills and enhanced confidence to use the tools and approaches**. Capacity building included national activities in response to specific government requests or tailored to key issues such as sediment management at hydropower plants, as well as regional activities on shared challenges and needs. National-level training was also directed at leveling the institutional playing field to address the capacity asymmetry in South Asia to make riparian interactions and negotiations more effective.

BOX 8: AFGHANISTAN CAPACITY BUILDING RESULTS

SAWI's capacity strengthening program for the Government of Afghanistan included study tours for senior officials, training in water diplomacy for 54 government officials, specialized training for government agencies to use water tools, and policy and technical capacity building in the country's three key water management agencies.

Most notably:

» The training informed the design of a high-level commission on transboundary water issues chaired by the President of Afghanistan.

» Each line ministry formed a transboundary unit enabling ministry officials to meet regularly through a new Transboundary Inter-Ministerial Working Group of the three ministries.

» The capacity building informed the design of Afghanistan's new Transboundary Water Policy.

SAWI's capacity building and knowledge work delivered significant results by helping to build skills and confidence in water diplomacy, particularly for Afghan officials engaged in water dialogue with neighbouring countries. The SAWI support also helped Afghanistan identify implementable policy recommendations for Pakistani authorities on the sensitive issue of reforming management of groundwater resources in their jurisdictions.

Afghanistan's situation was continuing to evolve at the time this report was prepared. Transboundary water management gains may not be sustained and are beyond the control of the World Bank or SAWI.

(v) **Riparian governments and institutions showed strong acceptance and uptake of SAWI knowledge products and tools**. By using knowledge to broaden the discourse away from stalemate issues, SAWI enabled participants to think beyond borders and engage on common challenges and shared opportunities. There are several examples of how knowledge was used, for instance:

- Framing the narrative of transboundary water around the whole river basin through assessment studies in the Brahmaputra and the Ganges brought deeper realization among stakeholders on the need for a holistic, basin-wide approach, rather than a piece-meal approach. In India, this enabled stakeholders at national and state levels to consider a basin-wide approach in planning future investments; and in Bangladesh, efforts were aligned with the country's longer-term Delta Investment Plan.
- SAWI's support to develop an investment plan for Bangladesh's Delta Plan 2100 – which represents a shift in the historical approach to delta management – was well received by the highest levels of government.

4 Press release page with short video, and link to the report is available at: https://www.worldbank.org/en/news/press-release/2021/06/01/to-slow-himalayan-glacier-melt-curbing-air-pollution-is-key

- In Bhutan, SAWI informed elements of Bhutan's updated hydropower policy that is critical to the country's plans to commission 12,000 MW of hydropower projects in coming years. Most notably, SAWI directly helped to develop both national sustainable hydropower guidelines and dam safety guidelines that now serve as the preeminent guiding documents for hydropower development in Bhutan. Additionally, the introduction of new procurement guidelines helped Bhutan conform to international standards and strengthened transparency. Bhutan requested follow-up technical assistance following SAWI's detailed study that identified gaps in the environmental and social management of hydropower. This work is a prime example of SAWI's significance both nationally and regionally. From a domestic perspective, it tackled social and environmental challenges to increase the efficacy of large-scale hydropower expansion. From a transboundary perspective, the work remains relevant, as India and Bangladesh are the main clients for Bhutan's hydropower and the guidelines are replicable elsewhere in the region and globally.
- Nepal's uptake of environmental standards strengthened the quality of hydropower investment plans.
- Four **Groundwater Studies** across South Asia brought locally relevant information together with a much-needed focus on the relationship between ground and surface water and the risks of over-extraction. This information continues to be critical as countries consider the competing uses of water, and policy options to manage a scarce resource. Pakistani authorities accepted some of the findings and SAWI's work more broadly continues to inform decision makers in two provinces that suffer from water scarcity. Studies in India informed policy discussions of Indian water agencies, and recommendations were adopted by the state of Rajasthan and by NITI Aayog, the Indian government's public think tank.

> *Groundwater abstractions account for 40 percent of all water withdrawals in the South Asian region.*
>
> *Hirji, Nicol and Davis 2017*

- Hydromet work in Bhutan resulted in the operationalization of new systems to provide accurate forecasts. In India, basin modeling tools were adopted by the Central Water Commission (CWC) to help water managers with more accurate models. Although this helped to strengthen capacity at that time, and added to the toolkit of the CWC, the extent to which these will remain in use in the longer term is less clear.
- Other analytical work in support of operationalizing Nepal's federalism, brought a holistic view of water supply and sanitation infrastructure requirements in a targeted project area. The work was used to advance World Bank discussions with senior government partners during project preparation of a Water Governance and Infrastructure Project and informed cross-departmental discussions.

(vi) **Small-scale pilots offered large-scale wins**:

- In Nepal, the creation of a water platform acted as a pilot that facilitated cross-departmental national action, instead of usual practice of fragmented action. For instance, a Water Sector Diagnostic Report, prepared under Nepal's water platform and now transferred to government, highlighted the criticality of clean water supply and sanitation in medical facilities during the COVID-19 response, and overall hygiene improvement in households going forward. SAWI facilitated inter-agency coordination among ministries in charge of water supply, schools and medical facilities to improve sanitation policies and services, and convened all development partners working on water and sanitation to align their activities. The platform will continue providing a convening space for cross-sectoral coordination and coordination with other global practices in the World Bank, with development partners, and sector stakeholders during project preparation and implementation.

- In the Indian state of Bihar, successful testing of flood forecasting tools for a stretch of the river prone to devastating flooding led to its uptake by the state's Flood Management Improvement Support Center. The model is being scaled up through the World Bank-supported Bihar Kosi Development Project and National Hydrology Project to expand coverage in the state.

(vii) **By approaching water as an integrator across sectors, SAWI laid building blocks for future cooperation in emerging areas such as inland water transport, hydropower, and hydromet services**.

While SAWI's main thrust was to promote regional collaboration on water governance, SAWI connected with related sectors such as transport (inland waterways), clean energy (hydropower), environment and agriculture (food security), all of which have positive impacts on regional growth, trade, climate adaptation and socio-economic benefits for the population. SAWI's technical knowledge brought deeper appreciation of the need to expand beyond just water allocation to a 'source-to-sea' approach across the whole basin, encompassing environmental and biodiversity links, and conjunctive use of groundwater and fresh water. In the long term, SAWI served as a regional integrator within South Asia and with its neighboring sub-regions, notably Central Asia and the Indo-Pacific region.

Inland water transport: Investment plans to make greater use of inland waterways to move people and goods are increasingly being pursued as national priorities. SAWI created a strong basis for a collaborative institutional framework to coordinate river navigation in the BBIN subregion. This is a strategic step supported by the BBIN countries that can help transcend individual interests in the common goal of operationalizing the proposed Eastern Waterway Grid across the subregion.

SAWI studies confirmed the overall feasibility of Eastern Waterways Grid and informed key stakeholders on the way forward. SAWI generated a credible baseline of information to evaluate the potential for an interconnected grid of waterways in the subregion. This included assessing commercial, policy, regulatory and institutional aspects, The SAWI studies also assessed existing infrastructure, trade patterns, routes, and cost datasets as reference points for measuring changes and impacts over time — something all the future work assessments can usefully build upon. SAWI notably brought the four BBIN countries to the discussion table, fostered their participation and built a more unified understanding of the value of an interconnected subregion to access markets and support people-to-people connectivity. While India and Bangladesh will host most of the active waterways, Bhutan and Nepal endorsed multi-modal links to connect with the investments on rivers in India and Bangladesh, which will enable them to benefit from bilateral trade and more access to sea ports in the Bay of Bengal.

Connectivity for India's land-locked North-East Region (NER) is also strategic. The resource-rich NER will benefit from connectivity and maritime access that boosts trade in agricultural products and manufactured goods. To ensure the NER has easy access to the sea, the ports of Kolkata / Haldia (India) and Chittagong (Bangladesh) are important interfaces. With efficient multi-modal links they will enhance the NER's connectivity with Southeast Asia and the rest of India.

Floating Solar: India's Ministry of New and Renewable Energy is formulating auctions to promote innovative renewable energy projects, possibly including solar arrays floating in canals and reservoirs. However, the market adoption of new renewable energy technologies — such as floating solar — is hampered by lack of experience in deploying these at scale. SAWI's pre-feasibility study on new technology for floating solar photovoltaic generation informed a 500 MW pilot in the Indian state of Madhya Pradesh that was mentioned in the Prime Minister's speech during the inauguration of the state's 750 MW ground-mounted Rewa solar park project supported by the World Bank.[5] SAWI identified barriers to scaling up capacity of floating solar in India and suggested measures to unlock its potential in India and other South Asian countries. The recommendations were well-received by the Government of India. Given India's strong commitment to its nationally determined contributions to emission reductions, this engagement is directly helping scale up the government's installation of cleaner, greener projects. Land is a scarce resource in urban areas and SAWI's work presents a huge opportunity to develop solar projects that use small bodies of water for floating solar panels that can also reduce evaporation of the water covered.

BOX 9: SAWI AS AN INTEGRATOR: FLOATING SOLAR PANELS FOR CLEANER ENERGY

India is committed to reduce the greenhouse gas emissions intensity of its Gross Domestic Product by 33-35 percent by 2030 from 2005 levels, requiring multiple technologies. Under the Paris Agreement, India targets at least 40 percent of its power generation capacity to be from non-fossil fuel sources by 2030. As of July 2021, India had installed about 44 GW of solar based capacity, mostly from ground-mounted solar projects deployed in the past decade.

Floating solar photovoltaic technology is an innovative alternative that installs photovoltaic panels on water surfaces such as hydroelectric dams, large ponds, lakes and reservoirs. The technology avoids the constraint of land availability, is relatively easy to install, and can use existing hydropower or irrigation infrastructure.

A crucial element for floating solar technology is the readiness of the value chain to support an expansion of the technology, which is often inhibited by high production costs and lack of skilled workers for installation and maintenance. Value chain support is also needed to promote the industry to become robust at home and competitive in international markets. Growth of the sector requires coordination among stakeholders in the value chain including utilities, developers, engineering procurement and construction specialists, manufacturers, and component suppliers. Also needed are faster completion of projects, larger investments, and greater agility to capture value in a rapidly growing sector, all of which will determine floating solar delivery deployment strategies and pricing in India.

SAWI's technical work brought early knowledge into the development of a nascent ecosystem for floating solar and achieved the following results:

- SAWI kickstarted deeper discussions on floating solar in the country. The ministry for renewable energy and India's central electricity planning body commended SAWI's efforts and described floating solar as an important intervention at the right time.
- SAWI's mapped 2,173 water bodies in India and integrated the information into the Global Solar Atlas.[6] Additional work analyzed 100 water bodies (20 each in five states) to help government agencies and project proponents identify specific sites floating solar development can be taken up at scale.
- A pre-feasibility report contributed preparatory work for a 500 MW floating project at Omkareshwar Dam in Madhya Pradesh – the first taken up at scale in India in a public-private partnership.
- SAWI identified barriers, constraints, and bottlenecks that could slow efforts to unlock the potential of floating solar across the value chain. SAWI developed a guidance document to describe gaps in technical standards and certifications for ensuring quality installations. The guidance was based on case studies from the 500 MW Omkareshwar project and the 40 MW Hirakud project, and will help the World Bank appraise future floating solar projects.

5 https://timesofindia.indiatimes.com/city/bhopal/pm-launches-rewa-mega-solar-park-says-india-in-top-5-in-green-power/articleshow/76901372.cms.

6 The database of potential floating solar sites in India is hosted on the Global Solar Atlas site at: https://globalsolaratlas.info/

Future Opportunities: India's Ministry of Power has constituted a committee on floating solar. The World Bank presented the SAWI studies to the committee to inform the way forward for this technology. The Bank plans to present the study outcomes to the International Solar Alliance, a platform that brings together solar-rich tropical countries to share knowledge with other countries. The World Bank is also supporting Solar Energy Corporation of India through a $200 million Innovation in Solar Power and Hybrid Technology project to bring floating solar into the mainstream. SAWI's work will continue to contribute over the long term by supporting India's development of an ecosystem to open the market for commercial investments for the technology.

SAWI helped initiate discussion and collaborative work in other areas such as water quality and plastic pollution, ecological security and nature-based solutions. For instance, SAWI drew on a multi-stakeholder platform with members from Nepal, Bangladesh, and India, to complete a global database of best practices and scientific literature on the conservation and management of the Ganges River dolphin. This study provided recommendations that will inform future sustainable investments in inland waterways.

A deep dive knowledge series on the mismanagement of plastic pollution in South Asia generated vital baseline knowledge on plastic debris flowing into rivers and seas of South Asia. This work has built a harmonized regional monitoring, management, and policy framework to reduce plastic waste and enable a circular economy model for plastics, providing a baseline against which investments in the region can be planned and monitored. The four reports include: (i) Plastics and Covid; (ii) Plastics, gender and jobs; (iii) Plastics and Climate Change; and, (iv) Plastics and Roads and Transport.

> ***South Asia alone generates 26.7 million tons of plastic waste annually despite being a pioneer in banning single-use plastic bags.***
>
> *The COVID-19 pandemic has escalated the problem of plastic waste. With this tidal increase of plastic waste and lack of effective solid waste management systems, plastic pollution poses significant economic and environmental risks across South Asia.*
>
> *— World Bank blog*

SAWI made policy recommendations to reduce the contribution of the plastic industry to climate change in South Asia. SAWI also supported the South Asia Regional Marine Litter Action Plan and related marine litter action plans in each member country by producing an evidence-based, objective baseline of all the aspects that govern and relate to plastic pollution flowing into waterways across South Asia. Innovation competitions, implemented in partnership with local agencies in Bangladesh and India, spotlighted this growing challenge in South Asia. SAWI's work also influenced and shaped the World Bank's Climate Change Roadmap for South Asia, released in October 2021. SAWI's technical and analytical work informed the World Bank's Plastic-free Rivers and Seas for South Asia ($37 million) and the knowledge serves as a base for development of national action plans to combat marine plastic pollution.

(viii) **SAWI-funded activities informed 43 World Bank investments totaling $9.5 billion, generating wider reach and impact beyond SAWI funding alone**. While aligned with World Bank lending, SAWI support aimed to shape national water investments and engagements in ways that better reflected transboundary considerations. The work covered a wide range of sectors, including:

- water resources management (e.g., India National Hydrology Project, India National Ganga River Basin Project, and Pakistan Water Sector Capacity and Advisory Services Project);
- disaster risk management (e.g., Bangladesh Weather and Climate Services Project and Bihar Kosi Development Project);

- groundwater management (e.g., India Atal Bhujal Yojana);
- agriculture (e.g., Afghanistan Irrigation and Restoration Development Project and Bangladesh Climate-Smart Agriculture and Water Management Project);
- environment (e.g., Bangladesh Sustainable Coastal and Marine Fisheries Project); and
- hydropower (e.g., Nepal Power Sector Reform and Sustainable Hydropower Project and Kali Gandaki A Hydropower Plant Rehabilitation).

C. How Does This Add Up Regionally?

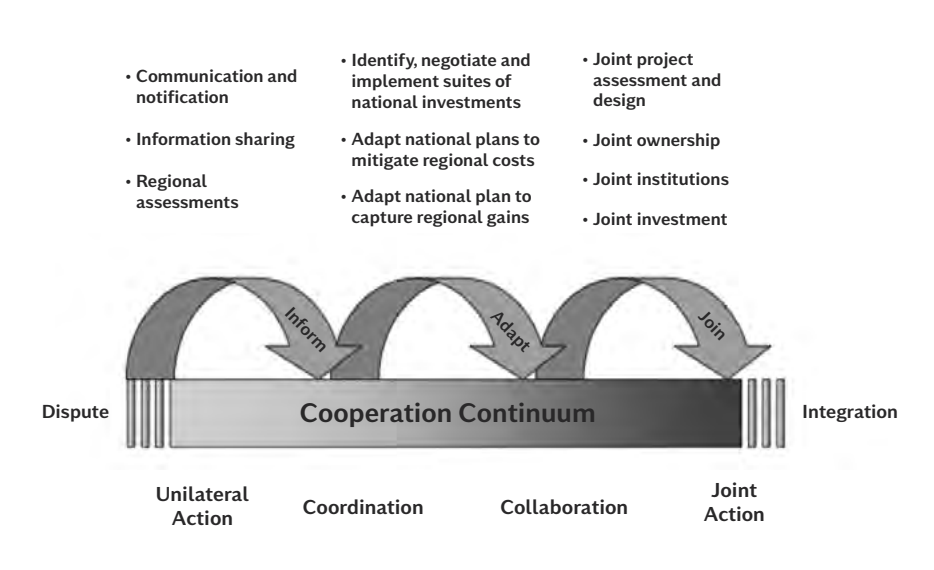
The concept of a continuum of cooperation (Box 10) reinforced SAWI's approach of national entry points as an effective means toward regional cooperation. By promoting national action that took account of basin dynamics as a whole, SAWI was able to strengthen awareness, bring stakeholders together, and to stimulate national action that could potentially have positive regional benefits in the longer term. SAWI recognised that policy choices in one country can impact the needs or vulnerabilities of local riparian communities living downstream in another country. Studies such as strategic basin planning in the Ganges and the Brahmaputra brought new understanding of the need to consider the whole basin when planning investments. This work was subsequently integrated into larger national investments.

BOX 10: A CONTINUUM OF COOPERATION IN TRANSBOUNDARY RIVERS

Water resource management debates have historically focused on conflict vs. cooperation that represents two extreme positions: winners and losers.

An alternative approach – represented by the Continuum of Cooperation (Sadoff and Grey, 2005) — proposes that while national interests predominantly influence state action, several practical benefits can be derived for all riparians from cooperative action.

A continuum of levels of cooperation can range from unilateral action (independent national plans), to coordination (communication and information sharing), to collaboration (adaptation of national plans for mutual benefits), to joint action (joint plans, management or infrastructure investment). Each of South Asia's transboundary river basins offers different potential cooperative benefits with different associated costs.



The Bank considers SAWI's impact to be far greater than the individual contributions of its activities by output and by Focus Area, and beyond the lifetime of this phase of the program.

SAWI's context-specific basin approaches established building blocks for countries to transition from piecemeal interventions to a holistic systemwide approach within the basins and regionally. Momentum has been built – buoyed by positive relationships between countries, particularly in the BBIN subregion. Stakeholders have a deeper appreciation and understanding of imminent threats from climate change and are amenable to finding solutions. The demonstration of successful pilots has spurred confidence of regional stakeholders. While it is unlikely that collaboration will happen at a regional scale, it is more than likely that these pockets of basin-level collaborative action will continue to progress – particularly in the BBIN. Further progress is largely contingent on the overall political landscape, good relations between neighbours, and sustained funding to enable cooperative processes to continue.

SAWI enabled the creation and sharing of significant water-related knowledge as a regional public good, made possible through external donor funding. Several technical studies that looked at issues through a regional lens would not necessarily have been taken forward by national governments, and access to reliable data remains a constraint. The World Bank, through SAWI, and supported by its own networks and country presence, was able to deliver technical work and tools to the public domain that show potential benefits to be shared through cooperation in an apolitical manner. Regional platforms provided the basis for stakeholders to come together and discuss opportunities for cooperation, and the demonstration of successful pilots in one region have sparked stakeholder interest elsewhere. SAWI's knowledge is also being absorbed and taken up by World Bank teams in other regions.

A positive outcome is that nongovernment stakeholders and regional institutions remain invested in supporting broader collaboration beyond geography for transboundary water governance. Partnerships and networks were forged and strengthened during SAWI. Stakeholders avidly participated in regional dialogues and events. SAWI successfully kindled a deeper awareness of water management issues and built momentum as evidenced by stakeholders' growing leadership, policy influence and advocacy in the region. For instance, several institutions have developed policy briefs and knowledge products on the benefits of regional cooperation with transboundary river basins, a critical step in shaping local and regional thinking and discounting information myths. There are also examples of institutional partnerships being formed – for instance between Nepali and Chinese universities, and between Indian and Bangladeshi researchers.

D. Value for Money

SAWI delivered value for money against all four criteria of economy, efficiency, effectiveness and equity. The trust fund's activities were managed in line with World Bank policies and procedures, with adaptive management actions to ensure efficient resource allocation and economy in expenditures.

SAWI achieved efficiency because its portfolio was selected through an internal screening process that ensured alignment with the World Bank's wider operations in South Asia. Economies of scale were achieved through regional knowledge generation and dissemination, and capacity building events, including a partnership with the International Centre for Integrated Mountain Development (ICIMOD) and with other Bank programs in the region.

The trust fund activities drew resources from multiple other sources including the World Bank's budget – in line with the Bank's "Whole of Finance approach" that emphasized SAWI as part of a wider, cross-sectoral effort in South Asia. This had the added benefit of enabling SAWI activities to progress beyond its financing

envelope and to enable continuity as some activities remain partially financed through other sources of grant financing.

SAWI achieved value for money in procurement by following standard World Bank processes in hiring international consultants with years of experience in the basin areas. This saved substantial costs that would have been incurred by starting from scratch. For instance, the same consultant that supported the technical assistance on water resources management in the India's North East Region also supported the development of SAWI's full model of the Brahmaputra River Basin. Bringing in expertise and knowledge from local consultants with significant experience working in the same geography and on similar activities helped to bring efficiencies setting up flood forecasting systems in Bihar, along with many other activities.

SAWI activities were aligned with other World Bank trust funds supported by the United Kingdom's Foreign, Commonwealth and Development Office (FCDO) and Australia's Department of Foreign Affairs and Trade (DFAT) that are managed by the SARRE team. For example, SAWI's hydromet, data sharing, disaster risk management and climate work are closely linked with the FCDO-funded Program for Asia's Resilience to Climate Change. SAWI's work related to regional connectivity with inland waterways and hydropower resonates closely with FCDO's Program for Asia Connectivity and Trade and with DFAT's South Asia Regional Trade Facilitation program, enabling a more integrated approach.

The SAWI trust fund delivered effectiveness in several ways. First, SAWI was strategically linked to 43 World Bank lending operations in South Asia worth approximately $9.5 billion, enabling an extended reach and sustainability beyond trust fund resources.

Second, SAWI delivered value for money by working with and through other partners and collaborators such as with ICIMOD on the Indus Basin Knowledge Forum, through the Bangladesh-India Sundarbans Regional Collaborative Initiative, and through the Nepal Water Platform. Additionally, SAWI partnered with the regional organization South Asia Co-operative Environment Programme, the implementing agency of the Plastic-free Rivers and Seas for South Asia project to disseminate knowledge about plastic pollution.

Third, SAWI's work was taken up by governments. For instance, the introduction of new modelling and forecasting tools in India, Nepal, Bangladesh and Bhutan delivered system efficiencies that will save lives and benefit many others in the long run. SAWI feasibility studies – such as those done for the Eastern Waterways Grid – helped to confirm the overall feasibility of the approach and informed governments in the region and multilaterals on the way forward.

E. Gender and Social Inclusion

An underlying theme of the World Bank's Gender Strategy (refreshed in 2016) is to build the resilience of women and men to cope with climate-related shocks. SAWI mainstreamed gender across its portfolio of activities. This meant that SAWI adopted the principle of 'do-no-harm' with a gender-inclusive approach. All five Focus Area strategies were sensitive to poverty, vulnerability and social inclusion in that particular context. Because SAWI activities were mainly analytical and facilitative, the portfolio did not include specific gender-targeted interventions.

In its early years, SAWI recognized the need to integrate gender and social inclusion in activities. However, the opportunities were rare and difficult to create given that stakeholders' attention focused on a myriad of other issues – mostly engineering-led solutions. Another challenge was that gender-disaggregated data was not immediately available and only limited literature and evidence existed on the differential impacts of transboundary water and climate on South Asian men and women.

Community consultations on the need for better weather and disaster forecasting in the Indian Sundarbans.

Source: World Bank internal Completion Report (2019).

SAWI found that women tend to be active in water management in civil society, but few are involved in water management within governments. An early realization was that deep and meaningful engagement with communities would require a much larger scale of effort than what SAWI could reasonably offer. SAWI, therefore, focused on encouraging female participation in workshops and capacity building events, and raising gender issues with policy makers and regional stakeholders.

BOX 11: SAWI'S GENDER FOCUS

Over the years, SAWI made incremental progress in strengthening its gender-focus. Some examples are as follows:

Dialogue events spotlighted gender issues (Output 1): SAWI used dialogue events to raise public awareness and bring gender issues into the discourse. A key theme of a 2019 regional workshop was, "Health, Gender and Social Inclusion: Engaging Communities to Address Challenges of Water Scarcity and Floods." Similarly, the Indus Basin Knowledge Forum in 2019 included a session on gender which was delivered in partnership with Australian institutions. Participants' feedback noted that they found it valuable and that these concepts had previously not been considered, such as gender requirements when developing river flow models[7]. Taking into consideration the socio-cultural context of the Indus Basin, it was a significant to have women representatives from the region participating in this public forum. SAWI approached the issue of women's participation in forums in a sensitive manner. One lesson learned was that while efforts should be made to attract women speakers and participants, some women may be uncomfortable taking a prominent role because it can affect how they are viewed after returning to their country or workplace.

Gender consideration informed design of World Bank investments. For instance, the project, **Improving Water Resources Management in Northeast India and Assam**, incorporated into flood shelters gender aspects such as separate rooms and toilet facilities for women, and easy access for those with disabilities. The early warning system under the World Bank's AIRBMP project that will link to the flood forecasting system supported under SAWI, will mainstream measures for ensuring equal access to early warning information to all. A functional review of agencies involved in water resources and disaster risk management was accompanied by an in-depth study of gender and social inclusion institutional issues – attracting, promoting and retaining women employees in government agencies.

Also, multiple consultations and capacity building events were conducted during the preparation of the environmental and social systems assessment for the National Groundwater Management Improvement Program in India. The assessment focused on gender issues and provided recommendations for a gender-informed groundwater investment program, such as ensuring women make up 20 percent of participants in developing groundwater security plans.

7 See Twitter hashtag #IBKF4 for participants' comments on this session and the broader event.

SAWI used emerging knowledge to spotlight and deepen understanding on the gender-dynamics in water (Output 2): An assessment and mapping of flood risks in the Ganges Basin resulted in preparation of the Flood Risk Atlas, hosted on the website of India's Central Water Commission (CWC). The atlas provided reliable estimates of the gender-disaggregated impacts of the devastating Bihar floods in 2017. In future years, this is expected to help government to prioritize its actions, including for women and the most vulnerable groups. Although this work added to the CWC's toolkit, the extent to which this remains in use is less clear.

Elsewhere, targeted environmental studies in the Sundarbans delved into issues of vulnerability. Women who spend long hours standing in wetlands water to catch fish, crab, prawn, and other marine life for income, tend to suffer from illness. A survey of over 900 households gathered information on the impacts of prolonged exposure to saline water for women and children as the sea level rises in the Sundarbans. The study also found that health and nutrition in flood-prone areas was better than in drought-prone areas, possibly due to the abundance of fish. The findings informed high-level policy discussions in Bangladesh and India. Gender and social inclusion were included in a rapid assessment report of the Brahmaputra Basin modelling activities and spotlighted in a high-level committee report to India's Prime Minister, based on inputs received from the World Bank.

The Gender Learning Project, a 2020 activity by Australia's Department of Foreign Affairs and Trade (DFAT), noted that SAWI's gender-disaggregated data and research provided an important entry point for engagement with policy makers on gender in the water sector.

It found that the Sundarbans Targeted Environmental Studies "strengthened understanding of the gendered impacts of prolonged exposure to saline water, [and] informed high-level policy discussions with regional actors at the Brahmaputra River Symposium."

SAWI drew on gender experience in the Sundarbans by engaging with local women in the community, including women leaders of villages and women heading local government. Women expressed different needs about adaptation strategies and described how they interacted with the broader Sundarbans ecosystem. The information gathered brought new learning to World Bank programs about options for selecting seed varieties, shrimp farming and other indigenous community-based solutions.

Inclusive capacity building strengthened skills of women water agents (Output 3): Over 250 women participants benefitted from SAWI training and other capacity building events. Women engineers in Bhutan were trained on dam safety and managing large civil works contracts in hydropower. In India, over 45 women benefitted from training in innovative analytical techniques for water management and modeling. Participants gained exposure to Big Data-driven geospatial analytics for water resources management, environmental and natural resources monitoring, and related sectors such as agriculture, climate change and disaster risk.

F. Lessons

(i) **A differentiated approach across each of the three sub-basins and landscape confirmed the design principle that a one-size-fits all approach would not be appropriate**. The early development of five Focus Area strategies, in consultation with stakeholders, helped to ensure that SAWI was well-grounded in contextual realities and responsive to the needs of individual basins. For example, in the Indus Basin, SAWI used the topic of climate change, a priority for all four riparian countries, to bring stakeholders together.

(ii) **While analytical work brought new insights, sequencing the work with capacity building and dialogue forums was important**. Targeted training, exchange visits and study tours became an effective way first to engage officials on transboundary water management, then to help operationalize tools developed by the program. The processes of collaborative knowledge generation fostered closer relationships and enriched the dialogues.

(iii) **Development is transient and certain technical tools or products may be time-sensitive to build capacity or facilitate immediate change. It is conceivable that once certain changes occur, the tool might have outlived its original purpose. This does not mean that the work is unsustainable**. For instance, work undertaken in SAWI's early years helped introduce new tools, models and approaches to government

stakeholders. Some of have since become embedded in government systems such as Bhutan dam safety guidelines and Bihar flood forecasting. Other tools were used immediately to advance government capabilities but may no longer be in use as technology evolves, such as the Central Water Commission dashboard tools in India.

(iv) **The use of national entry points to further a regional approach was highly effective**. It enabled SAWI to engage stakeholders in technical and policy-relevant discussions on the whole basin in a way that was relevant to national priorities and benefits, but without directly tackling contentious regional political issues. For instance, the concurrent progression of national papers on plastic pollution at the same time a regional baseline was developed helped build a harmonized approach to prospective action plans in each country.

(v) **SAWI's conceptualization of a source-to-sea approach became a key means to reframe the debate away from contentious water-sharing issues**. The SAWI approach considers the rivers in South Asia from their origins in the Hindu Kush Himalayan region to where the rivers drain into the sea. The holistic view enabled stakeholders to focus attention on a host of interconnected issues across the whole basin, not just the river's path within their geographic boundaries. This also helped focus stakeholder discussions on the potential uses of water as a regional integrator across sectors such as clean energy and inland waterways.

(vi) **Some activities on ecosystem services and nature based solutions emerged later in the SAWI program but could have been part of the Focus Area strategies from the start to build resilience and help vulnerable communities adapt to the impacts of climate change on transboundary waters**. Any future programming should consider this as a lesson and recommendation.

(vii) **The approach of convening of stakeholders around discrete pieces of analytical work proved to be a practical way of fostering collaboration and building momentum for action**. For instance, technical background work on hydromet services in the Sundarbans supported a BISRCI-led study and used a novel approach of engaging researchers from Bangladesh and India. The work found relevance and acceptance by both countries and was shared with the respective ministries. Indus Basin stakeholders developed a joint research proposal and are working to secure funding to take this forward.

(viii) **Donor-facilitated partnerships and diplomacy complemented SAWI's focus on policy, technical issues, and investment, but the efforts could be better harnessed, notably on the results side**. SAWI valued the role that donors played in enhancing cross-partner facilitation through the broader FCDO South Asia Water Governance Programme (SAWGP) and DFAT Sustainable Development Investment Portfolio (SDIP) programs. Sharing information, findings and lessons learned across partner programs is helpful for cross-fertilization of knowledge. Alignment of results frameworks could help to ensure that the overall programmatic efforts are coordinated.

G. Conclusion and Recommendations

Climate change is a significant risk with severe impacts for the region. There is strong evidence from World Bank and other analysis that the three major Himalayan transboundary rivers are likely to be significantly impacted by climate change in numerous ways. The World Bank's analytical work on water security for Pakistan concluded: "*Climate change is the biggest **longer-term** and currently unmitigated **external** risk to Pakistan's water sector. Climate change is not expected to greatly alter average water availability over coming decades, but inflows will become more variable between and within years, increasing the severity of floods and droughts.*"

In the Ganges basin, climate remains an unmitigated risk. SAWI's technical work — based on computer models of scenarios — concluded that by 2040, "*uncoordinated and increased economic activity and socio-economic development were most likely to have serious water resource consequences for the Ganges rather than climate change, previously considered to be the main threat.*" For the Brahmaputra, which has relatively low water withdrawals, climate change is associated with changes to flooding, sea level rise and salinity in the delta region.

> A World Bank study, "Groundswell: Preparing for Internal Climate Migration," (2018) suggests there could be as many as 40 million climate migrants in South Asia by 2050 without adequate climate action.

The imperatives for supporting regional actions on climate change and shared resources remain strong. The UN Intergovernmental Panel on Climate Change in 2021 released its 6th Assessment Report, presenting a stark forecast of the impacts of climate change on South Asia as global warming increases. This includes predictions of hotter weather, rates of glacial melt and meltwater volumes, uncertainty about monsoons, more droughts, rising sea levels and flooding for coastal areas. This is likely to have strong negative consequences for the countries of the region and their populations in terms of climate-related disasters that result in huge economic impacts and loss of lives, livelihoods and infrastructure. To add to this, water shortages and poor water quality increase the likelihood of escalation in regional tensions among riparian countries over shared rivers.

The case for funding a new phase of SAWI remains strong to sustain its good work and momentum. SAWI was successfully implemented and is valued by officials in the highest levels of government and non-governmental influencers and stakeholders in South Asia. Its pioneering efforts created and sustained first-of-its-kind dialogue platforms that gathered momentum despite political differences in South Asia. SAWI brought home the centrality of climate change and the environment, as well as the need to include social and economic aspects in the governance of transboundary rivers of South Asia. This will be fundamental to the region's growth, development and security in the long term. Solid networks have been created across the region – these play an influential role within their own countries and across the region and therefore provide a rich basis for continued non-formal yet dynamic engagement on the important issues of water, climate, and resource security as well as on tackling barriers to regional connectivity. Any future phases of work will continue to work with and through these networks.

Most SAWI activities are linked to the World Bank's operations in South Asia and there is a strong likelihood that its knowledge work will sustain. In the final years of the program, activities put in place measures to sustain dialogue processes and for access to and use of knowledge. Without donor funding and World Bank facilitation, and given the pandemic-related challenges, it is unclear to what extent dialogues will sustain beyond this phase. The SAWI team is exploring new partnerships and funding to transition the gains from this phase of the trust fund in a manner that continues to build momentum, leverages SAWI's more than 110 partnerships and networks, and supports South Asian efforts to build back better from the pandemic.

Recommendations for future programming include the following:

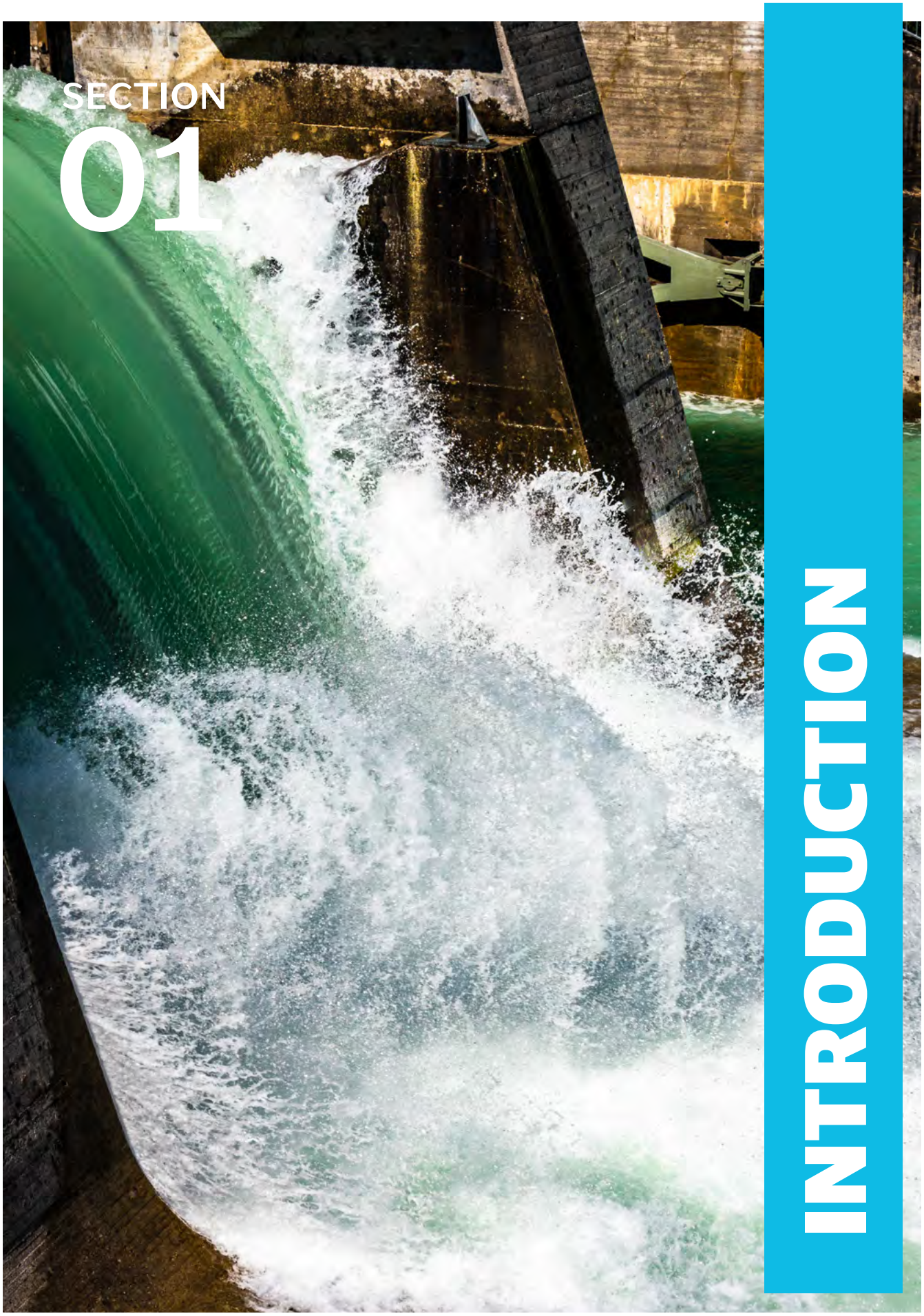
R1. Future programs should support basin-level dialogue forums to continue the momentum that has been built. Without donor funding, it is unlikely that these forums will continue at scale. Dialogues

for the Brahmaputra Basin and the Sundarbans Landscape may continue but at Track 2 or Track 3 levels through the efforts of civil society and regional institutions. Other dialogues may not be able to proceed at the same scale.

R2. Innovative nature-based solutions such as those initiated under SAWI Phase 2 should be further tested so future Bank investments can help to take these to scale. SAWI was able to promote nature-based solution approaches through its technical work – such as watershed and landscape management, community engagement in ecosystem management, plastics management, and aquatic conservation considerations in inland water transport. There is scope to strengthen further nature-based approaches and link them to World Bank investments and other climate investments so that these approaches can be taken to scale in strengthening resilience.

R3. Using water as an integrator across sectors can be effective in bringing stakeholders together to address water governance and climate change. SAWI leveraged emerging opportunities – such as hydropower, inland water transport, and disaster risk reduction. These require long-term effort and any future phase of funding should continue to support these efforts.

R4. Design of future phases could consider flexible funding to support community-based pilots, tackle emerging threats and leverage windows of opportunity.



SECTION

01

INTRODUCTION

The waters of the major Himalayan river systems — the Indus, Ganges and Brahmaputra Basins — and the Sundarbans Landscape provide critical ecosystem goods and services to more than 1 billion people living in the South Asia Region of Afghanistan, Bangladesh, Bhutan, southern China, India, Nepal and Pakistan. Transboundary water cooperation is challenging because of South Asia's diverse socioeconomics, varying and sometimes competing stakeholder interests, and dynamic political environment rooted in historic regional tensions and deeply entrenched positions. Challenges include limited water availability, depleted and polluted groundwater, frequent water extremes, environmental degradation, inadequate water supply and sanitation, energy and food insecurity, vulnerable populations, weak and fragmented water governance, and low regional integration.

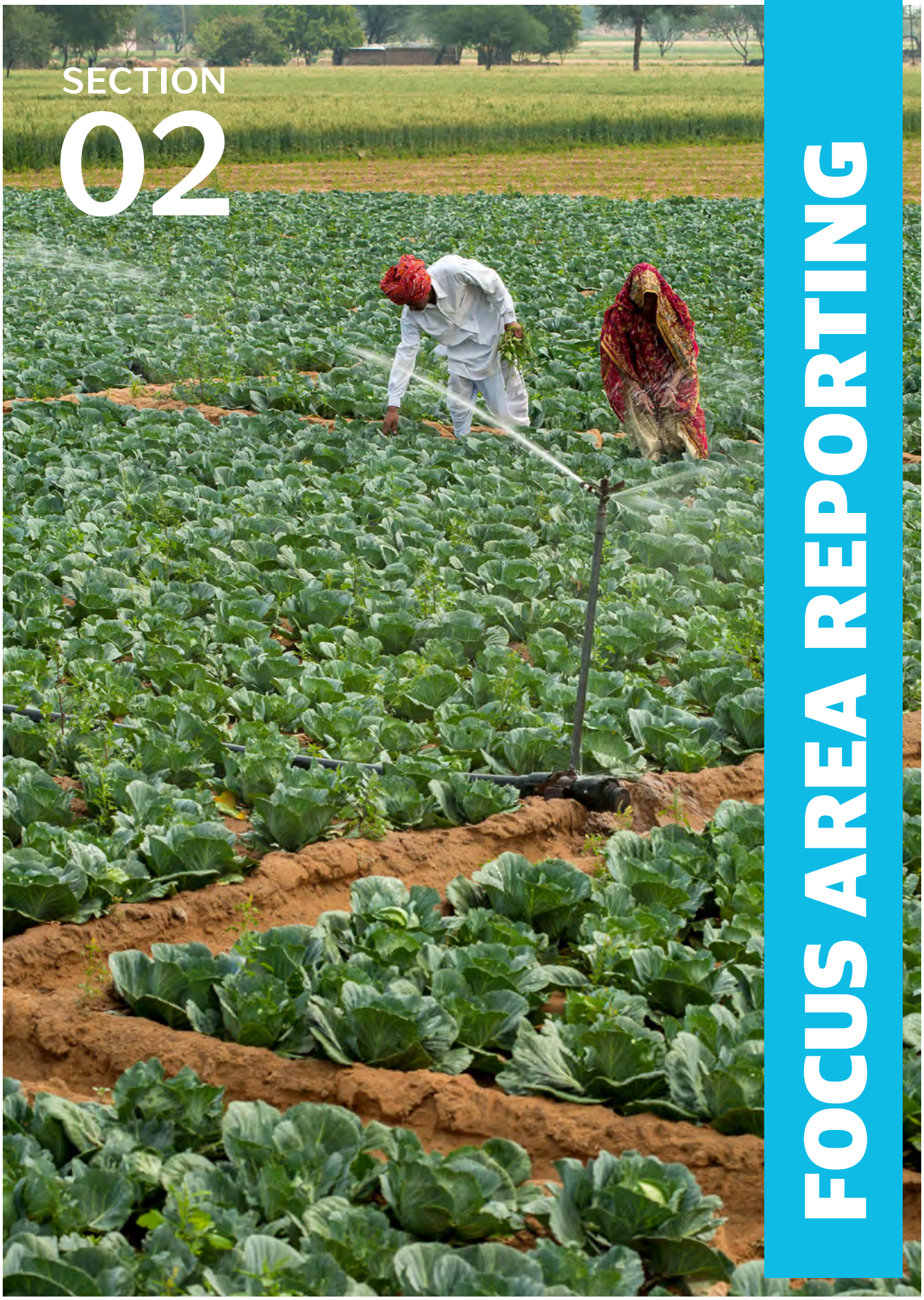
Although there are several ongoing efforts in South Asia to facilitate cooperative management of transboundary water resources, these tend to be localized and piecemeal, work with only subsets of stakeholder groups, and focus on particular sectoral issues. The South Asia Water Initiative (SAWI), conceptualized in 2007 and implemented over two phases (2009-21), was an important vehicle for building on individual efforts through a coordinated and strategic approach. SAWI strengthened momentum toward regional cooperation in sustainable water resources management and development.

SAWI was delivered as a Multi-Donor trust fund administered by the World Bank on behalf of three contributing development partners: United Kingdom, Australia and Norway. This arrangement enabled donors to commit funds to support a thematic framework rather than financing a specific project or activity.

SAWI was a first-of-its-kind trust fund to do this type of work in South Asia. The development objective agreed for the program from the outset was "to increase regional cooperation in the management of the Himalayan River systems to deliver sustainable, fair and inclusive development and climate resilience." In the context of water resources planning and management, the program promoted poverty alleviation, economic development, gender inclusion and climate change adaptation. SAWI was organized around four geographic Focus Area strategies for the Indus Basin, Ganges Basin, Brahmaputra Basin and Sundarbans Landscape. A fifth Focus Area strategy regional cross-cutting knowledge, dialogue and communications supported non-basin-specific work and translated basin-specific work for wider dissemination implementation.

These strategies laid out high-level objectives, planned areas of activity and provided an assessment and mitigation of key risks to program success. They were developed based on extensive consultation with key stakeholders in the region. The approach allowed SAWI to focus its efforts and incrementally build a portfolio of activities responsive to the evolving regional context. All activities were implemented in close partnership with client countries and a range of national and international implementing partners, including NGOs, research organizations, thinktanks and academic institutions. Many activities contributed to multiple result areas, providing the mechanisms to increase cooperation in water management across the region.

