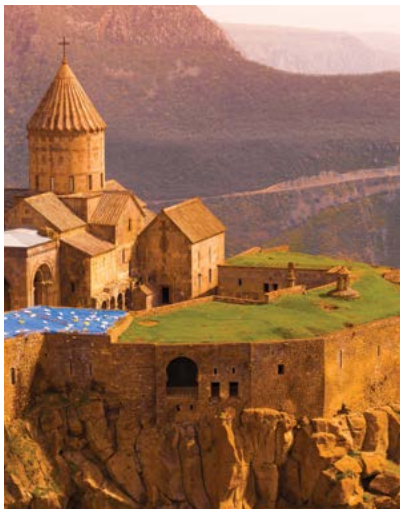
25 years gef

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

TIME TO ADAPT: INSIGHTS FROM THE GLOBAL ENVIRONMENT FACILITY'S EXPERIENCE IN ADAPTATION TO CLIMATE CHANGE







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Foreword

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This publication is a joint effort by the GEF partnership to showcase some of the insights gained from the now substantial portfolio of GEF-funded adaptation projects. The GEF has invested over US$1.3 billion to help communities in the developing world adapt to the changing climate, notably through the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). This publication, while drawing on only a sliver of the adaptation portfolio, gives readers a flavor of the diversity and breadth of activities that the GEF has supported. The projects featured in this publication illustrate that there is no one solution that fits every context. What these projects show perhaps most clearly is that development and adaptation are part and parcel of the same endeavor.

Despite our best efforts to mitigate greenhouse gas emissions, the world is already locked into climate change trajectories that we will have to cope with for many years to come. Indeed, the implementation of the commitments made in the Paris Agreement will only limit average warming to between 2.7-3.7C, confirming the need for continued adaptation measures.

We therefore have no choice. We must continue to invest, more than ever, in the health of the precious natural infrastructure that makes life possible, strategically protecting those existing defenses that, if lost, may greatly worsen the severity of the climate impacts. We must also urgently seize the opportunities that are available for adaptation now, for they may not be available later.

The imperative to meaningfully adapt and assist others in adapting is now almost universally accepted. This will require substantial funding, and it logically follows that we must invest those funds wisely. It is therefore important to take the time to better understand what the lessons are from the different efforts in adaptation.

The GEF is committed to using its programming resources to devise integrated solutions to the multi-dimensional problems facing the global environment. As articulated in the GEF2020 Strategy, the GEF will harvest synergies between its partner agencies and its multiple investment lines, such as chemicals management, international waters, biodiversity, the energy sector, and sustainable land management, given the importance of integrating adaptation within and across sectors.

The GEF will remain at the forefront of the international effort to strengthen countries' resilience and help them adapt to climate change. The GEF Scientific Technical Advisory Panel (STAP) has noted the urgency of GEF's projects seeking broader outcomes beyond single program silos, better addressing the key drivers of environmental degradation and not solely the pressure points, and developing a comprehensive approach toward scaling-up the impact of its investments. Adaptation funding offers an avenue to pursue programming that is integrated and synergistic with other efforts to improve the global environment.

In parallel, the role of the GEF and the value it generates in resilience alone, by protecting and enhancing the systems in which it operates — landscapes, oceanscapes, watersheds, and cities around the developing world — is directly relevant to the broader adaptation effort.

Lastly, the GEF's implementing agencies have greatly increased their awareness and capacity on climate change impacts and adaptation — and most have now developed tools and methodologies to address these. For projects that are sensitive or vulnerable to climate change, it is of utmost importance that current and future climate risk be taken into account in project design. Failure to do so could mean that the project will not yield sustainable benefits over the appropriate time horizon.

The Paris Agreement on climate change has ensured that the GEF will continue to play a fundamental role in the provision of finance for adaptation activities. Moving forward in the post-Paris era, the GEF aims to: (i) continue to demonstrate leadership with emerging issues in adaptation in the developing world; and issues with environmental dimensions in particular, (ii) help advance the effort of integration and mainstreaming of adaptation and resilience at all levels, including throughout the GEF's work; and (iii) assist countries in developing a better understanding of adaptation in practice, including synergies between adaptation and global environmental issues.

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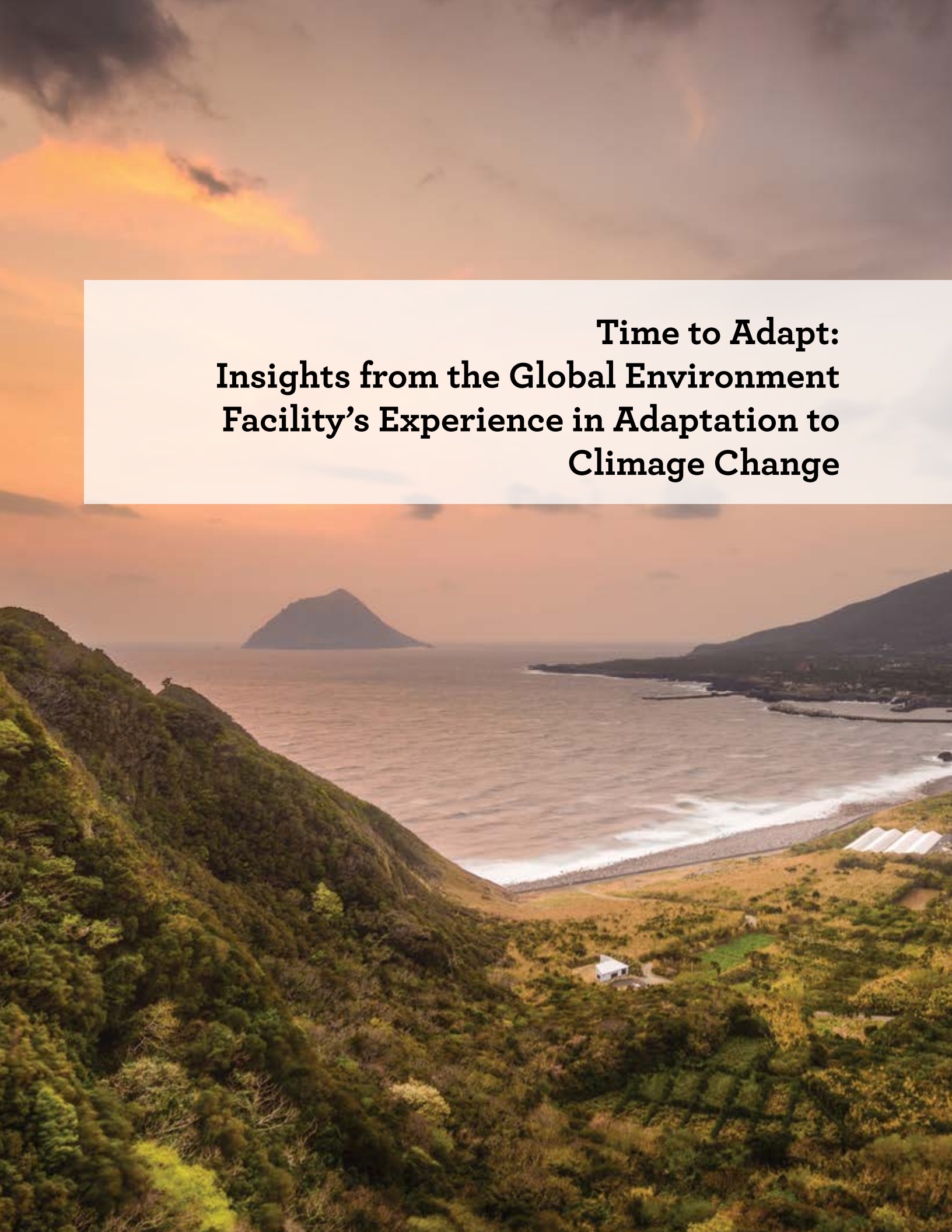


Time to Adapt: Insights from the Global Environment Facility's Experience in Adaptation to Climage Change

Introduction: Why this Book?

Adaptation is an issue of global concern and of equity. Climate change affects all countries, but many developing countries are particularly vulnerable due to their low adaptive capacities and lack of resources.[1] Yet, these countries, communities, and individuals are among the least responsible for climate change. Over the last decade, climate change adaptation has begun in earnest to prepare for rising seas, higher temperatures, worsening droughts, and other impacts.

This book shares the growing body of knowledge on adaptation, using the experience of adaptation project teams to construct narratives that convey meaningful and compelling knowledge based on practice. These adaptation projects have one thing in common: they have all been made possible by funding provided by the Global Environment Facility (GEF), under the United Nations Framework Convention on Climate Change (UNFCCC). As such, the book draws upon objective data and subjective observation, quantitative and qualitative methods nested in real-world examples. This approach builds upon and complements the growing number of other efforts to synthesize and share adaptation knowledge.

The wealth of adaptation literature, mostly theoretical and some practical, has lacked in-depth accounts of actual adaptation projects and programs, and the challenges that implementation brings. What is also markedly different about this effort is that it draws upon a mature and diverse portfolio of adaptation projects across the GEF's network of partners. Indeed, the projects showcased in this book were selected in consultation with the agencies involved in implementing GEF-financed adaptation projects in 130 countries, totaling over US$1.3 billion, embodying a diversity of perspectives, lessons, experiences, sectors, regions, and contexts.

The intended audiences for this publication are adaptation and development practitioners, fund managers, policymakers, adaptation decision-makers, and other stakeholders.

1 The UNFCCC (1992, p. 2) identifies categories of countries which are "particularly vulnerable": "[r]ecognizing further that low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change."

Key Questions

Uncertainty about future climate creates challenges in both adaptation planning and evaluation. Defining and determining success in adaptation therefore can be difficult. With adaptation, conventional development projects must take into account the potential future impacts of climate change. These impacts are often uncertain or unknown at the relevant geographic and temporal scales, compounding the other risks, uncertainties, and information gaps that projects would normally face.

GEF has a rich and relatively mature adaptation portfolio. The GEF experience thus can clearly help unpack some of the unknowns of adaptation. This publication, however, does not attempt to address all of the issues and concerns regarding adaptation. The case studies were instead structured around a few basic questions:

- What were the key challenges encountered, including failures?
- What were the key solutions, and factors considered critical for achieving success, even where "success" is tentative at this stage?
- What next steps would the authors recommend for the project?

Adaptation and Development

As awareness grows, and the development community increasingly makes an effort to integrate climate change concerns into project planning and design, we are seeing a growing trend toward more climate-resilient development.This has implications on many levels, including from the perspective of international funders. One of the likely consequences is that funding for sustainable development will need to systematically factor in climate change risks and adaptation.

Ultimately, the goal is for all development is to take into account climate change risks, and reflect them appropriately in design, execution, and management or maintenance aspects. Hard infrastructure may need to be strengthened or modified and, in some cases, decommissioned before its original expiration date. Engineers will need to devise creative ways of designing, maintaining, and even repairing buildings, roads, dams, bridges, and other structures to protect people and assets from the ill effects of climate change.

This challenge extends beyond engineering hard infrastructure. It reaches far into the domains of planning, policy, budgeting, capacity building, governance, and individual behavior. Climate adaptation concerns efforts to protect or manage natural systems in order to create natural buffers to climatic impacts and improve socioeconomic resilience. Adaptation reaches into the realms of public health, international water resource management, insurance, and social issues such as land tenure and gender equality. However, this is where the theory is well ahead of practice.

This book explores the early, real-world examples of projects benefiting from dedicated adaptation funding in developing countries.

What is in this Book?

This book is the result of the well-established, ongoing partnership between the GEF and the agencies involved in implementing GEF-financed adaptation projects. The case studies that follow take stock of — and compile — meaningful, illustrative examples of the design, process, and implementation of climate change adaptation projects. The case studies include telling examples of adaptation projects as well as valuable, candid observations and insights about challenges and opportunities. The result is a slice of the adaptation experience, in which the GEF plays only one of the roles, but a significant one.

The case studies that follow highlight the substantial adaptation knowledge generated by a wide range of stakeholders, including multilateral agencies, beneficiaries, field technical staff, external scientists and practitioners, civil servants, international financiers, and others. Unfortunately, these stakeholders are not sharing their expertise effectively. One of the most important insights emerging from gathering the case studies is the importance of providing opportunities for project designers, implementers, executors, beneficiaries, and others to contemplate and share their experiences in adaptation, in order to maximize the benefits from the knowledge that is emerging from their respective efforts.

In an age when various kinds of information are increasingly, and sometimes overwhelmingly, available, there is demand for knowledge that is curated, preferably through a collaborative process. The structure of this book is intended to provide definitions and sufficient context to the reader (see the "Background and Overview of the GEF Adaptation Program" chapter), including a brief overview of the GEF's adaptation initiatives. This is followed by selected case studies from the GEF's portfolio:

- In the **Andes**, a region with unique climate risks, Bolivia, Ecuador, and Peru are adapting to the rapid changes affecting Andean glaciers by improving the understanding of these changes (World Bank).

- **Armenia** is implementing measures to reduce frequent forest fires through reforestation, pest control, and capacity building that focus on improving the ability of fire teams to respond to these events (UNDP).
- **Bangladesh** is building resilience in its vulnerable coastal communities, transforming barren hectares of land into livelihood-supporting plots through an innovative land-use model that also contributes to reforestation in the project areas (UNDP).
- In **China**, the breadbasket of the world's second most populous water basin is at risk (World Bank).
- Farmers living in arid lands in **Ethiopia** are learning how to cope with drought through innovative techniques for watershed management and irrigation, seed production and distribution, and pest control (UNDP).
- **The Gambia** is adapting to climate change through improvements to its hydro-meteorological and climate information services that are the backbone of its early warning system (UNEP).
- **India** is addressing the issue of land degradation in drought-prone districts, and incorporating climate change adaptation into sustainable land management practices as a means of reducing rural poverty (FAO).
- Already experiencing both extreme flooding and droughts, **Malawi** is introducting more-resilient livelihood activities in rural areas, to help reduce the vulnerability of its populations (AfDB)
- A project in **Mongolia** is helping farmers cope with weather extremes in one of the world's harshest climates (IFAD).
- In **Niger**, food security and the economic empowerment of women are at the center of a climate change adaptation project being implemented in eight districts across the country (UNDP).
- The **Pacific Adaptation to Climate Change** program works across 14 small, highly vulnerable island states in the Pacific to help to craft solutions for their urgent adaptation priorities (UNDP).
- In **Southeastern Europe and the Caucasus**, the Europa Reinsurance Facility, with technical assistance from the World Bank, is introducing a mechanism for risk insurance (World Bank).

The "Conclusions and Discussion" chapter draws preliminary lessons about what has been accomplished and learned from these initial adaptation projects and what opportunities and challenges for adaptation in developing countries lie ahead.

References

UNFCCC. 1992. United Nations Framework Convention on Climate Change. Available: http://unfccc.int/files/essential_background/convention/background/application/pdf/convention_text_with_annexes_english_for_posting.pdf.

Background and Overview of the GEF Adaptation Program

This chapter outlines the basic concepts in climate change adaptation, provides a broad historical overview of climate change adaptation policy under the UNFCCC, and describes the role of the GEF in supporting climate change adaptation efforts across the globe. Figure 1 (see page 16) presents a timeline of key events in the field of climate change adaptation.

Figure 1.

Timeline of Key Events

1990 First Intergovernmental Panel on Climate Change (IPCC) report on climate science issued

1991 The GEF is established as $1 billion pilot program in the World Bank

1992 UN Conference on Environment and Development (Earth Summit in Rio)

1992 Negotiations for the restructured GEF begin

1994 GEF becomes part of the financial mechanism for UNFCCC

1994 UNFCCC goes into effect

1994 The GEF is restructured as an independent organization with World Bank, UNDP and UNEP as initial partners

2001 SPA, LDCF, and SCCF established at COP-7 in Marrakesh

2002 LDCF reaches $10 million mark in funding

2004 SCCF reaches $10 million mark in funding

2005

First SPA project approved

First National Adaptation Program of Action for LDCF submitted

2006

LDCF reaches $100 million mark in funding; first SCCF project approved for funding

2007

SCCF reaches $100 million mark in funding; first LDCF project approved for funding

Adaptation Fund formally launched at COP-13

2008

Development banks create Climate Investment Funds, pledge $6.5 billion for mitigation and adaptation projects

2010

GCF established at COP-16

2013

All LDCs have accessed funding from the LDCF for NAPA preparation

Fifth IPCC report on climate science issued

2014

GEF gets a record replenishment of $4.43 billion; LDCF and SCCF reach $1.23 billion total in donor contributions, reach $1.21 billion in project approvals

GCF capitalized, reaches $10 billion in pledges

2015

UNFCCC COP-21 in Paris, France Historic agreement achieved.

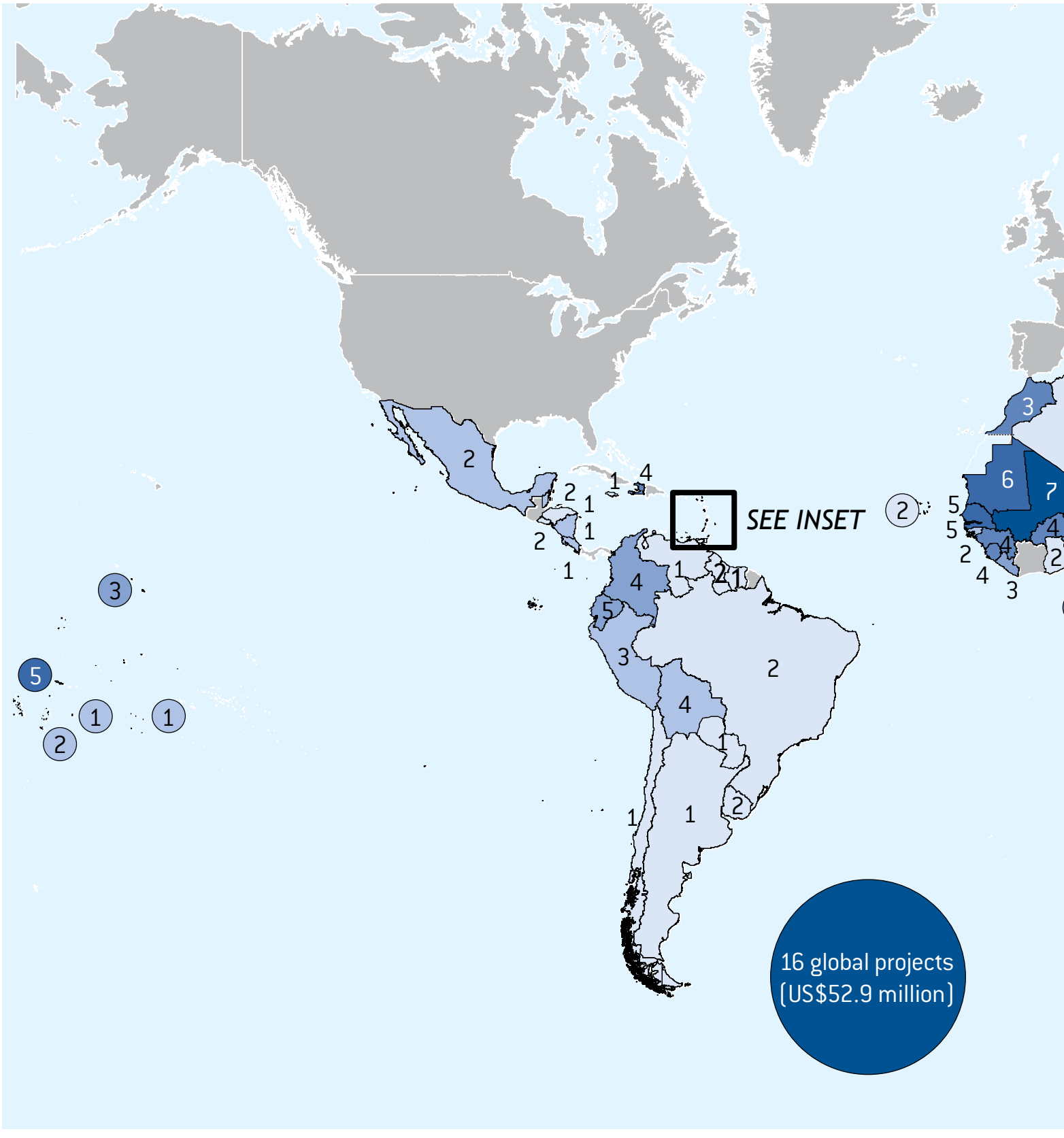
Note: All figures are US dollars.

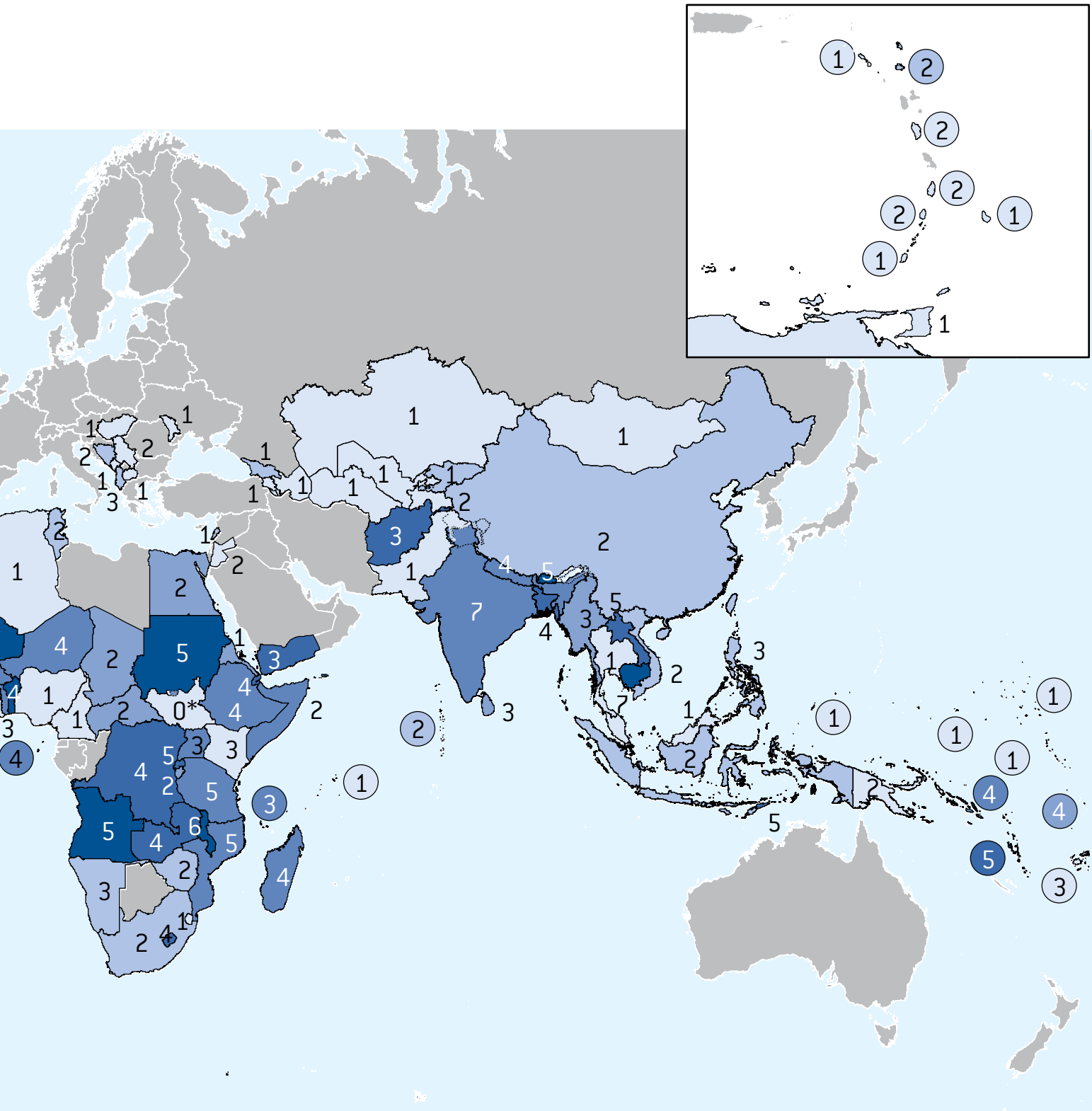
GEF Adaptation Program Investments

(since inception)

Least Developed Countries Fund, Special Climate Change Fund, and Strategic Priority on Adaptation

Data as of October 2015





Number of Projects

(#) Per Country
(may include regional projects)

*South Sudan has accessed funding for preparing its National Adaptation Program of Action

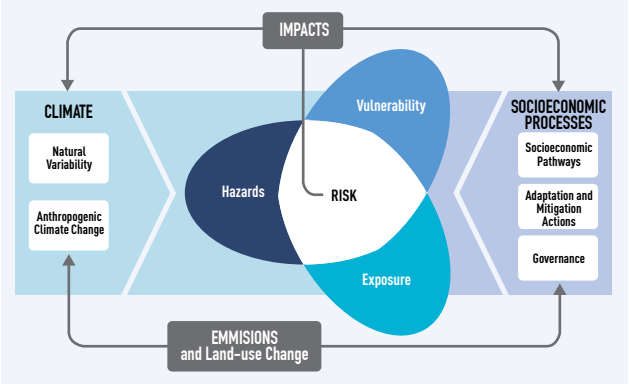
Funding by Country (US$ million)

<6 | 6–10 | 11–15 | 16–20 | 21–25 | 25+

Climate Change Adaptation Concepts

Climate change is amplifying challenges in areas already struggling with drought, floods, food insecurity, disease, displacement, political instability, and armed conflict (IPCC, 2014b). Climate change adaptation has the potential to help people in vulnerable areas prepare for — and respond to — climate change impacts (Figure 2).

Figure 2. Conceptual framing: key determinants of climate risk.



Source: IPCC, 2014a.

The IPCC defines adaptation as:

> "… the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2014a, pp. 833–868).

This definition introduces an element of purposefulness; actions that are not purposefully undertaken in response to observed or anticipated climate change are not included. Unplanned actions are sometimes called "autonomous adaptation." Other definitions related to climate change adaptation, and used throughout this book, are found in the text box that follows.

Adaptation has been often considered separately from disaster risk management despite their similar objectives and challenges. There has been an increased convergence in recent years (IPCC, 2014a), as well as a call for better coordination and integration (IPCC, 2014b), but adaptation and disaster risk management is nevertheless frequently addressed by separate international processes (e.g., Sendai Framework, following the Hyogo Framework for Action).

Brief History of Climate Change Adaptation in the UNFCCC Process

The international community's approach to climate change adaptation has undergone an evolution through the formal UNFCC process. This section describes some of the more significant actions resulting from this intergovernmental process.

1992: FORMATION OF THE UNFCCC

ARTICLE 4: Commitments

"1. All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:[…]

(e) Cooperate in preparing for adaptation to the impacts of climate change;[…]

4. The developed country Parties and other developed Parties included in Annex II shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects" (UNFCCC, 1992).

1995 (COP 1): Adaptation to the adverse effects of climate change will require short-, medium-, and long-term strategies, which should be cost-effective, take into account important socioeconomic implications, and be implemented on a stage-by-stage basis in developing countries that are Parties to the Convention (UNFCCC, 1995).

2001 (COP 7): Established the LDC work program and the LDCF to support the implementation of the work program (UNFCCC, Undated). A number of efforts to support LDCs in adaptation were initiated, such as institutional strengthening, technology transfer, and capacity building. Notably, the National Adaptations Programmes of Action (NAPAs) provided a process for the LDCs to identify priority activities that respond to their urgent and immediate adaptation needs, as identified ideally through a multi-stakeholder process, and would build on existing knowledge. Following the submission of the completed NAPAs to the UNFCCC secretariat, LDCs would become eligible to receive funding for the implementation of adaptation projects and programs.

DEFINITIONS (ADAPTED FROM IPCC 2014)

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Climate change: Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the UNFCCC, in its Article 1, defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 1992, p. 7). The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

Disaster risk management: Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Impacts of climate change: Effects on natural and human systems of extreme weather, other climate events, and climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance; responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.

Transformation: A change in the fundamental attributes of natural and human systems. Within this summary, transformation could reflect strengthened, altered, or aligned paradigms, goals, or values toward promoting adaptation for sustainable development, including poverty reduction.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

2006 (COP 12): The Nairobi Work Programme (NWP) was established to catalyze the development and dissemination of knowledge that would inform and support adaptation policies and practices (UNFCCC, 2015).

In 2010 (COP 16):

- UNFCCC establishes the Cancun Adaptation Framework (CAF), which affirms that climate change adaptation must be addressed with the same level of priority as climate change mitigation. The framework promotes a comprehensive approach to addressing adaptation at both national and regional levels, including the formulation and implementation of national adaptation plans (NAPs), bolstering the resilience of ecological and socioeconomic systems, developing research and information systems, and strengthening institutions. In addition, the COP creates the GCF (UNFCCC, 2011).
- The CAF establishes a process to formulate and implement NAPs as a means to address medium- and long-term adaptation needs and vulnerabilities, building on NAPAs. Like NAPAs, NAPs were intended to be participatory, multi-stakeholder national efforts. Unlike NAPAs, they would primarily facilitate the identification of medium- and long-term adaptation needs and the development and implementation of strategies and programs to address those needs in a continuous, progressive, and iterative process.
- The CAF establishes a work program on loss and damage.

2013 (COP 19):

- The COP agrees to continue the NWP and enhance its relevance by enhancing linkages with other adaptation processes and integrating gender issues and indigenous knowledge.
- The COP establishes the Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts.

2015 (COP 21):

- The Paris Agreement underwrites adequate support to developing nations and establishes a global goal to significantly strengthen adaptation to climate change through support and international cooperation, strongly urging the developed countries to scale up adaptation finance from current levels.
- All countries will submit adaptation communications, in which they may detail their adaptation priorities, support needs, and plans. Developing countries will receive increased support for adaptation actions and the adequacy of this support will be assessed.
- The COP agrees to significantly strengthen the existing Warsaw International Mechanism on Loss and Damage.
- The COP affirms the role of the GEF and the Green Climate Fund, as the entities entrusted with the operation of the financial Mechanism of the Convention, as well as the LDCF and the SCCF, in the Paris Agreement.
- The agreement includes a global stocktake starting in 2023 to assess the collective progress towards the goals of the agreement, to be done every five years. The agreement also includes a compliance mechanism.

The Founding of the GEF

In October 1991 UNDP, UNEP and the World Bank concluded an arrangement to cooperate in the implementation of a US$1 billion GEF pilot program. The GEF pilot was housed in the World Bank and tasked with the unique role of promoting global environment benefits, by providing new and additional grant funding, to cover the incremental costs associated with transforming projects with national/local benefits into ones with global environmental benefits as well.

Following the 1992 Rio Earth Summit, the GEF was restructured and became a permanent, independent organization. The new structure further enhanced the involvement of developing countries in the decision-making process and helped ensure country ownership of the projects. The World Bank has served as the Trustee of the GEF Trust Fund and has provided administrative services since 1994.

As part of the restructuring, the GEF effectively became the financial mechanism for both the UN Convention on Biological Diversity (CBD) and the UNFCCC. In partnership with the Montreal Protocol on Substances that Deplete the Ozone Layer, the GEF began funding projects that would enable countries with economies in transition to phase out their use of ozone-depleting substances. The GEF now also serves as a financial mechanism for three more international conventions: the Stockholm Convention on Persistent Organic Pollutants (2001), the UN Convention to Combat Desertification (UNCCD - 2003), and the Minamata Convention on Mercury (2013).

Climate Change Adaptation at the GEF

The GEF plays a key role in financing adaptation as an operating entity of the financial mechanism of the UNFCCC. According to the GEF Operational Strategy, “the overall strategic thrust of

GEF-financed climate change activities is to support sustainable measures that minimize climate change damage by reducing the risk, or the adverse effects, of climate change. The GEF will finance agreed and eligible enabling, adaptation, and mitigation activities in eligible recipient countries" (GEF, 1995, p. 34). From the beginning of its second replenishment in 1998, the GEF has financed six regional and global Stage II initiatives to build capacity for adaptation in vulnerable countries (UNFCCC, 1995, 2013). Totaling some US$27 million in GEF grants, these early programs, such as the Assessments of Impacts and Adaptations to Climate Change and the Caribbean Planning for Adaptation to Climate Change, served to prepare the ground for investments in adaptation.

- In 2001, the Marrakech Accords established three new avenues to finance adaptation actions, and moved the funding priorities from studies and assessments to concrete activities to reduce the vulnerability and increase the adaptive capacity of vulnerable communities, sectors, and countries. To support adaptation, the following funds were created: the LDCF, the SCCF, and the Adaptation Fund, which was financed through a share of proceeds of the Certified Emissions Reductions (CERs) from the Clean Development Mechanism (CDM) of the Kyoto Protocol (KP).

- In addition, the COP requested the GEF to provide financial resources for pilot or demonstration projects to show how adaptation planning and assessment could be translated into projects that provide real benefits. In response, the GEF launched the Strategic Priority for Adaptation (SPA) as a US$50 million allocation within the GEF Trust Fund. The objective of the SPA was to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in the GEF focal areas (GEF, 2005). Twenty-six pilot projects were approved under the SPA and initial lessons from the portfolio have been captured in a 2010 evaluation (GEF, 2010).

- The UNFCCC guidance handed to the GEF the management of the LDCF and SCCF in 2001 (UNFCCC, 2001). While the SCCF has four financing foci, adaptation constitutes the priority area for both the LDCF and the SCCF. The Adaptation Fund established a more autonomous existence, guided by a board independent from the GEF's governing bodies.

Starting the process of financing adaptation came with its own challenges. While the UNFCCC provided guidance in its decisions, this was not sufficient to capture with precision the expectations of the negotiating countries — donors and recipients — and, further, translate into operations. The criteria and procedures for eligibility had to be defined, no small task considering the challenges of understanding, defining, and prioritizing adaptation in practice. Implementing agencies and project proponents had to be mobilized. These challenges were compounded by the fact that contributions to the LDCF and SCCF were made on a voluntary or donor basis, and were therefore unpredictable.

The GEF and its network of partners developed a new financing framework that included the concept of "climate-resilient development," defined as development that meets current and future needs despite a changing climate, as well as the concept of the cost of adaptation being "additional" to the cost of development, which meant that the GEF would finance adaptation measures that would build on and enhance existing and planned development efforts.

The projects and programs supported by the SPA, the LDCF, and the SCCF are among the first in the world to translate vulnerability assessments and national development priorities into concrete measures for climate resilience in key sectors, such as agriculture and food security, water resources management, disaster risk management, health, infrastructure development, and the sustainable management of ecosystems. Their design is guided by national strategies and reports to the UNFCCC such as national communications and NAPAs.

Through the LDCF, SCCF, and SPA, the GEF has supported the most advanced global portfolio of multilaterally-funded adaptation projects and programs. The GEF's efforts build on and strengthen the resilience of baseline development investments amounting to nearly US$7 billion (see Table 1).

Table 1. Overview of LDCF, SCCF, and SPA resources as of February 2016 (US$M)

	LDCF	SCCF	SPA	Total
Pledges and Contributions*				
Total cumulative pledges	$1,188.6	$351.3	$50.0	$1,589.9
Total paid contributions	$991.4	$346.2	$50.0	$1,337.6
Project Grant Approvals				
Total Grants Approved (including Agency Fees)	$973.9	$347.5	$50.3	$1,371.7
Total Co-Financing Mobilized	$3,927.3	$2,644.6	$608.8	$7,180.7
Total Number of Projects	222	76	26	324

* Pledges and contributions as of December 31, 2015.
** Includes NAPA preparation projects.
Totals may not sum due to rounding.

Table 2. Climate adaptation actions financed by the GEF (modified from Biagini et al., 2014)

Types of Climate Adaptation Action Financed by GEF

This pie chart is an illustration of the GEF investments in various adaptation action areas and does not represent the actual allocations of funding per theme.

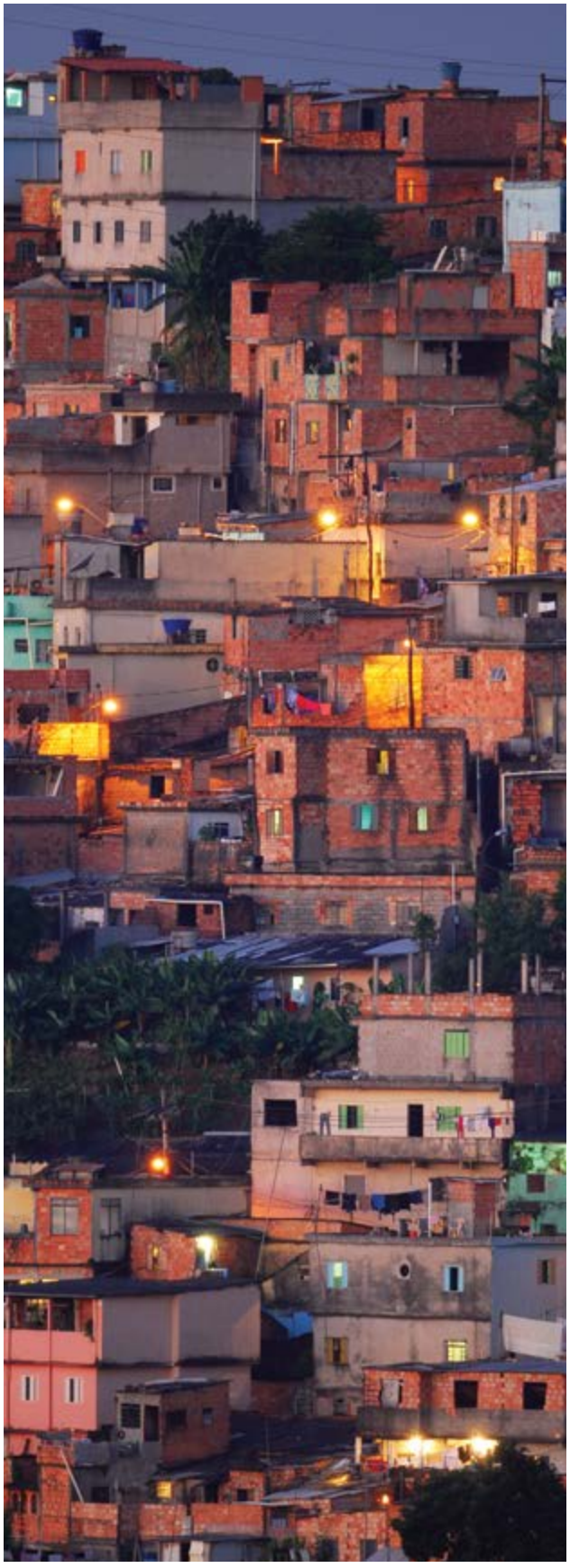
Adaptation Category	Category Description	Project Examples	Project Action Description*
Capacity Building	Developing human resources, institutions, and communities; equipping them with the capability to adapt to climate change	São Tome and Príncipe: Adaptation to Climate Change (World Bank, SCCF Project Grant: US$3.25 million)	■ Coastal communities trained in disaster preparedness and response through an engagement process that is raising awareness about the impacts of climate change ■ Government officials engaged in training in the areas of coastal spatial planning and resource management policy ■ Development of more reliable information dissemination to key decision-makers and stakeholders
Management and Planning	Incorporating understanding of climate science, impacts, vulnerability, and risk in government and institutional planning and management	Climate Resilient Coastal Protection and Management in India (Asian Development Bank (ADB), SCCF Project Grant: US$2 million)	■ Development of planning and design criteria to support investments in infrastructure for coastal protection across the country based on the information from the analysis of climate change impacts on the Indian coast ■ Enabling the participation of communities in the process of shoreline development planning in Karnataka and Maharashtra by providing information from the analysis of climate change impacts on the Indian coast
Practice and Behavior	Revisions or expansion of practices and on-the-ground behavior that are directly related to building resilience	Integrating Climate Resilience into Agricultural Production for Food Security in Rural Areas in Mali (Food and Agriculture Organization of the UN, LDCF Project Grant: US$2.4 million)	■ Switching from conventional agricultural practices to more productive ones, including cultivation of stress-tolerant crop species
Policy	The creation of new policies or revisions of policies or regulations to allow flexibility to adapt to changing climates	Addressing the risk of climate-induced disasters through enhanced national and local capacity for effective actions (UNDP, LDCF Project Grant: US$12.75 million)	■ Institutionalizing climate-resilient disaster risk management through legislation and policy frameworks ■ Development of the Disaster Management Act of Bhutan (2013), the bill that sets the institutional framework for disaster management in Bhutan, including the creation of a National Disaster Management Authority and district-level committees responsible for managing the operations

Adaptation Category	Category Description	Project Examples	Project Action Description*
Information	Systems for communicating climate information to help build resilience toward climate impacts (other than communication for early warning systems)	Integration of Climate Change Risks and Resilience into Forestry Management in Samoa (UNDP, LDCF Project Grant: US$2.7 million)	■ Geographic information system (GIS) mapping of forests and climatic risks ■ Development of fire-weather index ■ Implementation of a strategy for disseminating information to key decision-makers and the broader Samoan public
Physical Infrastructure	Any new or improved hard physical infrastructure aimed at providing direct or indirect protection from climate hazards	Enhancing the Climate Resilience of the Moroccan Ports Sector (European Bank for Reconstruction and Development, SCCF Project Grant: US$7 million)	■ Investments in upgrading the physical infrastructure of the port systems, such as wave walls and breakwaters that reduce the intensity of incoming waves, increasing the capacity of the drainage system to account for higher volumes of water, and dykes and sea walls that will help cope with flooding events and rising sea levels ■ Infrastructure adaptations also include waterproofing critical electrical infrastructure, and associated rail and road infrastructure that is vital for moving goods once they have reached the port
Warning or Observing Systems	Implementation of new or enhanced tools and technologies for communicating weather and climate risks, and for monitoring changes in the climate system	Strengthening Climate Information and Early Warning Systems in Cambodia to Support Climate-Resilient Development and Adaptation to Climate Change (UNDP, LDCF Grant: US$5.53 million)	■ Development of community-based early warning systems, and low-tech information dissemination mechanisms that are linked to national climate monitoring networks

"Green" Infrastructure	Any new or improved soft, natural infrastructure aimed at providing direct or indirect protection from climate hazards	Adaptation to Climate Impacts in Water Regulation and Supply for the Area of Chingaza-Sumapaz-Guerrero in Colombia (Inter-American Development Bank, SCCF Grant: US$4.64 million)	■ Securing Bogota's water supply by protecting the Chingaza-Sumapaz-Guerrero watershed through:
			  ■ Restoration of the high mountain ecosystems critical for hydrological regulation by increasing ecosystem connectivity through reforestation and revegetation
			  ■ Introduction of more climate resilient land-use practices by farmers in the region

Financing	New financing or insurance strategies to prepare for future climate disturbances	Promoting Climate Resilience in Viet Nam Cities (ADB, SCCF Grant: US$5.15 million)	■ Establishment of an institutional incentive scheme for an adaptation financing framework, an Innovative Climate Change Incentive Mechanism ■ Cities given the opportunity to compete for funding to work toward the resilience targets that they set
Technology	Develop or expand climate-resilient technologies	Reducing Vulnerability of Banana Producing Communities to Climate Change through Banana Value Added Activities — Enhancing Food Security And Employment Generation (United Nations Industrial Development Organization, SCCF Grant: US$3.18 million)	■ Development of the banana tissue culture industry, which will help mitigate the rising incidence of crop diseases ■ Provision of biodigestors to convert banana waste into biogas, the digestate of which can be used to maintain and improve soil fertility, to offset reduction in soil fertility due to climate change ■ Development of small-scale processing facilities that will aid in the diversification of products being generated by the vulnerable communities, thus improving the value chain

*Does not represent the full set of adaptation actions financed under the GEF project in the example



Through the LDCF, the GEF has enabled 51 of the world's poorest and most vulnerable countries to access resources for the preparation of their NAPAs. Fifty countries have completed their NAPAs, and all but one have accessed resources for the implementation of their NAPA priorities. Capacity constraints notwithstanding, LDCs have made rapid progress in accessing resources from the LDCF. The GEF has helped support a wide range of adaptation interventions, which have been grouped in ten main categories. The GEF's portfolio of projects has also spanned broad categories or types of adaptation. These categories of adaptation are described in Table 2, along with examples of projects that fall into each of these categories.

The GEF's approach to adaptation has been based on the recognition that climate change affects all aspects of human, social, and economic development. The GEF has supported the integration of appropriate adaptation measures into development plans, policies, programs, and projects at the regional, national, sub-national, and local levels, with the ultimate aim of achieving climate-resilient development.

GEF-financed adaptation projects are working to reduce the vulnerability of some 15 million people, while also introducing more climate-resilient management practices over 5 million hectares of productive and natural landscapes. Importantly, GEF investments are preparing the ground for effective adaptation at a larger scale by providing various forms of adaptation training to more than 600,000 people, strengthening hydrometeorological and climate information services in more than 70 countries, and offering technical assistance to help more than 80 countries integrate climate risks and adaptation into key policymaking and planning process at the national level and across vulnerable sectors (GEF, 2015).