SAWI remained strongly relevant, not only to its core objectives but also through its role as a regional integrator across sectors, geographies and stakeholders. The need for a regional approach in South Asia remains a priority, particularly as inaction and climate change are likely to have adverse impacts on regional growth, security, prosperity and the lives of 1 billion people. In the absence of a regional transboundary mechanism for water, SAWI was able to bring regional stakeholders together to work toward collaborative action.



SECTION

02

FOCUS AREA REPORTING

2.1 INDUS BASIN FOCUS AREA

Context

The Indus River Basin is of great significance to the region as millions of people depend on its water for agriculture, food, and livelihoods. The basin, which covers territory in Afghanistan, China, India and Pakistan, faces acute water stress due to increasing demand from a growing population of more than 300 million, energy deficits and the desire for more hydropower development, irrigation diversions upstream, and overextraction of depleted groundwater. The basin has a unique topography – it has extensive groundwater aquifers and the Indus and its tributaries are fed by more than 18,000 glaciers, snow melt and rainfall. The Indus Basin is highly vulnerable to extreme weather-related events such as floods, droughts and high temperatures. Climate change and shrinking glaciers are impacting river flows and water availability with potentially severe results for the basin population.

The Indus Basin is a complicated environment, affected by decades of conflict and layered in a complex network of natural, social and political systems. The complexities are intensified by data gaps about the basin that impede informed decision making. As inter- and intrastate competition grows over water resources, tensions within and between the countries are likely to escalate. While some issues can be managed at the national level, others require cross-border coordination. However, regional water management challenges are compounded by the basin's transboundary nature, capacity asymmetry, uneasy relationships between riparian countries, and the fragility of post-conflict Afghanistan. The absence of effective basin-wide management institutions results in missed opportunities for more effective, efficient water management and for knowledge exchange. Local knowledge of water resources is key information to be included in bilateral discussions and negotiations.

SAWI's Strategic Approach

The relations between state and non-state stakeholders reflect a complex political and social landscape in the Indus Basin. Given the context of the political economy and history of tense relationships between riparian countries, SAWI found the topics of water resources and climate change served as effective entry points to bring riparians together, both within countries and across borders.[8] SAWI's six activities worked together to broaden basin-level dialogue and build its influence through a Track 2 Indus Basin Knowledge Forum (IBKF) process, and its precursor, the Indus Forum. SAWI sought to build trust among riparian countries and establish an enabling environment for cooperation at the basin level, beyond the scope of the Indus Waters Treaty. SAWI activities facilitated national thinking and action toward a basin-wide approach through capacity building, exposure visits on climate change adaptation and water resources, and technical knowledge to inform policy making. All SAWI activities in the Indus Basin ended in a previous reporting year, with sustainability measures put in place, and there was no additional SAWI-follow up work in the final reporting year.

SAWI was implemented through six distinct, but highly interrelated and coordinated activities:

1. Indus (Pakistan) Groundwater Analysis
2. Indus Dialogue
3. Integrated Management of Kunar Basin
4. Kabul/Kunar Basin Development
5. Learning Innovative Approaches in Glacier Monitoring
6. Glacier Monitoring in Upper Indus Basin

8 Because of the World Bank's role in the 1960 Indus Waters Treaty and the importance of engaging in a neutral way in the basin, SAWI maintained transparency on the Indus Basin. SAWI's work did not fall directly under the purview of the Indus Waters Treaty.

Outcomes

The establishment of a functional regional Indus Basin Dialogue and Knowledge Forum process was the most significant outcome. Given the complex political and social landscape in the Indus Basin and historic tensions between riparian countries, this is a considerable achievement for a region with strained relations, including in the context of water. In partnership with other regional institutions SAWI supported four politically neutral events, organized jointly with regional knowledge partners, which grew to over 100 influential participants comprising senior government officials and non-government experts from Afghanistan, China, India and Pakistan. These events focused on water and climate, and in turn led to development of a joint research proposal by the participants from the four countries. This is a considerable achievement for a region with longstanding political tensions, particularly in the context of water. Without external donor-funded support it is highly unlikely that this type of neutral dialogue platform would have happened. The Indus Basin Knowledge Forum has shown serious intent to continue and identified three key strategies for catalysing future action: (i) identifying a representative group of champions to take forward the mandate; (ii) identifying priority research areas for building a business case; and (iii) using digital networks and platforms to share knowledge and research on cross-cutting issues in the region.

SAWI delivered 205 technical products, providing an analytical foundation to further dialogue among negotiating parties in Afghanistan and Pakistan, and to raise water resource management as a thematic priority in national policy and action. For instance, SAWI's groundwater analysis in Pakistan[9] was accepted by authorities – a vital step to inform upcoming reforms and policy direction on water management of this scarce resource, and relevant to building resilience in the context of the pandemic. The groundwater analysis work is likely to continue to have traction. It is anticipated that this work will continue to inform initiatives on managed aquifer recharge, conjunctive management, groundwater monitoring and data management, and the essential institutional reforms to provide the enabling environment for these initiatives to be implemented. The groundwater study is also relevant to the pandemic situation as its findings could be used to support the case for essential reforms to bolster future resilience for situations such as caused by the pandemic.

Capacity building for 1,983 people on water diplomacy and other topics built water officials' confidence to negotiate with larger neighbours, and broadened perspectives of regional stakeholders to other possibilities on cooperative water resource management. For example, Afghanistan drew on SAWI knowledge to strengthen ministerial collaboration on water resource management in dialogue with Iran and Tajikistan. This kind of increased willingness to engage on transboundary water issues could pave the way for strengthened dialogue on the Indus Basin and beyond.

Sustainability

To support sustainability of the dialogue process, SAWI facilitated a transition of the Indus Basin knowledge forum and joint research activity to the International Centre for Integrated Mountain Development (ICIMOD). SAWI succeeded in fostering relationships and building confidence of regional stakeholders by demonstrating the value of collaborative platforms on a common shared resource. In the longer-term, collaborative dialogue remains significant as water security and climate change challenges are likely to intensify and will require action. Stakeholders that have been involved in Track 2 dialogue continue to advocate for collaborative action.

However, without ongoing financial and institutional support, it could prove difficult to maintain the momentum for a forum such as this. It is unlikely that the Indus Basin Knowledge Forum will continue

9 Lytton,Lucy; Ali, Akthar; Garthwaite, Bill; Punthakey, Jehangir F.; Saeed ,Basharat Ahmed.
Groundwater in Pakistan's Indus Basin : Present and Future Prospects (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/501941611237298661/Groundwater-in-Pakistan-s-Indus-Basin-Present-and-Future-Prospects

in its current form or deliver meaningful joint action without externally facilitated support. The evolving political situation in Afghanistan and COVID-19 restrictions also introduced some uncertainty about the likely sustainability of the forum. Any follow-on activity will need to factor in the shifting geo-politics of the region, including the situation in Afghanistan, and adjust the approach to engaging with policy makers at the national, subnational and regional levels.

The World Bank's investment portfolio and its country-level operations remain the main avenue for uptake and sustainability of SAWI's work. Technical knowledge greatly enhanced stakeholders' understanding of the feasibility and opportunities for regional action. Partnerships established with regional institutions and influential networks will continue to sustain through the Bank's wider operations.

Output 1: Building Trust and Confidence

In the Indus Basin, the lack of knowledge, information exchange and trust among riparian countries have made investment in water management infrastructure a major challenge. SAWI's **Indus Basin Dialogue** activity, which originated in a regional Abu Dhabi Dialogue process,[10] facilitated a structured dialogue aimed at shifting thinking from national issues to a basin-wide and regional approach. One of the most important elements of this activity was the Indus Forum[11] — a Track 2 basin-wide dialogue established in June 2013. The forum helped engage influential government and non-government stakeholders from all four riparian countries in regional dialogue, not just India and Pakistan. SAWI expanded this partnership approach through a technical forum, the Indus Basin Knowledge Forum. Notably, four knowledge forum events were held in 2016-19 despite new regional political tensions that surfaced between the countries.

The Indus Basin Knowledge Forum created a neutral space that encouraged regular, continuous, and informal dialogue among government officials and opinion leaders. SAWI also supported dialogue between national and basin level stakeholders, particularly important for intra- and interstate water management challenges in the basin. These informal platforms positively influenced formal processes of policy development, transboundary dialogue and negotiations.

The Indus Basin Knowledge Forums created a rare opportunity for water managers in the four riparian countries to come together in a collaborative environment despite there being tensions between them, including in the water space.

The Indus Basin Knowledge Forum created a rare opportunity for water managers in the four riparian countries to come together in a collaborative environment despite regional tensions. The process evolved as an offshoot of the Indus Forum, as a strategic platform to build stronger collaboration between producers of scientific knowledge and users of knowledge to make more informed decisions. For example, while all dialogue between India and Pakistan was suspended for a few months in 2016-17, technical dialogue through an Indus Forum working group continued to keep the academic and research community engaged. Altogether, four Indus Basin Knowledge Forum events were held between July 2017 and August 2019. From an initial involvement of 15-20 government representative and opinion leaders from the four riparian countries, the most recent knowledge forum in August 2019 convened 100 regional stakeholders from government, academia, civil society organizations, and international experts. Further events were stalled due to COVID-19.

The quality of dialogue spurred regional collaborative action – particularly towards deepening knowledge on climate factors most relevant to the basin. The Indus Forum working group used science

10 The Abu Dhabi Dialogue was held in Abu Dhabi in September 2006, hosted by the International Institute of Strategic Studies with the support of the United Kingdom. The World Bank facilitated the dialogue during SAWI Phase 1 and it brought together senior stakeholders from SAWI's seven countries.

11 Since February 2016, the Indus Forum has been facilitated by the International Water Management Institute and International Union for Conservation of Nature.

as a mechanism to inform policy and public discourse on the Indus. The working group developed a joint research proposal, "Understanding and Assessing the Impact of Climate Change in the Indus Basin," to address knowledge gaps and inform policy makers on basin-wide water availability scenarios, their impacts on people, and adaptation strategies. The research proposal resulted from a collaborative approach aimed at strengthening understanding of climate change scenarios, establishing long-term benchmark glaciers and developing a framework to examine potential impacts of climate change scenarios on socio-economic development. The working group undertook a study tour to China, and Pakistan invited Afghan participants to capacity building training on glacier monitoring.

BOX 12: THE INDUS BASIN DIALOGUE PROCESS

SAWI drew on the World Bank's comparative advantage as a neutral broker of global knowledge through the Indus Forum. This Track 2 dialogue process took a basin-scale perspective and convened stakeholders from all four riparian countries to understand the basin in its totality. Over the years, the Indus Dialogues evolved with increasing engagement from the riparian countries.

2013	The first Indus Forum, hosted by the Government of Afghanistan in Kabul in June 2013, identified climate change research as an area for cooperative action because of expected impacts all four riparian countries, though with different effects.
2014	The second Indus Forum, in January 2014, occurred alongside a SAWI-funded study tour to Ecuador which stimulated ideas for collaboration.
2015	The third Indus Forum, Climate Change and Vulnerability of the Indus Water Resources, in March 2015 in Lahore, was hosted by the Government of Pakistan, the Water and Power Development Authority, and the Water and Environment Forum in Pakistan. Deliberations led to the formalization of a cross-basin technical working group mandated to develop a joint research proposal titled, Understanding the Impact of Climate Change in the Indus Basin. The working group initiated a joint research proposal development through virtual discussions and a scientific visit to China.
2016	The fourth Indus Forum met in February 2016 in Kathmandu, organized by SAWI, ICIMOD and International Water Management Institute. Participants consolidated collaborative efforts. In October 2016, officials and experts from the four Indus countries went on a study tour to the European Alps, where they finalized a joint research proposal and institutional arrangements to take it forward.

Output 2: Generating and Sharing Knowledge

SAWI learned that given the transient and fragile political economy of the sub-region, the most traction for its knowledge work came from country-focused technical work with potential for harnessing wider knowledge and impact.

In FY15, SAWI's **Integrated management of Kunar Basin** activity supported technical and analytical work on joint river management in the Kunar River Basin, which confirmed the economic feasibility of hydropower development that could provide low-cost energy supply for both Afghanistan and Pakistan. The Kunar River Basin plays a significant role in regional water security and provides irrigation to riparian communities in both northeastern Afghanistan and northwestern Pakistan. However, the area is shaped by historically complex relations between the two countries, their evolving geopolitical strategies and foreign policies, and their interests regarding national security and water use.

The timing of this work was opportune. In 2014, the Joint Economic Commission of Afghanistan and Pakistan identified development of a hydropower cascade in the Kabul/Kunar basin as a common project warranting further discussion between the two countries. In August 2013, the two countries also made a joint public announcement to engage in the development of a 1,500 MW 4 HEP cascade on the Kunar River and work toward a bilateral formula of cooperation. The World Bank was approached to help assess feasibility and to facilitate joint cascade development between the countries.

SAWI recognised that identifying all stakeholders and including them in operational planning would be critical to the ultimate success of hydropower development in the Kunar Basin. SAWI reviewed the area's untapped hydropower potential and investment opportunities. It also produced analytical work at the regional, basin/landscape and sub-basin level with strategic assessments and technical feasibility under a range of operational and climate scenarios, and identified institutional and policy considerations for transboundary water and infrastructure projects. Although this work initially helped build momentum in both Afghanistan and Pakistan for joint hydropower development in the Kunar Basin, investment opportunities were not taken up because of the changing political economy and shifting interests of Pakistani stakeholders.

Another important SAWI activity, **Indus Basin (Pakistan) Groundwater Analysis**, delved into the issue of conjunctive uses of groundwater in Pakistan and delivered recommendations that resonated strongly with government stakeholders.[12] The study focused attention on the fact that technical problems of groundwater depletion and contamination are fostered through institutional neglect and perverse economic incentives, and solutions must be found within the responsible jurisdictions. Groundwater is managed by provincial governments and it is at that level that uptake is occurring as part of projects in Punjab and Sindh provinces. Relevant information from SAWI has been inserted into World Bank project design documents that are the agreed foundation for projects implemented by the government.

BOX 13: THE INDUS BASIN (PAKISTAN) GROUNDWATER STUDY

Indus Basin groundwater is a vital part of Pakistan's water resource base and supplies 90 percent of domestic water in rural areas of Pakistan, 70 percent of domestic water nationally, and over half of agricultural water. However, unmanaged extraction of groundwater threatens the resource base while waterlogging threatens the viability of agricultural land. Deteriorating groundwater quality also threatens human health in Pakistan. The Indus Basin in Pakistan has a long history of major investment in surface water infrastructure.

By contrast, management of groundwater infrastructure has remained in private hands, leading to uncontrolled expansion of access to groundwater and its deterioration. Institutional capacity for governance of these resources is weak and essential groundwater data that would improve governance are fragmented and not easily discoverable for a significant proportion of the Indus Basin. For groundwater to remain a safe and reliable source of drinking water and a lifeline for tail-end farmers, a balance must be achieved between efficiency of the surface water system and sustainability of groundwater resources.

SAWI delved into the issue of conjunctive uses of groundwater and delivered important recommendations that were well received by government stakeholders. The activity focused on provincial governments of Punjab and Sindh in Pakistan and national government agencies responsible for groundwater management.

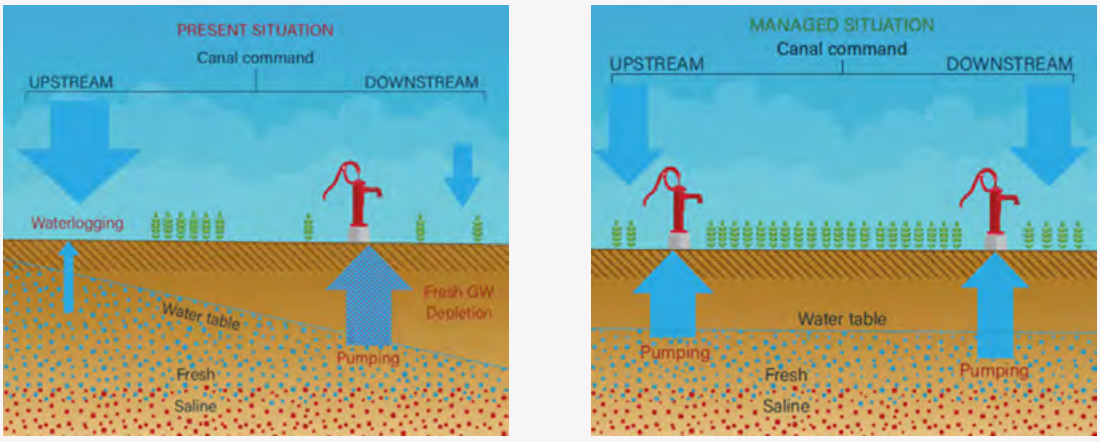


Figure 2: Conjunctive management of ground and surface water.

12 The sub-national (state/provincial) government has jurisdiction over groundwater, and the subject is not covered in the Indus Waters Treaty.

SAWI recommendations identified reform areas and options for tackling groundwater management challenges. This work provided key knowledge to inform the preparation and implementation of World Bank projects in Pakistan. The work is also expected to support initiatives on managed aquifer recharge, conjunctive management, groundwater monitoring, and data management and institutional reforms to provide the enabling environment for these initiatives to be implemented.

The work was timely as Pakistan's new national water policy, issued in April 2018, included a chapter on groundwater and the province of Punjab passed a new Water Act encompassing groundwater. The province of Sindh is drafting a new provincial water policy and SAWI prepared a background paper, at the request of the Sindh government, as a contribution to this legislation. The Khyber Pakhtunkhwa province has put a bill before Parliament that proposes a new Water Act. SAWI's report contains useful messages for the management and governance of groundwater in Pakistan, and the World Bank team is considering options for taking this work further.

The work also contributes to ongoing consolidation of the groundwater knowledge base in South Asia, and highlights opportunities for regional cross-learning on common groundwater management issues. It complements previous groundwater work completed by the World Bank in the Indian Punjab portion of the Indus Basin and in turn was informed by current activities in that state, particularly work being conducted around the energy-agriculture-water nexus in the Indian Punjab. SAWI's work benefited from its recently completed advisory work on managing groundwater for drought resilience in South Asia. The work continues to be relevant in responding to the COVID-19 crisis. The World Health Organization has emphasized the importance of safe water, sanitation and hygienic conditions as essential to protecting human health during all infectious disease outbreaks, including the COVID-19 pandemic.

Output 3: Building Institutional and Professional Capacity

An early strategy of SAWI was to build capacity of national and regional stakeholders and enable them to learn about other relevant Track 2 dialogues and international forums focusing on international waters. For instance, 37 senior government officials, technical experts and civil society leaders from Afghanistan, China, India and Pakistan visited Ecuador in January 2014 to learn about climate change and glacier monitoring from institutions participating in the Regional Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project. The main outcomes from this visit were that senior leaders were able to see first-hand how other regions were collaborating on tackling similar issues – by leveraging investments in glacier monitoring technologies to improve water resources and management and climate change adaptation. This spurred action among participants, who agreed to explore glacier monitoring and climate change as entry points for Indus Basin collaboration. Specifically, they agreed to work on coordination among water institutions within individual basin countries and to form a technical working group for the study of climate change impacts on the Indus Basin.

SAWI recognised that capacity building for both transboundary negotiations and technical management was required to facilitate technical studies, conduct basin planning, and foster dialogue for equitable benefit sharing. Experience indicates that countries with well-coordinated national structures can more effectively engage in cross-border dialogue and negotiations. At the request of the Government of Afghanistan, SAWI's **Kabul-Kunar Basin Development** activity supported a two-year capacity building program. This included transboundary waters training to enhance coordination between the Afghan ministries of Energy and Water, Foreign Affairs, and Finance. The capacity building program helped build collegial and close relationships among staff from the three ministries. According to program feedback from participants, the program led to closer collaboration than existed before the program began. The program helped develop the government's overall capacity to participate and engage in transboundary water dialogues in South Asia, and to apply the skills to other transboundary basins that Afghanistan shares with its Central Asian neighbours of Iran, Turkmenistan, Tajikistan, and Uzbekistan.

BOX 14: CAPACITY BUILDING FOR AFGHAN OFFICIALS DELIVERED RESULTS

"All the regional experts were impressed with the preparation and enthusiasm of the Afghan participants. We get many study tours here at the Nile Basin Initiative, but seldom do we engage with such an interested, committed and well-informed study group!"

Dr. Abdulkarim Seid, Head of Water Resources Management Department, Nile Basin Initiative.

From January 2016 to November 2017, SAWI organized training for members of key Afghan government ministries. The 19 workshops offered a combined 150 hours of class time in Kabul. In total, 54 government officials received training, with an average 15 officials participating in each workshop. Fourteen participants attended more than half of the trainings. The workshops ranged from half-day seminars to full-day sessions.

Each training was designed to first develop theoretical understanding, then practical understanding through case studies and simulations. Topics included global experiences with prior notification for transboundary water projects, information and data exchange for transboundary water arrangements, international water law, Islamic water law, negotiation theory, water diplomacy, developing a communication strategy to enhance public understanding, and climate change implications for transboundary water dialogue.

A study tour to the Nile Basin and the Nile Basin Initiative was the capstone event of the training program. It provided an opportunity for participants to relate their acquired theoretical knowledgebase to the Nile Basin as a real-life case study, and to talk with experts who have been negotiating Nile water resources over the last 20 years.

Output 4: Scoping Interventions and Investments

SAWI's technical assistance and implementation support was anchored within World Bank activities in Afghanistan and Pakistan. Although SAWI's technical work on the Kunar Basin did not result in a cascade of hydroelectric projects as intended, it informed the preparation of additional financing for two World Bank projects involved in management of shared river basins and transboundary water governance. The Water Sector Capacity Building and Advisory Services Project ($35 million) in Pakistan tackles transboundary water resource management at the inter-provincial level. The Irrigation Restoration and Development Project ($70 million) in Afghanistan supports inter-ministerial institutional capacity building for transboundary water management and access to irrigation in targeted areas. SAWI's strategic scenario analysis also brought a transboundary perspective to the rehabilitation of the Naghlu Hydropower Plant Project ($83 million) in Afghanistan.

Findings from SAWI's Pakistan groundwater analysis contributed to the World Bank's Sindh Water Sector Improvement Project ($150 million) and to the design of a pipeline project Punjab rural sustainable water supply and sanitation ($200 million). The SAWI findings will also contribute to a component of a planned Sindh Water and Agriculture Transformation Project ($350 million).

Implementation Challenges

Over SAWI's lifetime, the Indus sub-region was a challenging environment in which to hold dialogues and meetings due to security concerns and ongoing political tensions and conflicts. SAWI collaborated with regionally-based implementing partners and recognised that the institutions need solid financial and institutional support that enables them — and participants, many of whom need the sanction of their governments to attend — to plan ahead. Another challenge was the lack of reliable data, a significant constraint to the Pakistan groundwater study. SAWI gathered in-country datasets, drew on grey literature produced by organizations outside traditional academic publishing, and held extensive consultations with federal and provincial institutions, water experts and farmers to identify groundwater concerns.

Lessons Learned

1. **An underlying working assumption is that countries are likely to cooperate when there are clear sovereign economic and political advantages**, compared to unilateral action. For shared transboundary resources, SAWI learned that reaching agreement on equitable benefit sharing requires an initial degree of trust and structured dialogue among key stakeholders based on agreed evidence base and that it is important to get stakeholders on board both within countries and across borders.
2. **SAWI found that regional meetings are best held in a neutral county outside the region**. An early Indus Forum meeting was held within the basin. Its relatively low attendance showed that meetings in neutral countries would allow participation of a much larger, representative group of stakeholders with easier travel logistics. Subsequent Indus Basin Knowledge Forum meetings were shifted to locations in neutral countries.
3. **The inclusion of a successful gender session in the most recent Indus Basin Knowledge Forum encouraged women in the region to participate and helped expand thinking and discussion beyond engineering solutions to inclusive, people-centric issues**. The session was delivered in partnership with Australia's International Centre on Excellence in Water Resources Management on how gender inclusiveness can enhance research impacts. The conference proceedings concluded that gender and social inclusion are shared challenges in development priority areas, particularly in the Indus Basin, for meaningful research with impact. This experience shows the value that external development partners can bring to shaping agendas, providing technical expertise and bringing international experience from other regions.
4. **Finding neutral technical entry points that brings stakeholders together around a common set of challenges is a useful approach**. For the Indus Basin, SAWI found that climate change was a priority and a useful means to bring together participants from different basin countries despite their differences in perspectives and historical tensions.

2.2 GANGES BASIN FOCUS AREA

Context

The Ganges Basin is one of the largest and most populous river basins in the world, covering around 1.2 million km and home to more than 655 million people. It is one of the world's most revered rivers with deep spiritual and cultural significance for millions of people within and beyond the basin. The river flows from its glacial source in the Himalayas through India (84%), Nepal (12%), Bangladesh (3%) and China (1%) and drains into the Sundarbans Delta and Bay of Bengal. Its major tributaries are the primarily rain-fed Himalayan rivers of India and Nepal. The delta is characterized by extensive series of distributary channels, including the Damodar-Hooghly River, but the primary basin outlet is the main stem of the Ganges – called the Padma in Bangladesh – that merges with the Brahmaputra before flowing into the sea.

The basin resources, comprising both surface and groundwater, are hugely significant to the economies of the riparian countries. Agriculture dominates water use, with irrigation currently representing about 90 percent of the basin's combined surface and ground water uses. However, agricultural productivity in the basin is low compared to global averages. Improving water productivity would significantly contribute to food security, poverty reduction, and economic growth in the basin. Hydropower generation is critical to the economy of Nepal and developing its untapped hydropower potential is an ongoing development challenge with major transboundary dimensions.

The Ganges Basin faces several challenges, but also has enormous potential for economic development. First, urbanization and industrialization are changing the sector balance of water demand, giving rise to

increased competition for water and increased stress on water dependent ecosystems. Second, the health of the river and its water quality and quantity have deteriorated significantly from pollution, high levels of water withdrawal, changes in flow, and water infrastructure. Third, the basin has a complex hydrological system largely determined by the annual monsoon that delivers about 80 percent of annual inflows in just three months of the year. Consequently, vast areas of the basin are prone to frequent and devastating floods, droughts, and reduced groundwater supplies with serious loss of life and economic damage. The water sector remains fragmented, often with uncoordinated work across public sector agencies risking sub-optimal planning and investments.

National strategies are aimed at tackling part of the problem, with missed opportunities for leveraging bigger benefits. India has committed significant funds for the rejuvenation of the Ganges and early efforts are focused on point source pollution control. Nepal adopted a federalized system of governance in 2018, and its new Constitution prioritizes national investment in water resources based on people's participation and recognizes access to safe water as a fundamental right.

SAWI's Strategic Approach

SAWI recognised early on that it could gain traction by aligning with national priorities and using them as an entry point to build a regional narrative toward collaboration. This politically neutral approach carefully navigated the political economy challenges around water while responding to stakeholder priorities and was greatly valued by SAWI partners. Given the fragmented approaches to Ganges planning and management, SAWI worked to address broader capacity gaps. It equipped stakeholders with knowledge and tools to help them see water as a shared resource to be managed amid challenges from economic development and climate change.

In the Ganges Basin Focus Area, SAWI implemented nine activities:

1. Strategic Basin Planning
2. Ganges Dialogue
3. Bihar FMIS Flood Forecasting
4. Bihar Flood Modelling Capacity
5. India Water Resource Management in Transboundary Basins
6. Nepal Water Platform
7. Nepal Sustainable Water Resources Development for Hydroelectric Power (BE) and (RE)
8. Power Sector Reform and Sustainable Hydropower Development (RE)
9. Managing Watersheds to Reduce Upstream Sediment for Hydropower in Nepal

SAWI recognised climate change and weather-related events are likely to increase the vulnerability of the sub-region so it invested in analytical modelling and pilots to strengthen systems in Bhutan, India, and Nepal. In India, SAWI's work was closely aligned with national programs and World Bank investments. Technical assistance and capacity building across central and state organizations focused on strengthening integrated water management and improving flood forecasting in Bihar state and India's border with Nepal. Complementary work in Nepal focused on two priority areas: establishing mechanisms and capacity for basin planning to support sustainable hydropower development and supporting federalization of water management and service delivery in line with Nepal's new constitution.

Most SAWI activities ended in previous reporting years, with sustainability measures put in place. In its final reporting year of FY21, SAWI mainly focused on completing work in Nepal and embedding it into national systems and World Bank operations.

Outcomes

Unlike other Focus Areas, a Ganges transboundary dialogue forum could not be established due to the political economy and early realisation that the costs of such an activity would not deliver commensurate results. Instead, SAWI produced technical work better suited to the realities of the basin and stakeholder needs. This strategic approach was relevant and effective, enabling focused engagement with stakeholders and helping SAWI's work to be embedded within national programs while also being regionally relevant. Overall, the technical work brought deeper realization among stakeholders on the potential for economic

development and poverty reduction through more balanced and sustainable management of the water resources of the basin.

The most significant shift came through SAWI's Strategic Basin Planning (Ganges, India) activity that brought deeper appreciation of a basin-wide sectoral planning approach rather than project-specific. This comprehensive, sophisticated, and first-of-its-kind scenario-based river modeling and basin planning suite for the Ganges Basin in India provided central and state governments with an objective assessment of options and interventions to improve the health of the Ganges system. The work was innovative as it not only convened stakeholders through a participatory approach, but also strengthened Government of India's capacity in scenario-based river modeling and planning.[13] In India, SAWI convened stakeholders from 11 basin states, central ministries, departments and agencies, academic institutions, NGOs, and IGOs in a series of workshops. This includes four basin-wide workshops; 33 state workshops (three each in Uttarakhand, Himachal Pradesh, Uttar Pradesh, Haryana, NCT of Delhi, Rajasthan, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand and West Bengal); three meetings with the MoWR, RD & GR; and multiple expert meetings with staff from the Central Water Commission, Central Ground Water Board, National Institute of Hydrology, National Mission for Clean Ganga, Indian Institute of Technology and various NGOs. Without SAWI it is unlikely that this sort of neutral forum would have happened. The tool was transferred to India's Central Water Commission and was recognized by the Government of India as a pilot for multiple river basin modeling and planning activities that will progress under the National Hydrology Project.

The adoption of basin-wide sectoral planning was a departure from the usual individual project planning approach and helped to inform stakeholder perceptions. This enabled planners to take a more comprehensive view of the Ganges Basin as a whole and identify interventions that can improve livelihoods and ecosystem sustainability and focus on key zones for ecological restoration where specific improvements can be achieved. This is the first time that a participatory approach was applied for the development of a Ganges Basin model, which helped build trust and confidence in basin-scale water management.

In Nepal, water resources development planning prominently features tapping the country's vast hydropower potential. SAWI's knowledge and analytics broadened the narrative on hydropower development through the lens of water resource management so that the two sectors were not treated independently. This helped to build appreciation for the wider environmental and developmental challenges, and transboundary dimensions that need to be factored into hydropower. An integrated approach to river basin planning and hydropower master planning, coupled with capacity building, became vitally important in informing Nepal's preparedness for environmentally sound and financially sustainable hydropower projects.

Other analytical work focused Nepali and Indian stakeholder attention on concrete measures to increase resilience and adaptation.

- In India, an Environmental Flow Assessment via the **Strategic Basin Planning** activity pinpointed poor water quality as a key inhibitor to improving the ecological status of the river. It confirmed the severely degraded state of the Ganga River Basin was due to alterations in the flow regime and poor water quality, particularly in the middle reaches of the Ganga and Yamuna rivers. This offered new knowledge to Indian stakeholders that forward planning and actions should integrate additional measures to rehabilitate ecological and socio-economic values across the basin.
- In Nepal, SAWI helped initiate a consultative cross-government **Nepal Water Platform**. The benefits are becoming evident as the work supports the country's federalization of water management service delivery – an area that benefits from strong political consensus and an important role in

13 Project analyses are available at www.gangariverbasinplanning.com. The reports are also hosted on the Central Water Commission website at cwc.gov.in/basin-planning-studies.

Nepal's development. For instance, the Water Platform supported the government's preparation of a COVID-19 response strategy. A SAWI-supported water sector diagnostic report raised the criticality of clean water supply and sanitation in medical facilities during the pandemic response phase, and the need for overall hygiene improvement in households during the resilience phase. Activity findings are feeding into the policy dialogue with the Government of Nepal on its overall national water strategy and will be used to inform future World Bank operations in the country.

Another achievement was SAWI's successful testing, demonstration, and scale up of flood forecasting tools in Bihar, an Indian state prone to devastating floods with huge economic costs and loss of life. The model was tested in the Bagmati-Ahwara sub-basin[14] then operationalized by the state's Flood Management Improvement Support Center. The forecasting tools are now being scaled up through the World Bank-supported Bihar Kosi Development Project and National Hydrology Project to expand coverage in the state. Bilateral agreements between India and Nepal to share hydromet data provided an opportunity to test earlier flood forecasts 7-10 days in advance, giving disaster risk officials more time to prepare and intervene to minimize loss of life and other impacts.

Sustainability

SAWI's technical and capacity building work is being sustained. The strategic basin assessment work is recognized by the Government of India as a pilot for multiple river basin modeling and planning activities under the National Hydrology Project. The computer modelling suite was transferred to India's Central Water Commission for its use. India's National Mission for Clean Ganga — the World Bank's main counterpart for its Ganga rejuvenation operational support — is considering adopting the outputs from this work to support its recently expanded mandate as a river basin management agency. SAWI and the World Bank are exploring opportunities for potential follow-on activities, including wider dissemination of activity outputs across India.

Output 1: Building Trust and Confidence

Originally designed to increase technical interactions on river basin modelling work between India and Nepal, the **Ganges Dialogue** did not progress due to intractable political economy issues that required SAWI to focus on other entry points in India and Nepal. In developing its technical work SAWI coordinated working across agencies for water resources planning and management that helped build trust in the process, and broadened stakeholder views on the need to look at the basin as a whole.

Separately, the **Nepal Water Platform** supported the Government of Nepal in its federalization efforts to deliver services in the water sector. Notably, SAWI helped launch a Platform Support Unit in 2019 that brought together key decision makers from water sector ministries to deliberate on water development and management. This cross-government approach brought the required high-level backing and authorizing environment for approval and implementation of technical and policy recommendations. SAWI enabled the platform to facilitate coordination among ministries in charge of water supply, schools and medical facilities to improve sanitation policies and services.

SAWI helped to organise several roundtable and dialogue events that were well received by stakeholders and seeded new ideas on Nepal water sector development, such as leveraging opportunities and tackling challenges in urban water and service delivery. The activity has explored and showcased synergies and challenges among the use of water for energy, food, and people. In particular, SAWI highlighted the conjunctive management of Nepal's surface water and groundwater to improve water security for irrigation and drinking water. The platform continues to support cross-sectoral collaboration with national and subnational government agencies and within the World Bank Group. It also has helped align activities with development partners working on water and sanitation in Nepal.

14 These tools enable a robust 24x7 feed of short-to-medium range rainfall forecasts for operational flood forecasting models.

Output 2: Generating and Sharing Knowledge

In India, SAWI's technical work in **Strategic Basin Planning** delivered a Ganga river basin modelling suite — freely available online and taken up by government. This tool helps planners assess the basin's hydrology, water quality, distribution, and ecology in different scenarios. During this process, SAWI also improved basin-level knowledge and established a participatory approach, supported by integrated models, to raise awareness of the water consequences of economic development across the basin. The process increased trust and confidence in basin-scale water management in India through state- and basin-level workshops, and through analyses guided by state perspectives. SAWI found that engaging stakeholders from multiple government departments such as water, agriculture, health, mining, urban development and industry, the work enhanced stakeholder input to government decision-making. Extensive training was provided, including on-the-job training, which enhanced the capacity of state and central government water resources organizations. Technical and capacity support directed through the Government of India's National Hydrology Project — which is strengthening water monitoring throughout the country — helped national and state agencies enhance hydromet services and water resources planning, operation and management.

BOX 15: STRATEGIC BASIN PLANNING IN THE GANGES RIVER BASIN

SAWI's technical work on strategic basin planning brought new knowledge and tools and built capacity of Indian stakeholders for improved water management of the Ganga River Basin.

- A detailed and robust water resources planning model for the entire Ganga Basin in India was developed and documented, and central and state government engineers and planners were trained in its use.
- Surface water and groundwater interactions across the basin were analyzed and used to refine the river modeling.
- A multi-scale environmental flow assessment across the basin was used to guide scenario modeling.
- A multi-stakeholder consultation process was established, inside and outside government, to guide and share the strategic basin planning process.
- A series of plausible scenarios that explore alternative options to improve water management and river health were developed, modeled, documented and disseminated.

The model suite links to a Ganga Water Information System designed to support understanding of the natural and social systems of the basin. It provides a central place that allows data managers, modelers, policymakers and decision makers from different organizations in the basin to explore and visualize all model input and output data, including time series and spatial data. The suite also links to a data dashboard that displays scenario summary results as a series of key metrics and graphics to help policy makers compare and evaluate scenarios. These include information on the possible combined impacts of different technical measures or water system strategies, basin-wide and for each state.

The **Water Resource Management in Transboundary Basins** activity produced a final technical report, "Hydrologic and Water Resources Modeling for the Ganges Basin – A Compilation and Bibliography,"[15] that documents types of models and includes a bibliography of over 100 published papers on hydrologic or water resource modeling relevant to the Ganges Basin. An advanced hydromet manual serves as an exhaustive reference for all implementing agencies under the National Hydrology Project. It covers data collection for surface water, groundwater, water quality, sediment and rainfall, and includes material on site selection, installation supervision, and discharge measurement. The manual was published online at http://nhp.mowr.gov.in and printed copies were circulated to all implementing agencies.

The **Nepal Water Platform** activity builds on work done under a previous Water Platform funded through non-SAWI sources in FY18/19, in which a strategic note for water conservation, development and management was prepared after extensive consultations with stakeholder groups in Nepal. Most notably, SAWI helped develop a Nepal Water Diagnostic (2020) that identified the most pressing challenges and

15 The technical report is available at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/217491583389284853/hydrologic-and-water-resources-modelling-for-the-ganges-basin-a-compilation-and-bibliography

strategic priorities in the sector. This diagnostic presented a snapshot of Nepal's development story and the role of the water sector in the broader context of the national economy. It highlighted the importance of managing water for sustained economic growth and poverty reduction and presented five water sector challenges and priorities.

In Nepal, SAWI laid critical groundwork to support the government in preparing hydropower projects. This led to identifying prospective projects for Nepal's hydropower master plan and essential preparatory work following international standards and best practices. SAWI's work was done through two complementary activities - the S**ustainable Water Resources Development for HEP in Nepal,** a Bank-executed activity, and the **Nepal Power Sector Reform and Sustainable Hydropower Development Project**, a recipient-executed activity.[16] The proposed river basin planning work was a component of $20 million World Bank investment in Nepal's Power Sector Reform and Sustainable Hydropower Development project.

BOX 16: TECHNICAL PRODUCTS INFORMED NEPAL'S HYDROPOWER PROJECTS

SAWI generated vital new information that strengthened Nepal's hydropower investment planning, including:

- An extensive review of policies, legislation and institutions relevant to water resource development in Nepal.
- A political-economic analysis in relation to river basin water resources development in Nepal.
- Hydrological modeling of Koshi Basin and West Rapti Basin.
- A research working paper assessing electric power markets in Nepal, and in Bangladesh, China, and India. This analysis came amid debates on Nepal's surplus electricity generation and is informing economic studies of prospective hydropower projects in the river basins.

Output 3: Building Institutional and Professional Capacity

In Nepal, two complementary activities — one Bank-executed and the other recipient-executed — trained government agencies, academic institutions, and supported three study tours for government officials. The study tours are summarized as follows: (i) to the Columbia River Basin (Idaho and Oregon, USA); (ii) an exposure visit for 11 Parliamentarians and Journalists to the Three Gorges Hydropower Project and the Hubei Yiba Highway Project in China (August 29-September 5, 2017) on river basin and hydropower planning; (iii) five Government of Nepal officials were supported to attend the International Hydropower Congress in Ethiopia in May 2017 to enhance their knowledge of and share experiences in hydropower development. The study tours gave officials first-hand knowledge of best practices and built capacity in planning and implementing water projects in an integrated manner.

SAWI enabled three staff members from Nepal's Electricity Authority to attend a three-week course in Norway on the fundamentals of hydropower development and management in 2017. SAWI also facilitated faculty exchanges between Kathmandu University and Wuhan University in China beginning in 2018, and supported fellowship exchange programs between Nepali and Chinese students. Kathmandu University said that the faculty and student exchanges promoted networking, built stronger hydropower and water management expertise, and helped identify future projects.

Over the years, Indian stakeholders also benefitted from several capacity building activities. The **Strategic Basin Planning** work convened several workshops and training events that enhanced the capacity of water resources organizations throughout the basin. Nine officers from the Central Ground Water Board (CGWB), Central Water Commission (CWC), National Institute of Hydrology (NIH), and National Mission for Clean Ganga, for example, participated in an intensive on-the-job training program with the integrated modeling

16 The activities were part of Nepal's National Water Plan (2005) and Water Resources Strategy (2002) for integrated water resources management. The activities were intended to prepare river basin master plans to help power sector agencies plan and prepare hydropower and transmission line projects based on international standards and best practices.

platform. This enabled the officers to independently run and adapt models. In early 2018, the trained CGWB and NIH officers were formally assigned to work with the modeling suite as an integrated team with the trained CWC officers at the CWC Modeling Centre. Additionally, SAWI championed open exchange of data and information among participants in workshops and trainings. The modeling suite and dashboard are available to users through a central repository service designed to facilitate data exchange among modeling teams, with updates synchronized through cloud computing technology to ensure users have the latest version. Twenty-seven participants, including five women engineers, from water resource departments of 11 states in the Ganges and Brahmaputra basins were brought together for a training on WaterWare, an advanced river basin simulation software tool.

The **Water Resource Management in Transboundary Basins** activity trained stakeholders on new technologies to improve the extent, quality, and accessibility of water resources information. Over 235 people benefitted from training on Google Earth Engine applications — a technology that has revolutionized remote sensing data, processing and analysis. The training enabled participants to develop products for remote sensing analysis, water budgeting models and water availability reports. The user-friendly tool does not require high end hardware, and Indian states are using it to assess crop water requirements, water storage, and hydromet optimization. Google Earth Engine is also being taken up for water resources planning processes under the Government of India's National Hydrology Project, which has training resources on its website.[17]

SAWI supported two educational trips for officials from the state of Bihar, which experiences deadly flooding annually. A high-level delegation of officials from the Government of Bihar, headed by the Minister of Water Resources, visited China's Yellow River Basin in April 2018. Participants gained firsthand knowledge of institutional and technological aspects of real-time flood forecasting and management in the basin, and measures to control sedimentation. Separately, a five-member delegation led by the Government of Bihar's Principal Secretary visited the Asian Institute of Technology in Thailand. The June 2018 trip included training on flood management technology tools and techniques that were relevant to implementing a meteorological framework for the Bagmati-Adhwara and Kosi Basin.

Output 4: Scoping Interventions and Investments

In India, SAWI's work continues to sustain as it was linked to the Bank-financed Bihar Kosi Basin Development Project and scaled up by the World Bank-financed National Hydrology Project ($175 million), which is being implemented by 29 state-level agencies and 11 central government agencies. In Nepal, SAWI's support on river basin planning and hydropower development were linked to the World Bank's investments in the Power Sector Reform and Sustainable Hydropower Development project ($20 million), and to the designs of the energy sector Development Policy Credit ($72 million) and a second credit ($100 million). Analytical and cross-sector dialogue through the Nepal Water Platform indirectly informed several projects across sectors including irrigation, rural water supply and sanitation, urban governance and infrastructure, climate resilience, and hydropower.

Implementation Challenges

Weak capacity of water institutions was a significant challenge and resulted in the slowdown of several activities, particularly some managed as SAWI Recipient-Executed grants. In the absence of a regional dialogue platform, it was important to gain stakeholder acceptance for any work deemed to be politically sensitive or unacceptable. This meant reaching out to stakeholders in several states for incremental discussions that were done over time. Regional political tensions and extreme weather events also constrained data collection, and engagement with stakeholders on issues of a transboundary nature.