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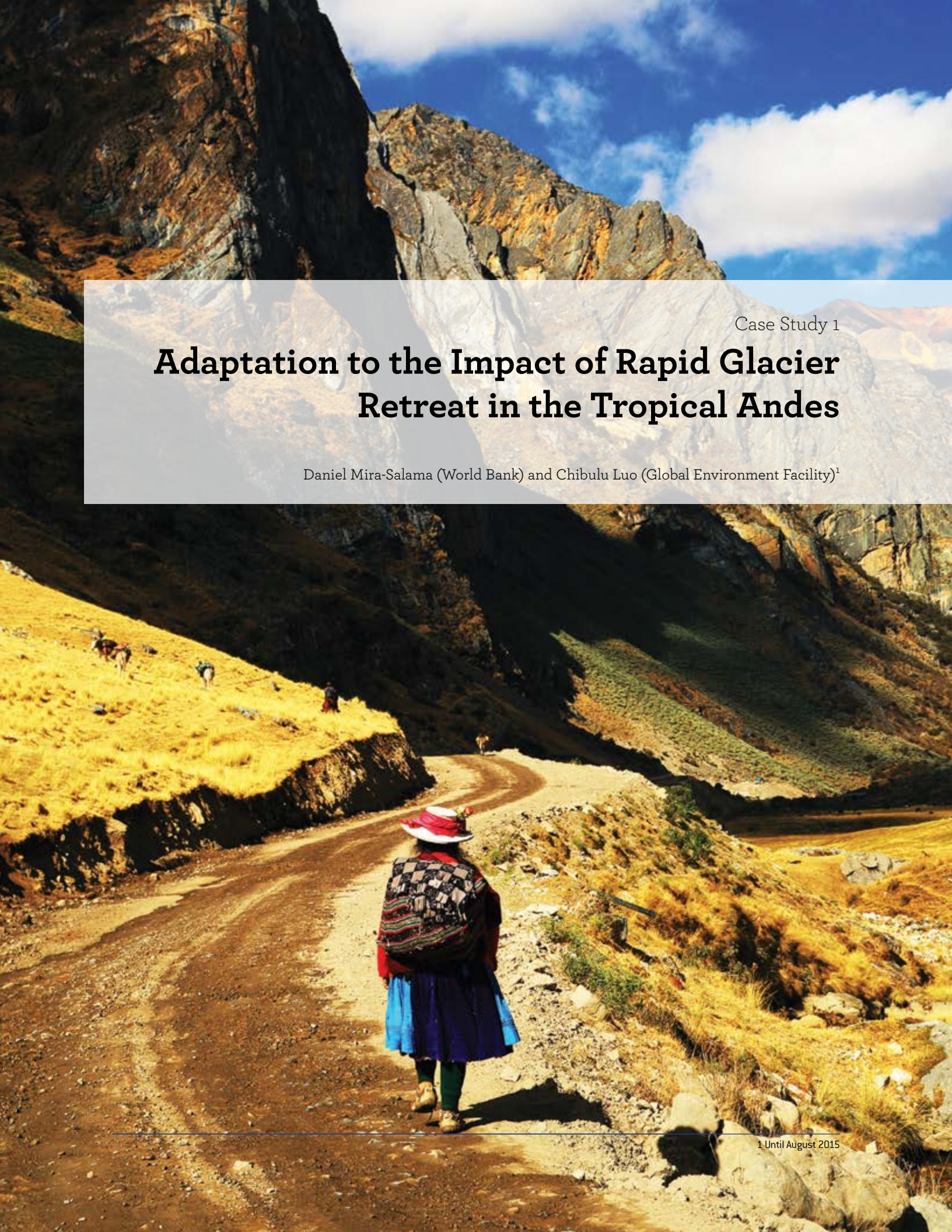

Case Study 1

Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes

Daniel Mira-Salama (World Bank) and Chibulu Luo (Global Environment Facility)[1]

1 Until August 2015

Case Study Overview

Glaciers in the tropical Andes of South America regulate water flows and hence are a key aspect of the region's water cycle. However, those glaciers are melting away, with overwhelming evidence pointing to climate change as the main cause. The project *Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes* (PRAA) in Bolivia, Ecuador, and Peru contributed to increasing the resilience of local ecosystems and economies to the impacts of glacial retreat.[2] PRAA helped generate climate change scenarios and tools to: assess the effects of glacier retreat; include climate change considerations in strategic planning, including expected temperature increase, consecutive dry or wet days, and precipitation variability; design and implement adaptation activities, such as improving water supply and irrigation; monitor glacier dynamics; and promote regional collaboration. The project also addressed fundamental issues for adequate country development: pressing potable-water demands in the cities of La Paz and El Alto, Bolivia; the need to strengthen water supply systems by protecting watersheds near Quito, Ecuador; and irrigation water management improvements in priority water basins in Peru.

2 In Spanish, the name of the project is Proyecto Regional Andinode Adaptación (PRAA).

Project Background and Brief History

Rising temperatures due to climate change have been and are expected to be more pronounced in high-elevation mountain ranges — mountains that extend into the troposphere, including the tropical Andes — than in adjacent lowlands (Pepin et al, 2015; Bradley et al., 2006).

Thus, heavily populated, high-elevation areas in the tropics now experience, and will likely continue to experience dramatic changes in climate. Among the most significant effects in the tropical Andes is the accelerated retreat of the region's glaciers. Various studies demonstrate a glacier retreat trend after the 1970s, with different phases of accelerated retreat thereafter (Rabatel et al., 2013; Schauwecker et al., 2014). One study concluded that glacier retreat in the tropical Andes over the last three decades is unprecedented (Rabatel et al. 2013).

Glacial melt plays a key role in regulating year-round water flows, with contributions especially relevant during the dry season. Accelerated glacial retreat will alter the regional water cycle, with negative effects on many ecosystems, such as in the *páramos* (Andean highlands), forests, and other vegetated areas. Many critical sectors, such as water supply for human consumption, agriculture, hydro-electric generation, and others, will experience the cascading effects of water cycle changes.

Moreover, the adverse impacts of variable rainfall and glacial melt will further degrade ecosystems, resulting in less ecosystem capacity to retain water and buffer runoff intensity. More-intense rainfall might increase soil erosion, sedimentation rates, and cause severe floods, glacial lake outbursts, or landslides (Harriman, 2013).

Conscious of these challenges, PRAA project staff aimed to bolster the resilience of local ecosystems and economies against the effects of glacier retreat in the tropical Andes through the implementation of specific pilot adaptation activities. The implementation process also served as an illustration of the costs and benefits of adaptation (GEF, Undated). The project took place in Bolivia, Ecuador, and Peru, and aimed to:[3]

- Integrate consideration of glacier retreat impacts into regional and local planning processes.
- Include consideration of glacier retreat impacts in local adaptation projects.
- Generate reliable data on glacier dynamics.

In Ecuador, most of the activities took place in the Pichincha and Napo Provinces, near the Antisana Volcano and the capital city of Quito. In Bolivia, implementation occurred in the Department of La Paz, and in the towns of La Paz, El Alto, Batallas, Palca, and Mecapaca. In Peru, activities took place in the Provinces of Piura, Junín, and Cusco.

Financing and partners

The governments of Bolivia, Ecuador, and Peru implemented the PRAA project through their respective ministries of environment and with the support of the World Bank. The General Secretariat of the Andean Community of Nations (SGCAN) led procurement, financial management, and inter-institutional coordination. A project Steering Committee, which included representatives from participating countries, ensured consistency, leadership, and an integrated vision. In addition to a core project implementing unit based within SGCAN, three National Technical Specialists provided technical guidance, monitoring and evaluation support, while contributing towards the planning and execution of the national projects.

Other strategic partners played important roles in the project. The Meteorological Research Institute of Japan and the Japanese Space Agency supported activities to model climate change scenarios and monitor glacier dynamics via satellite; *CARE* provided critical on-the-ground support activities related to community development, capacity building, and policy/institutional strengthening. The French Research Institute for Development provided scientific support. Additional partners included AGRO RURAL, the Peruvian agency in charge of basin reforestation and agriculture; the Fund for the Protection of Water (FONAG), in Quito, Ecuador; the Hydraulics and Hydrology Institute in La Paz, Bolivia; the Institutes for Hydrology and Meteorology in Bolivia, Ecuador, and Peru; and the water and sanitation utility companies in La Paz and El Alto (Empresa Publica Social de Agua y Saneamiento, EPSAS), Quito, and Huancayo, Peru. The Institute for Hydrology, Meteorology and Environmental Studies, based in Bogotá, provided leadership and implemented project activities in Colombia.

The overall project cost was US$33.6 million. Funding came from the World Bank (US$12.8 million), the GEF (US$7.9 million), project countries (US$6.6 million), CARE (US$3.9 million), the Japan Policy and Human Resources Development fund (US$0.9 million), and bilateral agencies (US$1.5 million).[4]

3 Some activities occurred in Colombia, focused on glacier monitoring, institutional strengthening, and regional coordination.

4 Bilateral partners include Japan's Meteorological Research Institute, the Global Facility for Disaster Reduction and Recovery, the French Research Institute for Development, and SGCAN.

Project Achievements

The project has had several notable achievements: promoting regional integration, generating climate change scenarios and tools, monitoring glacier dynamics, implementing adaptation activities in highly vulnerable sectors, engaging communities, mainstreaming gender considerations, and strengthening institutions. The beneficiaries of these activities included:

- Populations in and around the glaciated basins directly benefited from investments in adaptation activities for agriculture, livestock, irrigation, and water supply, as well as new management tools.
- Critical ecosystems, such as *páramos*, benefited from improved management and conservation.
- Participating countries strengthened their technical capacity in monitoring and research; tested different adaptation activities; engaged local communities in the adaptation process; generated relevant plans and strategies to influence investments; and increased the resilience and efficient use of scarce water resources.
- Nongovernmental organizations and in-country government agencies benefited from increased resources and activities that complemented and expanded on existing work; this created synergies and provided a foundation for future work.
- Water supply and sanitation utilities received funding for equipment and technical assistance to make better-informed decisions on water management (e.g., options to protect watersheds, options to manage water demand, options to improve monitoring systems, options to reduce water loss).
- Meteorological, water resources management, and scientific communities benefited from increased opportunities for knowledge exchange among countries. The communities also gained strengthened capacity in areas such as meteorological/hydrological monitoring and glacier dynamics modeling.

Promoting regional integration

Together with the implementation of specific adaptation activities, the project increased regional collaboration among the nations' scientists, decision-makers, and beneficiaries, creating the opportunity to exchange knowledge, processes, and experiences. Regional workshops, the establishment of data exchange mechanisms, and co-authorship of peer-reviewed publications facilitated this collaboration. The project also contributed to the publication of two important documents: *Andean Strategy for Integrated Water Resources Management*, and *Andean Environmental Agenda*, both led by SGCAN. These documents are the first of their kind at the regional level, and promote an integrated watershed approach to natural resources and water management. Another significant activity that brought together regional counterparts was AndesPlus, a regional database with guidelines for adaptation projects in the region. The database and guidelines have become points of reference for the preparation and implementation of projects, compiling technical knowledge, literature, and practitioners' experience for the design and implementation of climate change adaptation activities.

The regional nature of the project was fundamental in promoting inter-country capacities. For example, Bolivians became leaders in satellite imagery, providing support to Ecuador, Peru, and Colombia in interpreting their images; Peruvians made remarkable progress in understanding future climate change impacts on selected crops and hydrology, transferring that knowledge to the other three countries; and Ecuadorians implemented *páramo* restoration activities, disseminating their knowledge through their Ministry of the Environment.

Generating climate change scenarios and tools

All participating countries used Earth Simulator from Japan's Meteorological Research Institute to generate climate change scenarios. The scenarios were then used to better inform integrated watershed management plans, develop water utilities' investment plans, and expand meteorological monitoring systems. The project strengthened the capabilities of national meteorological and hydrological centers to run and interpret global climate models; carried out hydro-climatic studies to estimate the impact of climate change on hydrological resources; and developed trend analyses and impact scenarios based on agro-climatological models. The countries' modeling efforts and tools helped inform various activities, including:

Local and regional plans. Several cities – Papallacta, Ecuador, as well as Junín and Cusco, Peru – used new climate change data to update zoning plans or climate change strategies. In Bolivia, the Batallas and Palca catchments prepared integrated management plans with climate change considerations. The Ministry of the Environment in Ecuador used the experiences gained through PRAA to promote the inclusion of climate change considerations in development and zoning plans nationwide.

Water supply planning and investments. Several locations included data generated by the project in water supply

management or irrigation plans and investments. For example, in Ecuador, the Pita-Puengasí water supply system developed a new Adaptive Management Plan. In Bolivia, a number of plans have relied on project-generated information: Choquecota's plan was the first in the country to include climate change considerations; La Paz and El Alto now have a Master Plan for Water and Sewage; EPSAS has a five-year investment plan; and Batallas, Pucarani, and El Alto created a Multipurpose Irrigation and Water Plan.

National strategies. Ecuador prepared a National Strategy on Climate Change and a National Plan on Climate Change using this project's information, and SGCAN finalized the Andean Environmental Agenda.

Monitoring glacier dynamics

The project acquired and installed two high-mountain glacier monitoring stations in each of the participating countries (Figure 1). This activity was technically challenging because of the high altitude at which the stations needed to be installed in order to retrieve glacier-specific information. In Ecuador, 15 additional hydro-meteorological monitoring stations were also acquired to complement the country's national network.

Advanced Land Observation Satellite images were also acquired and processed to further characterize glacier retreat dynamics. These activities strengthened the capacity of national scientific institutions to generate and analyze meteorological, hydrological, and glacial data.

Implementing adaptation activities in highly vulnerable basins and sectors

Certain water basins and sectors within those basins are more vulnerable to glacier retreat than others. PRAA focused on designing and implementing adaptation activities that collectively increase the resilience of the basins and the selected sectors, specifically:

Water supply. In Papallacta, Ecuador, the project installed a water supply and sanitation system for over 180 people, which helped remove anthropogenic stresses to the *páramo*.

Complementary activities improved cattle ranching, ecological tourism, and enhanced *páramo* fire prevention. In Bolivia, EPSAS worked to improve its water distribution efficiency and increase water accounting through the installation of new equipment and an efficiency program; the effort significantly reduced water losses in a district of El Alto from 39.6% to 26.5%. EPSAS plans to replicate this exercise in other districts.

Agriculture and irrigation. In Batallas and Palca, Bolivia, the project built efficient irrigation schemes, established and trained irrigation committees on water efficiency practices, and prepared and enforced improved operational procedures.

Activities included: introducing sprinkler irrigation; improving canal lining; creating, formalizing, training and strengthening water user associations; promoting climate-resilient crop varieties; and supporting integrated crop- management activities, such as crop demonstration plots and integrated pest management approaches. These activities helped 155 local

Figure 1. High-mountain hydro-meteorological monitoring stations.

Credit: World Bank.

families. In Junín, Peru, irrigation activities included strengthening irrigation committees, installing three sprinkler irrigation systems, lining a canal, and capacity-building and training activities. The irrigation systems added 334 hectares of cultivation area and helped 526 local families. In Santa Teresa, Peru, adaptation activities included strengthening five local irrigation committees, developing five agricultural demonstration plots with climate-appropriate varieties, creating 16 communal plans and 15 agroforestry plots.

Ecosystems. In Papallacta and Antisana, Ecuador, the project helped improve the protection of key ecosystems and better manage natural areas. In Junín, Peru, a comprehensive strategy to manage the Shullcas Basin included the restoration of native shrubs and trees and the promotion of conservation. In Piura, Peru, PRAA installed a *páramo* conservation monitoring system; the regional government is now able to collect critical information to ensure stewardship of the area. This has improved the government's ability to manage both the ecosystem and ecosystem services.

Engaging communities

The project empowered communities to collaborate and act together. For example, PRAA strengthened irrigation associations in Peru, created new ones in Bolivia, and developed a new water-user association in Ecuador. Project partner CARE provided on-the-ground capacity-building and community development, using techniques such as "train-the trainer," identifying leaders, and empowering leaders to work within and among communities. In part, the engagement activities were successful because they were coupled with PRAA-financed infrastructure projects. The complementarity of interventions was one of the keys to project success.

The project has also served as a platform for key stakeholders such as scientists, decision-makers, water utilities, nongovernmental organizations, farmers, and community members to interact.

The project brought together groups that had never interacted before. For example, some scientists indicated they had never gone to agricultural fields to speak with the farmers and learn their needs (Personal communication). The project served as a convening platform for a climate change adaptation community of practice.

Mainstreaming gender considerations

Although the project had no explicit gender-related project objectives, community agriculture activities worked to address the needs and concerns of women. In high-altitude Bolivian communities, women manage agriculture practices; men commonly work in mines or cities. Therefore, CARE targeted its social development and capacity-building concerning water supply, irrigation, and agricultural information and activities to reach female beneficiaries. In Santa Teresa and Shullcas, Peru, CARE worked with women to improve income and food security for the women and their families.

Strengthening institutions

The project has been fundamental in strengthening institutions and has facilitated exchange among municipal, local, national, and regional entities. At the regional level, the project strengthened the ability of partners to monitor, collect, and interpret data. Moreover, the project has demonstrated how to use data to inform investments. Partners are confident in the project's long-term capacity because of multiple interactions and agreements among partner institutions, and the number of professionals trained through numerous workshops.

Project Challenges

Stakeholder group and partner coordination. Addressing the climate change implications of glacier retreat required the coordination of many stakeholders, including municipal, state, and national governments; intergovernmental organizations; nongovernmental organizations; utilities; scientists; community members; and others. Coordinating all project partners was an initial project challenge. Similarly, because PRAA was a regional project, SGCAN had to coordinate among national governments and multiple state-level governments. This created administrative, institutional, organizational, political, technical, and social challenges. As an example, initial project implementation was slow because of the complexity of regional regulatory frameworks; SGCAN had signed cooperation agreements with participating countries, but these needed to be ratified by the Foreign Affairs Ministers of the Andean Community of Nations, which took longer than expected.

Lack of data and know-how. At the beginning of the project, there was limited information on climate change and glacier retreat, and limited practical knowledge on how those issues affected development. It therefore was not clear how adaptation investments should be designed and implemented. As a result, it took more time than planned to design and agree on the priority adaptation investments in the countries.

Shifting priorities. Over the course of the project, large water supply projects in Bolivia and Ecuador, which PRAA had identified during early project design, became a lower priority or

were not ready for financing because of technical difficulties, unforeseen land-tenure issues, and other problems. As a result, the project had to be restructured. For example, in Ecuador, PRAA identified new priorities: a vulnerability assessment of one of Quito's main water supply systems, Pita-Puengasí, and water conservation and sustainable management of *páramo* ecosystems. In Bolivia, PRAA prioritized efforts to increase EPSAS's water-distribution efficiency and reduce losses.

Lack of qualified contractors. Another challenge faced by the project was the lack of experienced contractors to implement small or medium-sized interventions in remote areas. This gap became particularly evident during the implementation of the two irrigation projects in Bolivia. The remote project area and relatively low-contract values extended the bidding process much longer than anticipated, imposing delays in the project.

Ongoing project monitoring. Project monitoring by the World Bank ended when the project was completed. The World Bank left monitoring systems in place for ongoing monitoring; however, the monitoring systems effectively ended when the project did. The PRAA project had a robust monitoring plan to track progress on activities, capture results, and characterize the status of implementation. Many of the activities promoted by the project — reforestation, infiltration trenches, and integrated watershed management activities — had benefits that will only become clear in the future. The project should have advised on how to prepare and budget for a long-term monitoring and evaluation strategy with key stakeholders. At project closure, participating countries had committed to continued monitoring and learning. Additional monitoring and evaluation is being carried out by CARE.

Another project monitoring challenge, common to most adaptation activities, was illustrating adaptation benefits (e.g., how activities increased water flows, relieved pressure on critical ecosystems, or increased agricultural viability).

Measuring the number of hectares reforested or the number of kilometers of improved irrigation canals is useful, but does not capture the true adaptation benefit.

Analysis

Sharing the results and knowledge garnered through the process helped generate attention and interest in climate change adaptation. A number of scientific publications, reports, regional and national newspaper articles, radio stories, and blogs have helped share the development and final success of PRAA. This has sparked significant interest in the project, from both the media and other glaciated regions, such as the Himalayas. For instance, in January, 2014 a large delegation of government officials and practitioners from Afghanistan, China, India, and Pakistan visited the project in Ecuador to gain insights and ideas applicable to their own contexts. Participants mentioned their interest in replicating PRAA efforts in their own countries. An additional step to promote the project and its technical findings, which PRAA did not envision during its implementation, would have been to translate key publications into English.

Regional collaboration worked. Before the project, climate change adaptation communities of practice within the project countries were well-established, but few opportunities existed to exchange information between countries. The project provided collaboration opportunities through regional workshops, shared database protocols, unification of baseline information, and co-authorship of publications. PRAA demonstrated that glacier retreat and multi-national collaboration are suitable subjects for regional projects.

Carefully planned partnerships increased the chance of project success. The upfront involvement of CARE was crucial to facilitate all of the social interactions with rural communities and to ensure that the project had a strong local community-based adaptation component. CARE's ability to leverage resources also provided continuity beyond the end of the project for monitoring and evaluation.

Climate change adaptation required extensive community development. PRAA used a bottom-up approach that combined the knowledge and experience of communities with new scientific information and technologies to develop adaptation strategies. This approach provided a sound base for the design of activities, with a long-term vision for increasing resilience.

Community development, paired with infrastructure improvements, increased the chance of project success. CARE's on-the-ground presence, together with the project's planned infrastructure component, involved a wide range of stakeholders. This arrangement yielded more chances for success than standalone infrastructure investment or capacity building. Engaged and trained community members with access to improved basic infrastructure, better knowledge about climate change, and information on ecosystem conservation benefits can become ideal stewards of their own critical ecosystems.

Climate change resilience is linked to the capacity to generate and analyze data. Adaptation projects should include robust knowledge creation and capacity-building activities. Moreover,

although projects often strive to build climatic and hydrological models, the absence of good data is typically a hurdle to these efforts. Therefore, ongoing monitoring, operations, and maintenance mechanisms must be secured for the long run, beyond the project duration.

Next Steps

The project has adopted a comprehensive approach toward climate change adaptation, thus helping put in place key elements for improving national and regional adaptation efforts. It has also set up the processes and generated some of the instruments needed by the project countries. Some of the elements that will underpin the next steps are:

Well-trained government agency staff have the potential to carry on project activities. The project achieved significant successes in knowledge creation and improved monitoring capabilities. Technology and equipment accompanied this knowledge creation, including satellite images, high-mountain monitoring stations, and hydro-meteorological stations. This foundation of well-trained and better equipped meteorological and hydrological services presents an opportunity to further support the development of strategies in the region and continue climate change mainstreaming.

Plans are in place for project partners to continue ongoing work. The project supported the insertion of climate change considerations into plans, strategies, regulations, and frameworks; this laid a foundation for future work. As an example, project activities and investments with EPSAS in Bolivia informed a Master Plan for Water and Sewage in La Paz and El Alto, in addition to the EPSAS Quinquennial Plan. As a result, EPSAS has the tools, knowledge, and strategies in place to further reduce vulnerability of those cities to glacier retreat. In Ecuador, Papallacta has developed a zoning plan with climate change considerations for the municipality. Based on this experience, Ecuador's Ministry of the Environment is hoping to include climate change considerations in local plans nationwide. In Peru, the project contributed to integrated watershed management plans that local governments use to guide development in the basins; these plans informed the regional climate change strategies in Junín and Cusco.

Project partners and beneficiaries need to maintain investments. All investments completed under PRAA worked to integrate social processes (e.g., by strengthening or creating irrigation committees or water-user associations). These groups will generate resources for future system repairs and expansion. Local governments must also work to follow up and ensure the sustainability of investments. Many project-financed activities have already been incorporated into locally-owned routine responsibilities: EPSAS's replication of water efficiency in La Paz, Bolivia; Ecuador's Ministry of the Environment's replication of adaptation efforts in Papallacta; FONAG's ongoing operation of a new water resources monitoring system; and Peru's ongoing *páramo* monitoring work in Piura. The national governments, through their ministries of environment, have been closely following project results and now have mandates to promote the replication of PRAA activities elsewhere in their countries.

Conclusion

When it began its efforts to address the effects of climate change on Andean glaciers, PRAA had limited information and the project countries had little collective experience on adaptation in mountainous areas. By the end of the project, all participating countries had issued their national climate change plans or strategies, all of which explicitly addressed glacier melting as a priority. Examples include:

- Peru has a 2003 National Climate Change Strategy, a 2010 Action Plan for Climate Change Mitigation and Adaptation, and is updating its National Climate Change Strategy. The country is home to 71% of all tropical glaciers (Rabatel et al. 2013), and has identified adaptation to glacier retreat as one of the key items in its adaptation agenda.
- In 2009, Ecuador created a Climate Change Sub-Secretariat, and in 2010 an Inter-institutional Committee on Climate Change; these entities help coordinate and enhance the implementation of their climate change policy. Ecuador's National Climate Change Strategy was launched in 2012 and serves as the means to address climate change issues nationwide. It will serve as the basis for Ecuador's National Climate Change Plan.
- Adaptation to climate change and glacial melt in Bolivia is being addressed through a 2012 Mother Earth law. This law positioned climate change at the forefront of Bolivia's policy dialogue. The law contextualizes and institutionalizes national adaptation and mitigation mechanisms.

Participating countries have continued to secure external financing for high-mountain adaptation activities, and there are a number of initiatives to expand PRAA's work. Japan's International Cooperation Agency, CARE, the Swiss Development Cooperation, and others support these efforts. The World Bank is also supporting additional efforts, such as the Pilot Program on Climate Resilience in Bolivia, the Sierra Irrigation Project, and

the Water Resources Management Modernization Project in Peru.

The project's adaptation activities have the potential to be replicated and scaled up. The project has accumulated experiences, as well as data and specific tools such as models, methodologies, and baselines that will be useful elsewhere. PRAA's contribution to the global community of practice on high-mountain hydrology and glaciology has been significant. Additionally, media attention and other published efforts have helped trigger interest from other glaciated regions, such as the Himalayas.

Adaptation is ultimately a local challenge, and the material that PRAA generated will have to be adapted to specific circumstances, acknowledging the importance of local know-how. PRAA's activities, while well-suited to the Andean region, can inform adaptation efforts in other geographic locations.

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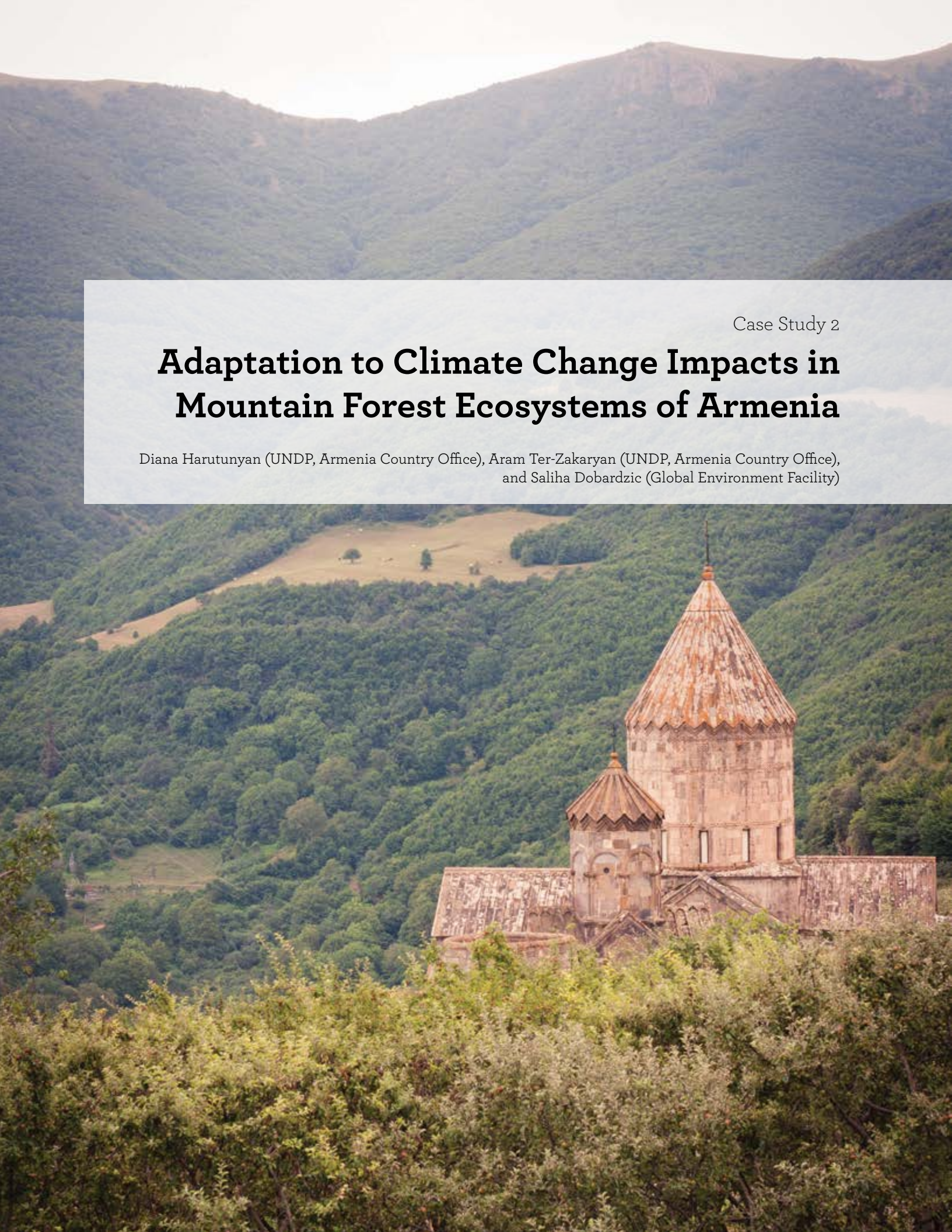

Case Study 2

Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia

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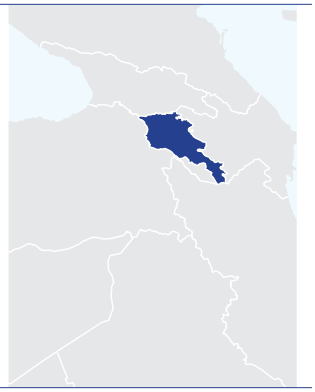


Case Study Overview

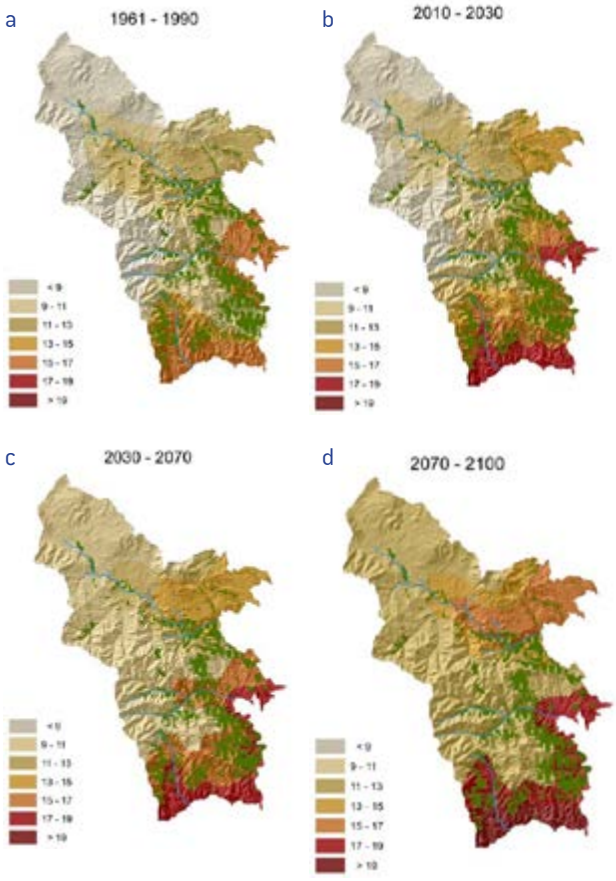
Armenia, a mountainous landlocked nation in southwest Asia, is vulnerable to severe forest fires. The pressures of climate change – rising temperatures, drought, and outbreaks of pests – are worsening the problem. The fires are harming the people of Armenia and reducing the country's ecosystems services capacity. In response, the GEF and UNDP supported a project in the species-rich forests of the Syunik region as a testbed to improve forest management in Armenia (Government of Armenia and UNDP, 2008). The project, which ran from 2009 to 2013, worked to implement forest rehabilitation pilot projects, establish early-response fire teams, enhance institutional capacities and coordination, and revise Armenia's legal and policy framework for improved forest management. The project improved forest health, forest fire management on over 100,000 hectares, and the capacity of the Syunik region to manage wildfire risk in nearly 95% of its forested area; it also supported national-level efforts to mainstream wildfire management considerations into national policies and frameworks (National Statistical Service of the Republic of Armenia, Undated).

Project Background and Brief History

Armenia's forests and local livelihoods — impacts of climate variability and change

Over the past decade, Armenia has faced rising temperatures, drier summers, and a resulting increase in severe forest fires. In 2010, Armenia experienced 50 forest fires, an unprecedented number — in 2007, there was 1 fire, in 2008 there were 9 fires, and in 2009 there were 17 fires. In 2010, fires burned 786.1 hectares of forest, according to Armenia's National Statistical Service — 22 times more than the total area burned from 2007 through 2009. In the southeastern Syunik region, increased fire intensity, pest outbreaks, and reduced regeneration and vitality are already severely diminishing the health of the remaining mountainous forest ecosystems.

Figure 1. Average air temperature in Syunik region: (a) baseline period (1961–1990), (b) 2010–2030, (c) 2030–2070, and (d) 2070–2100 using projections from the Hadley Center HadCM3 regional model using Intergovernmental Panel on Climate Change Fourth Assessment Report scenario A2.



Source: UNDP, 2012.

Climate change has contributed further to the risk and severity of forest fires and (Figure 1).

Armenia's forests provide a broad range of ecosystem services, such as climate regulation, soil and erosion protection, water regulation, carbon storage, biodiverse habitats, and non-timber products for local people. Sustaining the integrity of these ecosystem services is particularly critical for the local rural communities that are most vulnerable to the impacts of current climate and future climate change: 44% of Armenians are farmers, and more than 33% of all Armenians live below the poverty line (CIA World Factbook, 2015). Agriculture is an important sector of the national economy, accounting for around 20% of the gross domestic product. The impacts of climate change on this sector have direct effects on the people's livelihood and food security. For example, in 2005, an acute drought damaged the harvest so severely that that Armenia was forced to rely on international aid to feed its people (UNDP Armenia, 2010).

Local practices further contribute to vulnerability to forest fires. Farmers were routinely employing "slash-and- burn" agriculture and burning the agriculture residues in the fields (Adaptation Learning Mechanism, 2010). Because of the drying effects of climate change on forests, these deliberately set fires may be even more likely to rage out of control. This could lead to a cycle of forest degradation and loss, and could subsequently affect farmers' abilities to successfully grow food or maintain pasturelands.

This situation called for a climate change adaptation intervention across forestry and agricultural sectors with two objectives: (1) sustaining ecosystem services critical for local agricultural livelihoods, and (2) protecting natural areas of Armenia.

GEF's Forestry Project in Armenia

Given these concerns, the GEF and UNDP developed the project "Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia" (Government of Armenia and UNDP, 2008). The government selected the southeast region of Syunik as the project's pilot area, based on the comprehensive vulnerability and adaptation assessment that Armenia completed for its First National Communication to the UNFCCC. The assessment concluded that the forest in the southeast region of Armenia was critically vulnerable to climate change because of its distinctive mountain forest biodiversity (National Statistical Service of the Republic of Armenia, Undated). The area is a global conservation priority: the World Wildlife Fund listed it as a Global 200 Ecoregion, and Conservation

International identified it as a biodiversity hotspot. The Syunik forests support populations of valuable biodiversity, such as the Persian Leopard and the Golden Eagle; the forest also contains many of Armenia's greatest cultural attractions, some of which date back to medieval and ancient times, such as the Tatev Monastery and Zorats Karer (Figure 2).

Figure 2. Tatev Monastery.

Credit: Arekhtsyan Aram.

From 2009 through 2013, the project assisted the Government of Armenia in designing and implementing a range of capacity-building and technical assistance activities to address increasing forest fire risks and to enhance the resilience of the Armenian forests under climate change. The key activities, included: instating national policy change to catalyze improved practices beyond the Syunik region; supporting fire response teams in the region by providing training and equipment; training the forest enterprise staff; enhancing forest pest control; and facilitating reforestation through plantings.

Financing and structure

GEF supported the project with US$0.9 million in SPA funding. In addition, US$3.4 million in co-financing came from a variety of government and international partners, including the Hayantar State Non Commercial Organization (Forest Authority under Ministry of Agriculture); Arevik National Park; the Ministry of Agriculture of Armenia; the Rescue Service of the Ministry of Emergency Situations of Armenia; World Wildlife Fund; the Organization for Security and Cooperation in Europe (OSCE); the Government of Finland; and the Caucasus Nature Fund. At the national level, the project was executed by the Ministry of Nature Protection. The UNDP Climate Change Program led day-to-day implementation of the project, reporting to the Ministry of Nature Protection. The project engaged relevant Armenian governmental agencies: the Ministry of Agriculture, the Ministry of Emergency Situations, and ArmStateHydromet (Government of Armenia and UNDP, 2008).

Project Achievements

The project helped improve forest health and forest fire management on more than 100,000 hectares (386 square miles) and spearhead the development of new national forest management legislation, which integrated climate risks. The project also implemented a series of climate change adaptation pilot projects in the Syunik region. These activities reduced the vulnerability of targeted forest ecosystems to climate change and improved the resilience of local livelihoods. The achievements of this project can be grouped into four main areas: catalyzing policy change; engaging in forest regeneration; supporting fire response teams and early fire response efforts; and enhancing pest control (UNDP Armenia, 2013).

Catalyzing policy change

The government has succeeded in mainstreaming policies related to climate change risks and adaptation in the environmental management framework of Armenia through several means.

National Task Force on Wildfire Management. The formation of an Interagency Task Force on Wildfire Management was critical to the development and implementation of a national forest fire management policy that integrated climate-change risk. This task force included representatives from key ministries: the Ministry of Emergency Situations; the Ministry of Nature Protection; the Ministry of Agriculture; the Ministry of Defense; the Ministry of Territorial Administration; the Ministry of Transport and Communication; the Ministry of Health; the Ministry of Education and Science; and the Ministry of Energy and Natural Resources, as well as UNDP and OSCE. In 2013, the Armenian Cabinet of Ministries approved the task force's Action Plan on Improved Wildfire Management.

Target program and Action Plan to Improve Fire Safety in Forests and Other Vegetation-Covered Areas. The Action Plan on Improved Fire Management was the first national policy dedicated to improving wildfire management, with the focus of addressing current and future impacts of climate change. The policy drew the connection between climate change and changes in forest and grassland fires, prioritized prevention to minimize wildfire risk, and emphasized the importance of early response and firefighting coordination. The implementation of the policy was expected to mitigate the negative impact of climate change on forest ecosystems, and to help increase the resilience of forest ecosystems and local livelihoods.

Providing relevant analysis on wildfire incidences and their effects, incorporating international best practices on fire

prevention and management, and helping identify measures to address wildfires helped to enact the new policy. The project also developed guidance, including a draft action plan on early forest fire warning and response; a draft annual operations plan for forest fire management; and a user-friendly brochure on wildfire management for local communities.

Catalyst for nation-wide change. One of the most important outcomes of this project was that its impact went beyond the Syunik target region. The GEF-UNDP project succeeded in catalyzing a nationwide policy and legislative change in forest fire management. Specifically, to minimize the wildfire risk caused by agricultural waste and stubble field burning, the project supported a policy initiative spearheaded by Khazer, an Armenian nongovernmental organization, to develop an amendment to the Republic of Armenia's Law on the Protection of Atmospheric Air (Republic of Armenia, 2012). The new regulation prohibits the slash- and-burn practices that are sometimes used in agricultural field-clearing near forests or other protected areas. This measure was intended to help reduce the number of wildfires caused by people. Dry vegetation on protected lands are now managed through prescribed burning, which is closely controlled to minimize the risk of wildfires. The project advocated for the development and approval of related pieces of legislation to ensure the compliance and enforcement of the ban.

Engaging in forest regeneration

The project supported the reforestation of about 57 hectares among four sites throughout the Syunik region. The reforestation pilot projects aimed to rejoin fragmented forests into contiguous forest corridors or regenerate burnt forest areas. The project carried out infilling, agro-technical measures, watering, and survival rate monitoring. Additionally, by using a variety of plant species, the project increased forest resilience to climate change impacts by minimizing the damage posed by specific threats. Since certain plants are vulnerable to particular climate conditions, diseases, or pests, planting multiple species reduces the likelihood that a single threat will severely damage a broader ecosystem. In one of the pilot areas, the project also helped to protect wild fruit species. Field monitoring in 2012 confirmed plant survival rates in the range of 40–47% in the Kapan and Goris districts, 59% in the Arevik National Park, and 84% in the Tatev area. Based on these pilot experiences, lessons and guidelines were documented and shared for use in future forest management plans.

Supporting fire response teams and early fire response efforts

To build the capacity of forest fire response teams in the region, the project provided the Syunik Forest Enterprise, the Kapan Forest Enterprise, and the Arevik National Park with machinery, equipment, training, and horses to help their staff manage forest fires. Equipment included forest fire warning signs, firefighter backpack pumps, and pickup trucks mounted with water pumps and fire suppression instruments (Figure 3).

Thanks to the project's efforts, these early-response teams are now prepared to respond to fires on 89,400 hectares of forestland, with an additional capacity of 10,000 hectares in case of an emergency. Since 2011, the forest fire early-response teams have successfully prevented multiple grassland fires from spreading to neighboring forests. Because of the teams' success in significantly reducing forest fire effects in Syunik, other forest management teams have replicated their efforts.

Figure 3. Pickup outfitted with engine-operated water pumps.

Credit: UNDP.

Organized training sessions and discussions were a vital activity to strengthen the capacities of fire response teams. A two-day course conducted by Johann Goldammer, the Director of the Global Fire Monitoring Center, brought 50 local fire brigade representatives from the Syunik region to learn about international best practices in forest fire management. Following the training, 100 participants from forest enterprises, the national rescue service, military, police, the Armenian Red Cross, local governments, and other institutions involved in fire management, joined the fire brigade teams for a broad discussion. Topics included the need for emergency-response capabilities and legislation, as well as regional and international cooperation. A field exercise followed the training, and helped test the coordination of firefighting teams and train them in the use of equipment.

Enhancing pest control

As temperatures rise, pests such as leaf-eating beetles (*Euproctis chrysorrhoea L., Ocneria dispar L, Operophthera brumata L.*, etc.) will likely expand their territory and require new monitoring and management approaches. The project initiated and demonstrated an environmentally sound pest-control approach, developed by experts from the American University of Armenia in Syunik. Their approach relies on forestry experts to count early-stage insects, providing a forecast of conditions 9 to 10 months ahead of a potential pest outbreak. With this knowledge, experts at the national level are able to apply biological pest-control treatment, distributed as an aerial suppressor. Project participants also learned about additional pest-control information, including a textbook developed on Armenian forest pests and pest control and written for specialists, forest managers, and academic researches, as well as an easy-to-use manual for foresters and rangers.

Project Challenges

Biological timelines versus project timelines. Reforestation of degraded forest land, which the project led as part of its efforts to improve forest management, requires the selection, planting, care, and maintenance of vulnerable seeds and plants over a period of at least five years. The project partners initially faced a number of challenges in growing seeds and plants. In the first round of planting, rodents and other animals dug up and ate the seeds; therefore, in the second and third years of the project, the team switched to planting saplings instead of seeds. However, tree seedlings require sustained care and attention, sometimes over multiple years, until they have established root systems. The majority of the trees were planted during the second and third years of this four-year project. Further maintenance of the pilot reforestation sites has been handed over to the local project partners, including local forest management enterprises, Arevik National Park, and the Tatev Monastery. The final project evaluation confirmed ongoing sustainability of the project reforestation activities through strong national ownership of the project. However, the project team highlighted the need for an adequate maintenance and monitoring period, and outlined the limited project timeframe as the challenge.

Budget shortfalls. The project objective was too ambitious for the initial project budget. Furthermore, project co-financing fell half a million dollars short compared to original commitments. However, the project was able to successfully coordinate with other projects that had similar goals to accomplish critical project activities. As a result, the project engaged with more stakeholders and leveraged additional co-financing from governmental and international partners, including the Ministry of Agriculture, the Rescue Service of the Ministry of Emergency Situations of Armenia, World Wildlife Fund, OSCE, the Government of Finland, and the Caucasus Nature Fund. These partnerships helped the project leverage US$3.4 million — almost 80% more in co-financing than originally planned.

Donor coordination and adaptive management. Despite the success in leveraging co-financing, coordination with other initiatives was initially a challenge. Hayantar State Non-Commercial Organization and the GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit; German Corporation for International Cooperation) Sustainable Biodiversity Management Program had also planned to improve national forest information management systems and management plans. In particular, GIZ proposed a new forest management planning system in Armenia. However, after learning of the Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia project, Hayantar State Non-Commercial Organization and GIZ considered plans to mainstream climate change related risks within their project. This consideration was facilitated through the development of new national guidelines for incorporating climate change risks into the forest management planning process. The project's guidelines were intended to be included in comprehensive national guidelines within Armenia's 10-year forest management plan.

Analysis

On-the-ground, concrete assistance is effective. Establishing forest fire early-response teams, along with providing equipment and tools, had immediate positive effects on the wildfire management capacities in the region. This type of assistance proved to have a high potential for replication in other regions of Armenia.

Strong stakeholder partnership helped leverage key support for the project. Establishing strong partnerships among government agencies, donors, forest managers, fire fighters, and other key stakeholders led to the success of the project. Partners understood that the project's resources would not be sufficient on their own. Identifying partners working in the same sector and joining with them to work toward shared goals was both pragmatic and beneficial, and led to improved effectiveness, as well as higher levels of co-financing.

Successful adaptation needs adaptive management. A flexible and adaptive approach to project management is critical to

secure project sustainability and relevance to the beneficiaries, including the government, forest management enterprises, national parks, and local communities. Adaptive management provides the capacity to adapt to changes, such as disruptive events, and maintain overall project efficiency and effectiveness. Additionally, adaptive management helps to secure strong local ownership.

Learning by doing lasts. From the perspective of the Armenian government, the practical, hands-on training exercises — such as those that the project team conducted as part of improving the fire-response capabilities of the region's fire brigades — were particularly successful. People and organizations learn by doing; active learning helps people internalize and organizations institutionalize the adaptive capacities promoted by the project.