17 The National Hydrology Project has Google Earth Engine training materials at http://nhp.mowr.gov.in/HIS/docs/Manual/Hydromet_Manual.pdf

Lessons Learned

1. **A significant finding from SAWI's modelling work is that future water stresses in the Ganges Basin will likely be driven primarily by socio-economic factors, while climate change is a secondary driver — requiring a portfolio of interventions rather than a single sector-driven approach**. SAWI found that a significant increase in water demand is expected by 2040, which will mostly affect groundwater because during peak irrigation season available surface water is already mostly diverted. Supply-demand deficits for both drinking water and irrigation will increase, and water quality will further deteriorate. Climate change is expected to affect water demand more than water availability, although the uncertainty with respect to supply-side impacts is high.
2. **A participatory approach — as adopted in this activity — was critical to achieving acceptance of a vision and pathways to achieving the vision**. Data and knowledge about the Ganges River are fragmented across multiple government departments, and few officials are aware of the serious consequences that projected future population growth and economic development will have for the river. In India, the centrally-driven approach to water management requires capacity at national and state levels, sound monitoring, and enforcement – gaps which SAWI was able to support in some measure. SAWI found that a more varied approach that includes economic incentives, mutually agreed targets and outcomes, and stakeholder participation, could supplement the regulatory approach. Likewise, in Nepal, stakeholder engagement through the Water Platform was critical to bring together cross-government agencies and build deeper appreciation of water-related issues and their intersection across sectors.
3. **Alignment of SAWI activities with national programs and priorities was a useful tactical approach that worked well**. SAWI's work alongside national programs such as the National Hydrology Project in India and the water strategy in Nepal enabled engagement with a range of stakeholders and ensured a coordinated, sustained approach across various interventions. This was important, particularly in a basin with diverse interests, perspectives and limited regional collaboration. This also enabled demonstration of models, such as the flood forecasting work in Bihar, which then has an institutional home and can be taken to scale.
4. **Investing in a variety of capacity building activities at an early stage in the program engaged a broad set of stakeholders and allowed SAWI to gain their attention**. SAWI found that exposure visits are a useful mechanism to engage senior stakeholders and enable them to see other models in operation elsewhere, while hands-on training and access to user manuals are essential to develop specific skill sets for operational staff. Similarly, facilitating faculty exchange programs was a good way to foster partnerships that could continue beyond SAWI.
5. **In complex settings**, activities might need to adapt their approaches as new information is gathered and new ideas are being tested for the first time. This is an important part of the learning process – not a waste of resources. In India, SAWI learned that, given the diversity of local stakeholders, it was best to build up slowly and essential to bring state level stakeholders into the process. In Nepal, SAWI learned that despite political will, resource constraints can stall progress. An ambitious program of change requires consideration of many factors such as political, financial, social, and capacity.

2.3 BRAHMAPUTRA BASIN FOCUS AREA

Context

The Brahmaputra River Basin[18] ranks among the 10 largest rivers in the world and is one of the most dynamic and complex river systems due to its challenging topography and hydrological environment. It

18 The river is known by different names as it flows from China through Bangladesh, Bhutan, and India, and its full name is the Yarlung-Tsango-Brahmaputra-Jamuna River.

flows through a seismically active region where two major reported earthquakes in the last 125 years contributed to erosion, changing the topography of the basin. The river originates in the Himalayas of China and covers 580,000 square km in four countries: China (50 percent), India (34 percent), Bangladesh (8 percent), and Bhutan (8 percent), which also contributes four tributaries.

More than 100 million people live in the Brahmaputra Basin and 80 percent are farmers. The river is an important source of livelihoods and increasing demand for energy is spurring investments in hydropower. Countries are increasingly recognising the untapped hydropower potential of the river, but in-depth technical understanding of the basin dynamics and cooperation are prerequisites to realising the full potential of any investment. The river flow is fed by groundwater, glacial snowmelt and the South Asian monsoon. The Brahmaputra suffers water stress in the dry season but is also prone to intense flooding during monsoons in the North-East Indian states and Bangladesh. In Bhutan, flooding is caused by glacial lake outbursts floods with resultant loss of lives and economic damage. The UN estimated 41 million people were affected by floods and landslides in 2017 alone. Climate change is expected to have a strong impact on the Brahmaputra Basin as glacial and snow melt increases and monsoon rain patterns change, boosting flood frequency and intensity and raising the sea level.

The political economy of the Brahmaputra Basin remains complex and challenging for a variety of reasons that extend beyond river water sharing. Development in the basin has historically been piecemeal and undertaken project-by-project at the country level, based on national priorities. For instance, within the lifetime of SAWI, the countries have proposed more than 300 dams — a contentious point of discussion between upper and lower riparians, compounded by little understanding of the impacts on downstream communities or the ecosystem, or how to apply international best practices such as dam safety. Complex geopolitics between upstream and downstream countries are amplified by an incomplete basin knowledge base, varying technical capacities of water management professionals, and power asymmetry among the riparians.

SAWI's Strategic Approach

SAWI's approach was informed by early realization that the complex geopolitics of the region required a context-specific, yet highly challenging approach — one that could bring together riparian countries with different capacities and interests and shift the discourse. SAWI recognized that the lack of commonly agreed technical positions on the river basin as a whole was likely to become a challenge.

SAWI was implemented through 11 activities, namely:

1. Brahmaputra Dialogue
2. Brahmaputra River Basin Assessment
3. Basin Modeling and Analysis
4. Brahmaputra IWRM Study Tour
5. Environmental and Social Management for Sustainable HEP
6. Hydromet Modernisation in the Brahmaputra Basin
7. Strengthening Hydromet Services and DRM in Bangladesh
8. Bhutan Hydromet Services and Disaster Risk Resilience Regional Project
9. Delta Management Investment Planning
10. River Management Improvement Bangladesh
11. Non-Monetary Values of Water

SAWI used knowledge and capacity building as entry points to discuss issues with national stakeholders and to bring these to regional spaces. Specifically, the program focused on issues of common concern and interest: addressing water and disaster-related challenges (flood risk management and riverbank erosion control), assessing economic opportunities (hydroelectric power, food security) and facilitating South-South knowledge exchange activities. This approach demonstrated economic benefits from cooperative management and provided a platform for riparian countries to come together and build a case for regional cooperation. Additionally, strengthening the capacity of riparian countries was critical to enable them to draw on new knowledge generated, adopt innovative new tools and build resilience for floods and erosion.

SAWI's strategic approach engaged stakeholders at multiple levels. These included sub-regionally within India's North-East states, with

country-level activities such as Bhutan and Bangladesh hydromet services and disaster risk management, and at the regional level through dialogue activities. SAWI also brought consistency, alignment and integration with other-related World Bank investments at the state and country levels.

Outcomes and Sustainability

SAWI's activities promoted collaboration, prioritized and built a comprehensive the knowledge base on critical issues such as hydromet services, disaster resilience and water resource management, and enabled quick action in response to government requests.

Basin-level dialogues led to the establishment of formal and informal networks between countries — a significant outcome. Since 2017-18, the process has been led by a consortium of institutions from each of the four riparian countries. China's participation in the fourth dialogue event in 2018 indicated its increasing interest in regional cooperation in the basin, critical to advance the Brahmaputra Basin dialogue process. The dialogue opened up thinking on new themes to be explored for cross-border cooperation — for instance, on hydropower investment, food security, and inland navigation. Stakeholders acknowledged that political realities require the process to be nimble to leverage emerging windows of opportunity and to engage with higher level decision makers.

Over the years, the dialogues successfully advanced from Track 3 to Track 1.5, which regional stakeholders considered a huge breakthrough in a sub-region fraught with geopolitical tensions. The **Brahmaputra Dialogue**, a foundational activity, steadily opened up the dialogue space to multiple stakeholders from the four countries and eventually led to a Track 1.5 process. The discourse evolved beyond technical management issues and shifted toward a common understanding about sectors, geographies and on policy viewpoints. Events began to serve as a marketplace of ideas, bringing together the producers and consumers of knowledge, and Brahmaputra Basin knowledge partnerships slowly began emerging.

SAWI's knowledge and strengthening of capacity for hydromet services in Bhutan and Bangladesh led to improved access and accuracy in weather information — vital to improve disaster preparedness and climate resilience in vulnerable countries.

- In Bhutan, a roadmap for modernizing water and climate services – considered exemplary work – was taken up by government and informed the design of World Bank lending operations in Bhutan and Bangladesh. Technical support helped government operationalize an automated SMART-Met system, which is now being used by the National Center for Hydrology and Meteorology to prepare faster and more reliable weather forecasts. The state-of-the-art platform has cut in half the time needed to analyze observed data from weather stations throughout Bhutan, Himawari satellite images, and Numerical Weather Prediction computer models. The platform improved accuracy in weather forecasts, giving farmers critical information to take action and protect crops from severe weather and pests.
- In Bangladesh, technical work was used to scope and inform larger investments in hydromet systems to improve flood forecasts and early warnings. Other technical work to modernize weather observation systems and service delivery was used to improve the design of a $113 million World Bank-financed Weather and Climate Services Regional Project.[19]

Technical work helped to build understanding of the dynamics of the Brahmaputra Basin to inform investment planning and dialogue within and between riparian countries. For example, in India, SAWI built a comprehensive and much-needed knowledge base on the dynamics of the Brahmaputra Basin in India's North-East region (NER) for policy and decision makers. In response to the Prime Minister's water

19 See a description of the regional project at http://projects.worldbank.org/P150220?lang=en

initiative in NER, SAWI provided valuable analytical work that was taken up by a high level committee. Separately, SAWI's support to develop an investment scheme for the Bangladesh Delta Plan 2100 — a plan for a landmark shift in delta management — was well received by the highest levels of government. In Bhutan, SAWI work informed elements of Bhutan's new updated hydropower policy that is critical to the country's plans to commission 12,000 MW of hydropower projects in coming years.

All SAWI activities are being sustained through the dialogues, through the embedding of knowledge products within government institutions, and through linked World Bank investments. However, two activities could not take root. For example, the **River Management Improvement (Bangladesh)** activity was envisioned to support technical design to reconstruct sections of the Brahmaputra River's right embankment for erosion protection, but the program was subsequently dropped. Similarly, the **Non-Monetary Values of Water** study did not progress due to limited potential for uptake in the World Bank's current investment portfolio.

Output 1: Building Trust and Confidence

The idea for a "Brahmaputra Forum" came from regional participants on study tours in SAWI's early years, demonstrating the value of "exposure" or educational visits that bring stakeholders together.

Participants from the riparian countries suggested that these be formed at the national level in each riparian country to explore local and national solutions to basin challenges, and at the basin level to work toward a "joint response mechanism" for issues such as navigation, hydropower investment and food management. For such a dialogue to be effective, they expressed, the process would need to increasingly extend to higher levels of stakeholders and be nimble enough to deliberate on emerging windows of opportunity for cross-border cooperation.

The Brahmaputra Dialogue used multiple mechanisms to convene key stakeholders, increase understanding of the complex river system, and explore potential opportunities for collaboration. The mechanisms included national and regional workshops, closed-door meetings, knowledge exchanges, and study tours.

Originally initiated by the South Asia Consortium for Interdisciplinary Water Resources Studies (SaciWATERs) in India in 2013-14, the first phase included six consultation meetings in Bangladesh and India at the Track 3 diplomatic level with civil society organizations, NGOs and academics. An initial status report on water management practices and policies for the Brahmaputra Basin concluded: "the innumerable channels and tributaries, varied topographical and climate regimes, and multiple water uses across countries unequal in size and power dynamics have made a straightforward management strategy seemingly impossible; concerns and voices of legitimate stakeholders have largely been neglected in previous basin dialogues and forums; basin dialogue is only bilateral in nature; and negotiations are largely formed by virtue of adversarial positional bargaining."

SAWI provided behind-the-scenes support to the second phase of the dialogue (2014-15) and heightened riparian government awareness of, and confidence in, the dialogue process, and encouraged participation. SAWI's sustained effort was required to build support for a third regional dialogue (October 2016), including several rounds of formal and informal consultations at the national level and in multiple Indian states that share the Brahmaputra Basin. This led to a high-level regional meeting (Delhi 2017) presented as a knowledge symposium with 150 participants. Influential Chinese academicians were among the participants, the result of intensive one-on-one meetings in China to enhance the partnership between SaciWATERs and Chinese institutions and think tanks.

The fourth phase — the regional Climate-Water-Energy Nexus and South-South Cooperation Workshop (China, September 2018) — was significant as it marked the first full active engagement of all four riparian countries. It also showed China's increasing interest in regional cooperation in the basin, critical to move forward the Brahmaputra Basin dialogue. The 2018 event was jointly organized by the Indian Institute of Technology and Shanghai Institute for International Studies in close partnership with Bangladesh's Institute of Water Modelling. China planned to host a second conference but it was cancelled by the COVID-19

pandemic that began in 2020. The pandemic also forced the cancellation of a Brahmaputra Dialogue session planned as a side event during the Asian International Rivers conference hosted by Tribhuvan University of Nepal.

As the dialogue process evolved, SAWI's focus shifted to supporting and sustaining the collaborative partnerships formed around the dialogue process. Participants in the Brahmaputra Dialogue successfully worked together to produce several knowledge products (see Box 17).

BOX 17: BRAHMAPUTRA DIALOGUE PARTICIPANTS PRODUCED KNOWLEDGE PRODUCTS

"*Perspectives on the Yarlung-Tsangpo-Brahmaputra-Jamuna River Basin*," a report initiated at the request of the Brahmaputra Dialogue participants, was produced with dozens of contributors from the four riparians, including ambassadors, policy makers, top scientists, academicians, journalists and civil society. This work marked a first attempt at documenting the Brahmaputra as one river system and presenting a multi-layered, holistic perspective of the basin. The report showed that the dialogue process has succeeded in bringing the countries together around the common objective of producing a joint output. Both gender and climate change were prominent themes in the report.

An article. "Re-Interpreting Cooperation in Transboundary Waters: Bringing Experiences from the Brahmaputra Basin," was authored by several experts from the region and published in *Water Journal*, December 2019.[20] This brought a broader lens to cooperation, extending beyond formal diplomacy (Track 1) and recognized the role of institutions in influencing and informing dialogue and policy action.

Analytics were conducted to better understand the scale of the problem of discarded plastic and initiatives underway in the Brahmaputra and the major rivers in South Asia and inform subsequent plastics work.

A short video, Voices from the Field on the Brahmaputra Dialogue, produced in November 2019, captured development ideas and plans from community leaders, water management experts, and other stakeholders in the Brahmaputra Basin.[21]

The nature of the dialogue evolved over the years and institutionalized through partnerships established among institutions throughout the riparian countries. Such partnerships include the Indian Institute of Technology in Guwahati and China's Shanghai Institute of International Studies, and Bangladesh University of Engineering and Technology and the Indian Institute of Technology.

There is evidence that institutional partnerships built through the Brahmaputra Dialogue activity will continue beyond SAWI. Partners have started to leverage funds from other sources and are taking forward locally-based activities, while remaining in contact with each other to generate ideas and share knowledge. However, without external facilitation, these exchanges are likely to be at Track 2 or Track 3 levels instead of the regional scale that SAWI enabled.

Output 2: Generating and Sharing Knowledge

SAWI's **Basin Modeling and Analysis** activity delivered a rapid assessment of water issues in India's North-East Region,[22] which supported a unique process bringing together central and state stakeholders to devise an action plan roadmap and develop an online knowledge repository. The North-East Water Information Base or NEWRIB consolidates data and information to help inform decision makers with water management. SAWI helped develop a comprehensive model of the Brahmaputra Basin. India's National Hydrology Project

20 The paper was written by Anamika Barua, Arundhati Deka, Vishaka Gulati, Sumit Vij, Xiawei Liao, and Halla Maher Qaddumi and is available at https://doi.org/10.3390/w11122589

21 The film is at https://www.worldbank.org/en/news/video/2019/11/08/brahmaputra-dialogue-voices-from-the-field

22 The rapid assessment examined the state of water resources planning, management, and development in India's North-East region and recommended improvements including a high-level path to better manage water resources. The work informed a High Level Committee's report to the Prime Minister. The road map formed the basis for a request from the Government of India for support to the Assam Integrated River Basin Management Program, currently under discussion.

is exploring the adoption of both. This work was in line with active discussions at the time to establish a North East Water Management Authority under a Ministry of Jal Shakti-spearheaded bill to establish management authorities for 12 river basins in India.

BOX 18: BRAHMAPUTRA SUPPORT TO INDIA'S NORTH-EAST REGION

SAWI rapidly deployed its expertise to support the Indian Prime Minister's initiative to improve water resources management in North-East states following disastrous 2017 floods. A high-level committee for management of water resources was established in October 2017 and tasked with devising recommendations and an action plan for optimal use of water in the sub-region. The World Bank was invited to join an Expert Committee to support the high-level committee. A final report, commissioned and led by the World Bank's SAWI team, was delivered to the high-level committee in June 2018. The report was well received and the World Bank was requested to help the committee prepare its own report to send to the Prime Minister's office.

The **Delta Management Investment Planning** activity supported Bangladesh's General Economic Division in developing an investment plan to support implementation of the BDP2100 — a first-of-its kind long-term, integrated, and holistic vision of water and land management throughout Bangladesh. The investment plan for an estimated $37 billion to be financed from public, climate and private sources, was presented to the Prime Minister and ministers from finance, agriculture, water, and local government ministries. A highly consultative process with a broad range of stakeholders followed. SAWI also used an Adaptative Delta Management approach, which links short-term investments at different points in time and based on different scenarios to longer-term climate and development goals. The Delta Plan informed the preparation of the World Bank-supported Bangladesh Climate-Smart Agricultural Water Management Project ($170 million).

Hydromet work in Bhutan and Bangladesh generated critical knowledge that proved essential to developing planned investments in both countries. In Bhutan, the **Hydromet and Disaster Resilience** activity supported the development of a roadmap to modernize water and climate services, which was taken up by government. SAWI's work on upstream strategic environmental assessments and cumulative impact assessments helped estimate potential cross-border impacts and optimize design of the hydropower portfolio within and across borders. Additionally, SAWI's technical support to operationalize automated Hydromet tools improved weather forecast accuracy, enabling farmers to receive critical information in time to protect crops.

In Bangladesh, SAWI's technical assistance through the **Strengthening Hydromet Services and Disaster Resilience** activity supported the Bangladesh Water Development Board's site surveys to improve weather observation systems and modernize hydromet services delivery for the water board and the Bangladesh Meteorological Department. SAWI provided technical assistance to the Bangladesh Weather and Climate Services Regional Project, guiding the development of twice-weekly farm advisories for all 64 districts. The advisories combined weather, water and climate information with crop data and local situation reports to customize advisories for each district. The advisories are critical for strengthening climate resilience in Bangladesh, which sits in one of the most disaster-prone areas of the world.

In India's North-East states, the **Improving Water Resources Management in Northeast India and Assam** activity introduced a new approach for integrated water management and water-related disaster risks. This included technical assistance on integrated river basin planning, flood forecasting, and investment in the Assam Integrated River Basin Management Program (AIRBMP). SAWI identified investments for AIRBMP based on a feasibility review of the Assam Water Resources Department's detailed project reports on two tributaries of the Brahmaputra Basin. The work took into account transboundary aspects of one tributary shared with Bhutan and the other shared with the Indian state of Arunachal Pradesh. SAWI also reviewed flood forecasting and development of ensemble forecasts for the Brahmaputra Basin, building on work

that SAWI previously supported for the Ganges Basin. Separately, SAWI produced technical notes about its work to strengthen disaster preparedness by scaling up climate resilient villages in Assam, including flood shelters. In other technical assistance, SAWI prepared an institutional review of agencies involved in water resources and disaster risk management and included stakeholder mapping, a gap analysis, and recommendations to strengthen Assam's institutions, including exploring cooperative mechanisms with other states. SAWI promoted knowledge exchange between Assam and Bangladesh on issues of common interest — flood and erosion management — as part of two projects under preparation in each country, AIRBMP in Assam and the Jamuna River Economic Corridor Development Program in Bangladesh.

BOX 19: SAWI HELPED SCALE UP CLIMATE RESILIENT VILLAGES IN ASSAM

The state of Assam in India is highly vulnerable to natural hazards such as floods, landslides and earthquakes. Climate change is adding to this vulnerability with increasingly serious annual flooding and erosion, and extreme temperatures that widen the threat of new diseases. The challenges have already led to frequent cycles of disaster response and recovery, with long-term implications for affected communities. A new disaster often strikes before families have finished recovering from the previous one, relegating communities to hard-to-break cycles of poverty. Secondary impacts of disasters include loss of livelihoods, health problems, disrupted education, increased social conflicts, and threats to the traditional way of life in Assam.

To develop climate resilient villages, a framework focusing on 5 Ps — people, prosperity, planet, physical infrastructure, and partnerships — has been proposed. Village disaster management plans will help operationalise the framework.

SAWI's technical notes on scaling up climate resilient villages in the Brahmaputra Basin in Assam, including disaster risk management and flood shelters, are informing the design of the Assam Integrated River Basin Management Project. The notes addressed issues such as continuing school education during emergencies, harnessing nature-based solutions for erosion and landslides, setting up alternative livelihoods, and accessing clean water and sanitation during floods.

Output 3: Building Institutional and Professional Capacity

SAWI's early, critical strategy gave participants exposure to successful examples of integrated water management and transboundary governance in other countries. Participants' feedback suggested that they benefitted from seeing first-hand that the approaches could work. These visits opened space for South-South sharing of best practices in integrated water resources management and further exchanges. Some of these activities included:

- a one-week technical study tour to China's Yellow River in April 2014 to learn about a successful approach to a basin-level integrated water resource management program;
- a technical and policy learning visit to the Mississippi Basin in June 2015 with sessions on flood management, decision support tools and analytics, institutional and legal frameworks, and long-term basin planning; and
- a high-level delegation from Bangladesh and Bhutan visited the Mississippi River Basin in November 2015 to learn from experiences on collaborative arrangements across borders.

Over time, SAWI's training focused on an associated technical activity such as on-the-job training, classroom training sessions, and teaching computer methodologies, models, and other tools being developed. For instance, staff from the Assam Water Institute received on-the-job training about the implementation of SAWI's River Basin Modeling and Analysis activity in India.

SAWI's capacity building support to hydromet agencies in Bangladesh and Bhutan helped them gain better access to, and use of, weather-related data for accurate forecasts. In Bangladesh, capacity support to hydromet implementing agencies helped them design and procure critical weather observation packages for groundwater, surface water, weather stations, and coastal storm surge monitoring stations, and was followed by training. In Bhutan, government officials of the National Environmental Commission were

trained in international best practices to manage hydropower environmental and social impacts. Technical assistance to modernize hydromet networks strengthened institutional capacity in Bhutan and Bangladesh to respond to water-related hazards and climate risks.

Output 4: Scoping Interventions and Investments

Several SAWI activities continue to inform the design and implementation of larger World Bank investments in South Asia. Hydromet activities in Bangladesh and in Bhutan are informing longer-term programmatic activities such as the Hydromet Services and Disaster Resilience Regional Project ($4 million), which comprises technical assistance and investments in multiple countries, and the Bangladesh Weather and Climate Services Regional Project ($113 million). Other SAWI activities have led to requests from the Government of India for technical assistance ($70 million) for water resource management in the North-East region, and design of the AIRBMP program ($500 million).

Implementation Challenges

The biggest challenge in SAWI's early years was in bringing all four riparians and other representative stakeholders into common dialogue platforms — both at the basin level as well as nationally — a key step given the asymmetric capacities and political flare-ups in the sub-region. Another challenge was accessing hydrological datasets, especially where data was weak or not accessible between countries.

Lessons Learned

1. **Dialogue should first establish a solid foundation before gradually expanding to include higher-level stakeholders. The dialogue process must be nimble and take advantage of emerging windows of opportunity for cross-border cooperation**. The Brahmaputra Dialogue managed political sensitivity risk through the manner in which workshops and discussions were structured, informed by behind-the-scenes consultations with stakeholders. An early review of existing transboundary protocols and accords, and a map of power dynamics and institutions brought new understanding to the complex, multi-tiered institutional and policy landscape of the Brahmaputra Basin. This helped identify strengths and weaknesses, gaps and duplications, and feasible measures to strengthen cooperative mechanisms.
2. **Common areas of interest across riparian countries are the best entry points to dialogue**. The dialogue was successful in engaging a wider range of stakeholders, but government agencies in some Brahmaputra Basin countries hesitated to engage formally given the wider sensitivities. Country-level workshops enabled participants to speak candidly while regional events were apolitical and focused on thematic areas of common interest such as hydromet and hydropower development. For example, the hydromet work in Bangladesh and Bhutan were instrumental in informing larger World Bank-supported investments.
3. **Building a common vision requires sustained work and time**. Integrated river basin planning in a transboundary context is a complicated process apart from technical aspects such as modeling frameworks, analytical tools, and data. Such exercises require intensive consultation with the multiple stakeholders at various levels and across multiple sectors.

2.4 SUNDARBANS LANDSCAPE FOCUS AREA

Context

The Sundarbans Landscape (Ganges-Brahmaputra Delta), shared by coastal Bangladesh and India has potential to serve as a strategic model of transboundary cooperation. The Sundarbans is the largest delta in the world and home to more than 123 million people. The Ganges and Brahmaputra rivers wind across

Bangladesh, Bhutan, China, India and Nepal and drain into the Sundarbans before spilling into the Bay of Bengal. The Sundarbans contains the world's largest mangrove forest and a wetland of international importance with more than 13 million inhabitants, including some of South Asia's poorest and most vulnerable communities. Many depend on the ecosystem for their survival.

Many poorly understood factors affect development outcomes, ecosystem services, and livelihoods in the Sundarbans. The area faces enormous challenges from human activity and environmental threats. Climate-induced hazards are a significant threat with frequent cyclones, sea level rise, storm inundation, saline intrusion, coastal erosion, and channel sedimentation — many of which are set to intensify with global warming. The ecosystem is also being pressured by an increasing population and economic activity. Industrial and urban waste produced upstream is carried into the Sundarbans and contaminates the ecosystem. Pollution reduces fresh water flows, increasing the salinity of surface water and unfit for human consumption. Polluted water reduces the nutritional value of fish on which local communities depend for food.

Government responses in Bangladesh and India are insufficiently coordinated. Political boundaries have constrained development of a coherent landscape-level plan or program. Even within national boundaries, governance has tended to be narrowly sector-driven, and lacking coherence. In the absence of an integrated decision-making framework, sector-specific projects will remain uncoordinated with varying adaptation practices in Bangladesh and India. Scientific data, technical knowledge and awareness on the impacts of climate change are limited. So is knowledge about the relationship between human settlements and the ecosystems. All have hampered effective planning and management of the Sundarbans as a whole.

Bangladesh and India share a longstanding strategic relationship supported at the highest levels of both governments. The countries have stepped up bilateral cooperation in several areas including trade, transport, energy, eco-tourism, and development projects. The shared ecological habitats and natural resources of the Sundarbans present a unique opportunity for cooperation and joint action. In 2011, Bangladesh and India signed non-binding agreements on a host of issues to pave the way for joint action on the Sundarbans. This included an agreement to adopt joint management and monitoring of resources, promote joint research on climate change and adaptation strategies, improve information exchange, and support capacity building. Both countries continue to discuss the establishment of a joint mechanism for cooperation to guide development, conservation, and resilience of the Sundarbans, but are yet to reach formal agreement. A formal Joint Working Group (JWG) on Conservation of the Sundarbans continues to meet to set an agenda for collaboration.

SAWI's Strategic Approach

All SAWI activities were oriented toward creating the architecture for cooperative management of the Sundarbans through a two-pronged approach. This included a multi-stakeholder dialogue at several levels, from local and sub-national to regional. The forums and processes did not previously exist and were essential to create an environment of greater trust and bilateral cooperation. Also important was facilitating joint research, studies, and dissemination of information about government priorities and Sundarbans inhabitants' needs. Previous World Bank support through two technical assistance activities found a strong analytical base, institutional capacity, and planning frameworks were essential to facilitate a transition to collaborative management.

SAWI was implemented through five distinct, but highly interrelated and coordinated activities:

1. Sundarbans Dialogue
2. Delta Management Investment Planning
3. Sundarbans Landscape Hydromet Planning
4. Sundarbans Landscape-scale Joint Environmental Planning
5. Sundarbans Landscape Targeted Environmental Studies

Outcomes

The Bangladesh-India Sundarbans Regional Cooperation Initiative (BISRCI), created through SAWI, demonstrated the benefits of cooperation. BISRCI, a semi-formal representative forum of influential policy think tanks, civil society groups, and academic institutions, helped to advance a richer, deeper discourse between the two countries on the Sundarbans. Over the years, the dialogue evolved from initial discussion on framing concepts and options for cooperation, to influencing high-level discussion and policy actions, then to advancing strategic cooperation between Bangladesh and India.

BISRCI nudged forward the process of operationalizing agreements for joint management of the Sundarbans. A 2011 Memorandum of Understanding between Bangladesh and India framed their intentions but the countries have yet to formalize a joint institutional mechanism. BISRCI brought invaluable technical knowledge into public spaces, briefed senior ministers, and brought them together in discussions, including at COP 21 where they jointly represented the Sundarbans. This highlighted the benefits of transboundary cooperation to tackle economic, social, and environmental aspects and raised international visibility of the Sundarbans as a climate change adaptation issue shared by both countries.

Technical cooperation between Indian and Bangladeshi researchers helped build deeper understanding of each other's perspectives, enabled access to historic data records vital for technical work, and promoted capacity building exchanges. Another key achievement is SAWI's technical knowledge that elevated national consciousness about the Sundarbans and pushed the issues into the public spotlight. The Sundarbans became embedded in national institutions — rather than solely residing in BISRCI. For example, SAWI's support of Bangladesh's Delta Development Plan 2100 — the main developmental plan for coastal areas — brought the Sundarbans into focus. India, meanwhile, stepped up coordination of Sundarbans work among the ministries of Environment, Forests and Climate Change; External Affairs; Finance; and the Government of West Bengal's Department of Sundarbans Affairs. SAWI's technical knowledge brought new insights into issues previously overlooked such as the nutritional status of mothers and children, and sustainable shrimp farming. Both informed World Bank investments in Bangladesh and India.

Sustainability

The positive bilateral relationship and agreements between Bangladesh and India are a solid basis for SAWI's legacy in the Sundarbans. SAWI's four Sundarbans Focus Area activities encouraged personal interactions among government and nongovernment stakeholders that are likely to continue.

Until the eventual formalization of a joint institutional mechanism, BISRCI remains the main platform for dialogue and has traction at the highest levels. BISRCI continues to meet regularly with strategic discussions and activities aimed at creating greater momentum for cooperation from the local to the regional level. However, without external financial assistance, it is unclear how BISRCI will sustain its activities including, for instance, the maintenance of a public website which hosts a repository of knowledge and information about the Sundarbans.

SAWI's work also took root by informing the World Bank's investments in Bangladesh and India. The strategy of using SAWI's knowledge and the Bank's wider networks and finance proved to be a useful way of ensuring long-term sustainability. SAWI's activities provided key inputs for designing and implementing three World Bank-funded projects ($750 billion).[23]

Output 1: Building Trust and Confidence

The **Sundarbans Dialogue** activity created and supported the Bangladesh-India Sundarbans Regional

23 SAWI activities informed World Bank investments in the Bangladesh Sustainable Forests and Livelihoods Project ($179 million), Bangladesh Sustainable Coastal and Marine Fisheries Project ($272 million), and the proposed India Blue Revolution Project ($300 million).

Cooperation Initiative (BISRCI), a group of influential policy think tanks, civil society organizations, and academic institutions from both countries. The dialogue was a key contributor in building trust between Bangladeshi and Indian stakeholders toward operationalizing agreements for joint management of the Sundarbans. While a Joint Working Group between the two countries set a formal agenda for collaboration, BISRCI provided technical insights to influence thinking and action.

BISRCI progressed significantly after its first formal meeting (New Delhi, August 18–19, 2015) and a follow up meeting (Dhaka, October 5–6, 2015) that brought together ambassadors from both countries, other high-ranking officials, and influential members of civil society to cement the concept and future strategy. A stakeholder mapping exercise in April 2016 identified key roles of ministries, government offices, and champions working in external affairs, environment and forests, water management, inland water transport, national security, joint rivers, and news media. Over the years, the dialogue evolved from framing concepts and options for cooperation to indirectly influencing high-level policy actions and advancing strategic cooperation between Bangladesh and India. For example:

- BISRCI's facilitation and use of SAWI knowledge products enabled a policy action — an agreement allowing passenger and cruise vessels on coastal and protocol routes as part of the renewed Protocol on Inland Water Transit and Trade signed during the Indian Prime Minister's visit to Bangladesh in June 2015. Eco-tourism river cruises through the Sundarbans started in early 2019. BISRCI also supported two bilateral pacts on coastal shipping allowing the use of Bangladesh's Chittagong and Mongla ports by Indian merchant vessels.
- BISRCI provided key inputs to Bangladeshi and Indian delegations during a July 2016 meeting of the Joint Working Group to design cooperative activities. BISRCI did the same during a SAWI-supported January 2017 meeting of the Government of India and Government of West Bengal on cooperation on Sundarbans.
- Notably, BISRCI provided inputs to the agenda for discussion on the Sundarbans between the Prime Ministers of Bangladesh and India, in April 2017. This helped to establish local dialogues (between the community/local government and the state/federal levels of government), and was perceived as critical to strengthening the high-level discussions.
- In two sessions of the West Bengal State Assembly, Sundarbans development issues and cooperation with Bangladesh were discussed with expert contributions from the World Bank and its partners from BISRCI.

Altogether, the **Sundarbans Dialogue** activity delivered several key events and outputs toward creation of an enabling environment needed for the two countries to form a joint mechanism to manage the Sundarbans. There were over 13 outputs including technical reports and bilateral and international events with published proceedings. For instance, a global workshop, Risk Management and Adaptation to Climate Change for Sustainable Growth in the Deltaic Region, advanced thinking on the establishment of a formal joint mechanism. Two follow-up papers were developed: "Benefits of Cooperation: Focus on the Sundarbans," and "Vision for the Sundarbans Region – Rationale and Structure for Joint Action." The latter paper was released for discussion by the High Commissioner of Bangladesh in India in October 2017. The paper presented institutional options for a bilateral cooperation mechanism based on information from key policymakers, diplomats, civil society organizations, and experts from other countries that manage transboundary ecosystems.

To raise visibility of the Sundarbans, SAWI supported joint workshops for print and electronic media from both countries; a social media strategy using Facebook and Twitter; a documentary film, "Nature's Own People," shown at more than 15 international film festivals; and a website hosted by BISRCI at www.sundarbansonline.org as a digital platform for stakeholder dialogue. A joint India-Bangladesh side event on the Sundarbans was held at the UN's Conference of the Parties (COP 21) in Paris in December 2015.

Environment Ministers from both countries issued coordinated statements calling for increased cooperation in the Sundarbans and climate change adaptation.

Although the Bangladesh and Indian Sundarbans face common challenges, it can be difficult to get stakeholders working together when there are different perceptions, capacities, political motivations, and competing incentives. The strategy of engaging key stakeholders in both Bangladesh and India was critical to building a collaborative process and SAWI's deliverables found greater relevance and acceptance by both countries. The consultative process during development of technical products helped to build trust, increase scientific and economic knowledge, and improve working relationships between Bangladesh and Indian stakeholders. For instance, experts from both countries reached agreement on preparing a report on freshwater endowments in the Sundarbans Landscape without focusing on historical controversies and disputes.

Technical knowledge on climate impacts in the Sundarbans was scarce before SAWI began its work. SAWI used technical entry points to trigger and build collaborative dialogue among regional stakeholders. In addition to the dialogues, three complementary SAWI activities supported joint research and technical studies that deepened the discourse among senior policy makers in both countries. SAWI's work enlarged the discussion beyond traditional environmental conservation to an approach that encompassed development and growth across foreign policy, water resource management, inland waterways, and health services. The research also led to publication of more than 30 peer-reviewed research papers and reports covering a range of issues.

The **Landscape-scale Joint Environmental Plan** activity established a framework to prioritize joint actions with a longer-term perspective in water infrastructure and building resilience. This included a Sundarbans Joint Landscape Narrative describing the defining characteristics of the wetlands as a whole for the first time. SAWI created and disseminated 12 scientific, technical, and economic evidence products to support the case for joint management of the Sundarbans. All products informed stakeholders' dialogue, helped develop proposals for joint activities, and became base documents to use when a formal bilateral institutional mechanism is established. The outputs were also used to inform several World Bank investments and operations in Bangladesh and India.

The idea for the **Landscape Hydromet Design** activity arose from dialogue between the BISRCI and members of the Joint Working Group. Stakeholders from both countries agreed to prepare a plan for a joint hydromet system and focused on local data sharing instead of the larger issue of basin-wide data sharing that remains a work in progress. SAWI produced seven deliverables, including a data-based comprehensive picture of the Sundarbans that connects poverty, water resources information, and ecosystems. SAWI supported a highly consultative process aimed at preparing a plan to install a uniform hydromet information system in the Sundarbans. The trust fund partially funded the short-term (15 years) investment plan for the Bangladesh Delta Plan 2100. The final outputs were discussed as part of the Joint Working Group. SAWI used innovative methods to overcome the challenges of unavailable, unreliable and incompatible data. For instance, the SAWI team made a significant breakthrough after painstaking efforts to trace archived data from the Dampeir-Hodges Survey conducted in 1876 and later forgotten. The historical data helped delineate the natural boundary of the Sundarbans and correct misinformation and myths. To work around the lack of information sharing between riparian countries and poor ground-level data, SAWI used real-time satellite data for transboundary rainfall and flood forecasting.

In a novel approach, the **Targeted Environmental Studies** activity brought together a multidisciplinary team with local researchers from both countries to prepare hydrological, ecological, and econometric studies to assess the climate vulnerability of the Sundarbans biodiversity and population. The 19 studies generated new knowledge on the implications of changes in the quality, availability, and productivity of water for

women's and children's health. The studies also examined nutrition issues and women's participation in the labour force and household activities. SAWI's work informed World Bank operations and investments in Bangladesh and India. One of the products, "Fishing in Salty Waters: Poverty, Occupational Saline Exposure, and Women's Health in the Indian Sundarban," (ID number 621), was accepted for presentation at the annual conference of the European Association of Environmental and Resource Economists in June 2021.

SAWI's technical work contributed to a recent World Bank publication, "Coping with Climate Change in the Sundarbans,"[24] which places climate change adaptation and resilience at the center of overall development policy. The work synthesized multiyear, multidisciplinary climate change studies that found the Sundarbans ecosystem will be significantly altered by sea-level rise, storm-surge intensification, and water salinization. The report laid a technical foundation to better understand the Sundarbans challenges. Based on field research, the work recommends location-specific, adaptation measures to promote resilience and reduce vulnerability. Beyond the Sundarbans, the studies' methods and findings are of interest to development practitioners, policy makers, and researchers focused on island nations and countries with dense populations and economic activity in low-lying coastal regions threatened by sea-level rise.

Knowledge exchange became an important strategy to build common understanding between Bangladeshi and Indian stakeholders about the physical and economic impacts of climate change in the Sundarbans. For instance, SAWI brought together more than 400 researchers from both countries in a technical knowledge exchange (February 2017, Kolkata). SAWI held knowledge exchange workshops and hands-on training between Bangladeshi and Indian experts, including on data collection methods that were identified as a gap on the Indian side of the Sundarbans. The process established a common data protocol and research methodology for collaborative technical work areas and enabled teams to design surveys together. The teams co-authored 12 peer-reviewed analytical papers, prepared four geocoded datasets on erosion and accretion of the Sundarbans coastline, and Bangladeshi experts trained Indian researchers on modelling cyclonic storm surge and aquatic salinity. Memorandums of Understanding were signed between universities in Bangladesh and India. A senior official from the Government of West Bengal remarked that the large-scale knowledge exchange was a significant step bringing stakeholders together toward eventual framing of policy.

Output 4: Scoping Interventions and Investments

SAWI's **Targeted Environmental Studies** activity provided climate change impact information to six World Bank operations. Findings about mangroves informed the **Sustainable Forest and Livelihood Project** ($175 million), particularly which mangrove species are likely to survive in southwest coastal Bangladesh and expected impacts on forest-based livelihoods. The comparative gain and loss of habitats for each of 83 fish species in the southwest Sundarbans informed the **Bangladesh Sustainable Coastal and Marine Fisheries Project** ($240 million), along with identifying fish species (*Mystus gulio, Pama pama, Liza parsia, Lates calcarifer,* and *Acantho paguslatus*) with the potential to thrive in aquaculture.

SAWI's environmental study on geomorphological changes, including erosion or accretion for each island of the Indian Sundarbans, and the changing time-trend of cyclones informed the **India Integrated Coastal Zone Management** activity ($220 million). The cyclone research also was used in the **India National Cyclone Risk Mitigation Project** and the **Bangladesh Multipurpose Disaster Shelter Project** ($375 million). SAWI estimates of how various species of mangroves can reduce storm-surge height and water-flow velocity informed the afforestation components of the **Bangladesh Coastal Embankment Improvement Project** ($375 million).

24 The 2020 report was authored by Susmita Dasgupta, David Wheeler, Md. Istiak Sobhan, Sunando Bandyopadhyay, Ainun Nishat, and Tapas Paul. It is available at https://openknowledge.worldbank.org/handle/10986/34770.

Implementation Challenges

Travel to the Sundarbans was difficult due to its remote location, limited transport facilities, and tidal cycles. Limited internet and phone connectivity constrained the SAWI team's efforts for effective and regular engagement with local stakeholders. High turnover of staff in key ministries of the two governments posed a challenge as discussions and deliberations had to restart after the departure of senior officials, especially in the ministries for environmental issues and foreign affairs. Other external developments such as national and state elections (since 2018) in both countries diverted the attention of senior stakeholders. The combined factors drastically reduced the space for discussion on transboundary cooperation.

Lessons Learned

1. **A two-pronged approach to build trust and confidence through multi-stakeholder dialogue alongside technical work was effective and helped develop concrete ideas for collaboration based on the political economy, development priorities, and capacities in the two countries**. Multi-stakeholder dialogue established through BISRCI brought stakeholders together on a common platform. BISRCI also drew on technical work such as the Joint Landscape Narrative, Economic Case for Cooperation, and the Joint Institutional Mechanism on Sundarbans to inform its policy discussions.
2. **The collaborative process to create deliverables that emerged from shared knowledge and insight found greater relevance and acceptance in both the countries**. This led to development of need-based solutions and recommendations and generated wide support for coordinated stakeholder actions on the Sundarbans. In the absence of a formal joint mechanism, engagement through BISRCI has been an important mechanism to sustain engagement of high-level stakeholders in both countries. The forum also led to greater credibility and acceptance of the SAWI Sundarbans initiative.

2.5 REGIONAL CROSS-CUTTING FOCUS AREA

Context

SAWI Phase 1 showed that a purely regional approach was unlikely to deliver sustainable results at scale given the political economy of South Asia and the lack of regional institutional mechanisms for transboundary water governance. Phase 1 also encountered challenges convening senior stakeholders from all countries in regional dialogue because incentives and interests focused on the basin level.

SAWI's Strategic Approach

SAWI Phase 2 designed the Regional Cross-Cutting Focus Area to support capacity building and cross-fertilization of knowledge across basins toward SAWI's broader objective. Several activities included regional forums to build shared understanding on opportunities and challenges in regional water management. Activities also targeted capacity building that brought stakeholders together and innovative technical knowledge that spanned thematic areas and geographies.

Emerging Outcomes

Dialogues became important mechanisms to bring stakeholders together from across basins, helping to promote experience sharing, forging relationships and expanding dialogue. The events introduced new ideas and concepts into multi-stakeholder discussions. Over the years, familiarity developed among participants and encouraged them to discuss ideas more openly and to expand their networks.

Knowledge products on issues commonly faced across the region — such as groundwater management, water quality, climate change risks, and hydroelectric power — contributed to a larger body of knowledge for South Asia and built deeper awareness among stakeholders on the need for concerted action.

SAWI's capacity building led to concrete outcomes. For example, exposure or educational visits informed the need for open water data in India. A National Water Informatics Centre was established under India's National Hydrology Project, an important shift to better data management and utilization. Other training mainstreamed river basin modelling concepts and led to some state agencies integrating them into water management decision processes. Groundwater modelling tools introduced during training sessions are being used in the Ganga basin by India's central government and state agencies.

SAWI successfully established partnerships with regional institutions, including the Integrated Centre for Integrated Mountain Development (ICIMOD), International Union for Conservation of Nature, International Water Management Institute, and with South Asian universities. The partnerships helped to sustain broader support for transboundary water cooperation beyond SAWI funding. Partnerships resulting from the Himalayan University Consortium grant activity continue to thrive and two have won research grants. Other impacts have become evident. First, a network of water researchers and practitioners sustains on its own, carrying out concrete and collaborative actions using their own resources. Second, a governance framework strengthened the Indus Forum and revamped the Working Group. Key policy areas identified for future action have been linked to the Upper Indus Basin Network, which will enable this work to be taken further through its country chapters.

Output 1: Building Trust and Confidence

SAWI supported four **Regional Dialogue** events. The dialogues served an initial purpose of convening government and non-government stakeholders across the three river basins. While the events themselves did not directly lead to any collaboration, SAWI observed that these forums enabled stakeholders to engage informally with each other, discuss common challenges and share ideas — a notable result that would be unlikely without SAWI funding. For instance, participants acknowledged the unfavourable political climate and advocated for effective communication as the foremost action to change political mindsets, to govern from community to cabinet, and to close the science-policy gap.

The **Himalayan University Consortium (HUC)**, a recipient-executed grant in partnership with ICIMOD over 36 months, strengthened collaboration of research institutions in the Hindu Kush Himalayan region on regional water resources management. The network of research institutions grew to 67 full time members and 19 associate members, from a baseline of 33 members.[25] The HUC website and online portal at http://www.huc-hkh.org/ grew into a key resource for digital collaboration among some 800 registered academic users. A Strategy and Plan for Actions 2018-25 was developed through a wide consultative process, incorporating global learnings from similar higher education consortia and institutions working on natural resource management. To aid sustainability, the Indus Forum Secretariat became housed in ICIMOD to support coordination among the partners.

Output 2: Generating and Sharing Knowledge

SAWI delivered 205 knowledge products that spanned geographies and sectors — all intended to deepen the evidence base to inform policy makers, researchers, and practitioners on managing shared water resources in South Asia.

Some noteworthy examples are listed below.