Next Steps

An ongoing effort to reduce vulnerabilities to climate change is important for Armenia. The Action Plan on Improved Fire Management also envisaged the development of the National Policy on Wildfire Management and a related implementation strategy. This work continued building on the lessons and foundations laid by the GEF project, following its completion, with the support from OSCE and Germany's Global Fire Monitoring Center (OSCE, Undated). As a result, in January 2015, the Government of Armenia approved the national policy and its implementation strategy and action plan for the fire management on vegetation covered areas in forest lands, specially protected areas of nature, agricultural lands, and settlements (Republic of Armenia, 2015).

In its Third National Communication to the UNFCCC submitted in 2015, Armenia identified a number of climate change-induced threats to forest ecosystems associated with the forest wildfires, diseases, and mass generation of pests that may lead to the loss of 14,000 to 17,000 hectares of forest 2030.[1]

A regional European Union (EU) project, "Utilizing Stream Waters in the Suppression of Forest Fires with the Help of New Technologies," will help with this key need. This project seeks to create a complete and holistic system for suppressing forest fires in protected areas. The EU project focuses on Greece, Turkey, Romania, Ukraine, Armenia, and Moldova. Armenia's Arevik National Park is part of this regional project.

However, despite the importance of the EU project, future initiatives are required to address three key needs:

I. **A capacity-building and technical skills development strategy for key Armenian government institutions working on natural resource management, along with environmental conservation issues.** Important components of such a strategy would include technical training and professional development programs for those working in the natural resource sector. Capacity-building efforts should be ongoing, well-planned, and strategic, rather than *ad hoc*.

II. **Incorporating climate science and climate change adaptation into higher-level education curricula.** The project trained over 400 teachers and students in Syunik and Yerevan through seminars on forest biodiversity and fire prevention. However, a more comprehensive approach to education on climate change in Armenia is critical to generate qualified personnel to manage Armenia's forest ecosystems. Specialized technical training sessions are also crucial for keeping professional staff up-to-date on climate change adaptation solutions and technologies.

III. **Scaling up adaptation solutions piloted by the project: forest regeneration, forest fire prevention, and pest control.** The Government of Armenia and other partners can build on the GEF forestry project. One way is including the tested measures in Forest Agency work plans and in Armenia's National Adaptation Plan. The plan is under development by the Ministry of Nature Protection, and is expected to be submitted to the government within the near future.

Conclusion

The GEF forestry project in Armenia was successful in supporting improved forest management in a country facing the impacts of climate change, particularly after a series of hot spells during 2015. Where quick response teams were established, there have been almost no fires. The regulatory ban over agricultural burnings has had a strong effect as well. The project's successes are being scaled up within Armenia and across other countries with similar forestry challenges.

Sparking and extending national-level dialogue. The GEF forestry project demonstrated how an early, specialized, spatially-limited intervention can help pave the way for a more

1 Climate change in Armenia was assessed using the CCSM4 model in accordance with Intergovernmental Panel on Climate Change recommended Representative Concentration Pathways 8.5 (A2) and Representative Concentration Pathways 6.0 (B2) scenarios for emissions. Future climate change projections for temperature and precipitation were developed through 2100. Average annual temperature increase projections compared to 1961–1990 show that, in an A2 scenario, the temperature will increase by 1.70°C in 2040, by 3.20°C in 2070, and by 4.70°C in 2100. In a B2 scenario, the temperature will increase by 1.30°C, 2.60°C, and 3.30°C, respectively. Armenian Third National Communication on Climate Change.

comprehensive and strategic approach to adaptation planning at the country level. For example, should the project's proposed amendments be incorporated into the official planning guidelines, all forest management plans in Armenia would be required to integrate climate change adaptation measures. As a second example, the creation of the inter-ministerial National Task Force for Forest Fire Management sparked a dialogue to prepare a National Adaptation Plan for forests. In 2015, two years after the project completion, the ecosystem-based approach to climate change adaptation has been prioritized by Armenia under the UNFCCC.

Replicating success in other regions of Armenia. The GEF forestry project served as a strong example of how to build strategic partnerships that lead to replication of results. The successful approaches used in this work have been and will be further replicated through further improvement of legislation, training sessions, and guidelines, as well as at different national levels through hands-on training sessions. The Government of Armenia has been taking further measures to secure effective forest fire risk management. By 2015, early response groups were established and equipped with equipment similar to that supplied by the UNDP-GEF project. Additionally, crisis management centers were established in all regions of Armenia, fire drills are now organized annually in the regions, and voluntary fire-rescue brigades have been established in 109 communities (Ministry of Territorial Administration and Emergency Situations, 2015).

Engaging the private sector. The project built on strong local ownership and partnerships with Armenia's government.

However, the potential exists for alliances with the private sector. For example, the tourism sector of Syunik, which was sensitized during the course of project trainings, could help lobby for improved forest management, with the idea that healthier forests could lead to increased ecotourism. In other regions of Armenia, mineral water companies might wish to support forest management to ensure the continuation of the water-protection services that forests ecosystem provide.

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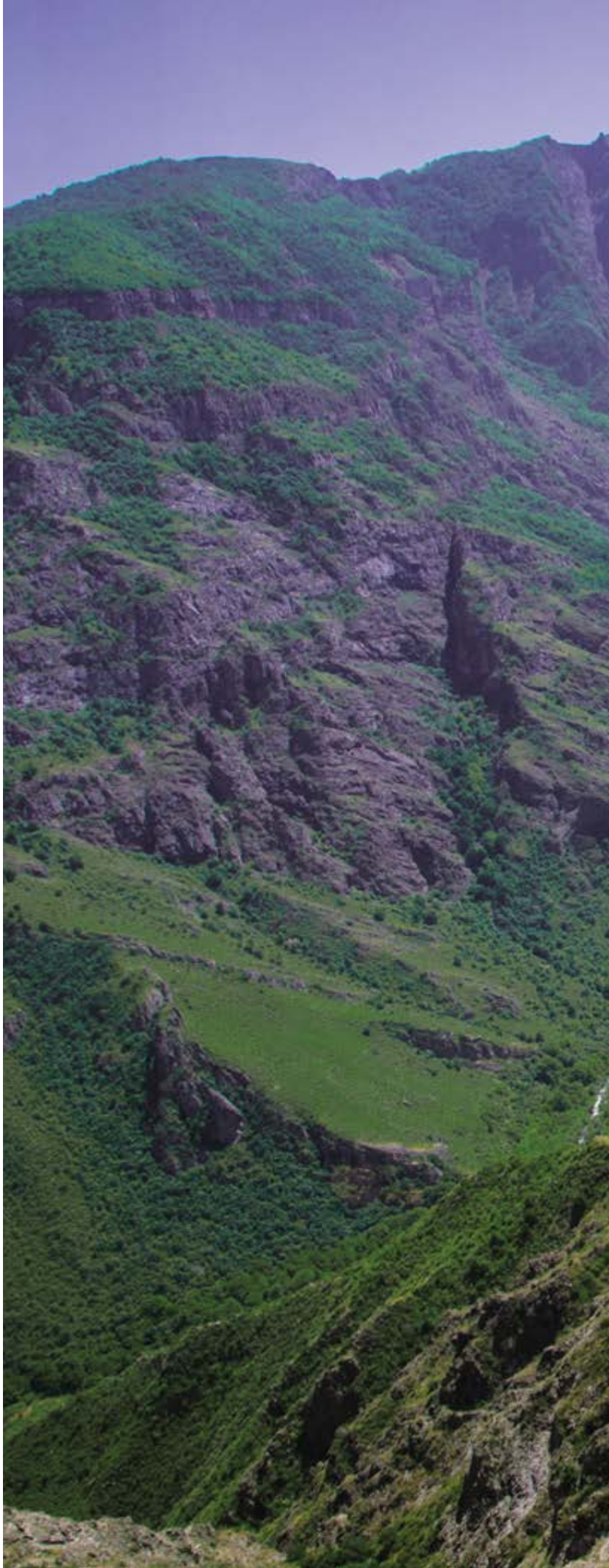

Case Study 3

Community-Based Adaptation to Climate Change through Coastal Afforestation in Bangladesh

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Case Study Overview

Coastal communities in Bangladesh face rising sea levels, changes in tropical cyclones, flooding, saltwater intrusion, and erosion. The Government of Bangladesh and UNDP are working to enhance the resiliency of the most susceptible coastal districts through mangrove reforestation and the *Forest, Fish, and Fruit* (FFF) project. The FFF project helps communities plant protective, productive vegetation interspersed with fish nursery ponds. The project provides Bangladeshis with additional income and has established a "green shield" surrounding some of Bangladesh's most vulnerable communities. To date the project has involved 30,119 households in adaptation and training measures; more than 9,000 hectares of vulnerable coastal zones have been planted with trees to protect these zones and maintain local livelihoods in a changing climate.

Project Background and Brief History

Bangladesh is one of the most vulnerable countries to climate change, based on the vulnerability of the country's food production, livelihoods, and infrastructure, particularly along coastal areas (World Bank, 2013). The country's NAPA identified projected climate changes, such as average temperature increases of 1.3°C by 2030 and 2.6°C by 2070; changes to the rainfall cycle with the monsoon season becoming wetter and the remainder of the year drier (with impacts of both flooding and drought); sea level rise; saline water intrusion; and more intense extreme events such as cyclones (Bangladesh, 2005). Sea level rise is of particular concern for Bangladesh, as significant portions of its population live in the low-elevation coastal zone. The Bangladesh Climate Change Strategy and Action Plan specifies the likelihood of 0.2 to 0.8 meters of sea level rise, using estimates from the Fourth Assessment Report of the IPCC (AR4; Bangladesh, 2009).

Climate change is expected to bring increased cyclones, storm surges, flooding, and soil salinity. Each of these projected changes has implications for the people of Bangladesh. For example, increased rainfall and wetter monsoon seasons (Hijioka et al., 2014) would likely increase flooding and have adverse consequences for infrastructure, livelihoods, food and water access, and human health (CDNK, 2014). Sea level rise will increase saltwater inundation, which could have significant implications for food production (Wong et al., 2014).

Sea level rise is also likely to exacerbate impacts from tropical storms and cyclones. Nearly one-third of Bangladesh's total landmass and more than a quarter of its population are located in coastal areas (Roy, 2011). Cyclones are already a serious threat to the economy and also inhibit long-term economic development by damaging infrastructure and diverting resources to recovery efforts. For example, Tropical Storm Mahasen, which struck Bangladesh on May 16, 2013, is estimated to have affected up to one million people, destroying thousands of huts and causing flooding in coastal areas (BBC News Asia, 2013). One of the beneficiaries of the FFF project is Abu Hanif, who lost his home to Tropical Storm Mahasen and has seen his livelihood constantly threatened. He said, "It was impossible to cultivate vegetables in this place [his home] due to periodic inundation." Indeed, the people of Bangladesh are already starting to sense a change in both the frequency and intensity of cyclones (Nandy et al., 2013).

The primary livelihoods of communities in coastal *upazilas* (district subdivisions) — livelihoods such as agriculture, fisheries, livestock, and forestry — are highly vulnerable to these projected impacts. Climate change can place increasing stress on households, and entire communities, which already struggle with poverty and a lack of basic services.

Addressing these factors will require innovative action to ensure that people who are most at risk to the effects of climate change have the ability to cope with its impacts (Nandy, 2014).

As a response, the Government of Bangladesh, with financing from the LDCF and support from UNDP, has begun implementing a series of activities, including mangrove reforestation; introducing climate-resilient livelihood practices; and improving the capacity of institutions and communities to address climate risks (http://www.cbacc-coastalaffor.org.bd).

Coastal ecosystems, specifically mangrove forests, form an important buffer from surges created by typhoons, cyclones, or other coastal storms (Ellison et al., 2012; Mazda et al., 1997, 2006). Mangrove root systems trap sediments, stabilize shorelines, and reduce erosion (Ellison et al., 2012), protecting vulnerable coastal communities from storms (Ellison et al., 2012; Mazda et al., 1997). Bangladesh, however, is losing 2,600 hectares of forest cover annually because of multiple development pressures. The primary drivers of deforestation are the logging and construction industries, which are responding to market pressures stemming from the rapid urbanization occurring in Dhaka and other parts of the country. The production of forestry products supports livelihoods, and the harvesting of trees supports domestic fuel needs.

Alternative livelihoods are therefore necessary to provide new sustainable income sources in the face of climate risks and to reduce demand for forestry resources in coastal areas, protecting communities from risk and preserving biodiversity (Alam et al., 2013).

The FFF project seeks to address the topmost priority in Bangladesh's NAPA, which is to reduce climate change hazards through coastal afforestation with community participation. Hence, the project supports community-based efforts to build, restore, and protect natural buffers, or "green shields", along the coast as a means of adapting to the anticipated impacts of climate change. The project also demonstrates that community-based participatory adaptation activities within an ecosystem-wide approach can achieve numerous co-benefits. This project reduces climate risks, sequesters carbon, supports the livelihoods of community members, and improves coastal biodiversity.

The aim of the project was to implement a community-based approach for enhancing the resilience of coastal communities and ecosystems in the coastal *upazilas* of Anwara (Chittagong District), Hatia (Noakhali District), Char Fassion (Bhola

District), and Barguna Sadar (Patuakhali District) (Figure 1). These coastal areas have unique social and environmental characteristics, including mangroves, large water-bodies, and newly created coastal char lands. "Chars" are newly gained or accreted lands; they are often settled by the poor, who inhabit and use the land without the security of formalized tenure rights (Hessel, 2013).

Figure 1. Map of Project Districts in Bangladesh

Source: UNDP, 2008.

People who do not own land, as well as marginalized families in coastal areas, depend on fishing and agricultural work. In Bangladesh, land is a scarce resource and a complex legal regime governs land rights. This project is the first in Bangladesh to enable these marginalized groups to gain access to government land through a benefit-sharing model: families gaining access to land and the government benefits by formalizing the use of previously unproductive land and reducing unauthorized use of that land.

Project Achievements

The project developed an innovative model for supporting multiple livelihood options on small pieces of land, while also establishing new coastal forestry practices that protect coastal communities and biodiversity. This combination of income-generating and reforestation activities built local adaptive capacity, while also creating an incentive for communities to sustainably manage their natural resources. The project has increased the resilience of 30,119 households through afforestation, diversifying livelihood practices, and training programs. In addition, the project has funded the equivalent of 464,790 days of labor by paying participants for their work to raise seedlings, operate nurseries, and cultivate plants. This has resulted in social protection for vulnerable households. Broadly, the project was based on two approaches: (1) a land-use model, which focused on diversifying livelihoods; and (2) mangrove reforestation (Kabir, 2014).

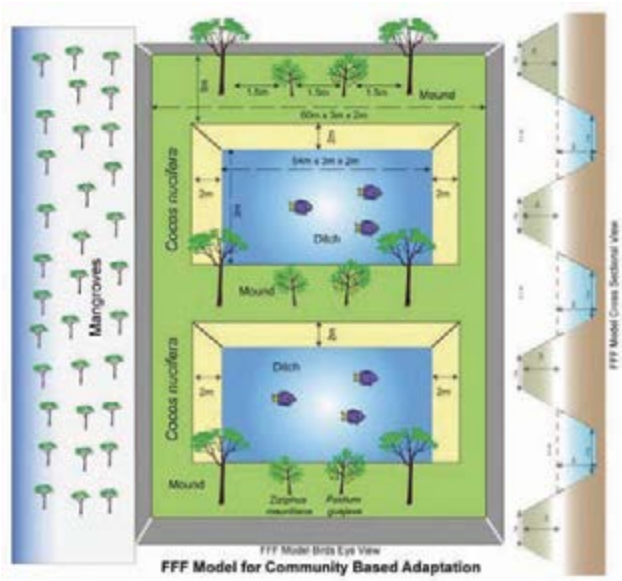
Innovative land-use model

This project pioneered the FFF land-use model for providing climate-resilient livelihoods for communities living around coastal forests. The FFF model helps improve households' abilities to respond to climate change by diversifying household food sources and income generation in the agriculture, forestry, fisheries, and livestock sectors. In the event that climate change negatively affects one income-generating activity, households should have additional food sources, income-generating opportunities, or improved finances to better absorb setbacks.

The FFF model integrates agriculture, forestry, fisheries, and livestock rearing to provide diverse short-, medium-, and long-term livelihood options on small parcels of land. The model largely piloted participatory ownership and adaptation practices using encroached-upon, periodically inundated, and unproductive fallow lands – the seasonally flooded inundation zone between the coastal forest and the embankment. In the FFF model, participants use this marginal, government-owned land as a place to build ditches and dykes for food production (Figure 2); the tops of the dykes offer land for planting food crops, while simultaneously creating "walls" around ditches or pools of freshwater for raising ducks and fish. The FFF model used a ditch and dyke structure that enables one hectare to grow enough food to support up to eight families. This approach has worked well in land-scarce Bangladesh, while diversifying livelihoods against climate risks. Thus far, the FFF model has been established on 112 hectares of coastal lands, reaching 896 landless and marginalized households (Nandy, 2014).

Project staff have trained local officials to help beneficiaries cultivate dykes with seasonal vegetables and improved fruit varieties, plant forest trees, and use ditches for irrigation and freshwater fish cultivation. Participants have learned about new management practices. Each family cultivates six or seven

Figure 2. FFF model ditch and dyke structure.



Source: UNDP, 2011a.

types of leafy vegetables on a 60-meter long and 3-meter wide strip of land on top of the dykes. Scaffolding maximizes the space for climbing vegetables, such as country beans, cucumbers, and gourds. Fruit tree seedlings are planted in-between forest tree species, yielding fruit two years after planting. Two high-yielding fruit tree varieties, BAU-Kul (*Ziziphus mauritiana*) and BAU-Guava (*Psidium guajava*), have been planted on dykes. Developed by the Fruit Tree Improvement Center at Bangladesh Agriculture University, the trees have thus far produced 10 kilograms of fruit per tree each season for two seasons per year. These trees have served as mid- to long-term resource-generation options. Forest tree species meet fuel needs in the medium-term and sell as timber in the long-term. The ditches provide space for aquaculture, irrigation water, and increased access to freshwater (Nandy, 2012).

The FFF model has been a highly promising alternative livelihood option. Short-term crops planted as dyke vegetation provide households with both food and quick income-generating options. Sales of surplus vegetables have increased family income by approximately US$120 per year. Families have also increased their incomes through aquaculture interventions; a single ditch produces about 300–350 kilograms of fish yearly, generating incomes of up to US$450–500 from annual fish sales. Duck rearing has provided income of up to US$45–65 per year. Beyond the additional income that duck rearing provides, duck waste also enhances the production of fish food, which reduces the costs of feeding fish.

To assess the income-generation benefits of the project, the project team grouped households by their pre-project baseline annual income, comparing each group to its own baseline. The household annual income increased across all groups.

Households with the lowest initial income increased their annual income the most (Figure 3). Some households increased their income by nearly US$700 within the first year from selling vegetables, ducks, eggs, and fish. Considering that most of the beneficiaries were living on less than US$1 per day before the FFF model, this was a substantial increase in income (see Figure 3). The FFF model has improved nutrition and provided consistent sources of income year-round, allowing for households to invest in health care and education, thus enhancing household well-being. Additionally, this model makes use of land that would otherwise remain dormant because of saltwater intrusion.

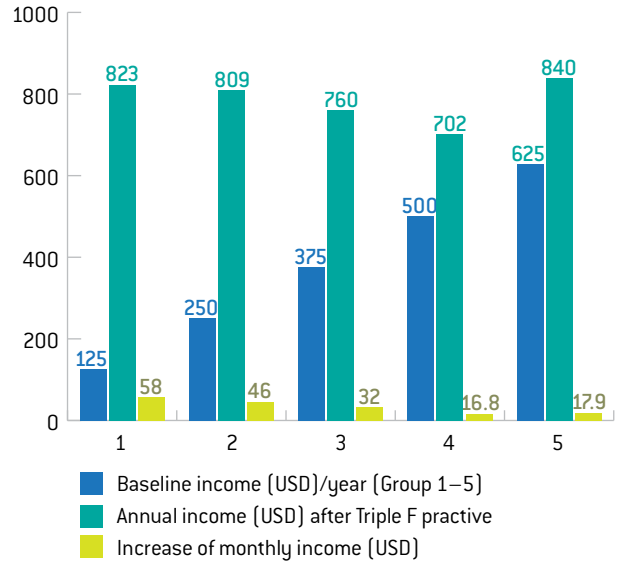
The project has converted unused land into highly productive land by integrating several climate-sensitive sectors into one model, incorporating recurrent resource- and income-generating options, and protecting barren land from encroachment. The project also helped to empower vulnerable coastal communities through land-ownership rights. The project model accommodates eight families per hectare, which is important in land-scarce Bangladesh. Before project implementation, the land was only used for short periods of time, primarily for fodder and marginal rice farming because of high salinity levels and routine flooding. (Figure 4). Land ownership has been transferred to coastal communities with tenure for diversified livelihood practices.

For the first time in Bangladesh, landless people and marginalized groups have been able to access government lands through this benefit-sharing model. New land rights developed through the model helped coastal communities participate in local decision-making processes, claim relevant services from government departments, and secure economic capital (Alam et al., 2013).

Mangrove reforestation

Mangroves are natural forests that live at the interface between land and sea. Mangroves support ecosystem services including fisheries, sediment regulation, and protection from cyclones, tidal and storm surges, and tsunamis (Alongi, 2002; Vermatt and Thampanya, 2006; FAO, 2007; Kerr and Baird, 2007; Polidoro et al., 2010). As the height of storm surges may increase with climate change, mangroves will have an increasingly important role to play in shore protection. Mangrove ecosystems are vulnerable because of monoculture, breaks or clearings in forests, and lack of regeneration; for these reasons, their functional and protective capacities appear to be diminished.

Figure 3. Income generation of 80 FFF participant families at the Naltona project site.



Source: GEF et al., 2013.

Figure 4. Images of the FFF model at Jahazmara in Noakhali, Bangladesh: initial phase (top) and production phase (bottom).

Credit: UNDP

FFF MODEL: BENEFICIARY STORY

Shanu Mallik from Sonatala Village in Barguna did not own land and therefore was unable to farm. He had to search for outside work to feed his family. Through the FFF model, Mallik accessed land rights for 10 years, with no loan. With project support, he started producing vegetables on the dyke and practicing duck and fish farming in the ditches in-between. Mallik said, "I have not seen such a ditch and dyke system before. I learned from different trainings how to cultivate agriculture crops and farm fish and rear ducks in a new way." In only three months, Mallik was able to feed his family and earned US$130 from selling vegetables. He also earned US$480 from selling fish and duck eggs in a single year. Mallik realized that he could increase his income if he cultivated dyke vegetables in different seasons. He has since repaired his house and rented land for paddy cultivation. Mallik is able to afford these projects because of his success using the FFF model.

Bangladesh initiated man-made coastal afforestation and reforestation in 1966, with a primary objective of saving the lives and properties of people who live on the coast, as well as stabilizing newly accreted land from the sea (Islam and Nandy, 2001).