- Taking a 'Source to Sea' approach, SAWI's **Glaciers of the Himalayas** research developed a flagship report that brings important technical knowledge gap by identifying the causes of potential changes to the glacier and snow dynamics in the Himalaya, Karakoram, and Hindu Kush mountain ranges, and by analyzing and quantifying the impacts of climate change and black carbon on glacier and snowmelt

25 A list of Himalayan University Consortium member institutions is available at: https://www.icimod.org/huc/members/. Associate Members are based outside the HKH and have a strong interest in the region and mountain issues.

in the Himalayas. This has important implications for future water resources within the Indus, Ganges, and Brahmaputra basins. The knowledge will allow infrastructure investment decisions that are robust under possible future scenarios and will provide useful benchmarks for World Bank teams planning hydropower, agricultural and livelihood projects.

- As part of mainstreaming nature-based solutions within World Bank investments, SAWI supported two activities. The first, **Practitioner Program on Transboundary Water Management**, developed guidance notes on sediment management and landslide risk assessment, and innovative methodologies in sustainable management of forested watersheds of regional importance, given the growing challenges and vulnerability from climate change. The work continues to inform the Regional Ecological Integration Platform, which aims to increase regional cooperation in South Asia to manage shared natural resources and responses to climate change. SAWI also developed a data portal[26] which houses open-source global datasets relevant to watershed management in South Asia. The second activity, **Plastic-free Rivers and Seas for South Asia** developed more than nine reports and supported three Innovation Competitions. All activities influenced and shaped the strategy of the World Bank in Climate Change Strategy and Marine Plastic Agenda in South Asia. SAWI's work is also a solid base for each South Asian country to develop their National Action Plans to combat marine plastic pollution.

BOX 20: SAWI AND PLASTIC POLLUTION

SAWI brought new analytical insights for tackling the issue of plastic pollution, which triggered and informed work at the regional and country level.

A series of four papers provided deep-dive perspectives on the mismanagement of plastic pollution in the South Asia region.

- Plastics x COVID-19 paper took stock of changes in perception/consumption of plastics due to the COVID-19 pandemic.
- Plastics x Gender & Jobs, prepared in collaboration with the Parley Foundation, examined the role of women in the region's plastic waste management system, the challenges they face, and provides recommendations for collaborative action.
- Plastics x Climate Change assessed the environmental impact of the plastic industry in South Asia with a focus on global warming potential.
- Plastics x Roads & Transport presented the environmental, economic and engineering performance of the use of plastic waste in road construction.

The **Baseline Assessment for Plastic Debris Flowing into Rivers and Seas of South Asia**[27] took stock of plastic waste leaking into rivers and seas in the region. This built a harmonized monitoring, management, and policy framework to reduce plastic waste and support a circular economy model for plastics. The assessment will provide a baseline against which investments in the region can be planned and monitored. The activity supports the South Asia Regional Marine Litter Action Plan and related marine litter action plans in each member country with an evidence-based, objective baseline of plastic pollution flowing into watercourses across South Asia. **A set of country-specific studies for India, Nepal, and Pakistan were also developed to support the regional baseline**.

Innovative events held in Bangladesh and India helped to raise the profile of plastic pollution. In Bangladesh, SAWI supported a Plastic Circularity Innovation Challenge which sought innovative solutions in two categories: collection/sorting, recycling of low-valued plastics and single use plastics, and digital technology and mobile apps to address plastic pollution. The World Bank Country Office, the Ambassador of Norway, and Special Guest Ziaul Hasan, Secretary, Ministry of Environment, Forest, and Climate Change attended the event. In India, youth were invited to offer innovative solutions to mismanaged plastic waste in an April 2021 competition in cooperation with the Indian Institute of Management-Lucknow, the South Asia Co-operative Environment Programme, and the World Bank's Youth-to-Youth Global Youth Climate Network.

26 http://spatialagent.org/SARWatersheds/

27 The 2021 baseline assessment is available at https://www.imcworldwide.com/project/baseline-assessment-of-plastic-debris-flowing-into-rivers-and-seas-of-south-asia/

- **Technical Assistance and Knowledge Sharing Facility for the Development of Utility Scale Floating Solar PV Power Generation in India** is timely, as, given India's strong commitment towards its NDC targets, this engagement will directly help in scaling up the measures being adopted by the Government of India in installing cleaner and greener projects in the country.
- Groundwater abstractions account for 40 percent of all water withdrawals in the South Asian Region (Hirji, Nicol and Davis 2017). Three regional groundwater studies brought new knowledge on this critical resource in South Asia and informed policy discussions. The first, **Capacity Building for Groundwater Management** developed an online report with seven case studies and highlighted the importance of managing groundwater in tackling water stress in South Asia. The second, a **Diagnostic Study on Groundwater-Energy-Agriculture Nexus** responded to the concern that solar power could lead to over-extraction of groundwater. SAWI successfully designed and tested alternative business models in the highly water-stressed state of Rajasthan focused on the use of solar panels to generate electricity for extracting groundwater and for selling surplus electricity in selected groundwater-stressed areas. SAWI's work showed that the proposed model of grid-connected solar irrigation can achieve the trifecta of increasing water productivity and water conservation, doubling farmer income, and increasing energy efficiency of irrigation. In addition, it has the potential to eliminate recurring power subsidy to agriculture, provide climate-resilient income to farmer, and reduce carbon footprint of agriculture. The recommendations were endorsed by the state government and NITI Aayog. The Government of Rajasthan subsequently took up field testing of the recommended business models through the Bank-supported Rajasthan Agricultural Competitiveness Project. The third activity, **Strategic Basin Planning for the Ganges** (reported in an earlier section under the Ganges Focus Area), included modelling and technical work on surface-groundwater interactions drawing on various literature and historic data.
- The quality of water remains a critical issue between Bangladesh and India. SAWI's **Monitoring Transboundary Water Quality in Bangladesh** undertook a rapid assessment of all 54 transboundary rivers. This study examined the status of the water quality monitoring system of the Department of Environment of Bangladesh, identified systemic gaps, including water pollution, and recommended measures to strengthen these. Key deliverables included: (a) Report on Review of water quality issues of all 54 transboundary rivers; (b) Report on pollution inventory and water quality data collection at two priority rivers (Mathabhanga-Churni River in Chuadanga District and the transboundary streams and canals of Akhaura Upazila of Brahmanbaria District); (c) Report including Design of upgraded water quality monitoring schemes for the two priority rivers; (d) Database on water quality at two priority rivers; (e) Development Project Proforma to be submitted to Department of Environment (DoE); (f) Hydrological and water quality model for Mathabhanga-Churni River in Chuadanga District and the transboundary streams and canals of Akhaura Upazila of Brahmanbaria District.

  SAWI also helped to facilitate discussions with Bangladeshi representatives on the Joint Rivers Commission (JRC, Bangladesh), the Bangladesh Water Board (BWDB) under Ministry of Water Resources (MoWR) and the Department of Environment under the Ministry of Environment, Forests and Climate Change (MoEFCC) focused on water quality issues in transboundary rivers.
- **HEP Sustainable Planning** supported the Royal Government of Bhutan in framing national guidelines to international standards, for implementation of the roadmap to tap the country's hydropower potential. This included the development of dam safety guidelines, procurement guidelines for hydropower construction work, and a confidential gap analysis to inform Bhutanese policy makers on addressing gaps for an upcoming Dorjilung Hydropower project.

Output 3: Building Institutional and Professional Capacity

SAWI used multiple approaches to strengthen capacity: firstly, by developing and delivering capacity building programs, secondly, by facilitating engagement through regional institutions for regional capacity

building, and finally, by using dialogue events to introduce new ideas and concepts. Some examples include the following:

- The **Regional dialogue** events exposed participants to new thematic topics and tools — for instance, on gender and social inclusion, using nature-based solutions to manage water extremes, and the use of disruptive technologies for managing water extremes.
- The **Practitioner Program on Transboundary Water Management** activity undertook numerous consultations to develop guidance and training for stakeholders on methods to reduce sediment and landslide risk and increase project resilience. The **Capacity Building - IWRM in Transboundary Basins** activity supported a study tour to Netherlands for over 37 Indian participants on water management practices, and training for 30 participants on groundwater modelling.
- The **Himalayan University Consortium** grant enhanced capacity of senior, mid- and earlier career faculty in conducting research on water and natural resource management from inter- and trans-disciplinary perspectives, including through training of 32 researchers, five study tours and 14 research visits to institutions. It also enhanced capacity of librarian and IT staff members of participating institutions in resource sharing through fully functioning HUC Online Platform, containing approximately 50 searchable institutional profiles and 300 individual profiles of researchers and scholars working in the fields of natural resource management and sustainable mountain development studies.

Output 4: Scoping Interventions and Investments

SAWI's work was strongly relevant and linked to World Bank investments in the region. For instance, the Glaciers of the Himalayas study informed technical design of the World Bank's South Asia Regional Climate Adaptation and Resilience (CARE) Program ($36M). SAWI's technical and analytical work complemented and informed the Bank's Plastics Free Rivers and Seas for South Asia (PLEASE) ($37m) and helped to position SACEP as a regional champion on marine plastic pollution. **Capacity Building for Groundwater Management** provided technical, environmental and social appraisal to the Atal Bhujal Yojana (Abhy)-National Groundwater Management Improvement for India and informed design of a management information system design to support local community involvement. The business model developed by the **Diagnostic Study on Groundwater-Energy-Agriculture Nexus** activity informed the Indian State of Rajasthan's program on options to transform the adverse outcomes of the water-energy-agriculture nexus into a virtuous cycle. **The HEP Sustainable Planning - Bhutan** informed development of hydropower investments in Bhutan and was followed by a request from RGoB for World Bank support to prepare the 1125 MW Dorjilung Hydropower Project. The **Development of Utility Scale Floating Solar PV Power Generation in India** activity informed World Bank initiatives (including a US$200m engagement in India) which support investments in floating solar projects including by setting the right course for undertaking due diligence for such projects, mapping reservoirs as an important link between solar and water resources planning and contributing to the Global Solar Atlas through creation of a database on large hydropower projects.

Implementation Challenges

Convening stakeholders across the four riparian countries and organizing these meetings at scale was a logistical challenge and required significant planning and organisation. Regional security events and supporting participants to secure visas was also another challenge. Supporting institutional readiness of regional institutions to sustain SAWI's work also proved to be a challenge — despite willingness to take on this work, securing funding for activities remains a challenge.

Lessons Learned

1. **Dialogue forums on transboundary water at the overall regional level in South Asia were useful in convening stakeholders but their immediate value was limited as the forums were too big and dispersed**. Smaller, more structured events might have been more useful to generate and progress

specific ideas for collaboration. In the longer-term, organizing and sustaining these types of regional-level events proved to be difficult. Also, COVID-19 showed that the use of online tools for knowledge sharing could be an alternative way of reaching the right sets of stakeholders.

2. **A flexible Regional FA activity offers the opportunity to create and seize windows of opportunity in a neutral way that does not single out any particular basin / geography**. For instance, the four groundwater studies were a common and critical challenge across all basins and SAWI's technical work was able to bring new insights into this sensitive issue across sub-geographies and use this to promote knowledge sharing.
3. **Engaging in partnerships and building capacity through regionally-based institutions was important to sustainability**. While this approach was effective in building networks and in institutionalising capacity building within regional organisations, financially sustaining these efforts beyond SAWI has remained a challenge.

SECTION

03

PROGRAM AND FINANCIAL MANAGEMENT

3.1 SAWI'S PORTFOLIO

Over its lifetime, SAWI had a portfolio of 67 grant activities across all five Focus Areas. This included six recipient-executed grants (approximately 9 percent of the portfolio). Two recipient-executed grants were with regional institutions: the International Union for Conservation of Nature for training on transboundary water governance and International Centre for Integrated Mountain Development for sustainable collaboration among a network of Himalayan universities. Four recipient-executed grants went to governments to strengthen specific government programs and / or to build capacity of departments. The four grants went to Government of Bhutan for hydromet services and disaster improvement, the state of Bihar for flood modeling, and the Government of Nepal's Water and Energy Commission Secretariat for hydropower (two grants). All other activities were bank-executed grants.

3.2 PROGRAM AND FINANCIAL MANAGEMENT

SAWI was an important and strategic instrument for the World Bank in South Asia and was fully aligned with the World Bank's strategy and operations. Over the years, the trust fund was administered by the World Bank South Asia Region's Regional Integration and Engagement (SARRE) team (previously called the South Asia Region's Regional Integration and Partnerships), which is headed by the Director, and was managed by a Secretariat including a DC-based Program Manager, a Delhi-based technical lead and co-lead, operations staff, a communications officer, and two M&E specialists. The World Bank's Water Global Practice provided technical leadership throughout, ensuring that SAWI was fully embedded within the World Bank's broader water agenda. Individual activities were managed by TTL experts from across multiple GPs (Agriculture, Energy, Environment, SURR, etc.,) which enabled SAWI to benefit from the Bank's wider experience of working on similar issues across other countries in South Asia and elsewhere.

In 2016/17, the SAWI team undertook a process of adaptive management which enabled it to streamline the portfolio, revisit activities that were not able to progress or to have any traction, and to redistribute financial resources to respond to emerging windows of opportunity that could have more impact. By 2018/19, the process for selecting all five of SARRE-managed regional Trust Funded activities became further streamlined under the World Bank's Trust Fund Reform. All proposals were reviewed and approved by the Regional Integration Programs Committee (RIPC) — an internal forum chaired by the SARRE Director, with representation from the South Asia Chief Economist's office, relevant Global Practices and Country Management Units in South Asia. This approach helped the Bank to manage all its Trust Funds as a portfolio, designed to bring efficiency in operations by ensuring that all activities remain aligned with regional and country priorities, and by maximising synergies between them.

SAWI received in total $35.4 million in contributions from United Kingdom, Australia and Norway. Accounting for administration fees and investment income, the total funding deposited in the two trustee accounts (TF071929 and TF073237) was $35,659,976. As of July 31, 2021, $35.287,526 was disbursed. leaving an undisbursed balance of $372,450. A summary is in Table 2 below, and more details are provided in Annex 4.

Table 1: SAWI Financial Overview

	Amounts (US$) (as of July 31, 2021)
Total deposited into trustee accounts TF071929 and TF073237 (donor contributions + investment income – administration fee)	35,659,976
Total disbursements	35,287,526
Fund balance	372,450

3.3 MONITORING, EVALUATION, PARTNERSHIPS AND COMMUNICATIONS

SAWI benefitted from being part of FCDO's larger South Asia Water Governance (SAWG) program, and DFAT's wider SDIP program in two ways: Firstly, SAWI participated and presented in wider forums organised by each of these donor-supported programs which enabled it to expand its networks and reach, share knowledge, and enhance complementarity of approaches. Secondly, SAWI drew on donor presence and expertise to further its activities (e.g. Norway's representation in events delivered in partnership with the Government of Bangladesh, Australia's delivery of technical tools in the regional dialogue and gender sessions in the Indus Basin knowledge forum, and UK's wide networks and leadership on climate change, including in the run up to COP-26 in 2021, and complementarity with other UK-funded regional integration Trust Funds in South Asia).

SAWI benefited from strong donor support and active participation by the donor representatives whose co-location in Delhi along with the Bank's technical lead facilitated frequent interactions in addition to formal annual meetings. A mid-year check-in process was introduced since 2016 to supplement the Annual Review; and, SAWI also conducted field visits for donors to experience the work first-hand. An independent evaluation, commissioned by donors in 2017-18, found positive results against SAWI's relevance, effectiveness, impact, sustainability, and value for money. Several recommendations from the Independent Evaluation for strengthening the program were taken on board, including adequately staffing and resourcing the SAWI Secretariat.

As part of its closure activities and knowledge sharing efforts, SAWI delivered a two-part virtual expedition: 'From Source to Sea' (June 2021) for donor partners to gain insight into the richness of its approach and the emerging results.[28]

Since 2019, the World Bank has stepped up efforts to communicate activities supported by regional trust funds in South Asia. A public website, OneSouthAsia at www.worldbank.org/OneSouthAsia, was redesigned to highlight success stories, reports, analyses, and videos about regional integration and collaboration. The site's content focuses on regional work in a half-dozen major areas: climate, energy, human development, trade, transport, and water. The website encompasses work with trust fund partners and Bank investments to build stronger regional links that can boost economic growth and climate resilience. SAWI work is included on the site, and on SAWI's own website at https://www.worldbank.org/en/programs/sawi. The latter has an extensive list of SAWI-funded knowledge products that include research papers, reports, and brief.

28 The virtual expedition tours several SAWI activities, providing text, maps, videos, and links to SAWI knowledge products. The expedition is at: https://geowb.maps.arcgis.com/apps/Cascade/index.html?appid=9e3c73ef0b3e4d72a236531cb6c68321 and also on the SAWI website.

3.4 MANAGING RISKS

SAWI's overall risk rating remained **Medium** over its implementation, with five key risks and mitigation measures identified in the Program Strategy (2013).

(i) **COVID-19 (new) – Medium**: The World Bank lost some of its key partners (including on SAWI) and staff due to the pandemic. Since early 2019, some activities faced delays or were unable to proceed with planned events due to non-availability of stakeholders, travel restrictions etc. Mostly, South Asian stakeholders were focused on dealing with the immediate threats of COVID, limited opportunity to press ahead on some aspects of SAWI. In the longer-term, global attention is refocusing on the threats of water and climate change — both of which remain relevant priorities for South Asia. SAWI's work is therefore expected to sustain.

(ii) **Operational Risks – Medium**: The main risk was the evolving political and security situation in South Asia — both in the western sub-region as events unfold in Afghanistan, and with respect to the on-going bilateral tensions between the bigger countries. This could result in more entrenched positioning on transboundary water resource discussions. SAWI's adoption of 'water as an integrator' was successful in broadening the dialogue away from sensitive issues towards a more encompassing view of benefits that could come from cooperation, including in water-related sectors. Internal operational risks were minimum as the Bank's SAWI Secretariat managed the program robustly, with international financial and management information systems to track activity process. Externally, the main operational risk arose from limited partner capacity to progress Recipient Executed activities and to secure additional financing beyond SAWI funds.

(iii) **Financial Risks – Low**: SAWI undertook a portfolio rationalization exercise in 2017/18 as part of adaptive management practice. Subsequently, the Secretariat kept a close track of expenditure on a monthly basis. SAWI funds were fully allocated and had a small balance at closure.

(iv) **Relationship Risks – Low**: The strategy of linking SAWI activities with larger World Bank investments paid off as SAWI was able to leverage the Bank's wider networks and in-country presence. Partnerships with regional institutions also enabled SAWI to broad-base its support. Over the years, stakeholders increasingly participated in SAWI's activities — suggesting a growing momentum for transboundary water resources.

(v) **Reputational Risks – Low**: SAWI's work was closely aligned with partner demand and priorities. Stakeholders continue to value and use the knowledge and analytical work generated through SAWI. Although this phase of the Trust Fund ended, regional stakeholders have expressed an interest in engaging in any subsequent phase.

3.5 SUSTAINABILITY

Water security remains an important priority and sharing of these resources remains the predominant issue in regional cooperation dialogues. However, countries are increasingly recognising the productive potential of water, and are focused on combating the destructive impacts from climate and weather-related events. This is focusing attention on the need to collaborate in specific sectoral areas and will remain a positive influence for SAWI's work to be taken up and used.

SAWI's measures for sustainability: SAWI put in place several measures for its activities to sustain beyond this phase of funding. As such, the likelihood of sustainability across its activities remains strong, with the exception of those activities that are subject to the evolving external environment or that are dependent on financial resources. Some examples of sustainability measures include the following:

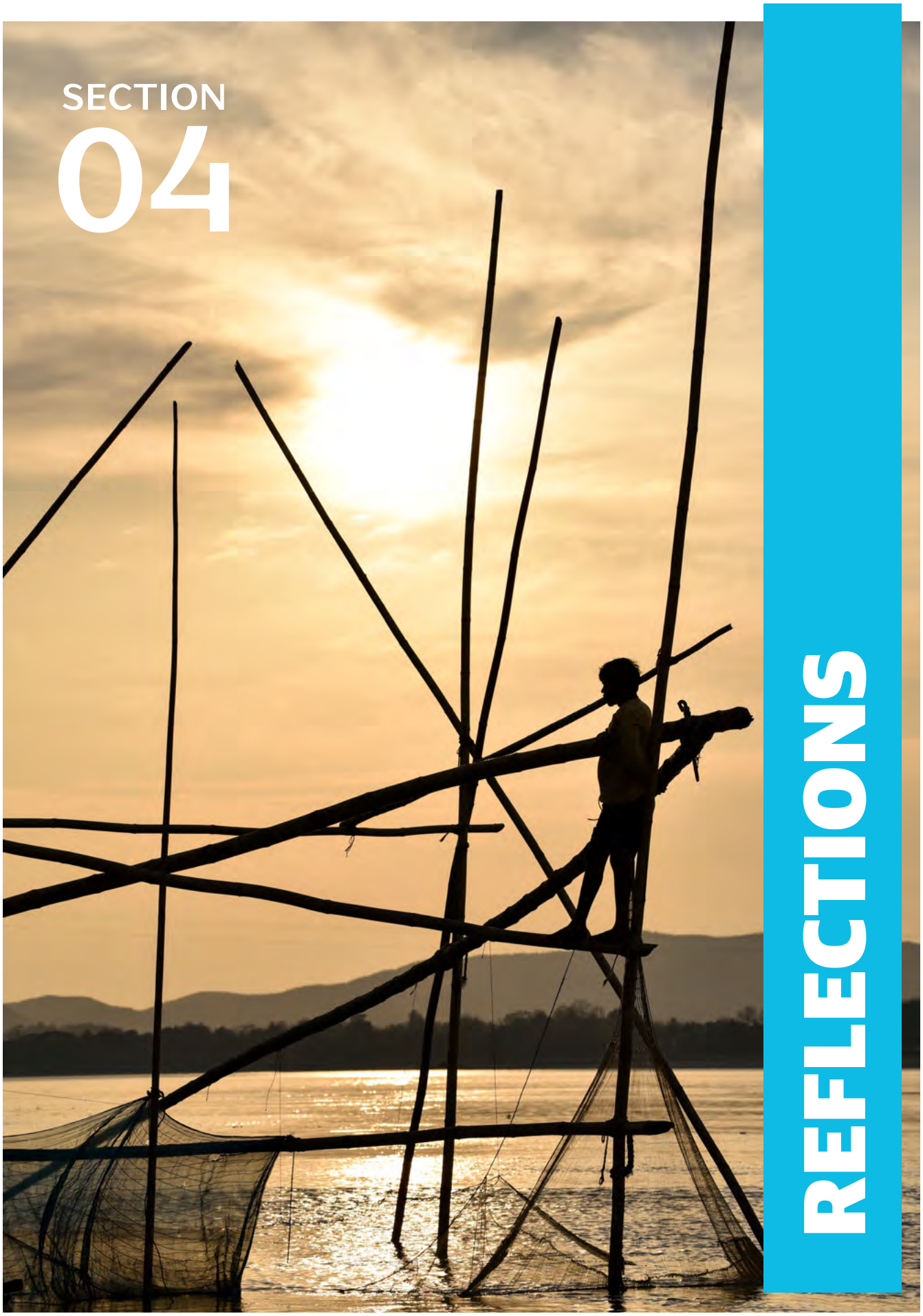
(i) Sustaining the dialogues: SAWI worked in partnership with and through others to build and transfer ownership. Other institutions have taken over the organization of sub-regional events and continue to pursue future financing options. The Brahmaputra Dialogue partners continue to collaborate on joint research, influencing policy makers in their own countries, and expanding networks; the Indus Basin dialogue and research activities are being facilitated by ICIMOD but, given the uncertainties in Afghanistan, it is unlikely that these will proceed in the medium term; and BISRCI became the main vehicle for regional dialogue and collaborative research between Bangladesh and India.

(ii) Institutionalizing knowledge products and tools and disseminating these externally and within the World Bank: SAWI's work has been taken up by government institutions, with numerous examples of work having become embedded in national systems and thinking. Those knowledge products and tools that are public are hosted on the Bank's website.

(iii) Continuing to inform linked investments (mainly World Bank and national projects, details of which are in Annex 9): This remains a significant vehicle for SAWI's work to be taken up. SAWI TTLs are also leading on other investment programs in South Asia, thereby enabling continued discussion with government partners, and a smooth transfer and uptake of knowledge within World Bank investments.

SECTION

04



REFLECTIONS

4.1 WHAT WORKED WELL

1. Building momentum and action towards improving cooperative transboundary water resources management requires a long-term, sustained effort and an appreciation that results may take time to become evident. Certain sectors, like hydropower development, require years of engagement before results become evident or support a transition to regional energy markets. Most of SAWI's activities built on years of World Bank engagement and SAWI support. Technical studies built a solid foundation and helped to deepen understanding of the whole system by stakeholders, annual dialogues and meetings helped to build trust, and regional networks helped to promote key messages with decision makers. This also enabled SAWI to keep steady progress despite changes in the political economy.

2. A long-term engagement with clear, short term interventions builds stronger ownership around basin-wide management and to the transboundary issues. Early development of the Focus Area Strategies enabled SAWI to adopt a longer-term planning horizon that linked with short-term delivery of SAWI activities. This approach also ensured that SAWI was closely aligned with the Bank's regional strategy and larger programmatic efforts in South Asia which helped to strengthen sustainability, facilitate uptake of SAWI knowledge in other World Bank investments, and ensure a coordinated approach to the World Bank's regional strategy in South Asia.

3. Working on issues of common interest was a useful mechanism to convene and engage riparian stakeholders. For example, flood and erosion management between Bangladesh and India; climate change in the Indus Basin; and climate change, disasters and the water-food-energy nexus in the Brahmaputra basin were common challenges that piqued stakeholder interest to work collaboratively.

Creating a shared context was also a helpful way to engage diverse stakeholders. For instance, a central theme on water stress at the Brahmaputra Dialogue workshop enabled participants to have candid discussions on all aspects of the topic in a politically neutral way. In India, convening cross-departmental stakeholders and presenting alternative scenarios to this group was a powerful engagement strategy, particularly on sensitive issues, or where there are diverse interests represented. For instance, the regional groundwater study in Rajasthan presented different business models for grid-connected solar irrigation, technical and financial analysis, institutional models, and related policy scenarios to achieve a virtual nexus among energy, groundwater and agricultural sectors. The workshop, chaired by the Additional Chief Secretary (Agriculture), started with a discussion of the nexus approach for understanding the long standing and complex issues of groundwater depletion, mounting farm power subsidies and stagnant farm income. The attractiveness and obstacles for each option and the different institutional models for implementing the proposed models were discussed. The participants in the workshop engaged in intensive discussions with the presenters and among themselves to understand the policy options better.

4. Regional meetings may be best held in a neutral country outside the region and are likely to have more senior-level people attend. One of the early Indus Forum meetings, for example, was held within the basin. Although attended by representatives from all of the riparian countries, the level of attendance proved that holding meetings in neutral countries allowed participation of a much larger group of stakeholders and made meetings, and travel and visa logistics for participants easier.

5. Incremental and multi-pronged approaches to Capacity Building were effective. Firstly, to build capacity in a sustainable way it is important to ensure training is phased, does not happen only through one-off events, but takes place as a series of trainings engaging the same stakeholders over multiple times. For instance, the shift from water planning and management based on administrative boundaries to that of River Basin level is a significant one. This required a lot of training, hand holding and follow up to realize actions on the ground.

SAWI phased training with varying levels of difficulty so that end users could progress from basic understanding of models to the actual implementing and running of complex models at the river basin scale. Secondly, despite strong ownership, the protracted procurement processes and lack of capacity of government agencies constrains their ability to adopt highly technical approaches (such as the use of modernized hydromet infrastructure). SAWI's TF grants were useful in helping to build capacity and readiness alongside the World Bank's larger investment programs. Thirdly, SAWI found that organising strategic exposure visits for high-level officials to other countries that are facing similar issues helped to convincingly demonstrate how regional approaches worked elsewhere. This was a useful way to get early buy-in as senior decision makers with policy level buy in can be tremendous catalysts of change.

6. Working with and through regional and national Institutions was an effective mechanism to extend SAWI's reach build ownership of the processes and ensure sustainability. There are several examples of where SAWI successfully drew on partnerships that it has built up over the years. For instance, the BISRCI in Sundarbans has drawn extensively on SAWI-knowledge products and has become an effective platform for stakeholders from Bangladesh and India to engage informally; the partnership with ICIMOD, including through the Himalayan University Consortium grant, has helped to widen the network in South Asia, build capacity and ensure further momentum on the Indus Basin research. SAWI's increasing shift towards a partnership approach — working with and through others — has enabled the program to broaden its reach, play a strong facilitative role with other partners, and set the stage for longer-term regional institutional capacity and sustainability beyond the program. For example, the Brahmaputra dialogue process is now being advanced by institutions in the four riparian countries: the Indus Basin Knowledge Forum was conducted through regional institutional partners (e.g. IWMI / ICIMOD / IIASA); SAWI has facilitated South-South exchanges such as training events between faculty from Chinese and Nepali universities, and a study tour of Afghan officials to the Nile Basin Initiative; and in Bhutan, the World Bank has had extensive consultations with UNDP and JICA on the hydromet-related work, and is seeking to build on ongoing efforts, including by other donors.

4.2 WHAT WORKED LESS WELL

1. The pandemic brought disruption to SAWI's planned work and raised future uncertainties about regional cooperation approaches in general. Since early 2020, due to Covid-19, there was limited face-to-face engagement with client partners, events to convene multiple stakeholders were not held, consultant experts were unable to travel to the field, and data collection efforts were severely hampered. Despite SAWI's efforts and use of virtual technology to sustain client engagement and deliver training, activities in the last two years of SAWI's implementation were affected. Also, client partners were distracted with other priorities, and the Bank lost staff, contractors and client partners in the second wave which hit South Asia in 2021, which deeply impacted morale. More generally, governments are immediately focused on tackling their national priorities and it is too early to assess whether the pandemic recovery efforts will leverage opportunities for cooperation or will hinder efforts in this direction.

2. Securing of funding beyond SAWI has been critical to sustaining momentum in the long term, particularly where these activities are being taken up by regional institutions or implemented as

Recipient-Executed activities. These considerations should be built into activities at an early stage. For example, the Himalayan University Consortium Secretariat is seeking external funding to maintain an active network. This remains a key challenge to the sustainability of the HUC Secretariat's work. Similarly, the joint research proposal emerging from the Indus Basin Knowledge Forum process has so far been unsuccessful in securing international funding without which it is unable to progress.

3. The upstream nature of SAWI's analytical and advisory work made it somewhat challenging to demonstrate downstream or direct impact. The very nature of SAWI's work was oriented toward providing technical and politically neutral evidence to support partners, systems and processes on a range of complex regional transboundary water governance issues. However, SAWI's strategic approach of building linkages with other longer-term World Bank investments provides an avenue for the uptake of these approaches.

TABLE 2: SELECTED SAWI RESULTS HIGHLIGHTS (CUMULATIVE)

DIALOGUE AND DIPLOMACY

1. SAWI's value add included convening diverse stakeholders, providing a neutral platform, bringing issues of gender and climate change onto the agenda, and using technical discourse to facilitate dialogue and discussion on a range of sensitive issues.

- The early phases of the Brahmaputra Dialogue process comprised a small group of stakeholders at the Track III and II diplomatic levels. With SAWI support, the dialogue morphed into an expanded and engaged group up to Track I½. To achieve this transformation, riparian country-level workshops and meetings — supported by informal one-on-one follow-ups with key stakeholders — established the political connection, commitment and momentum long needed for dialogue breakthroughs. The nature of the dialogue discourse evolved under the activity, going beyond technical management issues and opening up thinking toward common understanding across sectors and geographies, and on policy viewpoints. Events started to serve as a marketplace of ideas, bringing together the producers and consumers of knowledge, and knowledge partnerships started to emerge. The dialogue process is now institutionalized across the basin, with a consortium of institutions connected to government in each riparian country taking facilitation roles.
- SAWI conceptualized, financed and facilitated the BISRCI — a group of policy think tanks, civil society organizations and academic institutions from Bangladesh and India, along with the World Bank — as a knowledge-based advocacy platform to actualize effective bilateral cooperation for Sundarbans conservation. SAWI's programmatic approach to cultivate joint sustainable management of the Sundarbans, combining technical evidence with targeted advocacy and fostered dialogue, has incrementally shown dividends, and establishment of a joint institutional mechanism is within reach. There is now significant buy-in for adopting a holistic cross-country approach to landscape conservation and development, in an operating environment where different perceptions, capacities and political motivations and competing incentives have hindered sustainable development. SAWI's activities have built the momentum to unlock opportunities for future cooperative action and investments in areas that are emerging entry points, including disaster risk management, eco-tourism and hydromet systems. Without SAWI's interventions, it was unlikely that a BISRCI type of group would have emerged or that the 2011 agreements would have the political momentum to become operational within a reasonable time horizon.
- SAWI developed and deployed a comprehensive, sophisticated and first-of-its-kind scenario-based river modelling and basin planning suite for the Ganges Basin in India to provide central and basin state governments with an objective assessment of options and interventions to improve the health of the Ganges system. The work is recognized by the Government of India as a pilot for multiple river basin modelling and planning activities that will progress under the National Hydrology Project. SAWI's work was the first time a participatory approach was applied to development of a Ganges Basin model. The multi-stakeholder engagement process workshops, organized at both the state and basin level, and the decision to take state perspectives as a starting point for analysis, built trust and confidence between state and central government organizations and contributed to basin-oriented thinking, including taking into consideration the political economy sensitivities of stakeholder interests.

- SAWI's Indus Dialogue, which comprised the Indus Forum and Indus Basin Knowledge Forum, widened engagement on water management issues in the basin. Over time, an initial group of 15 riparian stakeholders expanded to regular meetings of around 100 people from the four basin countries, international experts, and donor partners. The expanded group of stakeholders encompassed a vast number of disciplines that contribute to the multi-faceted complexities that decision makers face when developing integrated approaches to water challenges in the Indus Basin. The regular meetings allowed participants to get to know each other, exchange information and experiences, and foster current partnerships or build new ones.

KNOWLEDGE AND CAPACITY

2. New knowledge products (205) and targeted capacity building (1,983 people and 124 water management organizations) deepened understanding of transboundary issues by key stakeholders and provided options and tools to address them, contributing positively to the wider operating environment.

- SAWI did hydrological, ecological, and econometric studies to assess the vulnerability of biodiversity and human populations across the Sundarbans in a changing climate with a rising sea level, cyclone-induced storm surges, and water and soil salinization. The research (more than 30 technical papers and reports) laid a technical foundation to better understand the challenges the Sundarbans faces, including responses of the ecosystem and human communities. Based on field research, SAWI recommended location-specific, resilience-smart adaptation measures to reduce climate vulnerability. Beyond the Sundarbans, the studies' methods and findings are of interest to development practitioners, policymakers, and researchers focused on island nations and countries worldwide with dense populations and economic activity in low-lying coastal regions vulnerable to sea-level rise.
- The SAWI Himalayan University Consortium (HUC) grant revitalized the HUC to a fully functioning, vibrant network that serves as an effective, holistic voice for mountain development and research. The research network now has more than 80 partner member institutions (from a baseline of 33). The grant helped improve the quality of membership and intensified member interactions. One-third of members that were previously inactive became active in the network, and a number took leading roles in key HUC activities. The grant facilitated collaborative research among HUC members to bridge the science-policy gap on sustainable mountain development issues in the HKH region.
- SAWI conducted a comprehensive analysis of groundwater in the Indus Basin (Pakistan). This work proposed institutional reforms and essential management interventions, which can be introduced over a span of years for long-term viability of groundwater in Pakistan. The study aimed to contribute to the ongoing consolidation of the groundwater knowledge base in the South Asia region and formed the basis for a long-term dialogue on groundwater management among provincial governments of Sindh and Punjab and the national government.
- SAWI supported the Government of Bhutan to develop national sustainable hydropower guidelines and dam safety guidelines. The guidelines will help ensure future hydropower projects in the country are environmentally and financially sustainable, socially inclusive, and conform to international standards and best practices. The two sets of guidelines were taken up by government and will help the country sustainably meet its ambitious plan to invest $9 billion and commission close to 12,600 MW of new hydropower by the end of the next decade.
- SAWI's Plastic X Series provided deep dive perspectives on mismanagement of plastic pollution in South Asia, and a baseline assessment of plastic debris flowing into rivers and seas of the region. The series serve as a base for the development of National Action Plans to combat marine plastic pollution in each country. The knowledge products are also influencing and shaping the World Bank's climate change strategy and marine plastics agenda in South Asia.
- SAWI developed an open-source flood model to operationalize a lead rainfall and flood forecasting system in Bihar, India, a state that is prone to devastating flooding. Through institutional capacity building, Bihar's Flood Management Improvement Support Center has taken up and successfully tested the model. The model is being scaled up under the Bihar Kosi Development Project and the National Hydrology Project to expand its coverage across the state.
- SAWI's demonstration work to advance development of utility-scale floating solar photovoltaic power generation in India kickstarted deeper discussions about using the technology throughout India to meet the country's renewable energy goals. The work mapped the floating solar potential in the country, conducted a preliminary detailed assessment of 100 water bodies to determine their floating solar potential, and prepared pre-feasibility assessments for certain locations.

LEVERAGE

3. Over the years, SAWI technical products, capacity building activities and dialogue processes informed 43 World Bank investments or operations South Asia, valued at about $9.5 billion.

- **Afghanistan**—Afghanistan Irrigation Restoration and Development Project, with an increased focus on transboundary river basin management (**$70M**).
- **Bhutan**—Hydromet Services and Disaster Resilience Project (**$4M**); South Asia Power Electricity Market Project (**$3.7M**).
- **Bangladesh**—Bangladesh Weather and Climate Services Project (**$113M**); Bangladesh Sustainable Coastal and Marine Fisheries Project (**$240M**); Bangladesh Coastal Embankment Improvement Project (**$375M**); Sustainable Forests and Livelihood Project (**$175M**); Climate-Smart Agriculture and Water Management Project (**$120M**); First Regional Waterway Transport Project for Bangladesh (**$360M**).
- **India**—Assam Integrated River Basin Management Project (**$500M**); National Hydrology Project (**$175M**); Atal Bhujal Yojana - National Groundwater Management Improvement Project (**$500M**); Uttar Pradesh Water Sector Restructuring Project–Phase 2, (**$360M**); West Bengal Major Irrigation and Flood Management Project (**$145M**); Bihar Kosi Basin Development Project (**$250M**); Punjab Rural Water Supply and Sanitation Project (**$200M**); Neeranchal National Watershed Project (**$178M**); National Ganga River Basin Project (**$1B**); Integrated Coastal Zone Management-India Project (**$220M**); the National Cyclone Risk Mitigation Project (**$310M**); Multipurpose Disaster Shelter Project (**$375M**); Rajasthan Agricultural Competitiveness Project (**$109M**); Innovation in Solar Power and Hybrid Technologies Project (**$150M**); IN Dam Rehabilitation and Improvement Project (**$350M**); Second Dam Rehabilitation and Improvement Project (**$500M**); Innovation in Solar Power and Hybrid Technologies (**$400M**); West Bengal Inland Water Transport, Logistics and Spatial Development Project (**$150M**); Assam Inland Water Transport Project (**$150M**); Capacity Augmentation of National Waterway 1 (**$800M**).
- **Nepal**—Power Sector Reform and Sustainable Hydropower Development Project (**$20M**); Kali Gandaki A Hydropower Plant Rehabilitation (**$27M**); Nepal Energy Sector Development Policy Credit project series (**$100M**); NP Modernization of Rani Jamara Kulariya Irrigation Scheme – Phase 2 (**$66M**); NP Rural Water Supply and Sanitation Improvement (**$72M**); Nepal Urban Governance and Infrastructure Project (**$150M**); Building Resilience to Climate Related Hazards (**$31M**); Kabeli A Hydro Electric Project (**$46M**); Nepal: Investing in Forests for Prosperity at a Time of Transformation (**$24M**).
- **Pakistan**—Water Sector Capacity Building and Advisory Services Project (**$35M**); Sindh Water Sector Improvement Project Phase I (**$150M**); Punjab Rural Water Supply and Sanitation Project (**$200M**); Sindh Water and Agriculture Transformation Project (**$350M**).
- **Region**—South Asia Region Climate Adaptation and Resilience Program (**$36M**); Plastic Free Rivers and Seas for South Asia (**$37M**).

ANNEX

01

ACTIVITY PERFORMANCE

1. PROGRAM INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)[29]

Results Indicators	IRB	GRB	BRB	SUN	REG	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes						
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	1/1	0/1	1/1	1/1	1/1	4/5
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing						
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	4/2	4/4	6/3	4/3	11/3	29/15
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation						
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	118/70	1254/465	108/49	167/20	336/277	1983/881
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	4/3	63/40	8/8	13/5	36/29	124/85
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers						
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	19/8	33/19	27/11	55/17	71/34	205/89
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability						
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	6/3	12/5	8/6	8/8	18/7	52/29

Acronyms: Indus River Basin Focus Area (IRB); Ganges River Basin Focus Area (GRB); Brahmaputra River Basin Focus Area (BRB); Sundarbans Landscape Focus Area (SUN); Regional Cross-Cutting Focus Area (REG).

[1] 3.1 tracks those who participated in training that was conducted over a sustained period of more than one day.
[2] 3.2 tracks "capacity strengthened" rather than the subjective "capacity significantly strengthened". Water-related organizations that participated in training conducted over a sustained period (more than one day) are counted.
[3] Performance targets were set in advance of detailed activity design.

29 How to read the Results Numbers: the numerator denotes annual Results actually achieved against the denominator of Targets in the Results Framework. Totals do not include double counting (i.e., participatory processes across years, same organization trained across years).

2. INDUS FOCUS AREA INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)

Results Indicators	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes									
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/0	1/1
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing									
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	1/0	1/1	1/0	1/0	0/0	1/1	0/0	0/0	4/2
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation									
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	16/0	6/5	27/10	44/5	25/50	0/0	0/0	0/0	118/70
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	0/0	0/0	3/2	4/2	4/1	0/0	0/0	0/0	4/3
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers									
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	2/1	0/1	6/1	2/1	5/1	2/1	2/2	0/0	19/8
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability									
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	0/0	2/0	2/1	0/0	0/1	1/0	1/1	0/0	6/3

3. GANGES FOCUS AREA INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)

Results Indicators	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes									
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	0/0	0/1	0/1	0/1	0/1	0/0	0/0	0/0	0/1
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing									
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	0/0	1/1	1/0	1/1	1/0	1/1	1/1	1/1	4/4
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation									
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	0/0	260/10	251/200	243/140	172/60	93/10	235/45	0/0	1254/465
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	0/0	6/1	45/40	24/40	29/20	20/1	24/10	0/0	63/40
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers									
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	0/0	2/2	4/2	2/2	6/2	9/5	10/5	0/0	33/19
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability									
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	0/0	0/0	4/1	2/0	1/1	3/1	1/1	1/1	12/5

4. BRAHMAPUTRA FOCUS AREA INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)

Results Indicators	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes									
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	0/0	1/1	1/1	1/1	1/1	1/1	1/1	0/0	1/1
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing									
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	1/1	2/0	3/1	2/0	1/1	0/0	0/0	0/0	6/3
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation									
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	8/8	60/5	9/5	0/0	31/0	0/10	0/20	0/0	108/49
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	0/0	0/0	2/2	1/2	2/1	3/1	0/2	0/0	8/8
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers									
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	2/1	1/2	3/1	7/2	4/1	6/1	4/3	0/0	27/11
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability									
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	0/0	1/2	2/0	2/2	2/1	3/1	0/0	0/0	8/6

5. SUNDARBANS FOCUS AREA INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)

Results Indicators	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes									
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	0/1	1/1	1/1	1/1	1/1	1/1	1/1	0/0	1/1
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing									
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	0/0	1/0	1/1	1/1	1/0	1/1	0/0	0/0	4/3
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation									
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	0/0	130/5	0/5	37/5	0/5	0/0	0/0	0/0	167/20
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	0/0	2/0	2/2	9/2	0/1	0/0	0/0	0/0	13/5
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers									
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	0/0	3/1	6/2	3/1	17/2	17/5	9/5	0/0	55/17
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability									
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	0/0	0/0	1/2	0/2	2/2	4/1	1/1	0/0	8/8

6. REGIONAL CROSS-CUTTING FOCUS AREA INTERMEDIATE RESULTS DASHBOARD (CUMULATIVE)

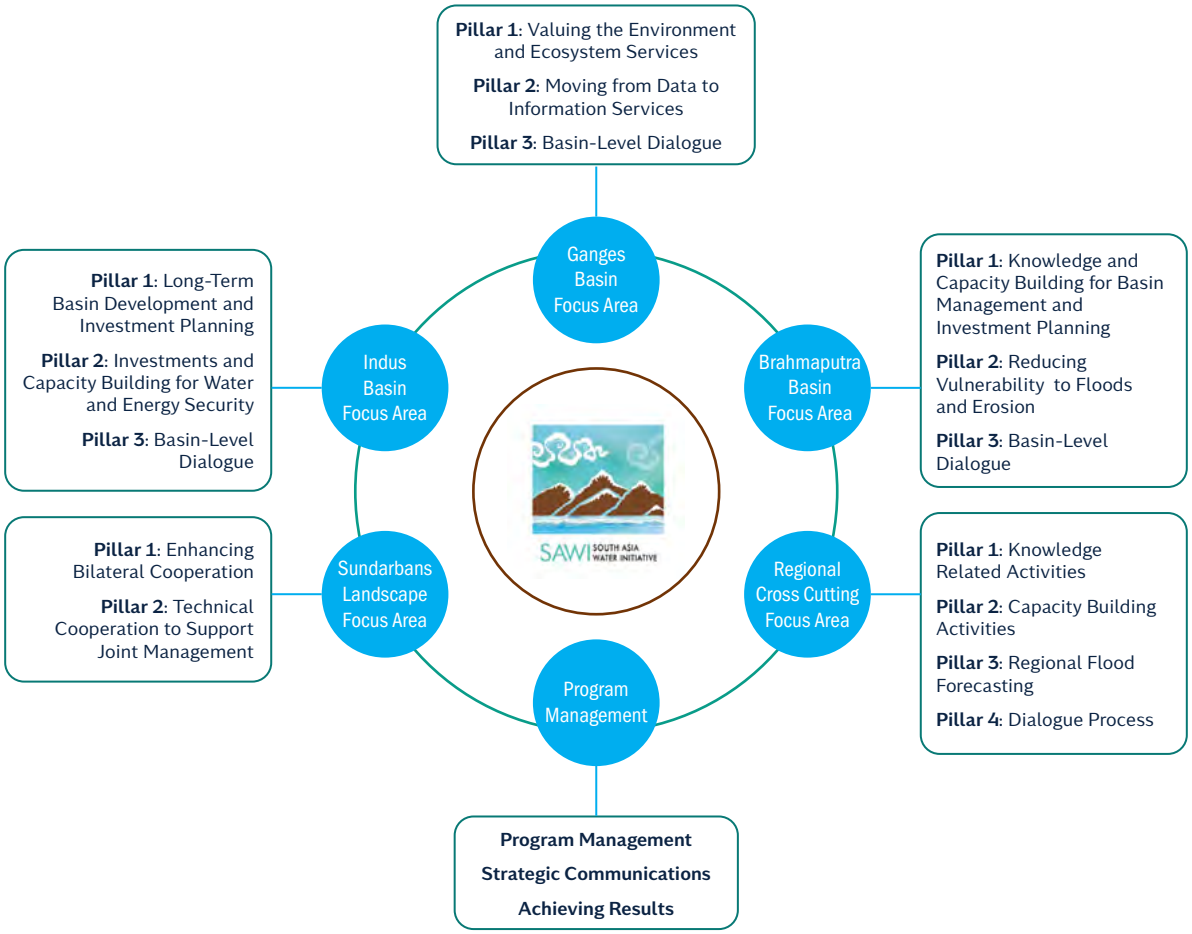
Results Indicators	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	TOTAL
1. Trust and confidence in regional or basin water management increased by dialogue processes									
1.1 Number of regional and basin/landscape dialogue processes facilitated or supported by SAWI	0/0	1/1	1/1	1/1	0/1	1/1	0/0	0/0	1/1
2. Stakeholder input to government decision making strengthened by participatory processes that facilitate transboundary knowledge generation and sharing									
2.1 Number of regional, basin/landscape or sub-basin level participatory processes that support transboundary knowledge generation and sharing and stakeholder input to government decision making	0/0	0/0	2/0	0/0	1/0	2/1	2/2	4/3	11/3
3. Capacity of water resources organizations strengthened in areas relevant to transboundary cooperation									
3.1 Number of professionals trained in the aspects of water management, water policy or water diplomacy relevant to basin-scale planning and management or regional cooperation[1]	0/12	10/15	101/80	120/50	43/30	62/50	0/30	0/10	336/277
3.2 Number of key water management organizations with policy or technical capacity significantly strengthened by SAWI activities in areas relevant to basin-scale planning or regional cooperation[2]	0/0	1/1	12/4	15/4	1/2	7/3	0/10	0/5	36/29
4. Regional, basin or sub-basin-level knowledge increased and accessible to stakeholders including decision makers									
4.1 Number of regional, basin/landscape or sub-basin-level knowledge products produced and shared with key stakeholders, including decision makers	0/1	2/2	6/2	9/2	9/4	5/3	11/10	29/10	71/34
5. Regional, basin or sub-basin-level interventions designed to improve livelihoods and ecosystem sustainability									
5.1 Number of regional, basin or sub-basin-level feasibility studies or intervention designs informed by SAWI activities	0/0	0/0	3/0	0/0	1/0	2/1	6/3	6/3	18/7

ANNEX

02

ACTIVITY SUMMARIES

(Selected Results)



Indus Focus Area

Objective

To improve water resources management and coordination among the Indus Basin riparian countries—Afghanistan, China, India and Pakistan—to enhance water and energy security in the basin.

Focus Area Theory of Change

Given complex water challenges, high glacier dependency and growing per capita water scarcity, the Indus is the most vulnerable river basin in South Asia. Relationships among riparian countries and different levels of capacity pose additional challenges to regional cooperation on water resources management. Given the World Bank's role in the 1960 Indus Waters Treaty and the importance of neutral engagement, maintaining transparency in World Bank engagement in the Indus Basin is critical. In response to communications from key riparian stakeholders, investment in this Focus Area was relatively low and focused on issues not under the purview of the Indus Waters Treaty.

Activities focused on tractable efforts where client demand was clear, including: (1) identification of the need for and provision of technical assistance at the national level to enhance transboundary (including inter-provincial boundaries) water resources management capacity; and (2) continued support to the basin dialogue (commenced in 2013) focusing on development of joint research activities on climate change impact in the Indus Basin.

Pillar 1 – Long-Term Basin Development and Investment Planning

Indus Basin (Pakistan) Groundwater Analysis

While the Indus region has a long history of major investment in surface water infrastructure, the management of groundwater infrastructure has remained in private hands, contributing to uncontrolled expansion of access to groundwater. Poorly managed conjunctive use of the interconnected surface and groundwater systems has led to a corresponding deterioration of the groundwater resource. Institutional capacity for governance of these resources is low and essential groundwater data that would facilitate improved governance are fragmented and not easily discoverable for a significant proportion of the Indus Basin.

Through extensive stakeholder consultation, this activity developed and published a synthesis of knowledge on groundwater and its governance in the Indus Basin (Pakistan) and an analysis of trends on available groundwater data. The study identifies both natural and anthropogenic factors that affect the temporal and spatial variability in the availability and quality of groundwater across the basin; it outlines sectoral risks posed by the ongoing challenges to adequately measure and manage the resource; it provides examples of targeted groundwater management interventions in the local, regional and international experience; and it proposes institutional reforms and essential management interventions, which can be introduced over a span of years, for long-term resource viability. This work provides an important knowledge base to inform the preparation and implementation of World Bank projects in Pakistan and is anticipated to support the design of initiatives on managed aquifer recharge, conjunctive management, groundwater monitoring and data management, and institutional reforms. This activity was also timely, as Pakistan's national water policy includes a dedicated chapter on groundwater, and the province of Punjab passed a Water Act that encompasses all water (including groundwater). SAWI prepared a background paper, at the request of the Sindh government, as a contribution to a provincial water policy for the province of Sindh. SAWI's work forms the basis for a long-term dialogue on groundwater management among the provincial governments of Sindh and Punjab and the national government, and contributes to the ongoing consolidation of the groundwater knowledge base in the South Asia Region.

Timeframe: March 2018 - May 2020. ***Geography***: Indus Basin; Pakistan. ***Grant Amount***: $0.30M

Glacier Monitoring in the Upper Indus Basin

The Indus, Ganges and Brahmaputra rivers have headwaters in the Hindu Kush-Himalaya Mountains (HKH), a region with about 50,000 glaciers. The impact of climate change on the volume and runoff timing of these headwaters is uncertain due to inadequate ground-based monitoring and data management. This uncertainty has caused concern in the HKH riparian countries over the future availability of water resources stemming from these headwaters for all uses.

This activity aimed to improve the understanding of the impacts of climate change on glacier dynamics and its ramifications on water resources availability in the Upper Indus Basin. It put together the building blocks for a credible hydrometeorological monitoring program for the HKH, with procedures for undertaking climate change, glacier and hydrology assessment and monitoring needed to bring clarity and predictability to future water and energy budgets. The produced report also sets out best practice instruments to improve glacier monitoring and the tools required to aid decision making based on glacier information. The grant was used to advance early implementation of the Tarbela Fourth Extension Hydropower Project (Pakistan).

Timeframe: October 2013 - September 2014. ***Geography***: Indus Basin. ***Grant Amount***: $0.10M

Learning Innovative Approaches to Glacier Monitoring to Address Climate Change

Although the Indus Basin ranks among the most important basins in terms of human dependence—supporting a population of about 270 million—and is among the most water stressed areas in the world, trending toward permanent water scarcity, water resources management in the basin is limited by insufficient knowledge of its glaciated land, which totals 21,000 square kilometers, making it one of the most extensive glacier-covered areas outside the polar regions. The 18,000 HKH glaciers feeding the basin are understudied and poorly monitored for several reasons: the inaccessibility of the area (much of the glaciated Upper Indus Basin sits 5,000 meters or more above sea level); a lack of conceptual models of the mountain hydro-meteorological environment; inadequate analysis of existing databases that monitor the region; very limited data and information exchange; no common knowledge platform; and the fact that basin decision makers are often disconnected from developments in the scientific community. Without better data on glacial and snowmelt water trends, it is difficult to understand future climate-change-driven hydrological changes.

The study tour under this activity, which included the Second Indus Forum meeting, took 37 senior government officials, technical experts and civil society leaders from Afghanistan, China, India and Pakistan to Ecuador in January 2014 to facilitate engagement on glacier monitoring through improving knowledge on physical processes and building capacity to successfully establish national and regional glacier monitoring networks. Participants visited institutions participating in the Regional Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project (PRAA). PRAA is relevant for the Indus representatives because, like the Indus riparians, PRAA communities and countries depend heavily on glacier-fed water resources systems for economic development. PRAA riparians, however,

are steps ahead in leveraging investment in glacier monitoring technologies to improve water resources management and climate change adaptation. The study tour included a visit to Antisana Glacier, whose monitoring stations, installed at more than 4,000 m above sea level, are among the very few located near and directly above the glacier surface. At the close of the Forum, participants agreed to further explore glacier monitoring and climate change as entry points for collaboration. Specifically, they agreed to work on coordination among water institutions within individual basin countries and to form a technical working group for the study of climate change impacts on the Indus Basin.

Timeframe: December 2013 - March 2014. ***Geography***: Indus Basin; all riparians. ***Grant Amount***: $0.21M

Pillar 2 – Investments and Capacity Building for Water and Energy Security

Integrated Management of the Kunar Basin

In August 2013, Afghanistan and Pakistan publicly announced they were planning to engage in the development of a 1,500 MW hydropower cascade in the Kunar River Basin (KRB) and work toward a bilateral formula of cooperation. The World Bank was subsequently approached to engage in assessing hydropower development feasibility—including reviewing existing technical studies related to hydropower development in the KRB—and facilitating joint cascade development between the countries. More specifically, the World Bank was engaged (1) to conduct hydrologic and institutional assessments of hydropower alternatives in the KRB as part of a due diligence assessment; (2) to facilitate bilateral coordination and cooperation between the two riparians; and (3) to facilitate financing of the potential hydropower projects.

As part of its first role, and through this activity, the World Bank (SAWI) prepared five analytical and high-level assessments as a preliminary investigation of hydropower cascade development potential in the KRB. The baseline of the preliminary investigation was established through a comprehensive review of existing studies related to the development of hydropower in the KRB. This undertaking identified knowledge gaps and development risks, as well as future studies required. Following this technical review, four additional assessments were prepared—a strategic assessment of hydropower alternatives in the KRB, which comprised a hydrologic assessment and climate change analysis; an assessment of remote sensing to aid the development of hydropower schemes on the Kunar River; an institutional design analysis for transboundary management of the KRB; and a political economy assessment of KRB hydropower development. Comprehensive feasibility of dam sites was not assessed under the preliminary investigation. Accordingly, the prepared assessments were intended to serve as the foundation for future studies to inform KRB hydropower cascade development, rather than as a single, definitive guide for investment planning. They showed that the development of a hydropower cascade in the basin would have significant benefits for both Afghanistan and Pakistan in addressing flood issues through regulated flow, providing sediment control, and producing much needed power to Pakistan in summer and Afghanistan in winter. Although this work initially helped build momentum in both Afghanistan and Pakistan for joint hydropower development in the KRB, the changing political economy and shifting interests of Pakistani stakeholders meant that investment opportunities were not taken up.

Timeframe: January 2014 - July 2016. ***Geography***: Indus Basin; Afghanistan, Pakistan. ***Grant Amount***: $0.45M

Kabul/Kunar Basin Development

In July 2015, SAWI held a workshop with the Government of Afghanistan to review and discuss the outcomes of the assessments carried out in the above activity and outline a process for a potential bilateral approach with Pakistan to joint cascade development. After identifying that there were few in-country academics and experts on transboundary waters governance; that only a small number of government officials were working on transboundary water issues; and that no in-country institutional training or opportunity for professionals to advance their knowledge on these issues existed, the government determined strengthening professional and institutional capacity to engage in regional transboundary water dialogue as a priority action. It subsequently approached SAWI to design and implement a capacity building package tailored for Afghan government officials to conduct meaningful dialogue with Pakistan and other riparian neighbors on management and development of shared water resources.

Nineteen workshops over two years were implemented (150 hours), training 54 officials from the Government of Afghanistan in water diplomacy, negotiation, international water law and good practices in water resources management. A study tour to the Nile Basin was also carried out. While causality is not always attributable, the capacity building program informed: (1) the design of a High-Level Commission on Transboundary Waters, which served as the highest decision-making body on transboundary water issues within the country; (2) The design, structure and phrasing of the country's Transboundary Water Policy, approved in principle by the President of Afghanistan in 2016, which had undergone a number of iterations before SAWI's involvement; and (3) The structure of the transboundary water department within the MEW, and the setting up of a dedicated transboundary waters unit in each of the MoFA and MoF. These units institutionalized the process of addressing transboundary waters within the ministries. The program also helped build collegial and close relationships across staff from the three ministries. This program was important in developing the then government's overall capacity to participate and engage in transboundary water dialogues in South Asia, as well as enable it to apply these skills to the other transboundary basins that Afghanistan shares with its Central Asian neighbors.

Timeframe: June 2015 - December 2017. ***Geography***: Indus Basin; Afghanistan. ***Grant Amount***: $0.6M

Pillar 3 – Basin-Level Dialogue

Indus Dialogue

SAWI utilized the World Bank's role as a neutral global knowledge broker in the basin through the Indus Forum, established in 2013 as a sub-group of a regional dialogue process facilitated by the World Bank and SAWI from 2007. This Track II dialogue process distinguished itself from other Indus Track II dialogues, as it took a basin-scale perspective and brought together participants from all four riparian countries to understand the basin in its totality. It aimed to play a critical role in galvanizing the study of hydrology, glaciology, and climatic and socioeconomic processes at the basin level to enable informed decision making for sustainable water resources management.

Through both the Indus Forum and Indus Basin Knowledge Forum (IBKF), engagement on water resources management issues in the basin widened—over time expanding from a group of 15 riparian stakeholders to meetings at the end of the activity that regularly involved around 100 people from the four basin countries, international experts working on the Indus and donor partners—and encompassed a vast number of disciplines that can account for the multi-faceted complexities that decision makers face when developing policies around integrated approaches to water-related challenges in the Indus Basin. The regular meetings allowed participants to get to know each other, exchange information and experiences, and foster current partnerships and build new ones. A proposed joint research program resulting from the dialogue is the first-of-its-kind that aims to systematically assess the historic and likely future trends of water resources availability and socioeconomic impact across the entire basin and the four countries that share it. The research outcomes will guide policymakers in the basin to devise an informed adaptation strategy for sustainable development of water resources. Commitment from Indus Forum/IBKF participants as implementing partners, interest from potential international collaborating partners, the uniqueness of the four-country process, and the relevance of the joint research program are expected to provide a good foundation for resource mobilization from national, bilateral and international research funds.

Timeframe: November 2014 - May 2020. ***Geography***: Indus Basin; all riparians. ***Grant Amount***: $0.85M

Ganges Focus Area

Objective

To improve management and development of water resources in the Ganges Basin to support economic growth and improve resilience to climate variability and change.

Focus Area Theory of Change

Countries in South Asia are unlikely to cooperate for effective basin management if water resources are not well-managed nationally. Therefore, the strategy for the Ganges Basin Focus Area was to support improved water resources management nationally and to facilitate connections between countries through technical dialogue and capacity building. In addition to improving water management nationally for economic stimulation and poverty reduction, these connected efforts built confidence in transboundary engagement and increased trust around knowledge and information exchange. In India, working to improve data sharing between the Centre and the States is a necessary precursor to broader public and international transparency.

SAWI supported river basin planning in Nepal via accelerating development of hydropower (with associated work on watershed management for sediment control), and in India via the drive for river cleanup as well as environmental flows for healthy rivers, cross-sectoral water allocation and inland navigation. Work under the Focus Area supported the design and implementation of the World Bank-financed National Hydrology Project (NHP) in India that includes river basin planning on a platform of more open data access and sharing, in addition to informing other lending operations.

Operationalizing flood forecasting in the Ganges Basin at the sub-basin-level focused on activities in the Baghmati sub-basin to build technical competence and improve forecasting skill, as well as to strengthen cross-border cooperation in flood management between Bihar and Nepal. This work guides larger-scale and longer-term efforts in flood forecasting planned under the NHP.

Pillar 1 – Valuing the Environment and Ecosystem Services

Strategic Basin Planning for the Ganges in India

The Indian Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR; now Ministry of Jal Shakti) and relevant state government agencies recognized that a successful Ganges rejuvenation effort would require a more integrated and basin-wide approach to planning and management, underpinned by major improvements in data and modeling, and conducted through a consultative process with key stakeholders. Beginning in 2016, SAWI, in close cooperation with these agencies, set out to support implementation of such a basin-wide approach by: significantly strengthening the capability of relevant central and state government agencies to undertake comprehensive, evidence-based strategic basin planning for the Ganges Basin; developing, documenting and disseminating, through detailed analytical work and stakeholder engagement, a set of plausible scenarios and strategies that would

significantly improve the health of the river while maintaining an acceptable level of economic productivity; an ongoing multi-stakeholder engagement process in the basin to support strategic basin planning; and building a stronger, more accessible information and knowledge base to guide dialogue and basin management.

SAWI developed and deployed a comprehensive, sophisticated and first-of-its-kind scenario-based river modeling and basin planning suite for the Ganges Basin in India to provide the central and basin state governments in the country with an objective assessment of different options and interventions for improving the health of the Ganges system. This work is recognized by the Government of India as a pilot for multiple river basin modeling and planning activities that will progress under the National Hydrology Project. This work is the first time a participatory approach was applied for the development of a Ganges Basin model. The multi-stakeholder engagement process workshops, organized at both the state and basin level, and the decision to take state perspectives as a starting point for analysis, contributed to building mutual trust and confidence between state and central government organizations and contributed to greater basin-oriented thinking, including taking into consideration the political economy sensitivities of multiple stakeholder interests. The modeling suite and associated dashboard were transferred to India's Central Water Commission in 2018.

Timeframe: December 2014 – December 2018. ***Geography***: India. ***Grant Amount***: $4.03M

Managing Watersheds to Reduce Upstream Sediment for HEP

Hydropower is an important economic sector for Himalayan countries, such as Nepal. It not only provides clean energy to support economic development, it is an important source of revenue for governments. The efficiency of this sector is, however, impaired by excessive sedimentation in rivers. Downstream management is needed because hydropower facilities have an impact on sediment flow (dams and reservoirs trap sediment that would otherwise have been carried downstream). Operation of hydropower facilities may also affect energy flow, further affecting erosion and sediment dynamics downstream. Construction may lead to increased erosion and sediment delivery, and the facilities may also induce land use change around the project area. On the other hand, sedimentation has an effect on hydropower projects, and this calls for upstream sediment management. The Kali Gandaki A Hydropower Plant lies in the middle mountains in the Himalayas, where increased erosion and sedimentation take place.

This activity supported implementation of the World Bank's Kali Gandaki A Hydropower Plant Rehabilitation Project through (1) identifying and prioritizing investments in the upstream catchments to reduce sediment inflow to the plant (through a literature review on the scientific, policy, legislation and institutional issues relating to sediment sourcing and watershed management issues for hydropower); (2) building capacity within the Nepal Electricity Authority and other relevant departments to apply tools and processes for improved watershed management; and (3) facilitating knowledge exchange and dissemination of upstream sediment management approaches to other countries. The Kali Gandaki A plant rehabilitation—to improve the reliability of power supply and plant safety—was completed in 2017.

Timeframe: July 2015 – November 2016. ***Geography***: Nepal. ***Grant Amount***: $0.22M

Sustainable Water Resources Development for HEP in Nepal (RE) and (BE)

In October 2014, in Kathmandu, a river basin planning workshop supported by SAWI was convened to raise understanding and generate buy-in among key governmental and non-governmental actors in Nepal on the value of integrated river basin planning, which was deemed critical to enable a strategic approach to hydropower planning and development in Nepal. Hosted jointly with the Government of Nepal, the workshop laid the foundations for the substantive technical work that SAWI would support on river basin planning for hydropower development. Key workshop conclusions were: (1) there is a clear rationale for Nepal to pursue integrated basin planning in the context of sustainable energy sector development; and (2) the Government of Nepal needs to strengthen hydropower planning capacity, sectoral coordination and ownership.

SAWI, through the promotion of an integrated approach to river basin planning and hydropower master planning, coupled with capacity building, strengthened the capacity of the Nepalese power sector to plan and prepare hydropower and transmission line projects according to international standards and best practices that take account of basin-wide water resource management issues, and improved the readiness of the power and water sector for regulatory and institutional reforms. The activity prepared a power market assessment to form the basis for economic analysis of prospective hydropower projects in the river basins in order to rank and optimize hydropower development plans; developed a status of basins report for each major river basin in the country, which includes information on basin water resources in terms of water demand forecast, population growth, drinking water supply and climate change issues; and compiled a list of prospective hydropower projects for inclusion in the hydropower master plans for each basin. This work is important to inform Nepal's preparedness for environmentally sound and financially sustainable hydropower projects to strategically meet Nepal's future water professional capacity needs to manage a planned hydropower regime 10 times what it is today.

Timeframe: September 2014 – May 2020. ***Geography***: Ganges Basin; Nepal. ***Grant Amount***: $0.86M

Timeframe: June 2016 – December 2019. ***Geography***: Ganges Basin; Nepal. ***Grant Amount***: $0.50M

Timeframe: April 2020 – May 2021. ***Geography***: Ganges Basin; Nepal. ***Grant Amount***: $0.65M

Pillar 2 – Moving from Data to Information Services

Water Resources Management in Transboundary Basins

The National Hydrology Project (NHP) for India aims to improve the extent, quality and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in the country. The NHP builds on earlier projects in peninsular India to address both the Ganges Basin and Brahmaputra Basin and to move from hydro-met data collection to cooperative river basin planning and flood management. The third component—water resources operations and planning systems—supports the development of interactive analytical tools and decision support platforms that integrate databases, models and scenario management for hydrological flood forecasting, integrated reservoir operations, and water resources accounting for improved operation, planning and management of both surface water and groundwater.

This activity provided support to the preparation and implementation of component 3 of the NHP by facilitating access to international best practice in basin modeling, hydrometeorological systems, flood management and reservoir operations to inform project design—especially relating to river basin planning and management. Notably, the activity produced an advanced hydro-met manual, which serves as an exhaustive reference for all implementing agencies under the NHP. It covers data collection and transmission pertaining to surface water, groundwater, water quality, sediment and rainfall/weather, and includes comprehensive material on site selection and installation supervision and discharge measurement. The manual has been published online (http://nhp.mowr.gov.in), with uptake by all NHP-implementing agencies. The activity also trained hundreds of stakeholders on the use of new and innovative technologies to improve the extent, quality and accessibility of water resources information to improve integrated water resources planning and management in the basin.

Timeframe: November 2016 – July 2021. ***Geography***: Ganges and Brahmaputra Basins; all riparians. ***Grant Amount***: $0.74M

Strengthening FMIS Capacity in Bihar | Bihar FMIS Flood Forecasting

Bihar is India's most flood-prone State, with 76 percent of the population in the north living under the recurring threat of flooding. Recurrent floods are devastating to Bihar's economy and undermine poverty alleviation efforts. There is a need to develop a long-term flood management strategy for Bihar based on analysis and stakeholder inputs that builds upon the wisdom of the substantial documentation that currently exists on the problem. The Flood Management Improvement Support Centre (FMISC) under the Water Resources Department (WRD) of the Government of Bihar is the lead agency responsible for generation and dissemination of flood warnings to the community and other disaster management agencies.

SAWI developed an open-source flood model to operationalize a lead rainfall and flood forecasting system in Bihar. The model was tested for the Bagmati-Ahwara sub-basin and subsequently operationalized by the FMISC. This work helped in reducing the impact of floods on downstream communities in Bihar. An estimated 24 million people are benefitting from this flood forecasting system, which now provides information on flood forecasts up to 72 hours in advance (a significant improvement from the previous system, which provided information only 24 hours in advance). This system improvement is helping to save lives, as people now have more time to respond and reach safety. SAWI also contributed to building the institutional capacity on flood forecasting and management within the FMISC by supporting travel of government officials to flood modeling centers of excellence (including to Japan). This work is being scaled up under the Bihar Kosi Development Project and the NHP to expand its coverage across the State.

Timeframe: November 2015 – October 2018. ***Geography***: Ganges and Brahmaputra Basins; India. ***Grant Amount***: $0.37M

Timeframe: February 2016 – June 2018. ***Geography***: Ganges and Brahmaputra Basins; India. ***Grant Amount***: $0.44M

Nepal Water Platform

Water is a key driver for improving economic and other quality of life attributes in Nepal. It has been deemed necessary that Nepal build knowledge, institutional capacity and decision support systems for prudent use of its water resources, with focus shifting from compartmental utilization to holistic and integrated management. Water allocation priorities in the country are not properly informed by data and do not follow enviro-economic considerations; financing opportunities are constrained; and private sector engagement and market development across water uses in energy, irrigation, water and sanitation, tourism, hydro-met services, aquaculture and aquaponics are limited. Public policy functions are dispersed among several ministries, departments and implementing agencies, compromising on integrated management.

This activity built on work done under the World Bank's Nepal Water Platform 1.0 in FY18 and FY19, in which a preliminary Strategy Note for water development in the country was prepared—which was based on extensive consultations with key stakeholders groups from the water sector in Nepal. The activity supported the Government of Nepal to better understand, value and manage its water resources, and improve water service delivery, in the context of the new federal structure, while addressing emerging challenges related to climate change and rapid urbanization. The Nepal Water Platform is as an innovative convergence mechanism for dialogue and coordination among the World Bank's Global Practices, development partners, and key government stakeholders involved in the development of water

in Nepal. Through the Platform, the activity explored and showcased the synergies and challenges among the different uses of water for energy, water for food, and water for people, and in particular, the conjunctive management of surface water and groundwater as a means to improve water security for irrigation and drinking water in Nepal. Most notably, SAWI developed a Nepal Water Diagnostic (2020), which presents a snapshot of Nepal's development story and situates the water sector in the broader context of the national economy, highlighting the importance of managing water resources for sustained economic growth and poverty reduction. It presents five pressing sector-related challenges and priority actions to overcome them. SAWI also helped to launch a Platform Support Unit in 2019 that brings together key decision makers from water sector ministries to deliberate on water development and management. This cross-government approach brought the required high-level backing and authorizing environment for the approval and implementation of technical and policy recommendations for the sector. SAWI enabled the platform to facilitate inter-agency coordination among Ministries in charge of water supply, schools and medical facilities for their efforts to improve sanitation policies and services. Activity findings are feeding into the policy dialogue with the Government of Nepal on the overall national water strategy and to inform World Bank operations in the country.

Timeframe: October 2019 – June 2020. ***Geography***: Nepal. ***Grant Amount***: $0.06M

Timeframe: June 2020 – June 2021. ***Geography***: Nepal. ***Grant Amount***: $0.02 M

Pillar 3 – Basin Dialogue

Ganges Basin Dialogue

Building on the national-level technical assistance in river basin modeling and planning in both India and Nepal, this activity aimed to support basin-wide dialogue on hydrologic and water resources modeling. It aimed to connect technical institutions in the region with scientists and academics around the world that are actively engaged in modeling the Ganges Basin. To this end, the activity reviewed active global efforts for hydrological and water resources modeling of the basin and compiled details of these efforts to compare and contrast and inform the design of a potential community of practices among Ganges Basin modelers to facilitate data sharing and to explore and debate technical issues. The activity also conducted a survey of these modeling groups to assess interest in a potential community of practice. The assessment concluded that there was limited value in pursuing a community forum, and the activity adapted its approach to focus on other entry points—separately in India and in Nepal.

Timeframe: November 2014 – February 2020. ***Geography***: Ganges Basin; all riparians. ***Grant Amount***: $0.15M

Brahmaputra Focus Area

Objective

To improve the shared understanding and management of the Brahmaputra Basin as a means to strengthen resilience and economic growth for the riparian countries.

Focus Area Theory of Change

Activities under the Brahmaputra Basin Focus Area focused on addressing water-related challenges (flooding and riverbank erosion) and assessing economic opportunities, including from hydropower and inland navigation. Knowledge exchange activities, study tours and workshops and assessments conducted to support these issues not only demonstrated economic benefits from cooperative management but also provided a platform for riparian countries to come together and build the case for regional cooperation.

Pillar 1 activities aimed to develop a shared knowledge base for the Brahmaputra Basin to support investment planning and decision-making. This included relevant assessments and modeling, decision support tools to assist policymakers in making informed, analysis-driven decisions, and capacity building activities within relevant agencies to operationalize these tools. The knowledge base fills critical knowledge gaps and supports basin-wide river management, investment planning at a national and/or basin level, adaptive management in deltaic regions, flood and sediment management and exploring cross-sector opportunities, such as hydropower and navigation.

Pillar 2 activities focused on reducing community vulnerability to water and climate-related risks and building community resilience. Activities included (1) improvements in investments and instruments, including early warning systems and flood mitigation measures; (2) improving the understanding of river morphology and sedimentation and erosion trends; and (3) capacity building, training and knowledge exchange activities, particularly focused on flood and erosion management.

Pillar 3 provided a platform for riparian countries to discuss challenges and identify opportunities for collaboration through study tours, workshops and conferences. The overarching aim was to improve cooperation through increasing opportunities to engage and discuss common challenges.

Pillar 1 – Knowledge and Capacity Building for Basin Management and Investment Planning

Brahmaputra IWRM Study Tour

Study tours serve as an important modality to provide platforms for engaging basin riparians, building a shared understanding of the participants' respective basins' development opportunities and risks, identifying opportunities for basin-wide collaboration, and exposing professionals to international experience and best practices in water resources management. SAWI organized and supported such tours for Brahmaputra Basin stakeholders in Integrated Water Resources Management (IWRM), including to the Yellow River in China and the Mississippi River in the United States.

As a precursor to the SAWI-supported Brahmaputra Dialogue process, technical specialists from Brahmaputra Basin riparian countries, Bangladesh, Bhutan and India, and Myanmar, participated in a one-week study tour to the Yellow River in China in April 2014 to witness a successful approach to a basin-level IWRM program. The similarity of management challenges between the Brahmaputra and Yellow Basins offered a valuable opportunity for technical and policy learning on regional cooperation in flood and sediment management, hydropower and water allocation. The tour was especially timely, given the growing focus among Brahmaputra Basin riparians on understanding the economic benefits of improved water resources management and the processes to realize them. Notably, participants recommended that a "Brahmaputra Forum" be formed at a national level in each riparian country and at the basin level. The Mississippi Basin was also identified as one that faces similar challenges to the Brahmaputra. The similarity of challenges between the basins and means of tackling them in the Mississippi presented an opportunity for technical and policy learning on Mississippi Basin cooperation in flood management, IWRM and navigation. In 2015, high-level delegations from Bangladesh, Bhutan and India traveled to the Mississippi River to discuss issues pertaining to the Lower Brahmaputra Basin in a neutral setting. The discussions during these tours demonstrated the value of such international exchanges and strength of the approach to gradually extend the dialogue process to increasingly higher levels by establishing a solid foundation and using emerging windows of opportunity. High-level national conversations on policy directions in the Brahmaputra Basin made reference to lessons learned from the tours.

Timeframe: June 2014 – October 2014. ***Geography***: Brahmaputra Basin; all riparians. ***Grant Amount***: $0.18M

The Brahmaputra River Basin Assessment

The Yarlung-Tsangpo-Brahmaputra-Jamuna River (the "Brahmaputra") originates in the Chinese Himalayas and flows through India and Bangladesh, with flow contribution from Bhutan. Its challenging topography and hydrology and complex geopolitical environment make its basin one of the most difficult in the world to sustainably manage. The Brahmaputra Basin is home to 130 million people, of which about 86 percent live in rural areas, and is a major source of livelihood. It is prone to major flooding and rapid geomorphological changes in the wet season, which threaten life and property. In the dry season, low water availability and an uneven spatial distribution of water cause water stress and competition among users. Climate change is expected to increase evapotranspiration (increasing water demand), alter the spatial and temporal distribution of precipitation, increase the frequency of floods and droughts, and accelerate glacier melting.

This activity aimed to improve understanding of the overall water resources management challenges in the Brahmaputra and strengthen the knowledge base to support a larger strategic analysis of water resources investments and management in the basin. To this end, SAWI produced two state-of-knowledge journal articles: (1) *Room for Improvement: Hydroclimatic Challenges to Poverty-Reducing Development of the Brahmaputra River Basin*—which proposes that the basin's hydro-climatological, economic, and political complexities are such that a basin-wide water system knowledge platform is needed to organize quantitative thinking on potential water-related investments in the basin; and (2) *The Future Nexus of the Brahmaputra River Basin: Climate, Water, Energy and Food Trajectories*—which presents a new hydro-economic water system model of the basin coupled with ex post scenario analysis under the "nexus thinking" concept to identify and illustrate where development paths are in conflict. These studies were used to inform Brahmaputra Focus Area programming.

Timeframe: January 2014 – December 2015. ***Geography***: Brahmaputra Basin; all riparians. ***Grant Amount***: $0.04M

River Management Improvement: Bangladesh

The World Bank's BD River Management Improvement Project (RMIP) in Bangladesh (US$650 million) was expected to support on-ground investments and operations dealing with flood mitigation infrastructure to reduce the impacts of erosion and channel migration. This activity funded technical work and broader consultation to inform the investment planning and to ensure international lessons learned as well as basin-wide aspects are taken into consideration under the project. The RMIP was dropped during its preparation stage.

Timeframe: June 2014 – September 2016. ***Geography***: Brahmaputra Basin; Bangladesh. ***Grant Amount***: $0.27M

Basin Modeling and Analysis

The North East Region (NER) of India accounts for more than 30 percent of India's water resources potential and almost 40 percent of the country's untapped hydropower generation capability (50,000 MW). This endowment, along with the region's strategic location as a vital gateway to international markets to the east (including through inland water transport), vast expanse of fertile land for agricultural

production across multiple cropping seasons, ecosystem services, and unutilized human capital could be harnessed to make the NER a commercial, industrial and tourism hub. This could bring wealth and employment to one of the least developed parts of India, characterized by low per-capita income, lack of private investment, inadequate infrastructure facilities, geographic isolation and poor connectivity. The diversity in its physiological characteristics—from steep Himalayan slopes to vast alluvial plains—and the complex cultural and political identities among its states make the NER particularly challenging to sustainably develop. Many of the development challenges, however, directly or indirectly involve water resources. Accordingly, their solutions lie in, or stem from, proper water resources management.

This activity assisted the High-Level Committee (HLC), established in 2017 at the directive of India's Prime Minister's Office, to develop a framework for proper planning and management of water resources in India's NER. The activity supported a rapid assessment of water resources for water resources management in the NER to present policy interventions and actionable measures the governments can take to optimally harness water resources to accelerate development in the NER. This involved an extensive consultation tour in the nine NER states. The rapid assessment finds that many of the development objectives and basin challenges can be addressed through a basin management approach and the establishment of a state-led basin management authority. It was used in and appended to the HLC's final report to the Prime Minister's Office, which was then shared with the Chief Secretaries and other officials in all NER states. The activity also supported the preparation of a time-horizon-bound and costed actionable roadmap for rolling out the measures identified. The actionable roadmap has formed the basis for a request from the Government of India for further technical assistance from the World Bank to support rollout of report recommendations.

Timeframe: March 2016 – May 2021. ***Geography***: Brahmaputra Basin; India. ***Budget Allocation***: $1.34M

Environmental and Social Management for Sustainable HEP

Bhutan's combination of abundant water and dramatic topography—with an altitude ranging from about 7000 meters down to 400 meters above sea level and Brahmaputra River tributaries that flow southward through this altitude drop into India—offers large potential for hydropower generation, estimated at about 30,000 megawatts (MW). While only 1,600 MW has been developed, hydropower already provides almost all of the country's electricity needs and contributes more than 21 percent of its gross domestic product and 45 percent of its annual revenue (largely through electricity export to energy-hungry India). Bhutan's 10th Five-Year Plan identified hydropower as "the proverbial engine of growth for the economy and the catalytical hub around which all round socioeconomic development has been possible." Recognizing the importance of hydropower in the country's development, the Royal Government of Bhutan has set goals for the hydropower sector, including "strengthening the economic self-reliance of the nation by realizing the electricity generation capacity" and "providing adequate, safe and reliable electricity through sustainable and environmentally friendly development of hydroelectric potential".

With its strong emphasis on preserving natural and cultural values, the government expressed concern over the country's absorptive capacity to address the socio-environmental impacts of a rapid hydropower scale-up. As a response, in 2015 it requested technical assistance from the World Bank (SAWI) to improve hydropower management in Bhutan to the level of international good practice, focusing on environmental and social issues. As part of this technical assistance, SAWI first prepared a rapid assessment study, *Managing Environmental and Social Impacts of hydropower development in Bhutan* (June 2016), in close collaboration with the Department of Hydropower and Power Systems, National Environmental Commission and Gross National Happiness Commission, to provide guidance on how to address the key potential environmental and social impacts (outside dam safety) of the currently planned hydropower projects, as well as the policy framework and institutional capacity needs to successfully manage those impacts. The study recommended that activities be implemented to improve environmental and social management of hydropower stepwise—first creating tools for better management, next building institutional capacity and data, and finally consolidating knowledge and information into strategic plans. As a result of the rapid assessment, the government moved to prepare the country's first ever national guidelines for preparing and constructing hydropower projects—urgently needed to support the sustainable development of the planned vast expansion of hydropower in the country over the coming decade.

Timeframe: July 2015 – June 2016. ***Geography***: Brahmaputra Basin; Bhutan. ***Budget Allocation***: $0.20M

Non-Monetary Values of Water

Compared to any other natural resource that interfaces with human beings, the discourse around valuing water is the most complex. Water serves many consumptive uses, but is also holds ritual, social and spiritual values in many cultures. Everyday practices surrounding water often serve to solidify hierarchies, especially those around gender, and in the case of South Asia, caste. For example, spaces within "water writ large" are often divided by norms around what is considered 'feminine' with women participating in decision making on domestic water and its use, and men in other spheres of water, such as used in irrigation. Water has a unique non-monetary value. Yet there is not much evidence on the non-economic, religious, social and political aspects of water and how these aspects interface with the design and implementation of policies and programs in the water sector. These non-monetary values of water have a bearing on the behavior of individuals and societies, especially their responses to water-related reforms or interventions.

The activity undertook an in-depth review of the literature on the methodological approaches available for valuation of natural resources and conducted interviews with experts on the subject matter. This was conducted along four lines of enquiry: (1) what are the different social, ethnic, religious, spiritual and cultural values associated with water? And how do these differ across communities, geographies, religions and identities? (2) Why should water managers account for these non-conventional, intangible values of water? (3) What are the different methodological approaches available for measuring intangible values of natural resources such as water? (4) How can social, spiritual and religious aspects of water be leveraged for modern day water administration and governance? The review found that the intangible values of water is under-researched and that calculating techniques, such as counting for cultural flows, are still emerging.

Timeframe: May 2018 – December 2018. ***Geography***: Brahmaputra Basin; all riparians. ***Budget Allocation***: $0.01M

Pillar 2 – Reducing Vulnerability to Floods and Erosion

Hydro-met Modernization in the Brahmaputra Basin

Nestled in the eastern Himalaya between China and India, Bhutan is a mountainous, landlocked country situated in the Brahmaputra Basin. Its location, topography and climate make it highly prone to a range of hydrometeorological (hydro-met) hazards, including glacial lake outburst floods, flash floods, riverine floods, landslides, landslide dam outburst floods, cloudbursts, windstorms, and river erosion. With climate change, the frequency and intensity of these extreme events are expected to increase, with adverse socioeconomic repercussions, particularly for poor and marginalized communities. The existing hydro-met observation network and forecasting and early warning system in Bhutan is highly insufficient to meet the needs of key sectors supporting the economy, including agriculture, aviation and hydropower. In line with the 11th Five-Year Plan, Bhutan began taking action in 2013 to strengthen the country's resilience to disasters and climate change by modernizing its hydro-met observation network, improving weather and flood forecasting capacity, strengthening community-based early warning systems, and transforming its Department of Hydro-met Services (DHMS)—the main agency mandated to manage the country's weather services and to coordinate with other user sectors—from a "data collecting agency" into a "reliable and credible hydro-met service provider." To support this agenda, Bhutan's Ministry of Finance requested technical assistance from the World Bank (SAWI).

In preparing for its technical assistance, it was identified that there was no comprehensive analysis of the existing status of the hydro-met observation network, forecasting and early warning systems in Bhutan. There had been no assessment of user needs or how monitoring and forecasting could be strengthened to meet those needs; nor was there a national hydro-met services policy or a strategic document to guide a modernization and institutional reform process. This activity conducted a comprehensive and detailed analysis of the existing hydro-met monitoring network and early warning systems for Bhutan, and prepared recommendations and a roadmap for modernization. The *Modernizing Weather, Water and Climate Services: A Road Map for Bhutan* report, which has been noted within the World Bank as exemplary technical analysis to spark the design of any country investment support in hydro-met modernization, is proving critical to developing the contours of World Bank investment in transforming hydro-met service delivery in the Brahmaputra Basin. The findings are continuously shared at the sub-regional level and are contributing to improved learning and understanding of regional disaster preparedness and transboundary climate risks. The recommendations and road map contributed to the preparation of the World Bank's Hydro-met Services and Disaster Resilience Regional Project (HSDRRP) in Bhutan.

Timeframe: December 2014 – September 2017. ***Geography***: Brahmaputra Basin: Bhutan. ***Budget Allocation***: $0.24M

Bhutan Hydro-met Services and Disaster Resilience

Weather forecasts and flood warnings in Bhutan have been delivered a mere 24 hours in advance. In addition to financing, knowledge and technical capacity weaknesses, policy bottlenecks, last-mile service delivery challenges and poor regional integration limit the effectiveness of hydro-met services in the country. To support and complement the above activity, this activity set out to address demand-side aspects of the use of weather and climate services for disaster risk management and agricultural management in Bhutan, including through organizational capacity building and new technology provision and installation. This technical assistance is part of the first stage of the World Bank's longer-term programmatic approach to strengthening disaster and climate resilience in Bhutan.

SAWI supported delivery of the HSDRRP's third component (co-financed with the World Bank's Global Facility for Disaster Risk Reduction and Recovery), which has the objective to advance some of the priority short- and medium-term recommendations from the road map, including facilitating the use of new hydro-met services information technology and strengthening the capacity of the National Center for Hydrology and Meteorology (NCHM)—the successor to the DHMS—to improve hydro-met monitoring, forecasting and service delivery to priority sectors. The NCHM was established as an autonomous scientific and technical government organization in January 2016 responsible for information generation and product and service delivery on weather, climate, cryosphere and water resources in Bhutan. Notably, SAWI supported the installation and operationalization of a SMART-Met system for enhancing weather forecasting, which is now being used by the NCHM for preparing its weather forecasts. Prior to its installation, forecasters had to go to individual screens of incoming data—a cumbersome task, which reduced the level of accuracy when working with different layers of data. The system now allows for analyzing all available observed data and forecasting models (including from hydrometeorological stations in the country,

global telecommunication systems, Himawari satellite images and the Numerical Weather Prediction models) on a single platform, providing well-organized and systematic generation of data, increasing forecast reliability and reducing the time for preparation of daily weather forecasts from four hours to two hours, on average. SAWI supported NCHM participation in highly technical trainings inside and outside the region, including to the Finish Meteorological Institute, which have enabled NCHM to efficiently access all available forecasting inputs, leading to improvement in weather forecast accuracy. SAWI also developed an agro-met DSS for preparing farm advisories is expected to increase farmer productivity and enhance crop resilience to weather extremes.

Timeframe: October 2016 – May 2019. ***Geography***: Brahmaputra Basin: Bhutan. ***Budget Allocation***: $0.50M

Strengthening Hydro-met Services and Disaster Resilience in Bangladesh

The Bangladesh Weather and Climate Services Regional Project (BWCSRP) aims to strengthen Bangladesh's capacity to deliver reliable weather, water and climate information services and improve access to such services in priority sectors and communities. Given institutional capacity issues within the Bangladesh government and the highly technical nature of the Project, this activity focused on documenting and applying regional and global good practices related to hydrological monitoring and forecasting; building capacity through regional training; and strengthening the hydro-met knowledge base in Bangladesh to better leverage the use of regional information resources available in the public domain within government agencies.