Given these considerations, project personnel designed the project's mangrove afforestation activities to provide the best protection possible. It ensured that mangrove plantings occurred in swaths 500 to 1,000 meters wide to create a greenbelt along the coast and to reduce the intensity of cyclones and storm surges (Project Factsheet, UNDP Bangladesh). Project personnel also considered planting density, distance from the coast, and the height and age of mangrove trees (Mazda et al., 1997). Project personnel have assisted in planting 9,200 hectares of mangroves, 444 hectares of non-mangroves, and 680 kilometers of roadside plantings, which help protect 800,000 people.

To enrich and sustain coastal vegetation, the project introduced 10 mangrove species tested for their ability to withstand different levels of salinity in inundated coastal habitats. The objective of this effort was to enhance the climate resilience of the ecosystem, improve ecosystem services, and introduce more biodiversity. These species have begun regenerating and spreading throughout the coastal belts of Bangladesh. This was the first time that a large-scale multicultural reforestation technique was used in Bangladesh. The project's success in mangrove reforestation has the potential to inform coastal

forest management guidelines. Furthermore, mangrove reforestation contributes to climate change mitigation efforts because mangroves in the tropics are considered to be the most carbon-rich forests in the world (Donato et al., 2011).

The project has facilitated the formation of 17 FFF- and VFF-based (vegetable, forest and fish) societies. The societies demonstrate the communities' intention to move forward in an organized way and continue current approaches. These societies have been registered by the Ministry of Local Government Co-operatives, and are building community self-sufficiency and leadership.

In recognition of its success and innovation, the Bangladesh project received the Earth Care Award in 2012; in 2013, the project was also runner-up for the People's Choice Award, an international contest on adapting to climate change.

Project Challenges

Securing land rights and overcoming institutional barriers became significant challenges during the course of project implementation. These challenges hinged on a range of social and institutional factors that had to be addressed for the project to be successful.

The project's primary challenge was securing land rights in a country with scarce available land and a complex legal regime. One aspect of this challenge was that most of the people living in project communities lacked a thorough understanding of the concept of land rights. For many, the idea that they needed to formalize their ownership was foreign. It was difficult, and sometimes incited anger, to explain to a household that they did not have legal rights to their home, business, or land. The project overcame that challenge by working with beneficiaries to acquire formal land ownership, including ownership of state-owned land. Beneficiary households received with a 10-year lease the option of renewal based on performance. It was crucial to have the local leaders' support and to have them advocate for this land-ownership plan.

Another significant challenge was the lack of institutional guidelines and understanding among local officials of the need to support climate-resilient livelihoods and improve land management in coastal areas. To address this issue, the project conducted local institutional and capacity-building trainings for government officials (including at least 100 female representatives) and community-awareness training programs in all of the project sites. Thus far, 1,415 officials at the district-, *upazila*-, and union-level governments, as well as those working for nongovernmental and community-based organizations (NGOs and CBOs), have been trained in assessing, planning, and implementing adaptation measures in the coastal areas. At first, the training events at the local levels of governance were difficult. Often, the project team was viewed with distrust, and members were seen as outsiders attempting to dictate how people should live their lives. Once a level of trust was built, and the benefits and goals of the project were clear, it became much easier to communicate among officials and community members, and build support for the project. This proved to be essential in gaining support from additional community members.

Many people, especially community elders, sensed changes in their environment and in patterns of storms. However, because many were unaware of the complex reasons behind these changes, adaptation to climate change was a new concept for the community. Local staff learned that it was important to address the issues in a way that was familiar to the people. Terms like "stewardship" and "preparedness" better communicated the goals of the project than discussing climate change more generally.

Analysis

Linking community- and ecosystem-based adaptation practices has generated large-scale socioeconomic and ecological benefits. Ecosystem-based adaptation practices transformed conventional monoculture plantation into a more complex ecosystem that fosters resilience by increasing plant densities and enriching the biodiversity of coastal vegetation. The ecosystems also provide adjacent vulnerable communities with natural layers of protection.

Community-based adaptation approaches created rational land use in project areas. It empowered coastal communities by establishing land rights and introducing an innovative land-use practice with adaptation measures that increased the resilience of these communities. In addition, this community-based adaptation approach supported ecosystem-based adaptation by minimizing threats to encroachment. For example, the Forest Department has been strengthened by voluntary community guarding of coastal forests.

Group-based livelihood practices are important to overcome unauthorized use of coastal government lands and to allow for marginalized people to take part in decision-making processes. Individuals might act contrary to the communal land management plan and attempt to use forested areas for personal production opportunities. This undermines ecosystem-

based adaptation. However, the group-based livelihoods model gives beneficiaries rights and avenues to address problems stemming from the unauthorized use of land.

The ditch and dyke structure provided a reliable means to protect land from the effects of saltwater and tidal inundation, which are becoming more frequent. This model has increased freshwater access through seasonal rainwater harvesting, allowing the water to be used for irrigation purposes. It supports the quick establishment of multiple types of manmade ecosystems because of the structural arrangement and introduction of agriculture, fisheries, and forestry ecosystems behind coastal mangrove forests. This ditch and dyke structure will also provide future learning opportunities because farmers can educate marginalized populations in other parts of Bangladesh about the FFF model.

Building awareness of climate risk management and adaptation measures among the beneficiaries is important for raising common issues and disseminating best practices among farmers. Community awareness workshops brought together farmers, councils of women, government officials, NGOs, and CBOs. This provided opportunities for the dissemination of knowledge and lessons, and also brought to light common challenges and ways to address them. For example, the project built awareness around the use of the seasonally flooded inundation zone. This has opened the discussion to explore land use and tenure issues that present both opportunities and risks. Because government allocation of forest land is limited, naturally occurring open space inside forests could be used to establish more FFF models.

Implementing livelihood diversification through fisheries production in ponds has proven challenging because of climate extremes like higher tidal surges and extended periods of drought. During the dry season of 2014, most ponds in the Naltona project site completely dried up. Some farmers had to sell all their fish, even fish that were below allowable size. Other farmers moved fish to their homestead ponds. Additionally, almost all beneficiaries were unable to give their fruit trees enough water and many trees died. However, 80 beneficiaries at the Naltona site formed a farmers' society to serve as a support group. Within two years, the society earned sufficient money to repair or restructure everything without outside support. In this disaster-prone coastal area, people are developing a self-sufficient culture that has the additional benefit of aiding the community during and after a natural disaster, should one occur.

Next Steps

This project is still in the pilot stage and is being implemented in only 4 out of 10 coastal unions in each *upazila*; coastal unions are the smallest rural local governments in Bangladesh. Plans for the expansion of the initiative have already begun; government departments (e.g., the Department of Agricultural Extension, the Department of Environment, the Department of Livestock) are providing diversified livelihood training and

demonstration activities in more coastal unions. Support for these expanded activities comes from the Swiss Agency for Development and Cooperation and the Government of the Netherlands, which have contributed US$2.17 million and US$0.98 million, respectively. Financial support from the GEF (US$5.6 million) will support implementation in nine additional coastal sites.

Future work will invest in longer-term adaptation needs, based on the projected impacts of climate change. To do this, there are two major barriers that need to be overcome. First, information on the future impacts of climate change — projections, models, and scenarios — need to become available at the project-site scale. Second, climate change adaptation needs to become recognized as a high- priority issue; this is difficult given other development priorities.

Conclusion

This project tested new ecosystem- and community-based adaptation approaches across Bangladesh. The FFF model is being replicated by other community members who have been motivated by the success of project participants. Through providing land rights to landless households, the FFF model empowers communities to participate in local decision-making processes, claim relevant government services, and build community resilience. In addition, the reforestation model promoted through the project activities demonstrates a novel solution to increase the resilience of mangrove ecosystems and protect coastal areas.

To increase and replicate coastal adaptation efforts, the project organized site visits with media, government officials, and national and international delegates. These visits have increased policy attention on coastal adaptation issues and on shared best practices. The project has developed *Adaptation Management Plans* for eight project sites in four coastal districts of Bangladesh; researched country-specific climate adaptation documents such as *Mainstreaming Climate Change Adaptation through Value Chain Analysis, Early Warning Needs, and Collaborative Resource Management in Coastal Areas of Bangladesh*; and reviewed the existing *National Forest Policy of 1994*, the *National Land-use Policy of 2001*, the *Coastal Zone Management Policy of 2005*, and the *National Environment Policy of 1992* with a view to providing policy recommendations on climate resiliency with a national framework for mainstreaming. As a result of this gap analysis, coastal land-use policies are currently under review to delineate land ownership and incorporate climate change into coastal zone management, expanding the reach of project initiatives across the country.

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Case Study 4

Mainstreaming Climate Change Adaptation in Irrigated Agriculture in China

Qun Li (World Bank) and Fareeha Y. Iqbal (Global Environment Facility)

Case Study Overview

The World Bank and the GEF partnered on the *Mainstreaming Climate Change Adaptation in Irrigated Agriculture* project in China's Huang-Huai-Hai River basin (the "3H basin"), spanning the provinces of Hebei, Jiangsu, Anhui, Shandong, and Henan. From 2008 to 2012, the project demonstrated mainstreaming climate change adaptation activities within a conventional agricultural sector project, how local development can be informed by integrated modeling that considers climate change, and the expanded uptake of adaptive practices by farmers. By the end of the project, average per capita income among farmers had risen by US$326 per year, and high-value crop production had risen from 3.2 million tons to 4.2 million tons per year (World Bank, 2015).

Project Background and Brief History

Development challenge addressed by the baseline project

Prior to receiving support from the SCCF, the World Bank had started implementing the US$200 million *Irrigated Agriculture Intensification Loan III* (IAIL3) project to address agricultural constraints in the 3H basin (see Figure 1).

This basin has historically provided 50% of China's grain output and 35% of its industrial output, and was moving toward growing water scarcity and deteriorating water quality (World Bank, 2012). Grain production was in decline. The IAIL3 project's focus was to increase agricultural productivity and improve water efficiency through modernization and innovation in the agriculture sector, thereby increasing farmer incomes.

Figure 1. Map of project area (World Bank, 2012).

Risks posed by climate change

Implementation of the IAIL3 project was underway when the project team realized that the 3H basin is highly vulnerable to projected adverse impacts of climate change. The IPCC estimates increased water scarcity and declines in food production in Asia (Hijioka et al., 2014). The World Bank and Government of China requested US$5 million in GEF adaptation support to analyze these risks and possibly lower them through additional or revised project actions.

Project objective, approach, and partners

The new collaboration between the GEF and the World Bank set out to support a systematic approach to:

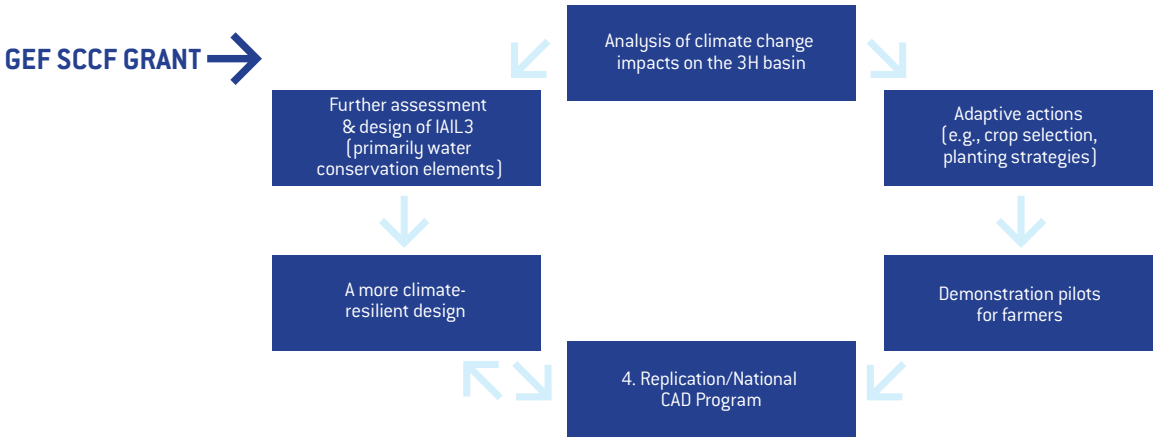
- Integrate adaptation into ongoing project activities through consulting climate change impact assessments, identify appropriate adaptation measures, and demonstrate adaption measures in selected sites for possible uptake by farmer groups.
- Modify and adjust interventions for the remaining duration of IAIL3 implementation.
- Assist the Government of China in incorporating climate change adaptation as a core theme in its national Comprehensive Agriculture Development (CAD) program.

The project consisted of three components:

1. **Identifying and prioritizing adaptation options.** This component included assessing and understanding climate change projections for the region, identifying regional vulnerabilities (or gaps) that may be exacerbated because of climate change, and identifying different actions to help reduce vulnerability in the region. Priority climate change adaptation activities were chosen based on this 3H Basin's climate change impact analysis, gap analysis, and study of adaptation actions.
2. **Demonstrating, implementing, and integrating adaptation measures.** This component was the largest of the three project components and entailed integrating and implementing the adaptation options identified in Component 1 in the IAIL3 activities.
3. **Mainstreaming adaptation into the CAD program and strengthening institutional capacity.** This component focused on knowledge-sharing and building adaptive capacity throughout China through lessons learned from the first two project components. It consisted of a number of activities, including research and development of adaptation policies, building institutional capacity on climate change adaptation, monitoring and evaluation, and project management.

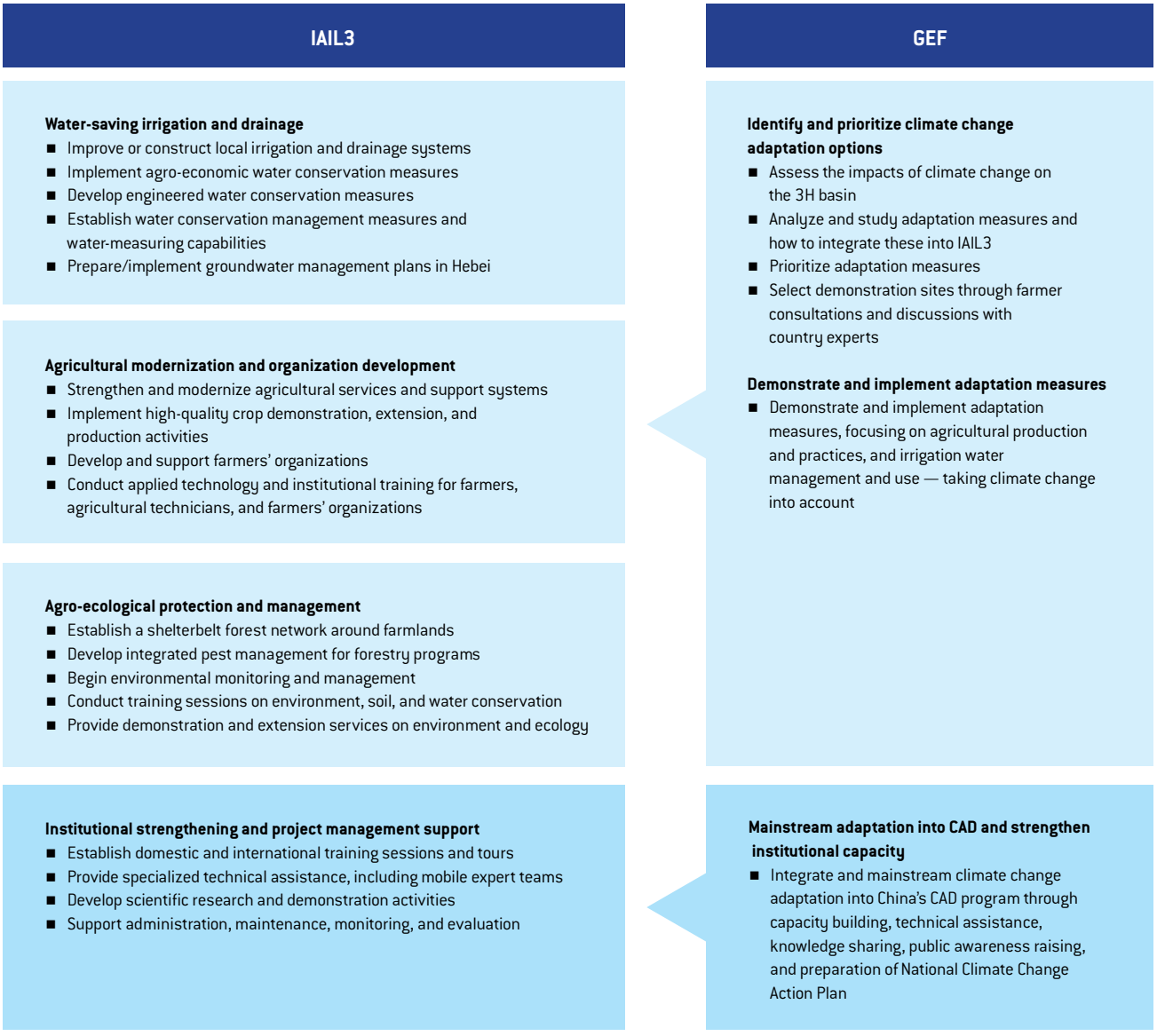
Figures 2 and 3 summarize these components and show how IAIL3 and the GEF grant were conceptually coordinated with a view to ultimately achieve adaptation benefits at scale.

Figure 2. Main project components and their sequencing.



Source: World Bank, 2008.

Figure 3. Activities supported by IAIL3 and GEF project.



Stakeholder engagement was a key component of this work. The primary partner agency was China's State Office of Comprehensive Agricultural Development (SOCAD). SOCAD coordinated project activities with the support of national, provincial, and local governments; farmers; local communities; and the World Bank. Specific stakeholders included:

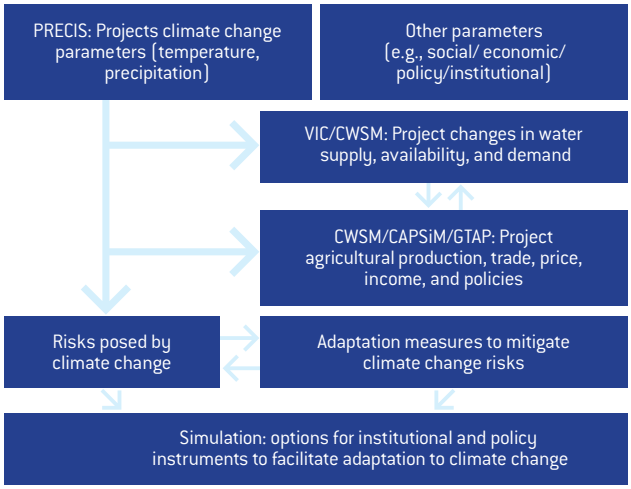
- National government departments, including the Ministry of Finance, the National Development and Reform Commission, the Ministry of Water Resources, the Ministry of Agriculture, the State Environmental Protection Administration, and the State Forestry Administration.
- Research institutions and universities including the Chinese Academy of Sciences (CAS) and the Chinese Academy of Agricultural Sciences.
- Local governments and government staff, especially finance bureaus, planning commissions, water resource bureaus, irrigation districts, water management stations, agriculture bureaus, and forestry bureaus.
- The private sector, including local input suppliers, traders/ merchants, and large-scale enterprises.
- Civil society and organizations, including water user associations (WUAs), farmer associations (FAs), and farmer cooperatives.
- Farmers in local communities (World Bank, 2008).

Project Achievements

Component 1: Identifying and prioritizing adaptation options

Analysis of climate change impacts on the 3H basin. SCCF resources supported preparatory work to better understand the impacts of climate change on agricultural productivity in the 3H basin. CAS, the Chinese Academy of Agricultural Sciences, and the Ministry of Water Resources conducted dynamic modeling exercises to assess the impacts of climate change on the region's agriculture and water resources. These models also assessed agricultural economics over key spatial and time scales, and impacts of farmer behavior and policies (e.g., pricing). Ultimately, this integrated exercise helped determine options that would maximize farmer income under changing climate conditions (Figure 4).

Figure 4. Integrated water and socioeconomic modeling framework.



CAPSiM – China's Agricultural Policy Simulation Model
CWSM – China's Water Simulation Model
GTAP – Global Trade Analysis Project
VIC – Variable Infiltration Capacity model
PRECIS – Providing Regional Climates for Impact Studies model

Source: Wang et al., 2010.

The climate change analyses conducted for the 3H basin found that:

- Annual average temperature was projected to rise by 1.4–1.6°C by 2030 in the 3H basin, which would increase evapotranspiration (ET) from crops.
- Annual average rainfall was projected to increase across the region by 3–8% by 2030, but the distribution would be uneven, and decrease in some sub-regions.
- Climatic variability was projected to increase. Greater variability was expected in the future for precipitation with longer dry periods, as well as more intense rain events. This would result in more severe seasonal droughts and floods. The Huai River could flood as frequently as once every 3–6 years; in the past, it flooded on average once every 20 years.
- Water supply was projected to fall and demand to rise due to factors other than climate change. In addition, much of the 3H basin region could experience a serious water deficiency by 2030 due to climate change. Total irrigation water demand in all three river basins is estimated to rise by between 8% and 12% due to increased crop water usage under climate change. A gap between water supply and demand greater than 5% in any river basin indicates serious water scarcity, and by 2030 this gap was projected to be 10% or more in both the Hai and Huai basins. (World Bank 2010)

Multiple climate change analyses for the project also projected that increased water scarcity would cause water reallocation

within the agriculture sector and across other sectors. As a result, the area of irrigated crops such as rice and vegetables would likely decrease relative to rain-fed crops.

Gap analysis. A gap analysis of IAIL3 showed its components were sensitive to climate change and did not integrate measures to build resilience to its impacts. Findings included that water-saving irrigation and drainage measures for the baseline project did not include rainfall collection or storage activities; adaptation of agricultural practices such as adjustments in sowing times, staggering sowing so that crops mature at different intervals, and the development of facilities for specialized climate-controlled agriculture (such as greenhouses) had not been considered; farmer organizations were not well-established and therefore ill-suited to assist with the dissemination of information on adaptation technologies; and since water and soil conservation through forestry initiatives had not been adequately considered, water loss and soil erosion were not effectively controlled by baseline forestry investments. Likewise, climate change adaptation had not been considered during the selection of forest tree species.

Prioritization and selection of adaptive actions. With climate change analyses and the gap analysis completed, the project team turned to the task of identifying priority, cost-effective measures that would address adaptation gaps in IAIL3. National scientists and local provincial experts worked closely with the World Bank's team of international experts.

Component 2: Demonstrating, implementing, and integrating adaptation measures

Demonstrating climate change adaptation measures. Several critical adjustments were made to IAIL3 to increase its resilience to climate change. Over 250 demonstration activities were implemented. One of the major demonstration activities included increasing surface water storage. Guided by current and projected rainfall data, several on-farm structures were constructed to harvest rainfall and store water (Figure 5). In Xinyi, 17 new sluices increased irrigation water storage by 850,000 cubic meters each year.

Water-saving technologies comprised another category of demonstration measures. These measures aimed to improve farmer incomes and reduce vulnerability to climate change impacts. Measures included lining canals with durable and freeze-resistant material to reduce water losses, installing irrigation pipelines, and sprinkler and drip irrigation systems. Switching from surface canals to irrigation pipelines led to large water savings through reduced evaporative losses.