SAWI provided technical assistance to the Bangladesh Water Development Board (BWDB) in conducting site surveys related to its observation systems and to strengthen the design of hydro-met modernization and service delivery for both the BWDB and the Bangladesh Meteorological Department. Expert technical assistance helped guide the BWCSRP in developing and delivering twice weekly agro-met advisories to all 64 districts of Bangladesh (which involves combining weather, water and climate information with agronomical data and local situation reports to customize advisories for each district). These advisories are critical for strengthening climate resilience in the country, which sits in one of the most disaster-prone areas of the world. Capacity building support to the hydro-met implementing agencies helped them to design and procure critical observation modernization packages, including groundwater, surface water, weather observation stations and coastal storm monitoring stations, and was followed by training on the use of these tools. The activity was also instrumental in supporting the revision in overall investment design and restructuring processes to allow Bangladesh to proactively manage the challenges in implementation of the technically complex BWCSRP investment program. Technical assistance was provided in a wide range of topics, including the development of tender documents, contract management for implement the large observation network procurements. The activity also supported Bangladesh's participation in the annual South Asia Hydro-met Forum (SAHF), which brings together representatives from government and development institutions working on the supply and demand side of weather and climate services in South Asia to share information on strategic visions to develop hydro-met services.

Timeframe: October 2018 – July 2021. ***Geography***: Brahmaputra Basin: Bangladesh. ***Budget Allocation***: $0.27M

Pillar 3 – Basin-Level Dialogue

Brahmaputra Basin Dialogue

Development in the Brahmaputra Basin has historically been piecemeal, and undertaken on a project-by-project basis at the country level. The complex geopolitics between downstream and upstream countries has been amplified by an incomplete basin knowledge base, the varying professional water resources management and technical capacities of the basin countries, and power asymmetry among the riparians. The absence of a basin-wide cooperative framework has translated into missed opportunities for regional economic growth, including in agriculture, hydropower development and trade, inland water transport, and disaster risk reduction.

The early phases of the Brahmaputra Dialogue process comprised a small group of stakeholders at the Track III and II diplomatic levels. With SAWI support, the dialogue since morphed into an expanded and engaged group up to Track I½. To achieve this transformation, riparian country-level workshops and meetings—supported by informal one-on-one follow-ups with key stakeholders—established the political connection, commitment and momentum long needed for dialogue breakthroughs. The nature of the dialogue discourse evolved under the activity, going beyond technical management issues and opening up thinking toward common understanding across sectors and geographies, and on policy viewpoints. Events started to serve as a marketplace of ideas, bringing together the producers and consumers of knowledge, and knowledge partnerships started to emerge. The dialogue process is now institutionalized across the basin, with a consortium of institutions connected to government in each riparian country taking facilitation roles. The first multilateral international workshop on the Brahmaputra in Shanghai in 2018 marked the Brahmaputra Dialogue's full active engagement in all four riparian countries. It also showed China's increasing interest in regional cooperation in the basin, which will be critical to move the dialogue process forward, with legitimacy. A book, *Perspectives on the Yarlung-Tsangpo-Brahmaputra-Jamuna River Basin*, was co-produced by institutions in each of the four riparian countries and has contributions from other stakeholders from the countries. This book is a first attempt at documenting the Brahmaputra as one river system and presenting a multi-layered, holistic perspective of the full basin from the viewpoints of the four riparian countries. The publication showed that the dialogue process has succeeded in bringing the countries together around the common objective of producing a joint output. There is evidence that institutional partnerships built up through the

Brahmaputra Dialogue activity will continue beyond SAWI. Partners have started to leverage funds from other sources and are taking forward locally-based activities, while also remaining in contact with each other to generate ideas and share knowledge.

Timeframe: January 2015 – May 2020. ***Geography***: Brahmaputra Basin: all riparians. ***Budget Allocation***: $1.05M

Sundarbans Focus Area

Objective

To operationalize joint management of the Sundarbans for sustainable development that delivers mutual benefits for the two countries.

Focus Area Theory of Change

Challenges in the Sundarbans, including extreme poverty, frequent natural disasters and erosion of ecosystem services, could be better managed if Bangladesh and India developed and implemented a joint conservation and development policy, and increased collaboration on plans and programs.

Bangladesh and India reached Memoranda of Understanding (MoUs) in 2011 on managing and sustainably developing the Sundarbans under an umbrella framework agreement for collaboration in water resources management, information sharing, disaster management and climate change adaptation. These agreements, however, are not yet operationalized. SAWI supported the two countries and their Joint Working Group on Conservation of the Sundarbans (JWG) through activities that aim to operationalize the 2011 agreements and coordinate country-level actions underpinned by a dynamic and permanent joint institutional mechanism for sustainable development across the entire Sundarbans Landscape. These activities were implemented through a programmatic approach to fast-track cooperation, focusing on (1) establishing and fostering multi-stakeholder dialogues to build an environment of trust and confidence for collaborative action; and (2) producing technical evidence, through a process of joint research and strong multi-stakeholder engagement, to inform the dialogues and serve as baseline guidance to determine strategic priorities once the institutional architecture is in place.

Pillar 1 – Enhancing Bilateral Cooperation

Sundarbans Dialogue

SAWI conceptualized, financed and facilitated the Bangladesh-India Sundarbans Region Cooperative Initiative (BISRCI)—a group of policy think tanks, civil society organizations and academic institutions from both Bangladesh and India, along with the World Bank—as a knowledge-based advocacy platform to actualize effective bilateral cooperation for conservation of the Sundarbans. This forum was a key contributor in building trust between Bangladeshi and Indian stakeholders towards operationalization of agreements for joint management of the Sundarbans Landscape. While the JWG between the two countries set the formal agenda for collaboration, the BISRCI provided technical insights to influence thinking and action. Over the years, the dialogue evolved from initial discussion on framing concepts and options for cooperation, to indirectly influencing high-level discussion and policy actions, and advancing strategic cooperation between Bangladesh and India. One of the key outputs of the BISRCI-led Sundarbans dialogue process—based on discussions with key policymakers, diplomats, civil society organizations, and experts and the experiences of other countries collaborating on managing shared eco-regions—is *Vision for the Sundarbans Region: Rationale and Structure for Joint Action*. This document presents issues for long-term action through a joint framework, including: increasing salinity in the Sundarbans, increasing pollution in the rivers and sediments, habitat degradation (terrestrial and aquatic), illegal wildlife poaching and trade, poverty eradication and livelihood generation, and disaster management. It also describes various institutional options for the formation of a bilateral cooperation mechanism and recommends the most preferred bilateral institutional mechanism that could be most effective toward sustained and mutually beneficial cooperation on the Sundarbans. The Vision document has been shared among the various levels of government in the two countries for consideration and uptake.

SAWI's programmatic approach to cultivate joint sustainable management of the Sundarbans, combining technical evidence with targeted advocacy and fostered dialogue, incrementally showed dividends, and establishment of a joint institutional mechanism is within reach. There is now significant buy-in for adopting a holistic cross-country approach to landscape conservation and development, in an operating environment where different perceptions, capacities and political motivations and competing incentives have hindered sustainable development. SAWI's activities have built the momentum to unlock opportunities for future cooperative action and investments in areas that are emerging entry points, including disaster risk management, eco-tourism and hydro-met systems. Without SAWI's interventions, it has been deemed improbable that there would be anything resembling the BISRCI and unlikely that the 2011 agreements would have the political momentum to become operational within a reasonable time horizon.

Timeframe: April 2015 – February 2020. ***Geography***: Sundarbans: Bangladesh, India. ***Budget Allocation***: $0.95M

Landscape-Scale Joint Environmental Plan

The Sundarbans has been a topic of great interest to researchers, scholars, hydrologists, botanists, environmentalists and economists, as well as writers and journalists, among others, from the South Asia Region and around the world. Literature is thus abundant, with more

than 20,000 books, reports, essays and other documents on various aspects of the landscape accounted for. Yet, there has been little attempt to understand the Sundarbans in its entirety, as one ecosystem; studies largely focus on only one side of the Sundarbans political border.

Under the premise that a fully functioning joint mechanism must be underpinned by a comprehensive understanding of the Sundarbans, SAWI facilitated preparation of the Sundarbans Joint Landscape Narrative, completed in April 2018, which integrates, for the first time, a mosaic of information to create a multi-layered and holistic understanding of the Sundarbans to initiate planning activities that transcend political boundaries, narrow perspectives and multiple scales; to align and analyze information on ecological, socioeconomic and cultural variables of the Sundarbans from different sources and records to support joint understanding of the Sundarbans; to synthesize current literature to identify effective management approaches and practices of the past; and to identify learning, knowledge, data and information gaps. The report was prepared by a joint team of experts from the two countries and involved several multi-stakeholder consultations over a period of more than a year. While the 2011 MoUs outline a commitment to transboundary goals and can provide the basis for funding and legitimacy for coordinated or joint activities in the Sundarbans, there is scope to expand or elaborate on some of the opportunities that the countries can focus on. Through a literature review and consultative multi-stakeholder process in Bangladesh and India, involving civil society organizations, research organizations, government officials, private sector representatives and local inhabitants, BISRCI developed a number of proposals for joint future activities, including: (1) Fisheries Resource Assessment for the Entire Sundarbans Eco-Region; (2) Promoting Sustainable Transboundary Inland Navigation in the Sundarbans Region; (3) Development of Collaborative Hydro-meteorological Services for the Entire Sundarbans Region; (4) Responsible Nature-Based Tourism (Ecotourism) for Sustainable Development of the Entire Sundarbans Region; and (5) Inventorization of Bio-Resources and Comprehensive Biodiversity Mapping for the Entire Sundarbans Eco-Region. Consulted voices and opinions resonate among these proposals, to help ensure their acceptance and relevance.

Timeframe: April 2016 – June 2018. ***Geography***: Sundarbans: Bangladesh, India. ***Budget Allocation***: $0.30M

Pillar 2 – Technical Cooperation to Support Joint Management

Landscape Hydro-met Design

The present hydro-meteorological setup for the Sundarbans covering both countries is inadequate for an integrated approach and cannot facilitate climatic parameter measurements required for area-specific hydro-met modeling on a real-time basis. This inadequacy includes the lack of substantial forecasting capability for the landscape within the two countries (especially for the Indian part) based on assimilation of near-real-time data into predictive models to provide essential advance forecasts that can guide both community preparedness and early interventions by governments to minimize impacts of cyclones, storm surges, tidal flooding, cloud bursts, breaches in the bunds, sea level rise and salinity intrusion.

SAWI produced scientific, technical and economic evidence for informed discussions to support the preparation of a plan to install a uniform hydro-met information system in the Sundarbans Landscape. The activity provided a comprehensive picture of the entire Sundarbans Landscape (Bangladesh and India) that connects poverty, water resources information and ecosystems, and provides a framework for both countries to adopt a holistic approach to the joint management of the eco-region. The key activity output is a document, *Needs Assessment and Detailed Planning for a Harmonious Hydrometeorology System for the Sundarbans*, which sets out technical evidence to support the case for and creation of a joint or coordinated hydro-met system in the Sundarbans. The highly deliberative consultation process to prepare the flagship study under this activity has helped build trust among stakeholders at different levels in India and Bangladesh. The recommendations coming out of these outputs are feeding into discussions within the JWG and are supporting early-stage development of a coordinated, harmonious hydro-met system covering the Sundarbans in both countries. These documents are also informing three World Bank projects with hydro-met components: the Bangladesh Weather and Climate Services Regional Project; the First Regional Waterway Transport Project for Bangladesh; and the National Hydrology Project in India.

Timeframe: July 2015 – December 2018. ***Geography***: Sundarbans: Bangladesh, India. ***Budget Allocation***: $0.40M

Targeted Environmental Studies

The impacts of a changing climate could differ significantly across the Sundarbans when measured in magnitude and time-phasing, leading to differential pressures across the political border for adaptation responses for the same resilience indicator, including when to relocate human communities and endangered species. Technical knowledge of climate change impacts on this critical ecosystem and its inhabitants, however, has been scarce.

To build a knowledge base for sound climate change adaptation and resilience responses, SAWI undertook hydrological, ecological and econometric studies to assess the vulnerability of biodiversity and human populations across the Sundarbans in a changing climate—especially to inundation from sea-level rise, inundation from cyclone-induced storm surges, and water and soil salinization. This knowledge base aims to promote future technical cooperation and facilitate a holistic approach to the sustainable management of the

extremely fragile landscape. The analytical work used an "out of the box" research design that drew on experts from many disciplines and established a notable research collaboration between Bangladesh and India, which had historically been a major challenge to deliver. The collaborative effort established a common understanding of the challenges and a respectful discussion space for resilience planning between the neighboring countries. Researchers from Bangladesh and India designed surveys together, assembled five geo-coded open-access databases and co-authored 14 analytical papers. The highlight of the collaboration was a workshop in Kolkata, India where 400 researchers from Bangladesh and India came together seeking to understand the physical and economic impacts of climate change on the Sundarbans. The workshop prompted the signing of a MoU between Calcutta University and Khulna University for further collaboration. The production and dissemination of these joint technical products, which are expected to become increasingly embedded into government and non-government systems, is creating a sense of ownership, building capacity and new understanding, opening up the space for collaborative action from the local to the international levels, and informing the design of a number of World Bank projects. Beyond the Sundarbans, the studies' methods and findings will be of interest to development practitioners, policymakers, and researchers focused on island nations and countries worldwide that feature high-density populations and economic activity in low-lying coastal regions vulnerable to sea-level rise.

Timeframe: April 2015 – December 2019. ***Geography***: Sundarbans: Bangladesh, India. ***Budget Allocation***: $1.05M

Delta Management Investment Planning and Basin Analysis

The Government of Bangladesh has formulated a comprehensive development plan - the Bangladesh Delta Plan (BDP 2100), focusing on economic growth, environmental conservation, and enhanced climate resilience. The plan lays out holistic and cross-sectoral action needed to improve productivity and minimize disaster risks in the country's delta region.

To support implementation of the BDP 2100, SAWI assisted the General Economics Division of the Government of Bangladesh (GED) with the formulation of the BDP2100 Investment Plan. Because Bangladesh is one of the most economically dynamic and climate change vulnerable countries in the world, any proposed investments must be planned in a fully adaptive way to ensure successful implementation and sustainability. The Investment Plan does this by applying the principles of adaptive delta management (ADM). The purpose of ADM is to ensure that the right investments are made at the right time. It aims to avoid both 'too little, too late' and 'too much, too early' by identifying tipping points when a change in approach is needed. The Investment Plan consists of 80 projects: 65 are physical projects and 15 are institutional and knowledge development projects. Its total capital investment cost is US$38 billion. All projects can be started within the next decade, though given the scale and programmatic nature of some investments, construction in some cases will extend over decades. Effective coordination and collaboration among multiple stakeholders will be key to achieving the vision of BDP 2100. The World Bank has been convening the Bangladesh Water Platform, with support from the Global Water Security and Sanitation Partnership, to coordinate and facilitate collaborative efforts among partners. Through this platform, it will also support policy reforms, institutional arrangements and capacity building to cross-sectoral government ministries.

Timeframe: September 2015 – September 2017. ***Geography***: Sundarbans: Bangladesh. ***Budget Allocation***: $0.80M

Timeframe: October 2015 – September 2017. ***Geography***: Sundarbans: Bangladesh. ***Budget Allocation***: $0.18M

Regional Cross-Cutting Focus Area

Objective

To build knowledge and capacity across the region in support of transboundary basin dialogue and cooperation.

Focus Area Theory of Change

The Regional Cross-Cutting Focus Area aimed to improve the regional water resources knowledge base, undertake capacity building for shared water resources management and cooperation, and support broad-based regional dialogue to enhance cooperation and management of transboundary waters in South Asia.

Pillar 1 – Knowledge Related Activities

Climate Change Risks in Water Resources Management

South Asia's rich human and physical geography are tightly bound to the rivers that radiate out and down from the great Himalayan massif and the extensive Indo-Gangetic basin aquifers. Driving some of the largest irrigation systems in human history and nourishing populations and ecosystems straddling rich alluvial floodplains, the annual flood pulses of these rivers—the Ganges, Indus and Brahmaputra amongst them—has determined the development of human civilizations and provided livelihood security for several millennia. More recently, groundwater from alluvial and hard-rock aquifers has augmented less reliable surface supplies for irrigation and become the primary source of rural, urban and industrial water supplies. These water resources are now rapidly changing, and this change brings heightened risk and uncertainty. Global warming is altering the behavior of the great ice mass—the cryosphere or 'third pole'—and is also affecting

the pattern and behavior of monsoonal rains, river flow regimes, evaporation and demand patterns. Groundwater resources are under unprecedented pressure. Water quality is deteriorating from contamination from communities, cities, industries and agriculture. Floods, droughts and cyclones cause devastation for millions. Climate extremes, together with changes in annual rainfall and sea-level rise, will affect the lives of over a billion people in the, increasing human insecurity and hindering the wider development efforts and economic growth directions of the region.

SAWI built knowledge, tools and capacity across South Asia to assist governments in adapting to emerging climate change challenges in the water sector. The flagship report *Climate Risks and Solutions: Adaptation Frameworks for Water Resources Planning, Development and Management in South Asia* provides a consolidated picture of climate change risks in water management in the region and the status of policy frameworks in place to manage these risks. The comprehensive study reflects discussions held during a regional meeting (Sri Lanka) that brought eight South Asia countries together to discuss climate-related water management for resilience and adaptation. The study unpacks and addresses the nature of resulting policy, planning and operational challenges as regional governments and social systems attempt to adapt, mitigate and manage these challenges and ensure that sustainable water management remains a central pillar in economic development and social stability. By assessing available evidence and mapping the landscape of existing knowledge and policy approaches in South Asia, while keeping in mind key socio-economic and institutional contexts, the knowledge generated under this activity informs public debate on climate change and water resources management in South Asia and provides valuable inputs to effective decision making. The hope is that the guidance and recommendations offered will enable South Asian governments and societies to enhance their capacities for building resilience to further climate change and ensure a more sustainable and secure future for the whole region.

Timeframe: November 2015 – July 2017. ***Geography***: Regional: Nepal. ***Budget Allocation***: $0.34M

Climate Change Impacts on HEP

Hydropower is potentially vulnerable to climate change, particularly in South Asia, where complex glacier- and mountain-influenced hydrology, high sediment loads, and high reliance on hydropower as a dependable source of electric energy present important challenges. Uncertainty in future climate projections remains, and downscaling efforts do not reduce this uncertainty. As a result, it is unwise to plan and design future infrastructure based on projections of unknown credibility or solely on the use of historic records (so-called "stationarity" approaches).

However, climate uncertainty should not stall decision-making or investment in hydropower. Rather, application of a climate-aware Decision Making under Uncertainty (DMU) approach can be used to support sound decisions. This activity developed a conceptual framework to guide project planners through the application of DMU techniques to climate change risk assessment and risk management (the "Decision Tree"). The Decision Tree was demonstrated in the proposed Upper Arun Hydropower Project (UAHP), and a closely related DMU approach was applied to the Koshi Basin. Both analyses are among the first of their kind to systematically incorporate both climate and non-climate uncertainties when assessing proposed water infrastructure. Both applications were conducted with the support and guidance of Nepalese energy sector and policy analysts. The Decision Tree framework offers a cost-effective, scientifically sound, replicable and transparent method for demonstrating the robustness of a development project in the face of the risks posed by climate change, natural hazards and other factors. The Decision Tree application led to design changes to climate proof UAHP, and provides proof of concept for DMU methods in Nepal. The applications also provide the starting point for a potentially broader geographic and sectoral analysis using the Decision Tree framework, which could be conducted in the future to assess, for example, national-scale energy sector planning in Nepal in the face of climate change and other important uncertainties.

Timeframe: August 2014 – April 2016. ***Geography***: Regional. Nepal. ***Budget Allocation***: $0.53M

Himalayan University Consortium Grant (RE)

While strides have been made in assembling and consolidating data and information on natural resources and social systems for sound water resources management and sustainable mountain development in the HKH, knowledge continues to be too fragmented and incomplete to derive meaningful conclusions about trends and scenarios, including, for example, on the role that the changing nature of monsoons, snow cover, permafrost, glacial lakes and wetlands play in the hydrology of the region, or on exacerbation of existing resource pressures from climate change. Universities and research centers can play a key role in generating, sharing and disseminating knowledge— infusing technical content into public discourse to influence policymakers and public opinion. Such institutions in the HKH region, however, have, for the most part, not been able to fulfill these important tasks, largely due to insufficient resources and institutional capacity, and to a siloed operating environment, with little collaboration and synergy on research, training and curricula development (to make higher education relevant to and useful for the mountains and its people). The Himalayan University Consortium (HUC) was founded in 2007 to foster a dynamic network of academic research and knowledge producing and sharing institutions within and outside the HKH region, to engage top professionals capable of undertaking high-quality research, education, teaching and knowledge dissemination for sustainable mountain development. The HUC needed a critical boost to re-instill member ownership, broaden and consolidate membership, and establish the network as a vibrant and active south-south forum for mountain knowledge generation and

sharing, curricula development, and capacity building among members, who could then leverage their participation to provide water- and mountain-related policy and technical advice to their respective governments.

A SAWI recipient-executed grant to ICIMOD has revitalized the HUC to make it a fully functioning and vibrant network that serves as an effective and holistic voice for mountain development and research. The grant was instrumental in (1) expanding the network of higher education and research institutions focusing on sustainable mountain development in the HKH region. The HUC now has more than 80 members; (2) Improving the quality of membership and intensifying member interactions. One-third of the members that were previously inactive once again became active in the network, and a number of them have taken leading roles in key HUC activities; (3) Re-instilling a sense of member ownership in the network through member visits and a highly participatory consultation process to prepare the HUC's Strategy and Plan for Actions 2018-2025; (4) Laying groundwork for the Consortium to foster the next generation of transformational leaders committed to mountain research, and capable of producing consequential knowledge, innovative policies, and environmentally responsible business practices to address mountain challenges in the HKH; and (5) Facilitating collaborative research among HUC members to bridge the science-policy gap on sustainable-mountain-development issues in the HKH region. The grant provided HUC Secretariat staff and staff from core member institutions with training in project cycles, program management and coordination, partnership building, fundraising, and monitoring and evaluation (M&E). By the end of the grant period, the HUC Secretariat was fully functioning with a high managerial and M&E competence to ensure effective implementation of the Consortium's activities moving forward and prepare for a continued expansion and intensification of HUC collaborative activities.

Timeframe: January 2017 – December 2019. ***Geography***: Regional: Hindu Kush Himalaya. ***Budget Allocation***: $1.22M

Transboundary Risk Management and Data Sharing

An important aspect of transboundary cooperation between the HKH basin countries is existing modalities and protocols for managing disasters and climate risks that are transboundary in nature. This activity supported preparation of a study to better understand key elements of transboundary early warning systems and support the development of such systems. The study presents evidence of good practice on transboundary flood early warning systems and to draw out lessons learned so these can be considered in ongoing and future cross-border early warning system programs. This study is based on a literature review and consultation with various key stakeholders, including early warning system practitioners, development partners and government agencies in three case study basins—the Rhine, Mekong and Limpopo. It was shared with officials at the sub-regional level through a dissemination workshop.

Timeframe: January 2014 – June 2015. ***Geography***: Regional. ***Budget Allocation***: $0.17M

Snow/Glacier Contributions to Stream-flows and Climate

Arun River, a primary tributary of the Ganges River, drains a large area on the Tibetan Plateau before crossing the Himalaya into Nepal, where its discharge increases dramatically. The steep gradient and relatively high seasonal flow of the Arun led to plans for major hydroelectric development, seen as a key opportunity for economic growth and human development in the country. The proposed Upper Arun Hydropower Project (UAHP) has been identified as one of the most attractive projects in eastern Nepal. At the same time, the project has been classified as having substantial potential sensitivities to future uncertainties, particularly climate change. This uncertainty requires additional studies on socioecological interrelations. In particular, there is a need to estimate how effects of climate change on the glaciers in the Arun Basin would impact the streamflow, and hence power generation, in the future. This required a quantification of the existing contribution from glaciers to the streamflow, and how this may change under future scenarios of climate change.

Glacier runoff is assumed to be a component of hydrology in the Arun Basin. One concern is that climate change and retreat of glaciers within the basin will result in a change in the volume and timing of streamflow to the river. To assess the potential of these changes, it is necessary to estimate the basic elements of glacier advance and retreat as defined by accumulation and ablation that determine the mass balance and runoff volume. However, with few exceptions, concepts of glacio-hydrology are based on studies of the European Alpine-type glaciers and western North American mountains, which consist of relatively well-defined zones of accumulation and ablation and extensive databases. The primary problem in developing similar studies for the Himalayan basins is the almost complete lack of comparable databases. SAWI conducted a study aimed at producing quantitative estimates of glacier- and snow generated runoff of the Arun River, under current and future conditions, to serve as inputs for detailed hydrological assessments of the basin and UAHP design studies. For the first time, a quantitative estimate has been made available for contribution of glaciers to the streamflow of the Arun River. This allows modeling of various scenarios corresponding to changes in glacier cover due to climate change. A low-cost and efficient methodology has been successfully used to develop the estimates of glacier contribution to streamflow in a basin with very poor data availability. This opens the possibility of developing similar estimates for other data-poor basins. These outcomes have been integrated in the broader work conducted by the World Bank on integrating climate resilience in hydropower development in Nepal, and published in the International Journal of Hydropower and Dams. This broader dissemination and acceptance should lead to greater sustainability of the outcomes. The study served as an input to detailed assessments conducted for the basin and UAHP, and to a "Decision Tree" analysis for investment planning.

Timeframe: October 2014 – December 2015. ***Geography***: Regional. ***Budget Allocation***: $0.15M

South Asia HEP Resilience Studies

It is widely recognized that sedimentation poses a significant threat to the longevity, usefulness and sustainable operations of storage reservoirs and run-of-river projects. Climate change could lead to increased sediment loads in rivers, amplifying the threat of reservoir sedimentation. Therefore, it is essential that dam and reservoir projects are designed, built and maintained with the long-term threat of climate change-induced reservoir sedimentation in mind. The sustained threat of reservoir sedimentation obliges hydropower planners to consider investing in projects with lasting benefits by ensuring that they incorporate sedimentation management measures that reduce future maintenance costs and save money throughout the lifecycle of projects.

SAWI supported the preparation of a book to provide guidance on adopting sediment management practices for hydropower and dam projects. Written by two of the world's leading experts on sediment management, it stresses the importance of incorporating sediment management into projects to safeguard the many important services of these projects. One of the key messages of this book is that incorporating sediment management into the planning and design phases of dam projects is essential for ensuring that the benefits of reservoir storage are sustained over the long term. Without sediment management, reservoir storage space is eventually lost, and it is extremely difficult—if not impossible—to reclaim it. Reservoir storage space is a key factor of production for water and renewable energy supply, and it is becoming increasingly important as climate change–related stresses increase and suitable storage sites become increasingly scarce. As a result, it is essential that projects incorporate sediment management at the outset as an integral part of their configuration to ensure lasting benefits. A key product within the text is a checklist intended for use by designers, financiers, and managers of hydropower facilities as a guide to ensure that projects adhere to the recommendations put forth throughout the book. This activity fed into SAWI's programmatic approach to hydropower development.

Timeframe: November 2016 – December 2017. ***Geography***: Regional. ***Budget Allocation***: $0.19M

Glaciers of the Himalayas

Melting glaciers and loss of seasonal snow pose significant risks to the stability of water resources in the South Asia region. Glaciers help to moderate river flows in the region's major rivers by providing a source of meltwater in hot, dry years and storing water during colder, wetter years. The dependence on glaciers and snow make these rivers particularly vulnerable to climate change. While there is evidence that South Asia's water towers are threatened by climate change, the impacts on glaciers, water availability and food security may differ substantially among basins and cannot possibly be generalized. It could be that the effects of climate change on the Indus and Brahmaputra basins will be more severe because a larger percentage of these basins are glaciated and more of their water falls in the mountain portion of the basin, creating greater dependency on seasonal melt. In addition to threats from global climate change, black carbon produced within the region is being deposited on the surfaces of some glaciers, causing them to absorb more solar radiation, and raising the air temperature above the glacier. In these ways, black carbon is also becoming a significant factor in the retreat of some Himalayan glaciers.

This activity developed a flagship report that brings important technical knowledge gap analysis by identifying the causes of potential changes to the glacier and snow dynamics in the Himalaya, Karakoram, and Hindu Kush mountain ranges, and by analyzing and quantifying the impacts of climate change and black carbon on glacier and snowmelt in the Himalayas. This has important implications for future water resources within the Indus, Ganges, and Brahmaputra basins. This knowledge will allow infrastructure investment decisions that are robust under possible future scenarios and will provide useful benchmarks for World Bank teams planning hydropower, agricultural and livelihood projects. The study informed technical design of the World Bank's South Asia Regional Climate Adaptation and Resilience (CARE) Program ($36M). It also led to the creation of an HKH Glacier and Mountain Economy Platform, which will work in a collaborative, cooperative and transboundary manner to co-produce, consolidate, share and utilize the knowledge on cryosphere, glaciers and mountain economy by linking to suitable programs on the ground. The Platform will take on regional action research and knowledge management projects, and regularly share results through organized knowledge and policy dialogues. Currently, the platform secretariat is hosted by the Government of Nepal at the Center for Green Economy and Development. This regional platform will gradually extend to each member country based on need and ownership.

Timeframe: May 2018 – June 2021. ***Geography***: Regional. ***Budget Allocation***: $0.44M

A Diagnostic Study on Groundwater-Energy-Agriculture Nexus

Rajasthan's agriculture growth has come at a high cost to the water and electricity sectors, but poor quality of power supply inflicts substantial costs on the farm sector. Rajasthan has limited surface water resources and its economy is highly dependent on groundwater. Agriculture consumes 86 percent of available water resources, 11 percent is used for services including drinking water, and three percent is utilized by the industry. The average per capita water availability is expected to drop below 450 cubic meters by 2050, which is below the international minimum of 500 cubic meters that defines absolute water scarcity. Rajasthan ranks fourth in India's food and grain production. Its agricultural growth has come at a high cost to the water and electricity sectors. While farmers are ostensibly the beneficiaries of subsidized electricity, the poor quality of the power supply imposes substantial economic costs on the farm sector and has given rise to a complex political economy which perpetuates this unsustainable situation.

SAWI successfully designed and tested alternative business models in the highly water-stressed state of Rajasthan focused on the use of solar panels to generate electricity for extracting groundwater and for selling surplus electricity in selected groundwater-stressed areas. SAWI's work showed that the proposed model of grid-connected solar irrigation can achieve the trifecta of increasing water productivity and water conservation, doubling farmer income, and increasing energy efficiency of irrigation. In addition, it has the potential to eliminate recurring power subsidy to agriculture, provide climate-resilient income to farmer, and reduce carbon footprint of agriculture. Business models developed under the completed *Energy-Water-Agriculture Nexus: Grow Solar, Save Water, Double the Farm Income* study (which were endorsed by the Government of Rajasthan and NITI Aayog), are now being field tested through "learning by doing" pilots under the Rajasthan Agricultural Competitiveness Project with the aim to implement solutions on the ground to calibrate the business models, increase engagement and outreach to farmers, and demonstrate viability for a scale up across the State. The business model developed informed the Indian State of Rajasthan's program on options to transform the adverse outcomes of the water-energy-agriculture nexus into a virtuous cycle.

Timeframe: May 2018 – February 2020. ***Geography***: India. ***Budget Allocation***: $0.15M

TA and Knowledge Sharing Facility for Development of Utility Scale Floating Solar PV

India is committed to reduce the greenhouse gas emissions intensity of its GDP by 33-35 percent by 2030 from 2005 levels, which would require the diffusion of multiple technologies in addition to the existing solutions. As per the Paris Agreement, India targets a share of at least 40 percent from non-fossil fuel-based sources in its cumulative power generation capacity by 2030. The National Solar Mission (NSM), launched in 2010, aims to achieve this. As of July 2021, India installed about 44 GW of solar-based capacity, the majority of which has come from utility scale ground-mounted solar projects that have been deployed in the past decade. Floating Solar Photovoltaic (FSPV) technology—an innovative technology involving the installation of PV panels on water surfaces such as hydroelectric dams, large ponds, lakes and reservoirs—is nascent yet projected to play an important role in India's future energy mix. The technology has advantages as it avoids constraints of land availability, is relatively easy to install and can make use of existing hydropower or irrigation infrastructure, and can contribute towards reduction in water evaporation and improvement in water quality by slowing algal growth. However, a crucial element is the readiness of the value chain to support the expansion of the technology, which is often inhibited by high production costs, lack of skills sets for installation and maintenance, and by promoting industry to become domestically robust and internationally competitive. Growth of the sector requires a greater degree of coordination amongst the stakeholders in the value chain, including utilities, developers, engineering procurement construction, manufacturers, and component suppliers; faster ramp-up times; and larger investments and greater agility to capture value in a rapidly growing sector which would in turn determine delivery capabilities, deployment strategies and pricing of the technology in India. The Indian Ministry of New and Renewable Energy is formulating auctions for promotion of innovative renewable energy projects in India and are considering floating solar as well.

SAWI's technical work brought early knowledge into the development of a nascent ecosystem for floating solar. SAWI kickstarted deeper discussions on floating solar in the country. In the meetings with Ministry and the central electricity planning body, SAWI's efforts were commended and acknowledged as the most important intervention at the right time of the adoption curve of this technology, and at a relatively larger scale, to set the market right. A mapping exercise involving 2173 water bodies across India were integrated with the Global Solar Atlas and is publicly available. A further detailed analysis was carried on the shortlisted 100 water bodies (20 each in five early mover States) to give early signals to the interested government agencies and project proponents to identify specific water bodies in their areas of interest where floating solar development can be taken up at scale. A Pre-Feasibility Report contributed preparatory work for a 500MW Floating Solar Project at Omkareshwar Dam, Madhya Pradesh – the first to be taken up at scale in India in a public-private partnership mode. SAWI also identified barriers, constraints, and bottlenecks to unlock the potential of FSPV across the value chain. As part of this work, a Guidance Document on gaps in technical standards and certifications for ensuring quality installations in floating solar was developed. The guidance was based on case studies from the 500MW Omkareshwar project and the 40MW Hirakud project, and will help the World Bank in appraising future floating solar projects. The Ministry of Power has constituted a committee on floating solar. The World Bank presented the outcomes of the various studies to the committee to inform the way forward for this technology. Given India's strong commitment towards its NDC targets, this engagement is directly helping to scaleup measures being adopted by the Government of India in installing cleaner and greener projects in the country. As land has an opportunity cost, newer ground-mounted solar capacities are slowing down and SAWI's work has presented a huge opportunity for the development of floating solar projects in the country.

Timeframe: July 2019 - March 2021. ***Geography***: India. ***Budget Allocation***: $0.15M

Timeframe: October 2020 - July 2021. ***Geography***: India. ***Budget Allocation***: $0.16M

Rivers and Plastics: Addressing Transboundary River Pollution in South Asia

The menace of plastic waste that pollutes land, flows into river systems and, ultimately into oceans, poses national, regional and global threats to development. The qualities that make plastic useful—lightness, durability, strength, versatility and low production costs—have resulted in fast growing demand, but mismanaged plastic waste has also created a mounting global ocean pollution crisis. The global production of plastic is currently estimated to be around 300 million tons per year, while plastic pollution in the marine environment

alone (including beaches) estimated at 9.5 million tons with 1.5 million tons ending up in the ocean annually. The SAR is the third largest contributor to plastic waste globally with an estimated doubling by 2050 unless action is taken. South Asia's transboundary rivers act as highways for plastic pollution to flow from mountains to the ocean. South Asia leads the world in open dumping of plastic and all waste, with 75 percent of South Asia's 334 million metric tons per year openly dumped; 12 percent of this—40 million metric tons per year (MMTY)—is plastic. Without action, South Asia will double its mismanaged waste to 661 MMTY by 2050, earning the unwanted distinction of owning the fastest growth of waste and plastic pollution of all regions of the world, according to the World Bank's What A Waste 2.0 report. Plastic pollution is both a national problem and transboundary in nature, thus binding mountain and ocean economies together. Microplastic particles are found in abundance throughout the uppermost reaches of South Asia's highest snow-capped mountains like Mount Everest to the deepest parts of the Indian Ocean.

SAWI's deep dive knowledge series on the mismanagement of plastic pollution in the South Asia Region brought vital baseline knowledge on plastic debris flowing into rivers and seas of South Asia. This work has built a harmonized regional monitoring, management and policy framework for plastic waste reduction and enables a more circular economy model for plastics, which will provide a baseline against which investments in the region can be planned and monitored. SAWI made policy recommendations to reduce the contribution of the plastic industry to climate change in South Asia, and supported the South Asia Regional Marine Litter Action Plan and related marine litter action plans in each member country by producing an evidence-based, objective baseline of all the aspects that govern and relate to plastic pollution flowing into watercourses across South Asia. Innovation Competitions, implemented in partnership with local agencies in Bangladesh and India, raised the spotlight on this growing challenge in South Asia. SAWI's work influenced and shaped the strategy of the World Bank in Climate Change Strategy and Marine Plastic Agenda in South Asia. SAWI's technical and analytical work also informed the World Bank's Plastic Free Rivers and Seas for South Asia and the knowledge serves as a base for the development of National Action Plans to combat marine plastic pollution for each of South Asian country.

Timeframe: March 2021 - July 2021. ***Geography***: India. ***Budget Allocation***: $0.09M

Timeframe: May 2020 - July 2021. ***Geography***: India. ***Budget Allocation***: $0.16M

Enhancing Ecological Integrity of the Aquatic Environment in the G-B Mainstems

The threats to river dolphins are both numerous and varied, but those that are most immediate, pervasive and severe are (1) fishing and fishing-related activities; (2) water infrastructure projects that affect habitat connectivity, integrity and quality, including hydropower dams, irrigation barrages, embankments, dredging; and (3) mining, agriculture and industrial development that degrade water quality. These three general threats are present in every river basin where river dolphins live, affecting the populations' survival, although the importance differs for each species or population and in each country. Anthropogenic activities driven by economic growth and political agendas have caused a substantial decline of the Ganges River Dolphin population and habitat in the GBM. This iconic mammal has been classified as an "endangered species" on the IUCN Red List. The dolphin population in the basin was estimated at about 10,000 in the late 19th century and has been steadily declining from an estimated 4,000-5,000 in the 1980s to about 3,500 in 2014. The dolphins face multiple direct and indirect threats related to human interventions and development in its habitat range.

SAWI drew on a multi-stakeholder platform, with membership from Nepal, Bangladesh and India, to complete a global best practices and scientific literature database on the conservation and management of the Ganges River Dolphin. The platform will be used for information dissemination on study findings, supporting behavior change and for canvassing key decision makers to champion the cause of protecting aquatic fauna while planning investments for harnessing the potential of the rivers. It drew from best international practice to assess key risks to the aquatic biodiversity (focusing on the Gangetic River Dolphin) in the two rivers and developed measures and mechanics to manage these risks. Outreach programs were held concurrently with the analytical work, with campaigns tailored to different challenges and targeted stakeholders. This study is important as it provides recommendations that will inform future sustainable investments in inland waterways. The study has compiled a set of global best practices, from all river dolphin range countries—in South America and Asia—for identifying potential strategies that could be applied in the context of Ganga-Brahmaputra system in Bangladesh, India, and Nepal. These best practices and a searchable literature database are now publicly accessible at www.riverdolphins.org. Building on the political economy analysis, consultations have been initiated with relevant government departments and civil society actors, including academia, research organizations, and conservation NGOs each country. The study was innovative because it was designed to benefit not only the South Asia Region but also experts working on dolphins in Latin America. The knowledge generated will be utilized under the World Bank's Assam Inland Water Transport Project.

Timeframe: May 2020 – July 2021. ***Geography***: Regional. ***Budget Allocation***: $0.60M

Price of Water

Water scarcity and stress are growing global crises, especially in South Asia. Water stress in some parts of the region is likely to worsen on account of climate change, Climate change may cause water supply to fluctuate both temporally and spatially and may alter the global hydrologic cycle. A range of supply-side and demand-side interventions have been used to tackle water stress. Measures to expand water

supplies often include improved water storage infrastructure, desalinization, and water reuse. While these supply-side interventions are essential, they are not enough on their own to resolve water management problems. Demand-side interventions have become more critical over the years as water has become an increasingly scarce commodity. Despite a growing body of knowledge and investments, efforts aimed at improving water use efficiency have not yielded positive results to scale. Given the current situation of growing stress across the region, South Asian countries are paying increasing attention to economic instruments such as water pricing, irrigation fees, and water markets that may provide incentives for conserving water and encourage efficiency in allocation and distribution both within and across sectors. Until now the political-economy challenges have largely prevented the implementation of these ideas. However, as the water tensions mount, the political appetite for bold economic solutions is increasing. Water markets have been successful at capturing economic efficiencies through trading. Several countries are using water trading to promote more efficient water allocation because a market-based price acts as an incentive for users to allocate resources from low value activities to high value activities. Water markets, based on water rights, allow these rights to be sold, making them more valuable and providing incentives for both conserving and reallocating water to higher value uses.

SAWI carried out a study to carefully examine the economic benefits that may arise from introducing such water markets in major regions/basins in the South Asian countries that meet all the pre-conditions necessary for water markets to exist. The study filled key knowledge gaps to help South Asian governments design and implement more effective policies to address the growing water crises in the region while promoting economic growth and poverty reduction. The assessment focused on the idea of introducing water markets to reduce water scarcity and stress on the use of well-established models, linked to cover linked to cover all important impacts of the policy measures on output, employment, and the provision of basic needs. The study answers the following questions: What are the regions/basins in South Asia that have favorable pre-conditions for introducing water markets? What are the potential water savings and increased water-use efficiency across various sectors from introducing water markets in these regions/ basins? What will be the economy-wide and distributional impacts of introducing water markets in the South Asian countries? The findings of this study are intended to be useful for a diverse audience, including policymakers in the region.

Timeframe: May 2020 – June 2021. ***Geography***: Regional. ***Budget Allocation***: $0.13M

Developing Regional Waterways in South Asia

Inland (transboundary) water transport is a complex endeavor, which has also historically been facilitated by formation of permanent regional intergovernmental structures such as River Basin Organizations. Despite the BBIN region being home to some of the major river systems in the world—and the countries having a shared heritage of extensive waterborne trade—inland water transport has been underutilized, largely due to the absence of a strong institutional foundation.

SAWI created a good basis towards a collaborative institutional framework for coordinating river navigation in the sub-region, which received positive support from the BBIN countries. This is a strategic step that can help transcend individual interests in moving toward the common goal of operationalizing the proposed Eastern Waterway Grid across the sub-region—which will help connect the relatively isolated and dense Northeastern and eastern states of India, provide more economic opportunities for landlocked countries like Nepal and Bhutan, and also pave the way for wider regional integration with Singapore, Malaysia and Thailand. SAWI's studies confirmed the overall feasibility of Eastern Grid Waterways and informed key stakeholders on the way forward. SAWI importantly generated a credible 'baseline' of information in evaluating the potential for an interconnected grid of waterways in the sub-region. This included assessment of commercial, policy/regulatory and institutional aspects; and assessment of existing infrastructure, trade patterns, routes and cost datasets. An encouraging intended outcome was that SAWI brought the four BBIN countries to the discussion table, fostered their participation and built a more unified understanding of the value of having an interconnected sub-region for improved access to cross-border markets as well as people-to-people connectivity. While India and Bangladesh will host most of the active waterways, Bhutan and Nepal endorsed having multi-modal linkages to connect with the ongoing investments on rivers in India and Bangladesh, which will enable them to benefit from bilateral trade as well as for a much-diversified access to the Sea ports in the Bay of Bengal.

Timeframe: July 2020 – July 2021. ***Geography***: Regional. ***Budget Allocation***: $0.50M

Timeframe: September 2020 – June 2021. ***Geography***: Regional. ***Budget Allocation***: $0.30M

Pillar 2 – Capacity Building Activities

Capacity Building for Groundwater Management

Groundwater is the primary source of drinking and irrigation water across South Asia. The use of groundwater resources is high across much of the region—together, South Asia and China account for more than half of global groundwater use. Groundwater is the dominant source for rural water supply and is indispensable in cities and towns as surface water supplies struggle to cope with the rapid pace of urbanization. Its use has been a critical factor in enabling the region to become more resilient to drought since the 1970's. During drought, groundwater can provide emergency relief because it is able to provide water locally and more reliably than surface waters. South Asia is expected to rely increasingly on groundwater as the region's population and economy grow. If droughts become more common or more

severe, groundwater will need to play an even more prominent role in water resources planning and management. More attention must be given to planning, protection, regulation and management, including community-based groundwater management. This is increasingly recognized by the South Asia countries, which are beginning to tackle the groundwater crisis through national programs to reform water policies. Groundwater is highly relevant to tackling water stress in South Asia, and there is increasing interest in conjunctive management (coordination on groundwater and surface water), including as this relates to transboundary water management.

The activity supported a number of India-specific studies that can potentially be replicated throughout the South Asia Region, including on standards and protocols for groundwater quality assessment, an assessment of groundwater quality in Rajasthan, and economic, technical and environmental and social assessments of the NGMIP. A flagship publication under the activity was *Managing Groundwater for Drought Resilience in South Asia*. This report presents the findings of a diagnostic study examining pathways and options for strengthening the governance of South Asia's groundwater resources in the face of climate change and increasing reliance on the resource by dependent communities, particularly during times of drought. This study identifies, analyzes, and recommends management interventions that aid reforms of groundwater governance and strengthens drought resilience. This has the potential to guide ongoing regional dialogue, building on the South Asia Regional Groundwater Forum, and encourage more strategic utilization of groundwater resources to buffer against drought shocks in South Asia. This work provided technical, environmental and social appraisal to the Atal Bhujal Yojana (Abhy)-National Groundwater Management Improvement for India and informed design of a management information system design to support local community involvement.