Other farmer demonstration activities focused on alternative crop varieties. These activities demonstrated the performance of crop species with high tolerances to drought, waterlogging, and extreme temperatures. In Hebei's Cang County, farmers switched to drought-resistant wheat, cotton, and corn varieties. In Jiangsu Province, farmers in Xinyi and Suyu counties adopted productive and disease-resistant wheat varieties. In Henan, farmers selected semi-winter wheat varieties to respond to warmer winters. Information on optimal cropping mixes and cropping patterns (such as adjustments to sowing date and cultivation methods) were also shared with farmers.

Through improved irrigation and drainage facilities, the project demonstrated another measure to adapt to projected increases in ET and high-intensity rainfall events. Surface irrigation and drainage facilities were adjusted to increase their water-handling capacity. Drip and mini-spray irrigation, and underground irrigation pipelines were used to help reduce evaporative losses associated with higher temperatures.

Figure 5. Water harvesting using flip-gates on drainage canal (left) and on-field (right).

Credit: SOCAD.

Farmer education on irrigation management was conducted simultaneously with irrigation infrastructure improvements. Members of WUAs and FAs were trained to enable them to effectively meet adaptation needs. For example, members were trained to practice irrigation scheduling during unpredictably long gaps in rainfall or practice deficit irrigation.[1] Provision of volumetric measuring devices also helped to monitor and control water usage. Additionally, instituting water charges based on actual consumption changed behavior and reduced water use.

Providing greenhouses enabled planting of off-season vegetables such as cucumbers, eggplants, and peppers (Figure 6), increasing farmer income.

Figure 6. Greenhouse.

Source: Wang et al., 2010.

Afforestation was achieved through the selection of climate-resilient tree species that created wind-breaks near farms, which reduced wind velocity, ET, and increased local atmospheric moisture. Hydrometeorological and satellite data were used in conjunction with actual crop ET observations to monitor project sites and estimate ET over large expanses. The remote-sensing data assisted in assessing the impacts of the project-supported water saving measures on agricultural production and ET.

Integrating adaptation measures into IAIL3 project implementation activities. SOCAD worked with WUAs and FAs to develop, test, select, and demonstrate cost-effective adaptation measures. By 2010 — midway through the project — more than 1,000 WUAs and 200 FAs had been set up. Farmers were actively involved in project design, and were offered training on climate risks and adaptation measures by mobile expert teams. These teams included agricultural and water resources experts from the Department of Climate Change of the National Development and Reform Commission, the China Clean Development Mechanism Fund Management Center, CAS, and the Chinese Academy of Agricultural Sciences. Farmers were introduced to new drought- and pest-resistant wheat varieties that would fare better under projected future growing conditions. Farmers were surveyed, consulted in groups, and had opportunity to meet face-to-face with experts (Figure 7).

Demonstration or pilot sites were critical in the uptake of new crop varieties, practices, and technologies by farmers. Many farmers were reluctant to abandon longstanding reliance on particular crop varieties. However, this was overcome when they witnessed the higher yields delivered by the new varieties in demonstration or pilot locations. Similarly, government-led pilot programs introducing new techniques to better manage irrigation water took hold after the farmers saw the benefits, such as reduced water loss, reduced expenditures on irrigation, and reduced groundwater depletion, which all resulted in greater water efficiency.

Women were key to the project's integration strategy. Increasing water scarcity in the 3H basin had spurred emigration of young males in search of employment. As a result, women now comprise as much as 70–80% of the agricultural labor force in some districts. With farms often located in the most poverty-stricken or fragile areas, these women are particularly vulnerable to adverse impacts of climate variability and hazards. CAD recruited experts from the China Agricultural University and the nonprofit Home of Rural Women to deliver targeted training sessions to these women.

Component 3: Mainstreaming adaptation into the CAD program and strengthening institutional capacity

CAD has county- and provincial-level offices that are the foundation for continued climate change adaptation efforts beyond the project lifetime. Adaptation is being increasingly mainstreamed across CAD programs (e.g., Anhui Province's CAD investment guidelines call for all local CAD project proposals and technical designs to take climate change adaptation into consideration).

Overall project achievements

The project met or surpassed a number of performance indicators for the IAIL3 and GEF projects (World Bank, 2011, 2012). Notable results include an increase in average per capita income among farmers of US$326 per year, and a rise in high-value crop production from 3.2 million tons to 4.2 million tons per year (World Bank, 2015). Additionally, the project improved agricultural productivity and water resources

1 Deficit irrigation has been widely investigated as a valuable and sustainable production strategy in dry regions. By limiting water applications to drought-sensitive growth stages, this practice aims to maximize water productivity and to stabilize – rather than maximize – yields (Geerts and Raes, 2009).

Figure 7. Left to right: Farmers taking a survey in Jiangsu, discussion with farmers of Henan's Wancheng District, and farmer consulting with expert.

Credit: SOCAD.

management on 505,500 hectares of farmland; established 494 new WUAs, covering an area of 95,424 hectares; enabled 182 WUAs to implement climate change adaptation measures; established 166 FAs; increased the percentage of farms with irrigation systems from 58% to 80% in the project area; built 135 hectares of greenhouses to enable farmers to plant higher-value crops; implemented 256 research and experimental/ demonstration activities focusing on rural water management, advanced agriculture technologies, and institutional capacity-building; built the technical skills of women farmers so they could be active participants in the implementation of adaptation activities; and increased awareness of climate change risks and adaptation measures among farmers, WUA and FA members, technical staff, and officials.

SUCCESS STORY

In February 2009, a 1-in-50 year winter drought occurred in wheat-growing Huaiyuan County within Anhui Province. Due to well-established irrigation facilities, better water management, and improved crop varieties provided by the project, the area's wheat seedlings remained unharmed and there was no crop damage.

Source: Wang and Li, 2011.

Project Challenges

Adjusting the baseline project to reduce the risks posed by climate change

IAIL3 was an ambitious baseline project that sought to increase farmer income, the 3H basin's agricultural productivity, and regional contribution to the national economy, but failed to consider potential impacts of climate change from the outset. When SOCAD and the World Bank decided midway through implementation that a thorough assessment of the impacts of climate change on the 3H basin was needed, an intensive, integrated (climate-crop-water-economic) modeling study was conducted by teams of international and local experts. Critical gaps in IAIL3 were identified. The GEF project financed retrofitting or redesigning baseline project activities to account for climate change.

Changing farmer behavior

At the beginning of the project, many farmers were unaware of climate change, unwilling to change practices they had adhered to for decades, and reluctant to switch to new crop varieties. These immense challenges were addressed in two ways. First, farming households, WUAs, and FAs were educated about climate change risks and impacts through various dissemination materials, visits by extension agents, and discussions with mobile expert team members who visited project areas. In Huaiyuan County of Anhui Province, the project management office organized a visit to the Huaiyuan Meteorological Station to allow farmers from neighboring areas to better understand climate change and its impacts on agricultural production and the lives of ordinary farmers. Second, and a critical factor in farmer uptake of adaptation measures, were the project demonstration sites. These allowed farmers to directly compare traditional and adaptation measures. Farmers observed the resilience of new crop varieties to climatic conditions and the ability of a new irrigation technology to conserve water. The demonstration projects proved powerful in overcoming farmers' reluctance to change longstanding practices.

Coordinating multiple moving parts

This large-scale project involved SOCAD, county- and provincial-level CAD offices, other government ministries working in climate change-related areas, climate scientists, teams of agricultural and water resources experts, WUAs, FAs, and over one million farming households. The project coordination structure set in place by SOCAD helped ensure close interaction and information flows across these key stakeholders.

Balancing adaptation grant size relative to baseline project size

The implementing agency found that the size of the GEF adaptation grant relative to the area and scale of issues covered by IAIL3 only allowed for a limited exploration of adaptation options. However, the project was able to set an example for subsequent adaptation work (see below).

Currency appreciation

Soon after SCCF resources were approved, the Chinese Renminbi appreciated with respect to the U.S. Dollar. By the time the executing agency received funding, the dollar value of the SCCF grant was converted to a smaller sum of local currency than anticipated. As a result, some components (e.g., study tours) had to be downsized and, in some cases, funds had to be reallocated from other sources to support adaptation measures. Speedier disbursement of funds to the executing agency could have helped avert this issue to some extent.

Analysis

The common approach to intensification of agriculture tends to be investment in new irrigation infrastructure. This project demonstrated that much can be achieved by improving water resource management using existing mechanisms, thereby obtaining real water savings and improving water efficiency. Large gains across a variety of topics can be achieved with minimal investment, and are described below.

Adaptation "mainstreaming"

Despite the inclusion of adaptation activities midway through implementation of a baseline investment, this project provides excellent lessons for adaptation mainstreaming into ongoing initiatives, including its sequence of activities: integrated modeling, identification and prioritization of adaptation options, and demonstration and implementation of adaptation measures.

Effectiveness of a multidisciplinary team

The project owes its success in part to the integrated and cross-cutting nature of its team, which comprised economists, climate change specialists and modelers, hydrometeorological agencies, agriculture specialists and researchers, and staff from various government agencies in China.

Value of data-sharing

The Environment and Water Ministries and Basin authorities pooled data from various monitoring stations, which greatly contributed to smooth coordination and information flows for the project.

Adoption of climate change adaptation measures

A study by the World Bank's Independent Evaluation Group found that the measures introduced were resilient to future conditions, but also made good farming sense for current climate risks (World Bank, 2015). The project's ability to deliver immediate and visible benefits during its implementation period likely contributed to its success.

Role of climate modeling

Through this project, the World Bank found that climate change modeling is useful for testing adaptation policies against a range of scenarios rather than a single future scenario (World Bank, 2015). This is a useful lesson, as some adaptation projects can get bogged down by trying to meet the apparent needs posed by highly specific model projections, rather than focusing on the general trends indicated by them.

Water measurement leads to better water management

A striking lesson from this project was that when water measurement devices were installed and farmers were subsequently charged based on their actual water consumption, water use patterns began to shift toward water conservation and careful usage. Simple water management measures can have powerful benefits.

Next Steps

The success of the GEF SCCF and IAIL3 projects has led to adoption of the same design for a recently approved World Bank project loan for an additional five provinces in China; the US$200 million *Integrated Modern Agriculture Development Project* was approved in December 2013 and seeks to develop sustainable and climate-resilient agricultural production systems in the Gansu, Hunan, Jiangxi, and Liaoning provinces; the Xinjiang Uygur Autonomous region; and the Chonqging municipality (World Bank, 2013). This new project, in addition to the IAIL3 and SCCF projects, effectively cover China's major food-growing regions.

The SCCF project's success has also catalyzed investment projects on the provincial level. In Anhui, climate change adaptation activities will be scaled up from 16 to 93 counties, extending the number of farmers involved in adaptation activities from 1 million to 31 million.

Additional insights emerging from the SCCF project that inform future work include the value of strengthening institutional capacity to better understand climate change risks and cross-cutting solutions, and ensuring strong linkages across teams conducting desktop analyses and field-level implementation. The ability of the project to demonstrate and provide immediate benefits to stakeholders is also valuable in boosting the uptake of adaptive actions. Policy mainstreaming of adaptation can pave the way for scaling-up and expanding adaptation projects, as has been the case for Anhui.

Conclusion

This project serves as an example of how to use additional grant funding strategically to integrate adaptation actions within a larger development initiative, leading to a catalytic and transformative effect. Not only did this structure have immediate influence on project design, it influenced the way SOCAD plans to finance future agricultural projects in China.

Upon completion of the IAIL3 and SCCF projects, SOCAD issued a new policy for its entire investment program — counties applying for funding need to discuss climate change impacts in the target area and how these will be addressed. The project also helped to develop a decision support system (DSS) for CAS, which included information on climate change impacts on water and agriculture resources for each county in the five provinces covered by the project. This DSS now plays a role in determining the investments SOCAD selects for funding.

A scaling-up study has been completed that includes an analysis of climate change impacts and adaptation measures for all major grain-production regions in China. Climate change adaptation policy and action plans are being formulated for the national CAD program. Also, with assistance from CAS scientists, a climate change information and data-sharing framework has been established through SOCAD, linking all provincial websites from the project (Conrad and Li, 2012).

The project generated uptake of demonstrated crop varieties and technologies from the project among farmers. Additional uptake of new crop varieties and practices is anticipated to continue. Box 1 shows the success in one village with a climate-resilient (drought and pest-resistant) wheat variety.

BOX 1. *XUZHOU WHEAT NO. 31* IN SANCHA VILLAGE

For decades, the people of the Xinyi municipality within the Jiangsu Province had planted the same variety of winter wheat. In 2009, the Xuzhou Municipal Agricultural Research Institute recommended planting the semi-winter and semi-winter spring wheat variety, *Xuzhou Wheat No. 31*, which was expected to respond well to projected climate changes in the area.

Farmers in Xinyi's Sancha Village were nervous about moving away from a familiar variety. However, Tang Xuerang, the leader of the Sancha Villagers' Committee, decided to champion the new variety. That year, Xinyi experienced high rainfall levels, which led to the failure of many crops. The new wheat variety, however, produced full seeds and suffered almost no failure.

Witnessing the high yield of the new wheat variety and the corresponding increased incomes, villagers were inspired to switch varieties. In 2011, Sancha Village bought 15,332 kilograms of *Xuzhou Wheat No. 31* seeds and planted 81 hectares for demonstration and extension. Villagers stated that they would continue to expand its acreage. As villager Liu Yuliang said:

"This year, I planted *Xuzhou Wheat No. 31* and the yield is over 500 kg! … Last year, no one dared to plant it, but this year everyone wanted to plant it. This is indeed a great favor the project did for us!"

Source: Wang and Li, 2011.

The project's prospects for sustainability are high due to three factors. First, it helped farmers help themselves. Supporting the development of WUAs and FAs through training and funding has equipped thousands of small-scale farm households in China with knowledge and resources to navigate the various risks associated with an increasingly evolving, market-based system in a changing climate. Second, the project helped to mainstream climate change adaptation considerations in SOCAD's investment programming. Critical capacity was built among institutions at national, provincial, and county levels that will ensure that resilience to climate change continues to remain a priority in the region. Third, the project built resilience to climate change impacts through adaptation on 100,228 hectares of land. Farming households of the 3H basin continue to become more open to moving away from practices and crops they had relied on for decades. Observing positive results at demonstration sites continues to be a driver for farmers to uptake new resilient crop varieties or other adaptive practices across this highly vulnerable and crucial basin.

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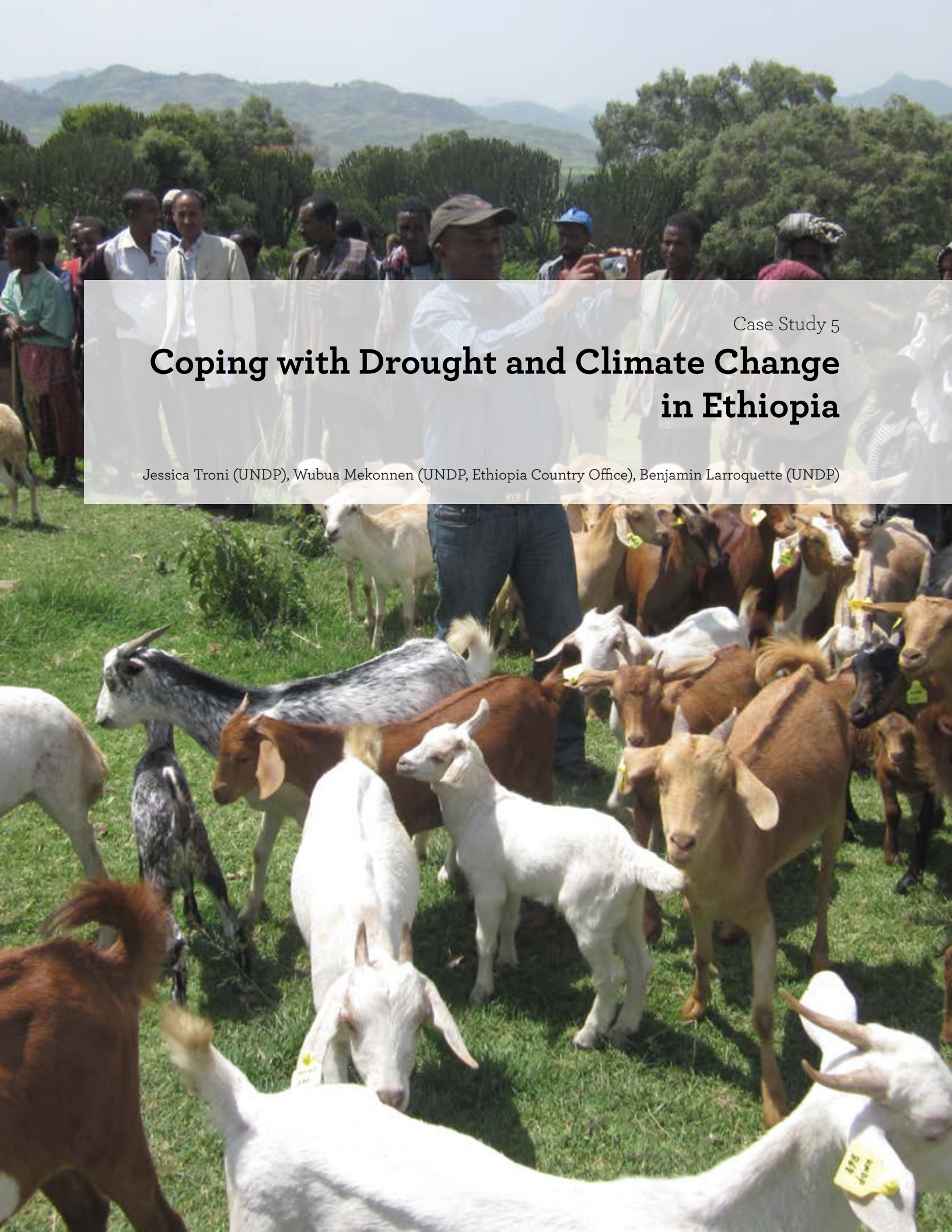
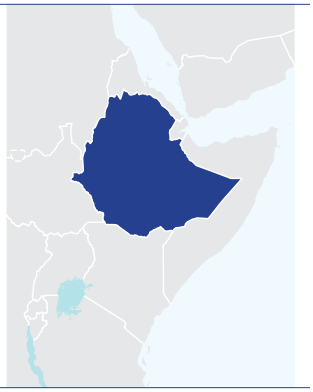


Case Study 5

Coping with Drought and Climate Change in Ethiopia

Jessica Troni (UNDP), Wubua Mekonnen (UNDP, Ethiopia Country Office), Benjamin Larroquette (UNDP)



Case Study Overview

With financing from the GEF and support from UNDP, the Government of Ethiopia undertook an early adaptation project to strengthen the resilience of Ethiopians to drought by improving agriculture-based livelihoods. The government implemented the project, *Coping with Drought and Climate Change in Ethiopia*, between March 2009 and March 2013. It was one in a series of projects in Ethiopia, Kenya, Mozambique, and Zimbabwe used to test and disseminate drought-resilient agricultural technologies and practices in Africa. This project led to increased incomes, improved nutrition, and more secure and resilient livelihoods for Ethiopians. The project also generated important lessons on effective techniques for livelihood diversification and climate change adaptation, which have been captured and shared in a variety of publications (see the References and Additional Tools and Resources sections at the end of this chapter).

Project Background and Brief History

The highlands of Ethiopia, home to a large number of subsistence farmers and herders, are sensitive to climate variability (Adger et al., 2007). Ethiopia is experiencing rising temperatures and declining rainfall in the northern half of the country. For Kalu Woreda in Amhara Regional State, which borders Sudan, this has led to repeated droughts in an arid landscape, making secure livelihoods a challenge.[1], This sensitivity could become greater under climate change, particularly given regional projections of increased aridity, higher susceptibility to drought, and the proliferation of crop pests (UNDP, 2012b). More than 80% of Ethiopia's labor force works in agriculture, the nation's most productive economic sector and a critical area for climate change adaptation (Bryan et al., 2009).

The government has recognized Kalu Woreda's chronic food insecurity and ongoing welfare needs for many years (Conway and Schipper, 2011); indeed, as part of national adaptation planning, in 2007 Ethiopia became one of the first Least Developed Countries to finish a NAPA. This NAPA outlined sustainable land, drought, and agricultural management as priority adaptation issues. Together with the GEF and UNDP, the Government of Ethiopia developed the Coping with Drought and Climate Change in Ethiopia project to strengthen the country's resilience to climate change by focusing on improving the livelihoods of those in the agricultural sector in Kalu Woreda.

The primary objective of the project was to develop and pilot technologies and mechanisms to reduce the vulnerability of farming communities, with a particular focus on women and children. The project tested and disseminated agricultural technologies, such as drought-resistant seeds, small-scale irrigation for fruit and vegetable production, livestock production, and integrated pest management (IPM). Community and farmer input and ownership were central to the success of these project activities.

Financing and partners

The project implementation was led by the Ministry of Agriculture and guided by the District Management Committee and *kebele*[2] (the smallest administrative unit of Ethiopia, usually at the village or neighborhood level) leadership. This work was supported with US $1 million from the GEF's Special Climate Change Fund, over US $1 million from the World Food Programme, and US $750,000 from the Government of Ethiopia.

1 Woredas are administrative districts within Ethiopia, composed of multiple villages.

2 "*Kebele*" and "village" are used interchangeably throughout this case study.

Project Achievements

The project promoted new agricultural technologies that have improved Ethiopians' lives and enhanced their capacity to prepare for and respond to adverse impacts, which in turn improves their chances of attaining climate resilience in the long-term. Below, we detail 11 individual project efforts and their achievements.

IPM

Recent changes in climate have altered microclimates, expanding the reach and population of crop pests. At the project's inception, stalk borer infestation had reduced harvests by 20–30% in the target communities. IPM, therefore, has become an essential activity to sustain agricultural livelihoods. IPM proved to be an effective method, drawing on indigenous crop pest control treatments to replace chemical pesticides.

Farmers in the district formed IPM groups to experiment with different techniques. With support from the Office of Agriculture and the Kombolcha Pest Surveillance and Study Center, the groups were trained and provided with tools, such as safety and spraying equipment. Each group member paid a small monthly fee for maintaining equipment and operations. Approximately 1,000 hectares of cropland was treated with more than 16,000 liters of botanical pesticides made from native plants and animal urine. Farmers indicated that they saved US$2,000 from avoiding chemical pesticide purchases, and their cereal crop yields doubled. In addition, farmers recognized significant environmental and health benefits from switching to natural pesticides. The IPM groups have continued to expand since the completion of the project, with additional farmers opting in as a way to improve their own livelihoods. Equipment is also rented out to farmers outside the group, expanding the groups' reach and allowing more farmers to take advantage of project-based techniques.

Irrigation for resilience

The project introduced and promoted small-scale irrigation. Poor access to water had limited agricultural production and food security. Irrigation ensured that crops could reach maturity and that farmers could sell crops during the dry season, when market prices are high. The primary technologies that the project promoted included irrigation ponds for harvesting rainwater, drip irrigation systems, and the redevelopment of irrigation canals. Building irrigation ponds to harvest and store rainwater was a particularly successful approach to improving reliability of the water supply. Project personnel and farmers dug irrigation ponds and lined them with geo-membranes, a

thin, synthetic material with low permeability that captures rainwater. The project also gave farmers access to pumps, to move the water from the ponds to crops for irrigation. This initial support helped 280 farmers irrigate 23.3 hectares of land and served as a foundation for additional work.