Timeframe: February 2016 – January 2020. ***Geography***: Regional; India focus. ***Budget Allocation***: $0.85M

Capacity Building - Transboundary Water Governance

South Asia's main river systems are inextricably linked to regional geopolitics. The main transboundary rivers involve countries that are both unequal in size and power and have different, and often competing, demands on these rivers. At the same time, the region sees a low level of transboundary cooperation at the basin level. In spite of increasing awareness in South Asia of the concepts of integrated water resources management, and the importance of a basin-scale approach to development of water resources both within and across countries, there has to-date, been limited practical progress on implementation. A significant barrier to implementation is a lack of professional capacity. Experience in other regions demonstrates that the lack of cooperation reflects, not political unwillingness, but rather a lack of capacity, and therefore hesitance, to engage with potentially more skilled neighboring countries in the complex negotiations and coordination process on transboundary waters resources management. While there are academics and experts in South Asia engaged in transboundary waters governance and hydro-diplomacy, technical and political capacity is limited. Further, formal academic courses in South Asia lack the flexibility to quickly adapt and respond to the region's highly dynamic environment, emerging events and changing priorities affecting transboundary waters governance. As of yet, there are limited opportunities for specialized training on transboundary water governance offered by institutions in the region.

SAWI supported the implementation of a two-year Capacity Strengthening Program requested and approved by the Bangladesh Ministry of Water Resources in 2015 for training of officials of the Joint Rivers Commission, Bangladesh, and the Bangladesh Ministry of Water Resources and Ministry of Foreign Affairs in transboundary waters governance. The grant supported 33 individual trainings within the context of 11 external training events. Seventeen Government of Bangladesh officials, one official from the Government of Bhutan, and one official from the Government of Afghanistan have filled these 33 individual training slots. Participants were nominated by the participating government agencies, and selection was based on a match between technical and decision making position and the scope of the training. Participants received training in both basic and advanced water resources management (e.g. fundamentals of hydrology and IWRM, river basin modeling, flood risk management, hydropower management, groundwater management and conjunctive use) and topics related to transboundary water governance (e.g. international law and institutional frameworks, benefit sharing, and hydro-diplomacy). The personal interaction with other water professionals and government officials from around the world through this program has been considered critical to learning and understanding, and fostering personal connections that will lead to future knowledge exchanges. Participants noted that they would be able to use the knowledge attained to educate others within their respective government departments. The activity also supported the preparation of a recipient-executed grant implemented by IUCN India to develop training modules and a training curriculum for uptake in teaching institutions and to make training on the topic of water governance available in South Asia in the long-term.

Timeframe: December 2014 – August 2017. ***Geography***: Regional. ***Budget Allocation***: $0.36M

Capacity Building - Water Governance

While there are academics and experts in South Asia engaged in transboundary waters governance and hydro-diplomacy, technical and political capacity is limited. Further, formal academic courses in South Asia lack the flexibility to quickly adapt and respond to the region's highly dynamic environment, emerging events and changing priorities affecting transboundary waters governance. As of yet, there are limited opportunities for specialized training on transboundary water governance offered by institutions in the region.

This activity supported the design of short training modules and curriculum in water diplomacy and basin governance for uptake by participating universities and other institutions for long-term teaching of the topics. The training modules aim to build capacity at the policy and technical levels, with a focus on transboundary water governance and hydro-diplomacy at the basin and sub-basin levels for policymakers, water agency technical staff and students. With a goal to institutionalize and ensure sustainability of teaching on these subjects, the modules support current and future decision makers to identify and consider transboundary and cooperative water governance as a policy option, and to negotiate and handle sensitive inter and intra-state water resources issues in bilateral and multilateral contexts. The modules have been developed with a focus on the economic, social, cultural and ecological aspects of water and regional cooperation in the great Himalayan River Basins. The content links the need for water cooperation with emerging issues such as livelihoods, disaster risk reduction, inland navigation, energy, ecology and economic development. The five drafted modules are titled: (1) Integrated Water Resource Management and Governance of River Basins; (2) Transboundary Water Governance: Principles, Instruments and Institutions; (3) Hydro-Diplomacy as a New Approach to River Basin Cooperation; (4) Cooperative Arrangements Worldwide and its Relevance to Himalayan Rivers; and (5) Cooperation in the Himalayan River Systems: Legal and Institutional Response. The draft modules were pilot tested at three workshops, held in India and Bangladesh (national level) and Bangkok (regional level) between October and December 2017. Participants provided positive feedback and said they found the modules informative, relevant and well designed. A video showcasing the developed training curriculum was presented at the 8th World Water Forum in Brasilia (March 2018) https://www.youtube.com/watch?v=n-wSZZOGCdM. The finalized e-modules for this curriculum are online at http://www.southasianwaters.org/.

Timeframe: January 2016 – June 2018. ***Geography***: Regional. ***Budget Allocation***: $0.35M

Capacity Building - Water Quality Monitoring and Analysis

Modern technological advances have the ability to significantly aid, and in some cases reshape, how water resources in South Asia are managed. SAWI has incorporated innovative approaches to its knowledge generation and sharing activities to facilitate more informed decisions on particular water resource management issues, better designed interventions, and near real-time, easy and inexpensive water resources analysis. This includes aiding water managers in selecting proper water resources software, enhancing data visualization through mobile applications, and utilizing crowdsourcing for water quality monitoring. Traditional water quality monitoring infrastructure is expensive and time-consuming, requiring laboratories, sophisticated testing technologies, specialists to conduct tests and comply with sampling and testing protocols, and information systems to control and manage data flows and reporting. The benefits of real-time or near real-time water quality monitoring systems have been realized to include an overall reduction in monitoring system costs, provision of better spatial coverage and long-term trends in fluctuations of pollutant concentrations, and a vastly improved understanding of natural river processes and conditions. Recent technological developments in sensors and telemetry are revolutionizing the monitoring landscape, enabling the collection of high frequency data from remote locations with high accuracy. Simultaneously, the ubiquity of mobile phones and internet enables citizens to participate actively in social causes.

The grant provided critical TA support to the Government of India at the central and State levels, to manage, monitor, and understand water quality. Analysis of real-time water quality data was conducted and a scorecard approach to data use was introduced. The grant provided training (to the Central Pollution Control Board; National Mission Clean Ganga) to understand and implement real time networks using innovate contracting modalities, analyze and use real time data, crowdsource water quality data, and understand water quality risk to drinking water wells. Three reports, Crowdsourcing Water Quality Data: A Conceptual Framework (2016); Existing and Emerging Technologies for Continuous Water Quality Measurement (2016); and Analysis of Water Quality Data from Real Time Water Quality Monitoring Stations on River Ganga (2017) were completed. This expanded the knowledge base on water quality, which is often not as easily understood and managed as water quantity.

Timeframe: February 2015 – September 2017. ***Geography***: Regional; India focus. ***Budget Allocation***: $0.31M

Capacity Building - IWRM in Transboundary Basins

Due to the complexity of the hydrologic cycle, and its interaction with socioeconomic and ecological systems in a basin, using numerical model technologies to assist managers in understanding risks and developing water management alternatives greatly adds to the ability to develop and implement water management decisions. The NHP in India will enhance hydro-meteorological monitoring and strengthen key aspects of water resources management, including river basin planning, flood forecasting and planning, and real-time operation of water infrastructure. Water resource software (WRS), which includes hydrologic, hydraulic, hydro-geologic and water quality simulations and optimization models to provide a means to quantitatively test and evaluate concepts and management strategies addressing water resource issues, will be required to support the NHP. WRS supports water resource management by illustrating the fundamental function and operation of systems; identifying and displaying data availability and efficiencies; identifying and quantifying the functional and operational limitations in systems; determining the optimal design for systems; providing a means of testing design, policy, and management strategies prior to implementation; and communicating results. There are diverse WRS available to support these tasks, but choosing the most appropriate software is difficult for water managers with limited experience, as is common across South Asia.

Under this activity, a unique "WaterWare" WRS has been introduced for the first time in India (Ganges), which can help to optimize reservoir operation for multiple uses including hydropower, irrigation and domestic uses, while also ensuring minimization of flood. The model has also been linked with real-time climate data so that it can be used to forecast flows and for operational planning. Indian water professionals have indicated their eagerness to apply this tool, even without formal training, because of its ease of use. This grant also supported activities relating to building capacity of water engineers, basin managers and policy/decision makers (including through study tours and participation in short course trainings) on holistic river basin approach for effective water resources planning and management across South Asia.

Timeframe: October 2015 - September 2017. ***Geography***: Regional; India focus. ***Budget Allocation***: $0.19M

HEP Sustainable Planning - Bhutan | Bhutan HEP Environmental and Social Planning

Bhutan's 10th Five-Year Plan identified hydropower as "the proverbial engine of growth for the economy and the catalytical hub around which all round socioeconomic development has been possible." Recognizing the importance of hydropower in the country's development, the Royal Government of Bhutan has set goals for the hydropower sector, including "strengthening the economic self-reliance of the nation by realizing the electricity generation capacity" and "providing adequate, safe and reliable electricity through sustainable and environmentally friendly development of hydroelectric potential". Accordingly, the government has embarked on an ambitious plan to invest US$9 billion and commission close to 12,600 MW of new hydropower by the end of the next decade, becoming by far the highest hydropower producer per capita in the world.

As a result of the rapid assessment conducted by SAWI under the Brahmaputra Focus Area, the government moved to prepare the country's first ever national guidelines for preparing and constructing hydropower projects—urgently needed to support the sustainable development of the planned vast expansion of hydropower in the country over the coming decade. A main focus of the sustainability guidelines would be to improve the management of aquatic biodiversity, river connectivity, cumulative impacts and downstream flow release, that are all essential transboundary water management issues in the region. The government made a request to the World Bank (SAWI) to support guideline development. SAWI specifically contributed to strong environmental and social guidance and cumulative impacts being part of the overall guidelines. The *Guidelines for the Development of Hydropower Projects* were developed in close collaboration with core hydropower institutions—the Department of Hydropower and Power Systems (DHPS), Druk Green Power Corporation (DGPC) and Bhutan Power Corporation, which set up a joint Working Group consisting of more than 20 individuals, and consultation with a wide range of more than 50 stakeholders. Through this effort, the participating institutions significantly strengthened their understanding of international good practice in hydropower development. The draft guidelines were tested through a field application of one major pipeline hydropower project in Bhutan—Dorjilung (which will likely export power to Bangladesh). The Royal Government of Bhutan has taken full ownership of the hydropower guidelines, which are in the process of being integrated into Bhutanese policies and now serve as the preeminent guiding documents for future hydropower in the country. These guidelines will strengthen the main hydropower-focused institutions on how to develop sustainable hydropower and ensure sufficient resources are allocated to environmental, social and transboundary aspects of hydropower project development. The guidelines will reduce the risk of cost hydropower project overruns and loss of opportunity cost due to delayed dam commissioning. Since the cost of the proposed large hydropower projects are in the order of billions of dollars, the potential savings of 20 percent in cost overruns (an overrun percentage that is a general average for the industry) would be in the order of hundreds of millions of dollars per project.

Timeframe: September 2018 – December 2019. ***Geography***: Bhutan. ***Budget Allocation***: $0.21M

Timeframe: January 2016 – December 2017. ***Geography***: Bhutan. ***Budget Allocation***: $0.29M

Improving Water Resources Management in Northeast India

The northeastern state of Assam (India), which lies in the Brahmaputra Basin, faces major water-related risks, such as routine flooding and rampant erosion. To date, responses have largely been piecemeal, reactive and inflexible in dealing with the dynamic nature of the Brahmaputra Basin and in adapting to climate change. Investments have not been conceived within the context of the entire river basin, including the transboundary dimension. Primarily grey infrastructure solutions—which are not appropriate in all cases, are often expensive, and can actually increase risk—have been designed and executed with limited consideration of the natural variation and inherent complexity of the basin.

This activity supported the Government of India and the States of the NER to develop a framework for resilient and commercial agriculture in the NER. The activity's work represents a significant change from "business as usual", as it introduced new approaches for integrated water resources management and water-related disaster risk management, including adaptive solutions, including nature-based 'green' infrastructure and non-structural measures. SAWI also uniquely helped to advance discussions on issues of joint concern between India (Assam) and Bangladesh, as follows: Technical analysis on flood and erosion management brought deeper recognition and awareness among government agencies in Assam and Bangladesh of the need to consider issues beyond their own borders – as the challenges that Assam confronts cannot solely be addressed by the state and that coordinated action is needed. An early start has been made in

translating the change in mindset into action. This is mainly being done through the use of SAWI's work to improve the design of AIRBMP (US$500M), which is considered to be a steppingstone to broader cooperation in the NE and other riparian countries. AIRBMP and other associated projects in Bangladesh and Bhutan provide a vehicle for the Bank to engaged on these issues, which would otherwise not exist. SAWI added value by ensuring that transboundary issues are front and center of the project's design and that activities under the first phase of the program provide a solid foundation for not only improving water resources management in Assam, but also improving coordination across the other NE States and riparian countries that share the Brahmaputra River Basin. SAWI laid the groundwork towards a planned Regional Network of Practitioners across the NE and with other riparian countries. The aim is to strengthen the network of water sector actors from neighboring States/countries to increase cross-sharing of experiences. This network is intended to build on the platform established under the Brahmaputra Dialogue and to link closely with related projects, such as the Jamuna River Economic Corridor Development Program in Bangladesh and World Bank-supported activities in Bhutan on strengthening hydro-met services.

Timeframe: June 2020 - July 2021. ***Geography***: India. ***Budget Allocation***: $0.49M

Agriculture-Water Nexus, Resilient Agriculture and Access to Markets in NER

The North East Region (NER) of India accounts for more than 30 percent of India's water resources potential and almost 40 percent of the country's untapped hydropower generation capability (50,000 MW). This endowment, along with the region's strategic location as a vital gateway to international markets to the east (including through inland water transport), vast expanse of fertile land for agricultural production across multiple cropping seasons, ecosystem services, and unutilized human capital could be harnessed to make the NER a commercial, industrial and tourism hub. This could bring wealth and employment to one of the least developed parts of India, characterized by low per-capita income, lack of private investment, inadequate infrastructure facilities, geographic isolation and poor connectivity. While the region is prone to disastrous flooding that wreaks havoc year after year, and to erosion, sedimentation and wetland degradation—all in part due to governance responses that have been reactive and piecemeal—the Brahmaputra holds promise for the NER, as it is one of the few "open basins" in India. This means, if managed properly, it has surplus flows that exceed the requirements for societal needs, pollution dilution, environmental flows, and flushing sediments, and is therefore "open" for further basin development.

This activity supported the Government of India and the States of the North East to develop a framework for resilient and commercial agriculture in the North East Region (NER). (1) It reviewed the stressors and socioeconomic factors influencing climate risks and vulnerabilities in the water and agriculture sectors; highlighted the synergies and trade-offs in the water and agriculture sectors affecting smallholders; analyzed the policies and institutions pertaining to climate-resilient agriculture; and identified the key interventional areas to promote climate-resilient agriculture. (2) It conducted a review of the agriculture sector with special focus on key agri-value chains where NER is already and potentially strategically positioned to derive competitive advantage and economic impact; analyzed the constraints and challenges facing the development of these value chains and opportunities for investments, including the potential for their integration in domestic and regional markets; and recommended interventions and investments for agricultural development in NER that focuses primarily on wealth creation for farmers and economic development of the region. And (3) It documented good practices and lessons from existing experience in the public and private sector on climate-smart agriculture and market access for small farms. This work fit into SAWI's broader support on WRM in the NER and will inform the Government of India's Act East Policy and planned substantial investments in proper WRM.

Timeframe: July 2019 – July 2021. ***Geography***: India. ***Budget Allocation***: $0.22M

Practitioner Program on Transboundary Watershed Management in Mountain Economies

This activity was part of a larger effort to mainstream nature-based solutions in SAR operations. It leveraged earlier work on watershed management tools for sediment management and landslide risk reduction developed with support of the Korea Green Growth Trust Fund in FY19 and in partnership with Stanford's Natural Capital Project. This stage 1 effort involved developing tools and approaches that can be used to prioritize investments in watershed management to maximize the flow of ecosystem services to benefit different stakeholders. The SAWI activity encompassed Stage 2, with the objective to build a robust knowledge base on South Asia Region watersheds. The activity developed guidance notes on sediment management innovative methodologies in sustainable management of forested watersheds of regional importance, given the growing challenges and vulnerability from climate change. The work informed the Regional Ecological Integration Platform, which aims to increase regional cooperation in SAR related to the management of shared natural resources and responses to climate change. SAWI also developed a data portal, which houses 65 open source global datasets relevant to watershed management in South Asia. Such datasets include cropping extent, standardized precipitation index, flood exposure, water stress, groundwater climate vulnerability and forest cover change. A major innovation of the activity was the development of an innovative landslide risk assessment methodology that allows for application of nature-based landslide risk mitigation solutions.

Timeframe: August 2019 – April 2021. ***Geography***: Regional. ***Budget Allocation***: $0.20M

Monitoring Transboundary Water Quality in Bangladesh

This activity undertook a rapid assessment of all 54 transboundary rivers entering Bangladesh. The study examined the status of the water quality monitoring system (WQMS) of the Department of Environment of Bangladesh, identified systemic gaps, including water

pollution, and recommended measures to strengthen these. The activity also supported the design and implementation of a pilot water quality monitoring program at selected entry points of the Padma, Teesta and Jamuna rivers. Based on the assessment and results of the pilot program, the activity developed a proposal to update Bangladesh's existing WQMS, based on international best practices and wide stakeholder consultations. SAWI also helped to facilitate discussions with Bangladeshi representatives on the Joint Rivers Commission, Bangladesh, the Bangladesh Water Board (BWDB) under Ministry of Water Resources and the Department of Environment under the Ministry of Environment, Forests and Climate Change focused on water quality issues in transboundary rivers. A workshop was organized to disseminate findings of the pilot monitoring program and to discuss potential regional cooperation on regular exchanges of water quality information on key transboundary rivers between DOE and its counterparts in upstream countries. Findings from this activity are directly contributing to the preparation of the Bangladesh Environmental Sustainability and Transformation Project (BEST) project.

Timeframe: June 2020 – June 2021. ***Geography***: Regional. ***Budget Allocation***: $0.23M

Pillar 3 – Regional Flood Forecasting

Improving Flood Forecasting in South Asia

Flood hazard types in South Asia include flash floods, where heavy rainfall in hilly or mountainous terrain leads to rapid increases in water level and fast river flows; glacial lake and landslide outbursts, where naturally formed dams fail, leading to torrential outflow; riverine floods, where rising river waters fed by rainfall inundate surrounding lands; rain floods, where sustained heavy rainfall associated with monsoons or tropical cyclones outpaces drainage; and storm surges, where ocean waters driven ashore by low pressure, high wind tropical cyclones inundate low-lying coastal areas. Major flooding in the region causes loss of lives, livelihoods and infrastructure, damages the environment, and hinders development processes. With the changing climate, floods could become more frequent, more intense, and less predictable. The Ganges Basin in South Asia is home to some of the world's poorest and most vulnerable communities. Annual floods during monsoon season cause widespread human suffering and economic losses. By 2030, with ongoing climate change and socioeconomic development, floods may cost the region as much as US$215 billion annually. Bihar is India's most flood-prone state, with 76 percent of the total population living under a recurring threat of floods.

Under this activity, analytical and mapping work on historical flood data was undertaken to estimate economic losses in the Ganges Basin and to help identify high risk flood areas so that activities and investments for flood mitigation across India can be planned accordingly. A Flood Risk Atlas was developed in 2016 and was endorsed by the Government of India's Central Water Commission and uploaded on their official website. The Atlas is capable of providing both inter-State and transboundary assessment, which makes it useful for wider dissemination and knowledge sharing. During the 2017 Bihar floods, the FRA Atlas was used by the World Bank to generate risk reports at different geographic points in the river basin and to estimate losses for areas with severely impacted populations. This is intended to prioritize areas that would benefit from immediate attention to flood risk reduction. The activity also developed a Flood Predictability Assessment for the Ganges and the Brahmaputra Basins. By providing operational real-time estimates, the tool aims to improve accuracy in the predictability of flood forecasting for rainfall and river flows, and enable comparison to be made across the basin. This can be used to help evacuation planning and mitigation of household economic losses. The tool uses different modeling techniques, makes innovative use of satellite transboundary data that is not reliant on information sharing between riparian countries or on-the-ground measurements, and provides the results in a way that can be easily understood. The tool was customized for Bihar. The forecasting framework is being scaled up to other basins under India's National Hydrology Project and has been replicated for the transboundary Rapti River Basin in Uttar Pradesh.

Timeframe: December 2014 – June 2016. ***Geography***: Regional. ***Budget Allocatio***n: $0.50M

Pillar 4 – Dialogue Processes

Regional Dialogue

The Regional Dialogue brought together government and non-government participants from all seven SAWI countries to deliberate on topics relevant to water resources management across the region. The approach has been to build on technocratic networks established at the country level and leverage the relationship to engage decision makers at the regional level. The dialogue process opened up government-dominated water management to participatory multi-stakeholder processes from the local to the river basin level. It has gradually extended reach, heightened awareness on the state of Himalayan rivers, and has built a shared understanding of opportunities and challenges in regional water management. The South Asia Groundwater Forum in Jaipur, India in May 2016 was the first-ever significant regional water event with participation from Government of India's Ministry of Water Resources. It brought together more than 125 delegates from all countries in the region as well as experts from beyond the region, including current and former ministers, senior bureaucrats, water practitioners and scientists. The Forum elevated the importance of groundwater for economic development in the region and reinforced the need for collaborative action to overcome existing challenges of groundwater quantity as well as quality.

Timeframe: December 2014 – February 2020. ***Geography***: Regional. ***Budget Allocation***: $1.3 M

Program Management

Program Management

The program management activities supported strategic oversight and coordination of the program across all Focus Areas and activities, financial management, and annual progress reporting and donor liaison. Donor liaison included the annual donor meetings, mid-year check-in meetings, governance processes as laid out in the Administrative Agreements, and interactions with the partner organizations funded by the United Kingdom's FCDO under their South Asia Water Governance Program (SAWGP) and Australia's DFAT under their South Asia Sustainable Development Investment Portfolio (SDIP).

Strategic Communications

This activity supported implementation of the program's communications and engagement strategy. This included advocacy, awareness building, dissemination and engagement with key stakeholders (government officials, NGOs, academia, civil society groups and the media). The activity worked upstream to strengthen positioning at dialogues, national and international workshops and conferences, and extended support to Focus Area activities toward the delivery of programmatic results.

Achieving Results (M&E)

This activity supported M&E at the program and Focus Area levels. This included tracking progress in achieving indicator targets at all links of the results chain—activities, outputs, intermediate results and, ultimately, outcomes. It included regular reporting, including annual, "mid-term" and closing. M&E also included qualitative narratives to report on and demonstrate impact in terms of tangible results aligned with the program objective.

ANNEX

03

KNOWLEDGE PRODUCTS

Indus Focus Area		
Title	**Date**	**Type**
Strategic Analysis of Hydroelectric Power Potential in the Kunar River Basin: Synthesis Report	FY14	Report
Monitoring of Glaciers, Climate and Runoff in the Hindu Kush-Himalaya Mountains	FY14	Report
International Conference on Climate and Environment Change Impacts on the Indus Basin Waters	FY16	Event Report
Review of Technical Studies on Kunar River Hydropower Development	FY16	Report
Strategic Assessment of Hydropower Development Alternatives in the Kunar River Basin: Water Balance and Climate Change Analyses	FY16	Report
Assessment of Remote Sensing to Aid the Development of Hydropower Schemes on the Kunar River	FY16	Report
Institutional Design Analyses for Transboundary Management of the Kunar River Basin	FY16	Report
Political Economy Assessment of Kunar River Basin Hydropower Development	FY16	Report
Managing Blue Gold in South & Central Asia: A Comparative Study of Islamic Law and International Water Law	FY17	Journal Article
GIS data-mapping tool	FY17	Database
First Indus Basin Knowledge Forum Proceedings	FY18	Event Report
Understanding and Assessing the Impact of Climate Change in the Indus Basin: A Joint Research Program Proposed by the Indus Forum.	FY18	Brief
Capacity Building Program Transboundary Waters Law and Negotiation Reference and Training Manual	FY18	Manual
Afghan Study Tour to Nile Basin	FY18	Event Report
The Second Indus Basin Knowledge Forum: "New Knowledge Frontiers for Development and Resilience"	FY18	Event Report
Indus Basin Groundwater Analysis Stakeholder Consultation Report	FY19	Report
Proceedings Report: Third Indus Basin Knowledge Forum "Managing Systems Under Stress: Science for Solutions in the Indus Basin	FY19	Event Report
Background Paper for Sindh Government as a Contribution to Water Sector Reforms	FY20	Report
Groundwater in Pakistan's Indus Basin: Present and Future Prospects	FY20	Report
Ganges Focus Area		
National Workshop on Integrated Water Resources Management Summary	FY15	Report
Summary Report – Workshop on Environmental Flows for Strategic Planning for the Ganga Basin	FY15	Report
Water Resource Software: Application Overview and Review	FY16	Report
Hydro-met Manual	FY16	Manual
Flood Risk Assessment for the Ganges Basin in South Asia	FY16	Report
Evaluation of Flood Forecasting Predictability	FY16	Report
Kali Gandaki Hydropower Plant Rehabilitation Project: Catchment Management for Sediment Retention	FY17	Report
Information System Design GangaWIS	FY17	Report
Implement and Operationalize a Customized Framework in Bagmati-Adhwara and Kosi Basins in Bihar State.	FY18	Report
Web-Based River Flood Forecasting and Information Dissemination System for Bagmati-Adhwara and Kosi River Basin in Bihar	FY18	Report
Implement and Operationalize a Customized Meteorological Framework in Bagmati-Adhwara and Kosi Basins in Bihar State	FY18	Report

Developing, Implementing and Operationalizing a Flood Forecast Model and Inundation Mapping Tool in Bagmati-Adhwara Basin Using Public Doman and License-Free Software.	FY18	Report
Report on Exposure and Study Visit to China	FY18	Report
Study Tour to AIT, Bangkok	FY18	Report
An Introduction to Real-time Hydrological Information System	FY19	Manual
Ganga River Basin Model and WIS Report and Documentation	FY19	Report
Software and Data Files for the River Basin Model and Information System to Support Strategic Planning of the Ganga Basin	FY19	Software and Data Files
Strategic Basin Planning for Ganga River Basin in India: Project Management Report	FY19	Report
Preparation of River Basin Plans and Hydropower Development Master Plans and Strategic Environmental and Social Assessment (Inception Report)	FY19	Report
An Introduction to Real-Time Hydrological Information System	FY19	Report
Screening Different Equipment Makes and Models for Specific Site Conditions	FY19	Online Tool
Web-Based Flood Forecasting and Information Dissemination System for Bagmati-Adhwara and Kosi Basin in Bihar State: Modeling Report for Bagmati-Adhwara (Final Report)	FY19	Report
Nepalese Student Fellowship Report: "Cooperation for Capacity Building Program on Education of Future Generation of Water Resources Development Professionals"	FY19	Report
Nepal Water Sector Diagnostic 2020	FY20	Report
Pre-Scoping Note for Investment in IWRM-Based Municipality-Wide Water and Wastewater Management in Nepal	FY20	Report
Nepal Policies Institutions and Regulations Assessment Pertaining to Provisioning of Water Supply and Sanitation Facilities	FY20	Report
Water Quality Management in Nepal	FY20	Report
Urban/Municipality-Wide WSS Service Delivery	FY20	Report
Status of River Basins in Nepal	FY20	Report
Power Market Assessment	FY20	Report
List of Prospective Hydropower Projects in Nepal	FY20	Report
Technical Note on a Stakeholder Analysis to Inform SESA	FY20	Report
Participatory Modelling of Surface and Groundwater to Support Strategic Planning in the Ganga Basin in India	FY20	Journal Article
Brahmaputra Focus Area		
Room for Improvement: Hydroclimatic Challenges to Poverty-Reducing Development of the Brahmaputra River Basin	FY14	Journal Article
Consultation Workshop on Policy Dialogue for Improved Water Governance of Brahmaputra Basin	FY14	Report
Role of Institutions in River Basin Management: The Mississippi Experience Informs the Brahmaputra	FY15	Report
Managing Environmental and Social Impacts of Hydropower in Bhutan	FY16	Report
Modernizing Hydro-Met Systems in Bangladesh	FY16	Report
Transnational Policy Dialogue for Improved Water Governance of Brahmaputra River: Advisory Committee Board Meeting	FY16	Brief
Dialogue and Water Cooperation in the Brahmaputra River Basin	FY17	Journal Article
Detailed Analysis of Existing Hydro-met Monitoring Networks, Forecasting and Early Warning Systems	FY17	Report
Knowledge Inventory Report (Brahmaputra River Basin Assessment)	FY17	Report

Brahmaputra River Basin Issues, Models, Needs Assessment	FY17	Report
Baseline of Brahmaputra Basin Water Resources for Development Planning within Key Economic Sectors	FY17	Report
Stakeholder Consultation Report	FY17	Report
Interactive Excel-Based File System (allowing users to explore the basin and extract relevant data)	FY17	Database
Framework for Planning and Management of Water Resources in North East India: Report of the Expert Committee for Suggesting Immediate Measures for Proper Management of Water Resources in North Eastern India. RTI International	FY18	Report
North East Water Resources Information Base	FY18	Database
Basin modeling of the Brahmaputra River System in Bangladesh	FY18	Report
Investment Plan for the Bangladesh Delta Plan 2100	FY18	Report
Write Ups for the High-Level Commission on Key Topics of Interest for North East Water Resources	FY19	Report
North East India Actionable Roadmap: Proper Management of Water Resources 2018	FY19	Slide Deck
Framework for Integrated River Basin Evaluation: SAWI Discussion Note	FY19	Discussion Note
Building Up Bhutan's Resilience to Disasters and Climate Change	FY19	Blog
Climate-Water-Energy Nexus and South-South Cooperation: Workshop Summary	FY19	Report
The Intangible Values of Water: Concept Note	FY19	Report
Yarlung-Tsangpo-Siang-Brahmaputra-Jamuna: The Restless River	FY20	Book
Understanding Plastic Pollution: Focus on South Asia	FY20	Report
Re-Interpreting Cooperation in Transboundary Waters: Bringing Experiences from the Brahmaputra Basin	FY20	Journal Article
Voices from the Field on the Brahmaputra Dialogue	FY20	Film
Sundarbans Focus Area		
Transboundary Media Workshop on Challenges and Management of Sundarbans Landscape: Finding a Shared Way Forward on Sundarbans	FY15	Report
International Workshop on Risk Management and Adaptation to Climate Change for Sustainable Growth in Deltaic Regions	FY15	Report
Climate Change Adaptation in Coastal Areas & Other Sectors: Experiences from the Sundarbans (India Pavilion, Paris, COP 21)	FY16	Report
Climate Change, Livelihood Threats and Household Responses in the Bangladesh Sundarbans	FY16	Report
Impact of Aquatic Salinization on Fish habitats and Poor Communities in a Changing Climate: Evidence from South West Coastal Bangladesh and Sundarbans	FY16	Report
Impact of Aquatic Salinization on Mangroves and Poor Communities in the Bangladesh Sundarbans	FY16	Report
Stakeholder Analysis and Engagement Plan for Sundarban Joint Management Platform	FY16	Report
Species Conservation Indicators for Bangladesh's Sundarbans Region	FY16	Report
The Impact of Aquatic Salinization on Fish Habitats and Poor Communities in a Changing Climate: Evidence from Southwest Coastal Bangladesh	FY17	Journal Article
The Impact of Climate Change and Aquatic Salinization on Mangrove Species in the Bangladesh Sundarbans	FY17	Journal Article
Nature's Own People	FY17	Film
Rising Water, Ebbing Life	FY17	Film
Toward a Blue Economy: Pathways and Prospects for Bangladesh's Investment in Sustainable Growth	FY18	Report

Sundarbans Joint Landscape Narrative	FY18	Report
Assessment of the State of Nutrition of Mothers and Children and Stunting in Children and the Causal Linkage to Diet of Expectant Mothers	FY18	Report
Development of Sustainable Tourism	FY18	Report
Inventory of Flora and Fauna and Comprehensive Biodiversity Mapping	FY18	Report
Cyclonic Storm Landfalls in Bangladesh	FY18	Report
Mangroves as Protection from Storm Surges in Bangladesh	FY18	Report
Sea-Level Rise and Species Conservation in Bangladesh's Sundarbans Region	FY18	Journal Article
The Socioeconomics of Fish Consumption and Child Health in Bangladesh	FY18	Report
When Cyclones Strike: Using Mangroves to Protect Coastal Areas	FY18	Blog
Aamaar sontaan jyano thaake maachhe-bhaate (in Bengali)	FY18	Blog
Jolobayu poribortoner saathe saathe ki Sundarban Elaakaay ki maachher praapyotaa kombe? (in Bengali)	FY18	Blog
Biodiversity of Indian Sundarbans	FY18	Database
Biodiversity of Bangladesh Sundarbans	FY18	Database
Database of Cyclonic Storms (Landfalls, Tracks and Wind-speed Along the Tracks) in Bangladesh, West Bengal and Odisha, 1877-2016)	FY18	Database
Database of Erosion and Accretion of Bangladesh and Indian Sundarbans: (1904-2016)	FY18	Database
Aquatic Salinization and Mangrove Species in a Changing Climate: Impact in the India Sundarbans	FY19	Report
Mangrove Spatial Distribution in the Indian Sundarbans: Predicting Salinity-Induced Migration	FY19	Journal Article
Quantifying the Protective Capacity of Mangroves from Storm Surges in Coastal Bangladesh	FY19	Report
Accounting for Regional Differences in Mother and Child Health: Bangladesh, West Bengal, Bihar and Jharkhand	FY19	Report
The Cyclone's Shadow: Historical Storm Impacts and Population Displacement in Bangladesh, West Bengal and Odisha	FY19	Report
Co-Location, Socioeconomic Status and Perceptions of Environmental Change in the Indian Sundarbans	FY19	Report
Protection from Cyclones: Benefits of Integrating Green and Gray Infrastructure	FY19	Blog
Can Mangroves Mitigate Catastrophic Consequences of Cyclone-Induced Storm Surges?	FY19	Blog
Needs Assessment and Detailed Planning for a Harmonious Hydrometeorology System for the Sundarbans, which consists of three volumes (Vol 1: Existing Hydrometeorological Set Up in Sundarbans covering both India and Bangladesh; Vol 2: Looking at Comparable Deltas: Experiences from the Mekong Delta; and Vol. 3: Specific Requirements: Sea Level Stations, Water Stations and Logistics for the Entire Sundarbans Landscape	FY19	Report
Inventory of Freshwater Resources in the Sundarbans Landscape	FY19	Report
Evolution and Geomorphology of the Sundarbans Landscape	FY19	Report
Conceptual Proposal for Preparation of an Integrated Asset Management System for the Sundarbans in India; Proposal for Development of Joint Hydrometeorological Services for the Entire Sundarbans Region	FY19	Report
Water Quality Analysis and Salinity Intrusion Analysis	FY19	Report
BISRCI digital knowledge and news platform (www.sundarbansonline.org)	FY19	Website
Institutional Structure for Joint Action in the Sundarbans Region	FY19	Report
Benefits of Cooperation: Focus on the Sundarbans	FY19	Report

Sundarbans Media Platform	FY19	Report
Erosion and Accretion of Bangladesh and India Sundarbans: 1904-2016 (Geocoded Database)	FY20	Database
Water (Tubewell and River) Salinity in Indian Sundarban: February-May 2019 (Geocoded Database)	FY20	Database
Co-Location, Socioeconomic Status and Perceptions of Environmental Change in the Indian Sundarbans	FY20	Journal Article
Long-Term Island Area Alterations in the Indian and Bangladesh Sundarban: An Assessment Using Cartographic and Remote Sensing Sources	FY20	Report
Discounting Disaster: Land Markets and Climate Change in the Indian Sundarbans	FY20	Report
Explaining Regional Variations in Mother-Child Health: Environmental Determinants in India and Bangladesh	FY20	Report
Fishing in Saltier Waters: Climate Change, Saline Exposure and Women's Health in the Indian Sundarbans	FY20	Report
Policy Brief for High-Level Decision Makers on a Joint Institutional Arrangement to Sustainably Manage the Sundarbans	FY20	Report
Web-Feature Stories: Drinking Water in the Indian Sundarbans; The Perils of Prawn-Catching for Sundarbans Women; Proactive, crosscutting adaptation measures are needed to reduce climate change impacts on the poor; Mangroves and Coastal Protection: A Potential Triple-Win for Bangladesh	FY20	Web Stories
Regional Cross-Cutting Focus Area		
Proceedings of the South Asia Regional Fulbright Alumni Workshop on the Water-Energy-Food Nexus 2015	FY15	Report
Proceedings of the Regional Flood Early Warning System Workshop	FY15	Report
Water, Ecosystems and Energy in South Asia: Making Cross-Border Collaboration Work	FY16	Report
International Cooperation and Transboundary Perspectives on Water: TERI India Water Forum, 2016	FY16	Report
Analysis of Water Quality Data from Real Time Water Quality Monitoring Stations (RTWQMS) on River Ganga	FY16	Report
Programmatic Approach to Impact of Climate Change on Water, Hydropower and Dams	FY16	Report
Guidance Note on Sediment Management, including Technical and Economic Assessment of Sediment Management Techniques, and Development of RESCON2 Software	FY16	Report
Estimation of Contribution of Glaciers to Streamflow of Arun River	FY16	Report
Existing and Emerging Technologies for Continuous Water Quality Measurement	FY17	Report
Workshop Hydrology and Decision Support Systems for Pradhan Mantri Krishi Sinchayee Yojana	FY17	Report
Crowdsourcing Water Quality Data: A Conceptual Framework	FY17	Report
Analysis of Water Quality Data from Real Time Water Quality Monitoring Stations on the River Ganges	FY17	Report
Flood Risk Assessment and Forecasting for the Ganges-Brahmaputra-and Meghna River Basins	FY17	Report
Climate Risks and Solutions: Adaptation Frameworks for Water Resources Planning, Development and Management in South Asia. Prepared by Hirji, Nicol and Davis	FY17	Report
Economic Assessment of India's National Groundwater Management Improvement Program	FY17	Report
Technical Assessment of India's National Groundwater Management Improvement Program	FY17	Report
Use of Remote Sensing in Monitoring Groundwater Use for Irrigation and Validating the Arrest of Groundwater Decline in India	FY17	Report
South Asia Climate Change Risks in Water Management: Climate Risks and Solutions: Adaptation Frameworks for Water Resources Planning, Development and Management in South Asia	FY18	Report
Status of Aquatic Biodiversity in Bhutan	FY18	Report

Integrating Cultural Landscape Considerations in Large Infrastructure Planning in Bhutan	FY18	Report
Guidelines for the Development of Hydropower	FY18	Report
Hydropower Sector Climate Resilience Guidelines	FY18	Report
Potential Health Risks from Inorganic Chemical Contamination of Groundwater in Punjab, India	FY18	Report
IUCN Training Module Course	FY18	Web
IUCN Training Module Course Video	FY18	Video
Fostering a Spirit of Cooperation Among the Brahmaputra Basin Riparians	FY18	Blog
Managing Water Extremes in South Asia: Reflections Report	FY19	Report
Managing Groundwater for Drought Resilience in South Asia	FY19	Report
Eight case studies demonstrating groundwater management approaches in different types of groundwater settings around the South Asia Region	FY19	Report
HKH Regional Conference on Cryosphere, Glacier Melting And Mountain Economy Transboundary Solutions for Resilient HKH Mountains: Meeting Proceedings	FY19	Report
Sources of Black Carbon Deposition to the Himalayan Glaciers in Current and Future Climates	FY19	Journal Article
Energy-Water-Agriculture Nexus: Grow Solar, Save Water, Double the Farm Income	FY20	Report
National Guidelines for Dam Safety for the Government of Bhutan	FY20	Policy Guidelines
Guidance for Harmonized Bidding Documents for Works on Hydropower Projects in Bhutan	FY20	Policy Guidelines
Review Report for the Dorjilung Project (Nepal)	FY20	Report
Analyzing the Covid-19 Pandemic Impacts on Agriculture Value Chains in NER	FY20	Report
South Asia Watersheds Dashboard Data Portal	FY20	Database
Due Diligence Report of Omkareshwar Reservoir: Global Knowledge and Experience in FSPV	FY20	Report
Pre-Feasibility Report on Omkareshwar Dam	FY20	Report
Database on 2173 Water Bodies	FY20	Database
List of 100 selected reservoirs for Preliminary Floating Solar Panel Potential	FY20	Report
Himalayan University Consortium Online Portal	FY20	Website
Plastics x Covid-19 short paper	FY21	Report
Plastics x Gender & Jobs	FY21	Report
Plastics x Climate Change	FY21	Report
Plastics x Roads & Transport	FY21	Report
Baseline Assessment for Plastic Debris Flowing into Rivers and Seas of South Asia	FY21	Report
Country Study (India) on Material Flow Accounting	FY21	Report
Country Study (Nepal) on Plastic Materials Flow	FY21	Report
Country Study (Pakistan) on Interfaces Between Waterways and Plastic Hotspots	FY21	Report
Regional Ghost Fishing Gear Audit	FY21	Report
Mapping of Floating Solar Potential in India	FY21	Report
Detailed Assessment of 100 Water Bodies (Floating Solar PV)	FY21	Report
Guidance Document for Appraising Floating Solar Projects	FY21	Report
Unlocking Floating Solar Potential in India	FY21	Report
Review of Water Quality Issues in all 54 Transboundary Rivers (Bangladesh)	FY21	Report

Pollution Inventory and Water Quality Data Collection and Transboundary Streams and Canals of Akhaura Upazila of Brahmanbaria District	FY21	Report
Design of Upgraded Water Quality Monitoring (WQM) Schemes for the Two Priority Rivers	FY21	Report
Database on Water Quality at Two Priority Rivers	FY21	Database
Hydrological and Water Quality Model for Mathabhanga-Churni River in Chuadanga District	FY21	Report
Political Economy Analysis and Stakeholder Engagement and Communication Strategy for Ganges River Dolphin Study	FY21	Report
Global Best Practices in River Dolphin Conservation and Management	FY21	Report
Ganges River Dolphin Stakeholder Workshop Report	FY21	Report
Review of Scientific Knowledge of the Ganges River Dolphin	FY21	Report
Gaps and Recommendations for Effective and Sustainable Conservation of the Ganges River Dolphin	FY21	Report
Strengthening Regional Waterborne Trade and Transit Framework	FY21	Report
Understanding Technical, Economic and Political Economy Implications of Traffic Diversion from Roadways to Waterways - Kolkata-Jessore Traffic Diversion study	FY21	Report
Understanding Technical, Economic and Political Economy Implications of Traffic Diversion from Roadways to Waterways - Sahibganj-Narayanganj (Bangladesh) and Sahibganj-Jogighopa (Assam) through Dhulian-Rajshahi route	FY21	Report
Integration of Coastal Shipping with Inland Waterways	FY21	Report
Transition to a Regional Navigation Organization	FY21	Report
Compendium of all Studies and Dissemination Strategy for Developing Regional Waterways in South Asia	FY21	Report

ANNEX

04

PROGRAM MANAGEMENT

OVERVIEW

The SAWI program was supported by a Multi-Donor Trust Fund (MDTF) administered by the World Bank on behalf of contributing development partners. This specific type of MDTF is known as a "Programmatic Trust Fund" to which donors commit funds designed to support a thematic framework rather than financing a specific project or activity. Within this framework, SAWI supported activities executed by recipient organizations as well as activities directly executed by the World Bank. Consistent with standard World Bank Trust Fund practices, donors pledged funding for SAWI (pledged total was US$35.4M) and funds were deposited on agreed schedules outlined in the administration agreements signed with the donors. Accounting for administration fee and investment income, total funding deposited in the two trustee accounts (TF071929 and TF073237) was US$35,659,976. Allocations were approved by the Regional Integration Programs Committee (RIPC). SAWI worked with clients (for recipient-executed (RE) activities) and World Bank Task Team Leaders (for Bank-executed (BE) activities) to develop Grant Funding Requests (GFRs) and related activity documentation. The World Bank then followed technical, legal and fiduciary procedures to establish activities and commit funds through its standard processes. As of July 31, 2021, $35,287,526 was disbursed. leaving an undisbursed balance of $372,450.

FINANCIAL SUMMARY AT PROGRAM CLOSURE

Focus Area	Grant Amount
Indus	$2,768,302
Ganges	$8,422,037
Brahmaputra	$5,130,858
Sundarbans	$3,205,268
Regional Cross-Cutting	$12,282,869
Program	$3,478,192
TOTAL	**$35,287,526**

DISBURSEMENTS BY ACTIVITIES

TF Number	Activity Name	Grant Amount US$
TF014935	SAWI Indus FA Engagement	$ 271,734.53
TF015737	Project Development: Glacier Monitoring in the Upper Indus Basin	$ 101,824.54
TF016290	Learning Innovative Approaches to Glacier Monitoring to Address Climate Change	$ 212,567.34
TF016430	Integrated Management of the Kunar River Basin	$ 439,166.72
TF0A0640	Kabul/Kunar Basin Development	$ 600,225.85
TF018455	Indus Dialogue	$ 852,224.50
TF0A7388	Indus Basin (Pakistan) Groundwater Analysis	$ 290,558.16
Total Indus Basin		**$2,768,301.64**

TF Number	Activity Name	Grant Amount US$
TF0A0621	Managing Watersheds to Reduce Upstream Sediment for HEP: Nepal	$ 219,712.81
TF015480	SAWI Ganges FA Engagement	$ 348,611.06
TF018717	Strategic Basin Planning	$ 4,030,627.56
TF0A1373	BMIS Flood Forecasting	$ 370,959.06
TF0A1269	Strengthening Flood Modelling Capacity in Water Resources Department	$ 446,031.92
TF018129	Sustainable Water Resources Development for HEP in Nepal (BE)	$ 863,308.64
TF018488	Water Resources Management in Transboundary Basins; India	$ 743,965.29
TF018570	Power Sector Reform and Sustainable Hydropower Development Project (RE)	$ 500,000.00
TF018509	Ganges Dialogue	$ 152,670.91
TF0B1361	Nepal Water Platform	$ 61,938.14
TF0B3495	Nepal Water Platform	$ 19,412.69
TF0B4904	Power Sector Reform and Sustainable Hydropower Development Project (RE)	$ 664,798.72
Total Ganges Basin		**$8,422,036.80**
TF016291	Brahmaputra Basin Focus Area	$ 40,217.92
TF016429	The Brahmaputra River Basin Assessment	$ 35,525.88
TF017496	River Management Improvement: Bangladesh	$ 268,212.81
TF017526	Brahmaputra Integrated Water Resources Management Study Tour	$ 183,699.51
TF0A0642	Environmental and Social Management for Sustainable HEP: Bhutan	$ 199,168.64
TF0A1154	Delta Management Investment Planning and Basin Analysis	$ 797,999.59
TF018637	Hydro-met Modernization in the Brahmaputra Basin	$ 243,727.68
TF015001	Concept Note Development Brahmaputra FA	$ 195,807.53
TF0A3513	Bhutan Hydro-met Services and Disaster Resilience Project	$ 499,857.59
TF0A7705	Non-Monetary Values of Water	$ 10,525.00
TF018849	Brahmaputra Dialogue	$ 1,047,056.63
TF0A2312	Basin Modelling and Analysis	$ 1,335,099.95
TF0A8696	Strengthening Hydro-met Services and DRM in Bangladesh	$ 273,959.39
Total Brahmaputra Basin		**$5,130,858.12**
TF017032	SAWI Sundarbans FA Engagement	$ 327,448.26
TF0A1366	Delta Management Investment Planning	$ 178,299.75
TF0A0986	Landscape Hydro-met Design	$ 399,839.29
TF0A2516	Landscape Joint Environmental Plan	$ 299,973.19
TF0A0121	Targeted Environmental Studies	$ 1,049,814.41
TF0A0122	Sundarbans Dialogue	$ 949,893.41
Total Sundarbans Landscape		**$3,205,268.31**
TF015757	SAWI Cross-Cutting Knowledge, Dialogue and Consultation	$ 252,365.76
TF016326	Transboundary Risk Management and Data Sharing	$ 171,385.53
TF017907	Climate Change Impacts on HEP	$ 337,045.49

TF Number	Activity Name	Grant Amount US$
TF018522	Snow/Glacier Contributions to Stream-flows and Climate	$ 147,173.66
TF0A3877	Bhutan-HEP Environmental and Social Planning	$ 288,961.01
TF0A1491	Climate Change Risks in Water Resources Management	$ 531,854.17
TF019090	Capacity Building - WQ Monitoring and Analysis	$ 305,493.71
TF018768	Capacity Building - Transboundary Water Governance	$ 363,657.83
TF018290	Improving Watershed Management, India	$ 121,118.43
TF0A3996	South Asia HEP Resilience Studies	$ 190,861.74
TF018731	Improving Flood Forecasting in South Asia	$ 499,492.76
TF0A1367	Capacity Building - IWRM in Transboundary River Basin; India	$ 188,022.65
TF0A3886	Capacity Building - Water Governance	$ 353,449.00
TF018766	Regional Dialogue	$ 1,125,139.62
TF0A2044	Capacity Building for Groundwater Management	$ 854,628.58
TF0A4131	Himalaya University Consortium Grant (RE)	$ 1,219,994.68
TF0A7870	Glaciers of the Himalayas	$ 440,913.07
TF0A7575	A Diagnostic Study on Groundwater-Energy-Agricultural Nexus	$ 148,836.32
TF0A8509	HEP Sustainable Planning	$ 213,720.70
TF0B0815	Practitioner Program on Transboundary Watershed Management in Mountain Economies	$ 199,487.22
TF0B0852	TA and Knowledge Sharing Facility for Development of Utility Scale Floating Solar PV	$ 149,697.50
TF0B4373	TA and Knowledge Sharing Facility for Development of Utility Scale Floating Solar PV	$ 162,384.16
TF0B0702	Agriculture-Water Nexus, Resilient Agriculture and Access to Markets in NER	$ 218,334.25
TF0B2753	Enhancing Ecological Security of Aquatic Environment in G-B Mainstems	$ 574,651.73
TF0B3989	Pakistan Inland Waterway Transport Strategy	$ 249,161.80
TF0B3617	Developing Regional Waterways in South Asia	$ 478,579.32
TF0B3128	Monitoring Transboundary Water Quality in Bangladesh	$ 231,666.66
TF0B2822	Rivers and Plastics: Addressing Transboundary River Pollution in South Asia	$ 1,553,880.35
TF0B5540	Rivers and Plastics: Addressing Transboundary River Pollution in South Asia	$ 88,222.04
TF0B2799	Price of Water	$ 133,309.80
TF0B3781	Improving WRM Management in NER	$ 489,379.86
Total Regional Cross-Cutting		**$12,282,869.40**
Activities Total		**$35,287,525.82**
TF014265	SAWI II Program Administration and Management	$ 2,149,376
TF0B2763	Program Management and Administration	$ 243,134
TF017869	Strategic Communications	$ 885,978
TF0A2362	Achieving Results	$ 199,703
Total Program		**$3,478,192**

FINANCIAL MANAGEMENT AND FIDUCIARY RISKS

Ethics: All trust fund beneficiaries and bidders were required to observe the highest standard of ethics in World Bank-financed grants and contracts. SAWI grants were subject to the World Bank's Anti-Corruption Guidelines, the Procurement and Consultant Guidelines, and the Standard Conditions for Trust Fund Grants, which delineate standard operating procedures for any fraud issues. The Anti-Corruption Guidelines provide for certain actions to be taken by grant recipients to prevent and combat fraud and corruption, and the Standard Conditions provide for suspension and/or cancellation of disbursements, as well as the refund of disbursed grant proceeds in the event that fraud and corruption does occur.

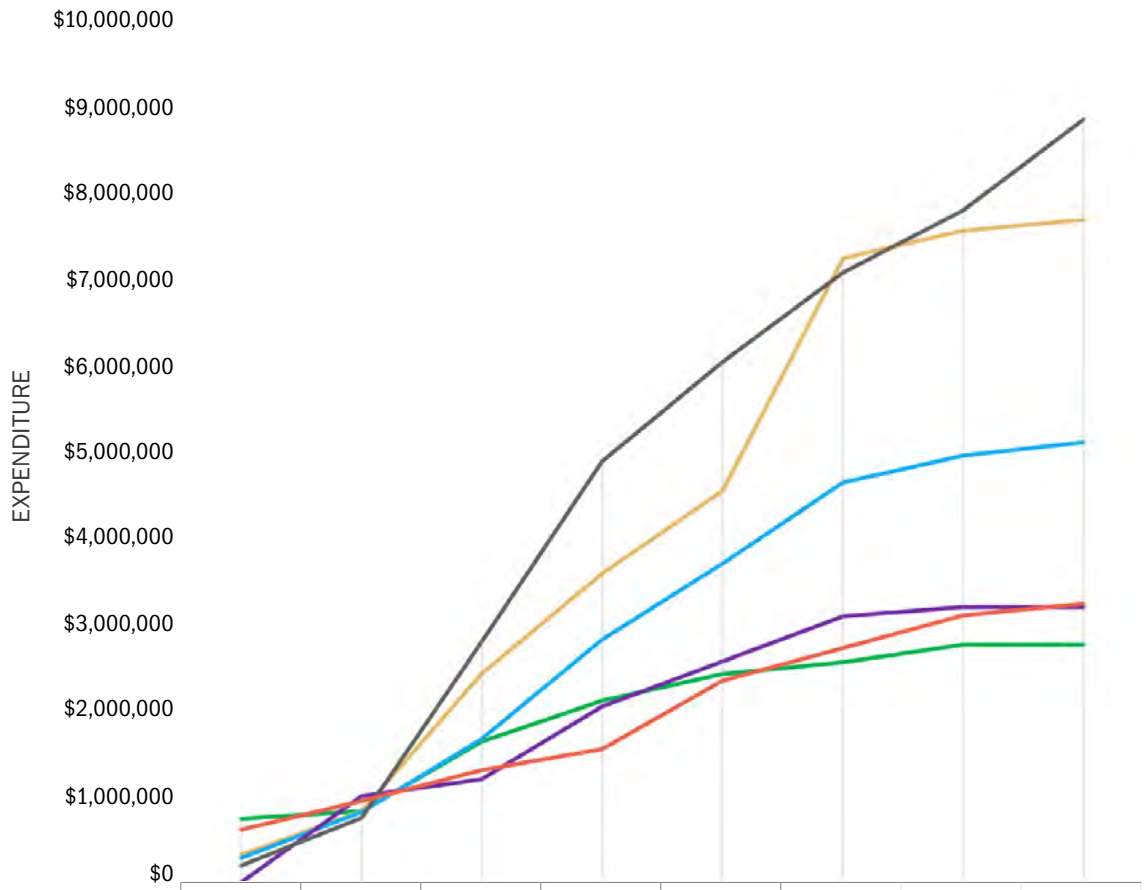
Audits and Financial Management: The World Bank provided donors, within six months following the end of each World Bank FY, with an Annual Single Audit Report in respect of all cash-based trust funds, comprising: (1) a management assertion together with an attestation signed by the external auditors concerning the adequacy of internal controls over cash-based financial reporting for trust funds as a whole; and (2) a combined financial statement together with the external auditor's opinion thereon. The Single Audit Report finds no instances of corruption or fraudulent conduct in FY21 (available at: www.worldbank.org/financialresults).

For RE trust funds, recipients are required to maintain adequate financial management systems, prepare annual financial statements in accordance with accounting standards acceptable to the World Bank, and to have these statements audited by independent auditors acceptable to the World Bank. The recipient is also required to submit interim financial reports acceptable to the World Bank. Each RE trust fund operation involves a Financial Management Specialist who reviews financial management compliance of the recipient and is responsible for reporting instances of non-compliance.

PORTFOLIO SPEND AND EFFICIENCY

There have been 73 grants under SAWI since program inception. In FY21, 11 grants were under implementation and completed. The cumulative transfer of funds to approved SAWI activities was $35.4M. Cumulative disbursement was $35.28M, leaving an undisbursed balance of $372,450. A summary graph of expenditure across fiscal years is presented below.

Focus Area Cumulative Expenditure Across FYs (US$)



	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21
IRB	750,000	835,020	1,648,253	2,124,407	2,427,368	2,563,623	2,768,303	2,768,303
GRB	330,000	842,866	2,428,695	3,590,509	4,551,636	7,248,596	7,574,666	7,702,069
BRB	300,000	834,569	1,670,857	2,828,244	3,707,769	4,653,172	4,964,691	5,118,350
SUN	10,000	1,010,587	1,210,539	2,050,599	2,578,604	3,101,758	3,205,267	3,205,267
REG	210,000	764,771	2,801,661	4,897,813	6,048,327	7,090,175	7,802,348	8,862,014
PRO	630,000	954,687	1,316,403	1,558,878	2,349,644	2,732,193	3,113,160	3,248,645

ANNEX

05

SAWI PHASE ONE

SAWI PHASE ONE

Inception and Objective

In the face of the identified complex challenges, SAWI was conceptualized in 2007 and formally established as a partnership between the United Kingdom, Australia, Norway and the World Bank in 2009. (Funding profile: UK ($3.76 M); Norway ($3.04M); and Australia ($2.98 M)). The Phase One program objective was "to promote the goals of poverty reduction, economic growth, mitigation of and adaptation to climate change and water security through significant and measurable improvements in water resources management and development at the regional, international basin and national levels in South Asia".

Phase One Pillar Structure

SAWI Phase I was structured around three pillars:

(1) **Generate new knowledge**: build the knowledge base through basin-wide modelling, research on complex hydrologic issues and development of decision-making tools;

(2) **Facilitate multi-stakeholder dialogue**: create platforms for formal and informal dialogue across a diverse set of stakeholders (including government, private sector, opinion leaders, civil society and academics) to share information and start building partnerships; and

(3) **Enable innovative investments and institutional development**: enhance the capacity of national institutions, inform decision making on investments in the water resources sector and lever investment using SAWI funds.

Progress Toward Objectives

SAWI enabled the execution of important groundwork that contributed to the preparation of several projects related to water resources with relevance to the regional cooperative agenda:

(1) At the regional level, SAWI supported countries in building the knowledge, relationships and institutions necessary to work towards achieving water security and managing climate change risks.

(2) At the basin level, SAWI supported countries that share river basins through strategic basin assessments of water systems and economic dynamics. These assessments aimed to improve countries' understanding of the impacts of current management and of future scenarios under a cooperative and benefit-sharing approach, including the potential effects of climate change.

(3) At the national level, SAWI supported technical assistance, capacity building and the preparation and implementation of sovereign, in-country projects with regional dimensions. These projects aimed to build local information and institutions in order to leverage investments across borders.

Phase One Highlights

Generating New Knowledge

(1) Ganges Strategic Basin Assessment: an evidence-based study of the Ganges Basin that provided an integrated perspective on the major water resources planning. The study demonstrated the importance of focusing on "soft" approaches, such as information and warning systems, in addition to "hard" infrastructure solutions;

(2) Bangladesh Hydro-met Technical Study, which provided insights on the needed improvements to Bangladesh's hydro-meteorological and flood forecasting systems;

(3) Building Knowledge and Capacity for Regional Management of the Sundarbans: cross-border studies in Bangladesh and India that provided important information on the economic and social value of ecosystem management in the fragile Sundarbans.

Facilitating Multi-Stakeholder Dialogue

(1) Abu Dhabi Dialogue (ADD). This flagship initiative launched in Abu Dhabi in 2006 prior to the formal commencement of SAWI. ADD facilitated high-level, multi-stakeholder dialogues on the shared risks and opportunities of the rivers of the Greater Himalayas. SAWI supported knowledge creation and information sharing and the establishment of knowledge-based partnerships through the ADD Knowledge Forum (ADDKF). ADDKF was supported by a Small Grants Program to facilitate collaboration between relevant knowledge institutions;

(2) Bangladesh Responsible Sourcing Initiative. This was a facilitated multi-stakeholder dialogue to help identify low-cost, cleaner production practices with the potential to enhance factory productivity and reduce water use and pollution in the textile industry in Bangladesh.

Enabling Innovative and Institutional Development

(1) Afghanistan: Enhancing capacity in the Afghan water ministry to identify and implement best-option investments.

(2) Nepal: Facilitated capacity-building activities for staff at Nepalese government agencies supported by establishment of a GIS-based water resources knowledge base.

Phase One Voices From the Field

"*The Abu Dhabi Dialog is a unique platform to build trust. It provides space to participants to raise sensitive issues with counterparts from other countries in side conversations during regional meetings, which is very important for nurturing water diplomacy in the region.*" — Surya Nath Upadhyay, Secretary General, Jalshrot Vikash Sanstha, Nepal.

"*Joining hands and working together to manage our glaciers is the key to social and economic prosperity in the South Asia region. SAWI initiatives have demonstrated how we can tap into this resource in an efficient and cooperative manner.*" — BG Verghese, Center for Policy Research, New Delhi.

"*SAWI provides valuable avenues for cross learning, from countries within the region and through its various South-South Knowledge Exchange Platform.*" — Dr. Leena Srivastava, Vice Chancellor, TERI University, New Delhi.

Independent Review

An independent review of SAWI in 2012 (commissioned by AusAID and DFID) confirmed that the complex long-term water resources challenges in South Asia can only be addressed through regional, transboundary action driven by a shared understanding of potential benefits, and acknowledged the significant contributions of SAWI towards these challenges. The evaluation pointed to SAWI's significant achievements in contributing to an enabling environment for regional cooperation through a combination of enhancing the knowledge base, cultivating a platform for high-level multi stakeholder dialogues, and enabling significant innovative investment and institutional development in different countries, including the establishment of a new interstate basin institution on the Ganges in India.

The independent review identified ways to deliver greater impact in a future phase of the program.

Better Align the Program: Align the regional process more strongly with the overall SAWI goals in order to achieve greater results at the transboundary level. As a consequence of limited regional cooperation and integration, and the absence of formal institutions in the region mandated to facilitate transboundary cooperation, the review assessed the regional process as somewhat disembodied. To the extent possible, SAWI engaged national and local institutions and organizations in the design and implementation of its regional program components. However, these partnerships remained weak, partly because national and local institutions have limited capacity and no particular mandate for transboundary work. The review suggested that strengthened partnerships and capacity enhancement could bring about greater local acceptance, more needs-based and more relevant activities, and greater impact of SAWI work at the policy and decision-making levels.

Increase Stakeholder Engagement: Consult a wider range of stakeholders (including civil society groups) and pursue gender equity in consultations, and involve all stakeholders in an open deliberative process. The review found that national and existing transboundary forums and mechanisms have not yet been fully explored. The facilitation of the ADD and involvement of ICIMOD as a partner were good and effective initiatives; however, the range of engaged stakeholder groups should be widened to include civil society groups and to improve gender equity.

Address the Complex Political Economy: More directly address the complex realities of the political economy of the region to allow SAWI to better contribute to regional policy and decision making on transboundary water resources management. The review found that the complex political economy of the region should be central to the SAWI strategic direction, thus enabling SAWI activities to achieve higher acceptance and impact. With a focus on regional and transboundary water cooperation, SAWI has to address the concerns of individual governments in promoting better water resources management. In other words, the regional processes need to be connected to national policy development and implementation.

Enhance Communication: Enhance the communication of research findings and knowledge to the broader public, particularly at the programmatic level, and including through a dedicated, interactive website. SAWI outputs had been disseminated to stakeholders. However, this dissemination was primarily at the activity level and not the program level. The review recommended that SAWI develop a comprehensive knowledge and communication strategy.

Incorporating this Guidance

This guidance was incorporated into the strategic planning and programmatic design for the second phase of SAWI. Drawing on the lessons from Phase One, SAWI would adjust its program in the following ways:

(1) It would sharpen the focus on specific river basins and landscapes by prioritizing strategic basins or landscapes where the potential for achieving regional cooperation is the greatest;

(2) It would strengthen its engagement with governments, research institutes and civil society by encouraging stakeholders to jointly define and continuously refine a strategy for each of the priority basins or landscapes; and

(3) It would adapt ongoing multi-stakeholder activities to strengthen its advisory role, establish targeted working groups, and broaden its reach to include more civil society representation. This would enhance the capacity of national actors to engage in regional processes. Phase II would emphasize a more strategic, focused and deliberative approach that is more firmly grounded in local socio-cultural, political and economic realities.

ANNEX

06

COUNTRY MAPPING

LEGEND

Afghanistan | Bangladesh | Bhutan | China | India | Nepal | Pakistan

INDUS FOCUS AREA

- Indus Dialogue
- Project Development: Glacier Monitoring in the Upper Indus Basin
- Learning Innovative Approaches to Glacier Monitoring to Address Climate Change
- Integrated Management of the Kunar River Basin
- Kabul/Kunar Basin Deveopment
- Indus Basin (Pakistan) Groundwater Analysis

GANGES FOCUS AREA

- Managing Watersheds to Reduce Upstream Sediment for HEP: Nepal
- Strategic Basin Planning
- BMIS Flood Forecasting
- Strengthening Flood Modelling Capacity in Water Resources Department
- Sustainable Water Resources Development for HEP in Nepal (BE)
- Water Resources Management in Transboundary Basins; India
- Power Sector Reform and Sustainable Hydropower Development Project (RE)
- Ganges Dialogue
- Nepal Water Platform
- Power Sector Reform and Sustainable Hydropower DevelopmentProject (RE)

BRAHMAPUTRA FOCUS AREA

- TheBrahmaputra River Basin Assessment
- River Management Improvement: Bangladesh
- Brahmaputra Integrated Water Resources Management Study Tour
- Environmental and Social Management for Sustainable HEP: Bhutan
- Strengthening Hydro-met Services and DRM in Bangladesh
- Hydro-met Modernization in the Brahmaputra Basin
- Bhutan Hydro-met Services and Disaster Resilience Project
- Non-Monetary Values of Water
- Brahmaputra Dialogue
- Basin Modelling and Analysis

LEGEND

Afghanistan | Bangladesh | Bhutan | China | India | Nepal | Pakistan

SUNDARBANS FOCUS AREA

- Sundarbans Dialogue
- Targeted Environmental Plan
- Landscape Joint Environmental Plan
- Landscape Hydro-met Design
- Delta Management Investment Planning

REGIONAL CROSS-CUTTING FOCUS AREA

- Transboundary Risk Management and Data Sharing
- Climate Change Impacts on HEP
- Snow/Glacier Contributions to Stream-flows and Climate
- Bhutan-HEP Environmental and Social Planning
- Climate Change Risks in Water Resources Management
- Capacity Building - WQ Monitoring and Analysis
- Capacity Building - Transboundary Water Governance
- Improving Watershed Management, India
- South Asia HEP Resilience Studies
- Improving Flood Forecasting in South Asia
- Capacity Building - IWRM in Transboundary River Basin; India
- Capacity Building - Water Governance
- Regional Dialogue
- Capacity Building for Groundwater Management
- Himalaya University Consortium Grant (RE)
- Glaciers of the Himalaya
- A Diagnostic Study on Groundwater-Energy-Agricultural Nexus
- HEP Sustainable Planning
- Practitioner Program on Transboundary Watershed Management in Mountain Economies
- TA and Knowledge Sharing Facility for Development of Utility Scale Floating Solar PV
- Agriculture-Water Nexus, Resilient Agriculture and Access to Markets in NER
- Enhancing Ecological Security of Aquatic Environment in G-B Mainstems
- Pakistan Inland Waterway Transport Strategy
- Developing Regional Waterways in South Asia
- Monitoring Transboundary Water Quality in Bangladesh
- Rivers and Plastic: Addressing Transboundary River Pollution in South Asia
- Price of Water
- Improving WRM Management in NER

ANNEX

07

PARTNERSHIPS

SAWI activities were carried out with national, regional and global partners. These partnerships aimed to ensure the sustainability of SAWI activities, including beyond the duration of the program. They also helped in crowding in knowledge and disseminating knowledge to multiple stakeholder groups. Most events were organized in collaboration with partners. Policy think tanks, civil society organizations and academics were active participants in knowledge generation. Sometimes the modality of this was the execution of an activity through an external implementing agency. In other cases, knowledge institutions were contracted as consultants. Many partnerships were not contractual in nature but through convening partners around common themes and interests.

SAWI'S GOVERNMENT AND COUNTRY-SPECIFIC PARTNERS

Afghanistan

Inter-ministerial working group on transboundary waters, comprising technical-level staff representatives from the Ministry of Energy and Water, the Ministry of Finance, the Ministry of Foreign Affairs and the National Environmental Protection Agency

Bangladesh

Dept of Water Resources; Bangladesh Forest Dept; Joint Rivers Commission, Bangladesh; Bangladesh Fisheries Research Institute; Institute of Water Modeling; Bangladesh Soil Research Institute; General Economics Division; Bangladesh Water Development Board; Bangladesh Meteorological Dept; Dept of Environment

Bhutan

Dept of Hydropower and Power Systems; Druk Green Power Co; Bhutan Power Co; National Center for Hydrology and Meteorology; Dept of Hydro-met Services; Dept of Disaster Mgmt; Dept of Agriculture; Royal Society for the Protection of Nature; Ministry of Agriculture and Forests; National Environment Commission; Bhutan Electrical Authority

China

Chinese Academy of Sciences; China Meteorological Division; Shanghai Institute of International Studies; Yunnan University; Fudan University; Beijing Institute of Contemporary International Relations; Wuhan University; China Reform Forum

India

Ministry of Water Resources, River Development & Ganga Rejuvenation; Central Water Commission; Central Groundwater Board; National Institute of Hydrology; Brahmaputra Board; Dept of Economic Affairs; Central Pollution Control Board; NITI Aayog; Ministry for the Development of the North East; multiple State Governments in Ganges/Brahmaputra Basins; Ministry of New and Renewable Energy; Rewa Ultra Mega Solar Ltd; Ministry of New and Renewable Energy

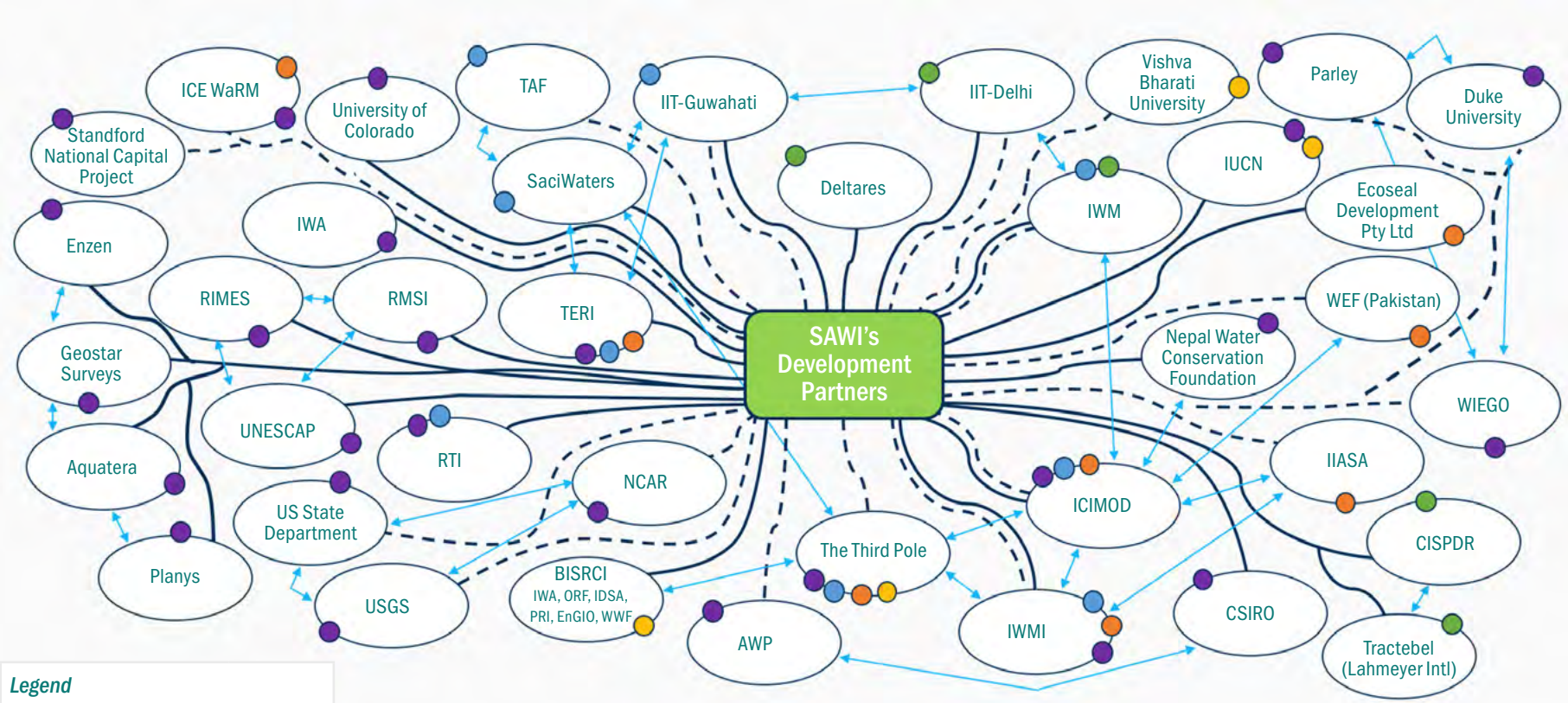
Nepal

Water and Energy Commission Secretariat; Dept of Soil Conservation and Watershed Management; Nepal Electricity Authority; Independent Power Producers Association of Nepal; Kathmandu University; hydroelectric power authorities; Ministry of Finance; Ministry of Energy, Water Resources and Irrigation; Ministry of Water Supply; Center for Green Economy and Development

Pakistan

Ministry of Climate Change; Provincial Governments of Sindh and Punjab

SAWI'S DEVELOPMENT PARTNERS



Legend	
Contracted Partnership	
Knowledge Partnership	
Inter-relationships	
Indus Basin FA	
Ganges Basin FA	
Brahmaputra Basin FA	
Sundarbans Landscape FA	
Regional Cross-cutting FA	

AWP	the Australian Water Partnership
BISRCI	Bangladesh India Sundarban Region Cooperation Initiative
CISPDR	Changjiang Institute of Survey, Planning, Design and Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EnGIO	Environment Governed International Organization
ICIMOD	International Centre for Integrated Mountain Development
IDSA	Institute for Defence Studies and Analyses
IUCN	International Union for the Conservation of Nature
IWA	International Water Association
IWM	Institute of Water Modeling
IWMI	International Water Management Institute

NCAR	National Center for Atmospheric Research
ORF	Observer Research Foundation
PRI	Principles for Responsible Investment
RIMES	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia
TAF	The Asia Foundation
TERI	The Energy and Resources Institute
UNESCAP	UN Economic and Social Commission for Asia and the Pacific
USGS	United States Geological Survey
WEF	Water Environment Forum Pakistan
WIEGO	Women in Informal Employment: Globalizing and Organizing
WWF	World Wildlife Fund

ANNEX

08

WORLD BANK INVESTMENTS/OPERATIONS LINKED TO SAWI

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
Indus	Indus Basin Dialogue	700,000	1. Pakistan Water Sector Capacity Building and Advisory Services Project – Additional Financing (P155226)	To improve the country's management and investment planning of water resources in the Indus River system through: a) capacity building of and support to federal institutions in water resources planning and management, b) improvement in water resources management and development in Water and Power Development Authority and c) project management and additional studies.	Jun 2008 to Jun 2021	$35M
	Kabul / Kunar Basin Development	600,000	2. Afghanistan Irrigation Development and Rehabilitation Project – Additional Financing (P152892)	To improve access to irrigation in targeted areas and strengthen capacity for water resources management.	Apr 2011 to Dec 2020	$70M (plus $1M Counterpart)
	Indus Basin (Pakistan) Groundwater Analysis	295,000	3. Sindh Water Sector Improvement Project Phase I (P084302)	To improve the efficiency and effectiveness of irrigation water distribution in Ghotki Area Water Board (AWB), Nara AWB, and Left Bank AWB, all in the Province of Sindh, particularly with respect to measures of reliability, equity and user satisfaction.	Sept 2007 to Dec 2019	$150M (plus $25M Counterpart)
			4. Punjab Rural Water Supply and Sanitation project (P169071)	To provide safe, sustainable and continuous water supply for drinking and sanitation in select districts of rural Punjab.	Pipeline	$200M (plus $50M Counterpart)
			5. Sindh Water and Agriculture Transformation Project (P167596)	To boost the rural economy and promote sound water resources management for agricultural development, economic growth, and environmental sustainability.	Pipeline	$350M (plus $130M Counterpart)
Ganges	Strategic Basin Planning for the Ganges in India	4,000,000	6. India National Ganga River Basin Project (P119085)	To support the National Ganga River Basin Authority in: (a) building capacity of its nascent operational-level institutions, so that they can manage the long-term Ganga clean-up and conservation program; and (b) implementing a diverse set of demonstrative investments for reducing point-source pollution loads in a sustainable manner, at priority locations on the Ganga.	May 2011 to Dec 2019	$1B (plus $556M Counterpart)
			7. India National Hydrology Project (P152698)	To improve the extent, quality, and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in India.	Jan 2017 to Nov 2024	$175M (plus $175M Counterpart)
			8. India Uttar Pradesh Water Sector Restructuring Project Phase II (P122770)	To strengthen the institutional and policy framework for integrated water resources management for the entire State and increase agricultural productivity and water productivity by supporting farmers in targeted irrigation areas.	Aug 2013 to Oct 2020	$360M (plus $155M Counterpart)
	Power Sector Reform and Sustainable Hydropower Development Project (RE)	2,500,000	9. Nepal Power Sector Reform and Sustainable Hydropower Development (P150066)	To strengthen the capacity of the power sector agencies to plan and prepare hydropower transmission line projects following international standards and best practices. To improve the readiness of the power sector agencies for regulatory and institutional reforms.	Apr 2014 to Jun 2020	$20M (plus $1.5M Counterpart)
			10. Nepal Energy Sector Development Policy Credit (P154693) and (P170248)	To support the government's efforts in improving the financial viability and governance of the electricity sector.	Sept 2018 to Mar 2019	$100M (plus $150M Counterpart)

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
	Sustainable Water Resources Development for HEP in Nepal (BE)	1,200,000	As above	As above		
	Managing Watersheds to Reduce Upstream Sediment for HEP	220,000	11. Nepal Kali Gandaki A Hydropower Plant Rehabilitation Project (P132289)	To improve the reliability of power supply of Kali Gandaki A Hydropower Plant through rehabilitation and safety measures and to and improve the response capacity of Nepal in case of an emergency.	Aug 2012 to Jun 2017	$27M (plus $3M Counterpart)
	Water Resources Management in Transboundary Basins	500,000	India National Hydrology Project (P152698)	See earlier		
	Strengthening Flood Modelling Capacity in Bihar (RE)	475,000	12. India Bihar Kosi Basin Development Project (P127725)	To enhance resilience to floods and increase agricultural production and productivity in the targeted districts in the Kosi river basin, and to enhance Bihar's capacity to respond promptly and effectively to an eligible crisis or emergency.	Dec 2015 to Mar 2023	$250M (plus $126.5M Counterpart)
	WRM in Transboundary Basins	500,000	13. India's West Bengal Major Irrigation and Flood Management Project	To strengthen Irrigation and Flood Management capacity in West Bengal.	Under Preparation	$145M
	Bihar FMIS Flood Forecasting	500,000	As above	As above	--	--
	Nepal Water Platform	250,000	14. NP Modernization of Rani Jamara Kulariya Irrigation Scheme - Phase 2 (P158364)	To improve the irrigation service and to strengthen farmer organizations in the irrigated areas of the Rani Jamara Kulariya Irrigation Scheme.	Mar 2018 to Dec 2023	$66M (plus $6M Counterpart)
			15. NP Rural Water Supply and Sanitation Improvement (P143036)	To (i) increase sustainable access to improved water services and promote improved sanitation and hygiene practices in rural areas; and (ii) develop and implement a long-term support mechanism to promote the sustainability of water supply schemes in selected districts.	May 2014 to Dec 2020	$72M (plus $18M Counterpart)
			16. Nepal Urban Governance and Infrastructure Project (163418)	To expand municipal infrastructure and strengthen institutional & financial systems in participating urban local governments in Nepal.	Pipeline	$150M
			17. Building Resilience to Climate Related Hazards (P127508)	To enhance government capacity to mitigate climate-related hazards by improving the accuracy and timeliness of weather and flood forecasts and warnings for climate-vulnerable communities, as well as developing agricultural management information system services to help farmers mitigate climate-related production risks.	Jan 2013 to Nov 2020	$31M
			Nepal Power Sector Reform and Sustainable Hydropower Development (P150066)	See earlier	--	--
			18. Kabeli A Hydro Electric Project (P122406)	To add hydropower generation capacity to supply the Nepal electricity authority (NEA) grid through public private investments.	Jul 2014 to Dec 2019	$46M (plus $62M Counterpart)

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
Brahmaputra	Basin Modeling and Analysis; India	1,200,000	India National Hydrology Project (P152698)	See earlier	--	--
			19. Assam Integrated River Basin Management Program (P174593)[30]	To improve water security in Assam.	Pipeline	$500M
	Hydromet Modernization in the Brahmaputra Basin	250,000	20. Hydro-met Services and Disaster Resilience Regional Project (P154477)	To strengthen the Royal Government of Bhutan's capacity for improved weather and hydrological forecasting and disaster related early warning systems.	Sept 2016 to Jun 2020	$4M
	Bhutan Hydro-met Services and Disaster Improvement (RE)	500,000	As above	As above	--	--
	Hydromet Modernization in the Brahmaputra Basin	250,000	21. Bangladesh Weather and Climate Services Project (P150220)	To strengthen Bangladesh's capacity to deliver reliable weather, water, and climate information services and improve access to such services by priority sectors and communities.	Jun 2016 to Dec 2022	$113M
	BD: Strengthening Hydromet Services and Disaster Resilience	250,000	As above	As above	--	--
Brahmaputra and Sundarbans	Delta Management Investment Planning	800,000	Bangladesh Delta Plan 2100[31]	To realise a sustainable delta vision, long term strategy and plan, agreed with all stakeholders, for an optimum level of water safety and food security as well as economic growth and a framework for its implementation.	Jun 2015 to N/A	$4B in total
	Delta Management Investment Planning	800,000	22. Climate-Smart Agriculture and Water Management Project (P161534)	To enhance productivity and climate resilience of irrigated agriculture, improve water management, build institutional capacity for water and agriculture service delivery, and improve market opportunities for farmers small-holder farmers, especially women.	Pipeline	$120M
Sundarbans	All Sundarbans Activities	--	23. Bangladesh Sustainable Coastal and Marine Fisheries Project (P161568)	To increase coastal and marine fisheries' contribution to the economy, poverty reduction, and environmental stability.	Jul 2018 to N/A (in prep)	$240M (plus $42M Counterpart)
			24. Sustainable Forests and Livelihood Project (P161996)	To improve collaborative forest management and increase benefits for forest dependent communities in targeted sites.	Oct 2018 to Sept 2023	$175M (plus $4M Counterpart)
			25. Bangladesh Regional Waterway Transport Project 1 (P154511)	To improve Inland Water Transport (IWT) efficiency and safety for passengers and cargo along the Chittagong-Dhaka-Ashuganj Regional Corridor and to enhance sector sustainability.	Jun 2016 to Dec 2025	$400M (plus $360M Counterpart)
			Bangladesh Weather and Climate Services Project (P150220)	See earlier	--	--
			India National Hydrology Project (P152698)	See earlier	--	--

30 This project will be implemented in a multi-phase approach, of which the first phase will include an approx. US$120M World Bank investment.

31 Note: This is not a WB lending operation / loan (as is the case of the others). It is a plan that totals $4 billion. The SAWI-financed Delta Management and Investment Plan activity supported the preparation of a shorter-term investment plan for the Bangladesh Delta Plan 2100.

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
			26. Coastal Embankment Improvement Project (P128276)	To (a) increase the area protected in selected polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) improve agricultural production by reducing saline water intrusion in selected polders; and (c) improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible crisis or emergency.	Jun 2013 to Dec 2020	US$375M (plus $25M Counterpart)
			27. Integrated Coastal Zone Management - India (P097985)	To assist Government of India in building national capacity for implementation of comprehensive coastal management approach in the country, and piloting the integrated coastal zone management approach in states of Gujarat, Orissa and West Bengal.	Jun 2010 to Mar 2020	US$220M (plus $60M Counterpart)
			28. National Cyclone Risk Mitigation Project (P144726)	To reduce vulnerability to cyclone and other hydro-meteorological hazards of coastal communities in project states, and increase the capacity of the state entities to effectively plan for and respond to disasters.	May 2015 to Mar 2021	$310M (plus $80M Counterpart)
			29. Multipurpose Disaster Shelter Project (P146464)	To reduce the vulnerability of the coastal population in selected coastal districts of Bangladesh to natural disasters.	Dec 2014 to Sept 2020	$375M
Regional Cross-Cutting	Capacity Building – Water Quality Monitoring and Analysis	310,000	30. IN Punjab Rural Water Supply and Sanitation Project (P150520)	To improve water and sanitation service levels, reduce open defecation, and strengthen service delivery arrangements in targeted villages in Punjab.	Mar 2015 to Mar 2021	$248M (plus $106M Counterpart)
	Capacity Building – Water Quality Monitoring and Analysis	310,000	India National Ganga River Basin Project (P119085)	See earlier	--	--
	Capacity Building – IWRM in Transboundary River Basins	200,000	India National Hydrology Project (P152698)	See earlier	--	--
	Capacity Building for Groundwater Management	400,000	31. Atal Bhujal Yojana - National Groundwater Management Improvement Program (P158119)	To improve management of groundwater resources in selected states of India.	Jun 2017 to Jun 2022 (in prep)	$450M (plus $550M Counterpart)
	Improving Watershed Management	125,000	32. India Neeranchal National Watershed Project (P132739)	To support the watershed development component of PMKSY through technical assistance to improve incremental conservation outcomes and agricultural yields for communities in selected sites, and adoption of more effective processes and technologies in participating states.	Aug 2012 to Mar 2022	$178.5M (plus $178.5M Counterpart)
	Improving Flood Forecasting in South Asia	500,000	India Bihar Kosi Basin Development Project (P127725)	See earlier	--	--
	HEP Sustainable Planning	220,000	33. South Asia Electricity Markets Program (P167971)	To support regional cooperation in the power sector and regional electricity market in South Asia. It will comprise advisory, analytical and capacity building and knowledge sharing activities that will enhance country client readiness for power trade and energy cooperation; develop options for regional power market trade and development and foster the authorizing environment for regional power market trade and development.	Oct 2018 to Jan 2022	$3.7M

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
	Practitioner Program on Transboundary Watershed Management in Mountain Economies	200,000	34. Nepal: Investing in Forests for Prosperity at a Time of Transformation (P170798)	To improve sustainable forest management; and increase benefits from forests and to address climate change in selected landscapes in Nepal.	Pipeline	$24M
	Diagnostic Study on Groundwater-Energy-Agriculture Nexus	150,000	35. Rajasthan Agricultural Competitiveness Project (P124614)	To establish the feasibility of sustainably increasing agricultural productivity and farmer incomes through a distinct agricultural development approach by integrating agriculture water management and agricultural technology, farmer organizations and market innovations in selected locations across the ten agro ecological zones of Rajasthan.	Mar 2012 to Jun 2020	$109M (plus $87M Counterpart)
	TA and Knowledge Sharing Facility for Development of Utility Scale Floating Solar PV	150,000	36. Innovation in Solar Power and Hybrid Technologies Project (P160379)	To demonstrate the operational and economic feasibility of utility-scale innovative renewable energy technologies and battery energy storage solutions, and to strengthen institutional capacity to facilitate scale-up of such technologies on a commercial basis in India.	Mar 2019 to Dec 2024	$150M (plus $50M Counterpart
			37. IN Dam Rehabilitation and Improvement Project (P089985)	To improve the safety and operational performance of selected existing dams in the territory of the participating states.	Jun 2010 to March 2021	$350M (plus $87M Counterpart)
			38. Second Dam Rehabilitation and Improvement Project (P170873)	To increase the safety of selected dams and to strengthen dam safety management in India.	Pipeline	$500M (plus $215M Counterpart)
	Developing Regional Waterways in South Asia	480,000	39. Capacity Augmentation of National Waterway 1 (P148775)	To enhance transport efficiency and reliability of National Waterway-1 and augment institutional capacity for the development and management of India's inland waterway transport system in an environmentally sustainable manner.	Apr 2017 - Dec 2023	$800M (plus $375M Counterpart)
			Bangladesh Regional Waterway Transport Project 1 (P154511)	See earlier	--	--
			40. Assam Inland Water Transport Project (P157929)	To improve passenger ferry infrastructure and service in Assam and to improve capacity and framework for inland water transport in Assam.	Dec 2019 - Dec 2024	$150M (plus $88M Counterpart)
	Enhancing Ecological Security of Aquatic Environment in the Ganges	575,000	41. West Bengal Inland Water Transport, Logistics and Spatial Development Project (P166020)	To improve the efficiency and safety of passenger and freight movement across the Hooghly River; and to establish a spatial planning framework to enhance accessibility within Kolkata Metropolitan Area.	Nov 2020 - Mar 2026	$150M (plus $105M Counterpart)
			Assam Inland Water Transport Project (P157929)	See earlier	--	--
			Bangladesh Regional Waterway Transport Project 1 (P154511)	See earlier	--	--
	Plastic Free Rivers and Seas for South Asia	1,640,000	42. Plastic Free Rivers and Seas for South Asia (P171269)	To strengthen innovation and coordination of circular economy solutions to plastic pollution flowing into South Asian Seas.	May 2020 - Jul 2025	$37M

Focus Area	SAWI-II Grant	Grant ($USD)	World Bank Investment/ Operation Informed	Development Objective of World Bank Investment/ Operation	Duration	Bank Investment/Op ($USD million)
	TA and Knowledge Sharing for Development of Utility Scale Floating Solar PV	160,000	43. Innovation in Solar Power and Hybrid Technologies (P160379)	To demonstrate the operational and economic feasibility of utility scale innovative renewable energy (RE) technologies and battery energy storage solutions (BESS), and to strengthen institutional capacity to facilitate scale-up of such technologies on a commercial basis in India.	Mar 2019 - Dec 2024	$400M (plus $150M Counterpart)
SAWI is Linked to 43 World Bank Investments/Operations (Valued at Approx. US$9.5B)						