Irrigation brought significant financial returns for the farmers. The majority earned US$498–$996 more than the previous season, with the most successful model farmers earning US$2,987. These were significant earnings improvements: in 2013, the per-capita gross domestic product in Ethiopia was US$505 (World Bank, Undated).

Furthermore, small-scale irrigation enabled the farmers to grow a variety of crops, including papayas, onions, and other produce. On average, for example, model farmers (described below) earned approximately US$2,000 per year by primarily growing papaya and onions.

Using a pass-through, "train-the-trainer" approach to create a model farmer system

To spread agricultural innovations and practices through villages, the project used a diffusion-based, revolving model, also called a pass-through system (Rogers, 2003). Under this system, an initial set of farmers trains subsequent sets of farmers. District officials trained the initial set of farmers, called "model" farmers. These model farmers obtained irrigation equipment only after receiving training in its operation. Model farmers then trained successive groups of farmers.

Communities chose the model farmers based on the individuals' exposure to risk, their work ethic, and their willingness to demonstrate the benefits of the project to others in their community. This peer-to-peer, pass-through exchange was the central avenue for the successful promotion and replication of technologies. As farmers saw the success of the model farmers' techniques, they began to adopt project practices. A testament to the success of this approach is that, after seeing the effect of the technologies and techniques on the model farmers' crops, more than 300 additional farmers requested irrigation pumps of their own. They acquired pumps, seeds, and geo-membranes at a subsidized rate. This train-the- trainer model was still in place in early 2016, with ongoing technical support from the Ministry of Agriculture.

Dissemination of improved seeds and goats using a rotating beneficiary approach

For another aspect of the project, staff combined the pass-through model with a rotating beneficiary approach. The first set of beneficiaries received seeds of high-yield, drought-

Figure 1. Irrigation pond for rainwater storage.

Credit: UNDP.

resistant, and early-maturing crop varieties of vegetables, grains, and pulses.

During the next harvest, these beneficiaries provided an equivalent number of seeds to the cooperative seed bank; these seeds were then passed on to the next set of beneficiaries. Not only did farmers share the seeds, they transferred their knowledge to the next set of beneficiaries.

The project disseminated improved seeds to 2,540 farmers, which led to increased crop production, food security, and a safety-net for households to adapt to drought conditions. By using a revolving fund system for seeds the project was able to extend the benefits to support more households.

Cultivating cropland with the improved seeds resulted in dramatic increases in crop yields and crop diversity. This increased the annual average household income of project farmers by US$44 from cereal crops, US$42 from grain legumes, and US$332 from vegetable crops. These increases in income were the result of a wide range of increases in crop output. For example, teff, a staple crop, had a production increase of 100%; the increase for sorghum was 22% (UNDP, 2012a). The average increase for all cereal crops was 46%.

The project relied on a similar method for livestock cultivation, with the first set of beneficiaries sharing livestock offspring with subsequent sets of beneficiaries. Original beneficiaries chose sheep and goats from local markets in consultation with a livestock expert to ensure the animals' health. The original distribution of 570 sheep and 760 goats led to a shared second distribution of 200 sheep and 730 goats. This rotating beneficiary structure provided a successful mechanism for

replicating the project's efforts and for growing the program's cost-effectiveness. With less than US$3 million of financial support, the project benefited 100,000 people, and continues to benefit people well beyond the duration of the project. The dissemination of seeds and goats, along with other project activities, helps beneficiaries to diversify their income sources and absorb losses if a particular income-generating activity is affected by climate change.

Flood protection measures

Climate change is expected to alter rainfall distribution patterns in Ethiopia, which could mean heavier rainfall condensed into a shorter period of time (IPCC, 2013). In Kalu Woreda, erratic rainfall and high floods have forced many farmers to relocate from their most productive lands. To adapt to these floods, the project constructed and installed more than 2,000 gabions throughout the district, protecting 560 hectares of cropland. In addition, communal management of watersheds and natural resources, discussed in the next section, included measures that helped bolster natural defenses against flooding.

Communal management of watersheds and natural resources

The project implemented integrated soil and water conservation activities to increase agricultural productivity and protect the area's natural resource base. Activities included area closure, land rehabilitation, and revegetation. Two drivers of poor agricultural productivity are deforestation and erosion. Jatropha, an evergreen that is resistant to drought, was easily planted on degraded lands to slow these drivers.[3] However, efforts to propagate jatropha have not been universally successful (Wahl et al. 2012). The tree is also a bio-fuel and has helped reduce local people's charcoal use by 50%, and alleviate the need to cut pre-existing trees, thus resulting in mitigation benefits. Other forage and tree plants, including pigeon pea, *Acacia polyacantha*, Sesbania, and Lablab — all nitrogen-fixing plants — are also performing well; six nurseries have been established to grow roughly 892,000 trees and grasses. The project rehabilitated a total of 3,049 hectares of land in six micro-watersheds. Focus groups with members of the farming communities and agricultural experts revealed that the discharge capacity of springs and rivers has improved, floods have declined, and soil moisture of cultivated lands has improved. These project efforts will aid in the regeneration of the lands and will help communities better manage their watersheds.

3 The use of Jatropha is not without its controversies, see for example Wahl et al. (2012).

Fruit and vegetable production

The promotion of horticultural crops has been identified as an important mechanism for coping with drought and climate change. The project's nursery work was managed centrally from the government-owned Habru Fruits and Vegetables Production Nursery site. The project increased production in fruit and vegetable quantity and quality. The nursery helped disseminate the materials and seeds necessary for farmers to grow fruits and vegetables on their homesteads. In total, 2,540 farmers benefited from this aspect of the project and were able to produce their own fruits and vegetables.

Cultivation of forage plants for livestock

The cultivation of forage plants for livestock grazing was another successful component of this project. The project provided forage seeds to the Office of Cooperatives to distribute to farmers. Locals sowed these seeds across six watersheds where livestock could feed, even during drought-induced livestock feed shortages. This gave beneficiaries some protection from losing livestock, one of the critical vulnerabilities presented by droughts. The forage plants also helped to alleviate problems associated with overgrazing by rehabilitating land and limiting land degradation, which contribute to soil erosion. Finally, the cultivation of forage plants also created new habitat for bees and beekeeping.

Development of alternative livelihoods

Beehives and bee colony supplies were provided to beneficiaries as an additional means to diversify livelihoods. Approximately 360 modern beehives, 140 bee colonies, and equipment for honey processing were distributed to 280 farmers. In addition, approximately 1,200 kilograms of honey wax were procured to facilitate honey production within the hives. During the project, the beneficiary farmers produced more than 25 kilograms of honey from the beehives and increased productivity by 20–25%. The beekeepers, most of whom are also farmers, engaged in a number of activities to increase suitable bee habitat, including tree planting, fighting deforestation, and area closure.

Development of weather forecasting

Farmers face difficulties when they have to make farming decisions in absence of weather forecasts, a situation that is typical for farmers in the Kalu Woreda. With climate change, farmers face an additional difficulty in that the current and future weather conditions may be quite different from the past, and their current farming practices may be ill-suited to future conditions. This project attempted to reduce weather-related

uncertainty, and support farmers' decision-making by developing weather advisories from the National Meteorology Agency, in addition to 10-day, monthly, and seasonal forecasts.

Rainfall information was regularly sent to the district agricultural office, where the meteorology agency used this data to issue forecasts, advisories, and early warnings to over 9,000 farmers. The capacities built in the district offices allowed for replicating this system beyond the target villages. Since the project formally ended, the government procured and installed automatic weather stations to further facilitate the national climate information gathering and early warning systems.

At a local scale, the villagers learned to use rain gauges and thermometers at Farmer Training Centers so they could collect and use weather information themselves. For instance, farmers learned that if there were four consecutive days with 20 millimeters of rain, they could begin preparing their land for planting.

Introduction of high-value crops

Introducing high-value crops, such as sesame, mung bean, and haricot bean, has had the benefit of generating more income, diversifying the crop mix, and in some cases increasing the productivity by intercropping. The introduction of new fruit and vegetable seeds has increased the food supply through domestic consumption and income from sales, and in this way has helped enable farmers cope with drought and climate change impacts.

Summary of project achievements

The combination of approaches compounded the success of the individual efforts described above. By the end of the project, 474 households no longer needed safety-net support, by government standards: 1,804 men, women, and children had enough food for the majority of the year and no longer received government aid. Still, some of the project beneficiaries experienced a food deficit during parts of the year, signaling that they also continued to be vulnerable to climate change. The activities spread beyond the 41,000 farmers in the originally targeted six *kebeles*, reaching 100,000 people. The promotion of drought-resistant seeds, small-scale irrigation, IPM, and the livestock improvement program continued after the end of the project, demonstrating the sustainability of these activities and the effectiveness of the mechanisms that supported them. The project also contributed to the knowledge base of best practices in climate change adaptation, particularly in developing countries, and this was an outcome with potentially global benefits.

Project Challenges

Community-based adaptation poses specific challenges. Project implementation difficulties are not unique to adaptation projects. For this project, in addition to the more standard issues, such as notable delays, rushed activities, and gaps in project reporting, the lack of consistency in implementation also resulted in difficulties interacting with the beneficiaries. Familiarity between the implementing team and the farmers eroded each time a new team member came on board.

An additional project challenge was obtaining goods and services for project activities. This led to delays and detracted from the project focus. Local merchants were not always reliable and did not always bring supplies on time. A lengthy government procurement process compounded this with further delays. Working to build relationships among all public and private stakeholders proved to be critical in improving the provision and delivery of project inputs.

This project was among the earliest adaptation projects implemented anywhere.. As such, this project relied mostly on development experience, rather than experience learned from other climate change adaptation efforts. In hindsight, this fact is apparent in the project design, which did not account for sensitivity to climate change in many components.

The lessons on the successes of this project are well documented and widely available (see the References and Additional Tools and Resources sections at the end of this chapter).

Analysis

The project uncovered two categories of lessons. First are project-specific technical lessons; since many of these are captured in existing publications (e.g., Worku, 2012), they are not discussed here. Second are more general lessons on the administration of a climate change adaptation project, which contributed to the project's success. These general lessons follow.

Engage a diverse set of stakeholders across multiple levels to build ownership. One of the greatest achievements of this project, and one that is being felt after the project's end, was a strong sense of community ownership. Engaging farmers and local representatives from the beginning, whether by asking what income-generating activities they would like to participate in or by having them prioritize which community members should fall into which phase of the beneficiary model, planted this seed of ownership. This allowed for agricultural technologies to be responsive to farmers' needs and ensure the

uptake of new technologies and practices. The farmers were asked to invest their own resources, including their land, time, and knowledge, which connected them more closely to the effort as a whole. This kind of project ownership was critical to the sustainability of the benefits the project generated; it promoted coordination among community members. They were not only passing along their own resources, but also sharing their knowledge as to how these resources could be effectively managed (Adger et al., 2007). One of the reasons this may have been effective in the project implementation area may have been the unique cultural context. In Ethiopia, it is not unusual to provide labor, finances, or other in-kind support for land rehabilitation activities (Wubua Mekonnen, UNDP, personal communication, August 24, 2015).

One of the unique experiences of this project was the integration of concerned sectoral offices (such as agriculture, water, environment, etc.) in the implementation of project activities, as devised by the District Management Committee. This approach to partner integration proved pivotal, as it increased cooperation and gave everyone a degree of responsibility over the activities and outcomes. As such, the sectoral offices included the project activities in their annual planning, and evaluated their own progress against the project targets. This helped prioritize project activities within local institutions.

Sharing research results helped project personnel identify new ideas and techniques. Throughout the project, there was consultation among community members, government officers, and university and research centers — including Wollo University, the Bako Agricultural Mechanization Center, the Sirinka Drylands Agricultural Research Center, Kombolcha Technical & Vocational College, the Kombolcha Pests Surveillance and Research Center, and the Federal Ethiopia Institute for Agricultural Research. These consultations were essential for identifying new research avenues, in many cases proposed by farmers. The farmers suggested research topics, such as identifying sufficient rainfall levels for early-maturing crops, measuring soil fertility, tracking the change in temperature, and suggesting the need for drought-tolerant crops. In turn, the researchers and government officers helped farmers acquire improved seeds and agricultural technologies.

The model farmer system was an effective dissemination framework. Diffusion of practices through model farmers provided a useful avenue to demonstrate new technologies and allowed for knowledge exchange among farmers. The phased model ensured sustainability and cost-effectiveness, and allowed for the expansion of project resources to increase the numbers of beneficiaries. The second- and third-round beneficiaries learned practical experiences from their predecessors, providing a systematic means to spread knowledge. One of the reasons this may have been effective in the project implementation area is that in Ethiopia there is an existing nationwide model farmer program (Wubua Mekonnen, UNDP, personal communication, August 24, 2015).

Successful climate change adaptation techniques were key. Providing sheep, goats, bee colonies, fruit trees, and vegetable seeds increased productivity, diversified income sources for farmers, and effectively helped farmers cope with drought. In addition, early-maturing and high-yielding crop varieties will reduce the effects of drought and climate change in the future. However, it is unclear whether all project activities were screened for sensitivity to climate change. For instance, it would be useful to know if the financial benefits of beekeeping are sufficient to offset the climate risks, and whether the beneficiaries thought this was a good way to make their livelihoods more resilient.

Given its achievements, the project provided many lessons at a broader level, which could be applicable to similar adaptation projects in the future.

Invest in effective project design, including monitoring and reporting.

- Business models need to adequately account for agricultural technology promotion. The high cost of these technologies can act as a detriment to subsequent post-project dissemination. Microfinancing and clear strategies for dissemination, replication, and scaling-up should have a prominent role in future climate change projects.
- Evidence-based indicators of adaptation to climate change can support the business case for future investment in the types of adaptation measures that have been tested in this way.

Identify context-appropriate climate change adaptation techniques.

- Easily deployable, high-return measures such as improved seeds, IPM methods, household fodder production, and minor rainwater harvesting for kitchen gardens should be given a greater emphasis in drought and climate change adaptation programs to improve community awareness of basic technologies.
- Watershed rehabilitation programs should integrate a full set of intensive micro-watershed management measures, including customized plantation (potentially coupled with fodder production) that measurably improve groundwater recharge and stream flows around targeted communities.

- Enhanced technical inputs, customized multi-faceted measures, and monitoring of results can produce high returns on investment in drought-affected areas.
- Moisture conservation should be given a higher priority in water harvesting and dryland crop production, including measures to reduce evaporation rates from farm ponds and irrigation systems, and promotion of tilling and mulching methods for improved conservation agriculture.
- Rainwater harvesting and small-scale irrigation systems need to be developed to maximize the dissemination potential, minimize subsidies, and create greater awareness of the financial viability of these systems for small farmers. This includes reviewing the risks of over-pumping, and repair and maintenance of small community irrigation systems. At the time of this writing, project beneficiaries were involved in hands-on training to learn to effectively manage irrigation systems.
- Livestock distribution and beneficiary transfer programs should explicitly assess the landscape suitability for grazing/browsing requirements of the animals that are distributed.

Next Steps

This project has led to a significant reduction in vulnerability in target communities in Ethiopia. However, the project activities were only a demonstration and need to be expanded to the remaining 22 *kebeles* within the Kalu Woreda and beyond. Mainstreaming this successful pilot project would require broad levels of engagement on the part of national ministries and local stakeholders to achieve the additional interventions that would further reduce the vulnerabilities of other people in the region. This could be achieved with fewer resources, given that there would be reduced costs for capacity development.

Furthermore, there was evidence of demand among farming communities for these technologies and techniques, as people saw how the project had improved the lives of those who participated. The goal is that, as word spreads about the best practices of this project, the technologies and techniques will continue to spread among farmers. For this to be achieved, however, proper frameworks will need to be established to ensure access to the technologies and techniques.

In general, project personnel recognize that: (1) the project achieved farmer-led innovations and significant improvements in livelihoods for the farmers; (2) more work would need to be done to strengthen the application of climate forecast information to farming strategies — for instance, a separate agricultural forecast could indicate ideal crops to plant (e.g., drought resistant, early maturing), or when it is time for farmers prepare their land, plant crops, or harvest crops, which would promote resilience to drought; (3) a multi-pronged approach to improving agricultural production would improve the resilience of livelihoods (e.g., use of water harvesting and irrigation with soil management, use of improved seeds, crop diversity); and (4) microfinancing and savings vehicles would help communities implement business ideas for climate-resilient enterprises. Thus, although vulnerability may be reduced for the farming households, the sustainability of such actions would need to be considered carefully.

The long-term success of this project will require supportive policies at the national and regional scales (Rogers, 2003). The project itself had a specific focus on community-level implementation, but without policy links across the region and in the capital, success will be limited to the few areas of implementation.

Conclusion

Lessons from this project have been captured and disseminated beyond the target communities in Ethiopia, and are expected to be especially useful to other dryland areas. Project activities were replicated outside of the targeted *kebeles*, as farmers learned of the project techniques and were eager to implement them. Project personnel organized special events, called "Farmers' Days," to help project farmers share their experiences outside of the project area, which included visits to model farmers' fields for a practical demonstration, and opportunities for discussion so that visitors and model farmers could share their best practices with each other. Although these events were based on a simple idea, they proved to be one of the most effective means to expand the project benefits beyond sites directly involved in the project. As such, these events may be a vital pathway to extend the project's impact.

Beyond the Farmers' Days events, many project activities have been replicated by other organizations in Ethiopia. For example, the GEF, Save the Children USA and its 28 affiliated nongovernmental organizations, and the municipality of Diredewa in Ethiopia have begun the project, "Promoting Autonomous Adaptation at the Community Level." Successful approaches have also been implemented in Kenya, Zimbabwe, and Mozambique, which replicated this project's achievements, particularly in watershed management. Additionally, as a result of the project successes, several national agencies and international researchers became engaged in learning about the project, such as ICF International, the Center for Climate Change Law, Columbia Law School, Tufts University, and others. The existence of a number of reports and publications, some of which were specifically designed with the objective of replication and scaling up the successes of this project, demonstrate a concerted effort to realize the potential that pilot projects, such as this one, offer in terms of new knowledge.

Finally, the private sector has a significant role to play in scaling up the technologies that this project used, including through credit services and linking communities to product markets (Adger et al., 2007). Currently, the technologies promoted through the project are not available in local markets. The project has demonstrated that there is a demand for these technologies, and attracting private-sector participation would be important in furthering the project's reach; private-sector participation could be considered an indicator of transformational change.

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Case Study 6

Strengthening The Gambia's Climate Change Early Warning Systems

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Case Study Overview

The Gambia is vulnerable to a number of hazards associated with climate change, including drought, windstorms, coastal flooding, and sea level rise. Between 2011 and 2014, UNEP, the GEF, and The Gambia Ministry of Fisheries, Water Resources and National Assembly Matters supported *Strengthening The Gambia's Climate Change Early Warning Systems* to: (1) improve the capability and resources of hydrometeorology personnel, (2) engage stakeholders to interpret and disseminate information, and (3) integrate climate change into national policies and protocols. The project successfully developed a more adept national hydrometeorology agency, enhanced the capacity of local hydrometeorology and media agencies, and created more effective means for sharing climate information with farmers and other stakeholders through radio listening groups.

Project Background and Brief History

The Republic of The Gambia is one of the smallest and most densely populated countries in Africa. The Gambia relies heavily on its agriculture sector, which employs three-fourths of the population and accounts for one-fifth of the country's gross domestic product (CIA, Undated). Since the late 1960s, The Gambia has experienced increasing temperatures, shorter crop growing seasons, decreasing average annual rainfall, and changing rainfall patterns (Jaiteh and Sarr, 2011).

Key climate change concerns for The Gambia include drought, wind, coastal erosion, and sea level rise. Available climate change projections indicate that The Gambia will continue to face temperature increases, in addition to changing rainfall patterns. Specific projections of climate change include a 3°C to 4.5°C temperature increase by 2075 and a variable rainfall pattern ranging from a 60% decrease to a 30% increase by 2100 (Republic of the Gambia, 2003).[1] These changes could lead to increased incidence or severity of drought. Simultaneously, The Gambia could face more frequent episodes of intense rainfall, leading to soil erosion and flash floods. The Gambia could also be severely affected by projected sea level rise of 0.4–1 meter by the end of the century (IPCC, 2014). The Gambia's National Communication and National Adaptation Programme of Action (NAPA) identified increased wind storms and coastal erosion as significant climate change risks. In absence of effective adaptation measures, these changes could reduce yields for key crops, reduce groundwater recharge, increase saline intrusion of freshwater resources, and increase tidal flooding (Republic of the Gambia, 2007).

The Gambia is highly vulnerable to projected changes in climate and has a low capacity to adapt. This low capacity is due to the relatively low income of The Gambia's citizens and the country's low level of development. A number of constraints inhibit the generation of climate risk and adaptation information:

- Insufficient quantity and quality of climate data collection and monitoring equipment.
- Insufficient computing hardware and software to analyze climate data.
- Shortage of qualified personnel to transform data into weather forecasts and early warnings.
- Inadequate knowledge of user-friendly products, advisories, and warnings.
- Inadequate knowledge of appropriate media communication methods and messages.
- Absence of an interface between providers and users of climate information.
- Inappropriate media outlets to distribute information.
- Need to distribute materials in multiple languages.

As a result, The Gambia lacks the ability to effectively predict climate events, assess potential impacts, and deliver short- or long-term warnings (UNEP-GEF, 2011).

In July, 2011, with support from UNEP and the GEF, The Gambia began this project, which addressed climate change adaptation needs identified in The Gambia's NAPA. The project aimed to strengthen The Gambia's hydrometeorological, climate information, and early warning systems (EWSs) to enable improved decision-making by the national government, local communities, households, and individuals in the face of climate change. Project activities took place in the Greater Banjul area, the North Bank region, and five other sites.

Project financing and partners

A number of partners helped to finance and carry out project activities. Primary financial support came from UNEP and the GEF, with additional support from the Republic of the Gambia. The total project cost was US$2.8 million. The Gambia's Ministry of Fisheries, Water Resources and National Assembly Matters led the implementation efforts; this ministry houses the Department of Water Resources and the National Meteorological and Hydrological Service (NMHS). Several additional project-specific groups were created to support project management and implementation. A Project Steering Committee oversaw activities and validated annual work plans, budgets, procurement plans, and monitoring and evaluation reports. A Project Coordination Unit was responsible for the day-to-day implementation, financial management, and project reporting. It included experts in meteorology, hydrology, socioeconomic/ policy analysis, information management, and communication. A UNEP staff person served as a Project Task Manager and worked closely with the Project Coordination Unit on oversight tasks. Additional Task Teams and a Chief Technical Advisor provided sector and technical guidance.

Stakeholders were also an important part of the project structure. Primary stakeholders comprised two categories:

1. Climate information and early warning message providers (Department of Water Resources and NMHS).
2. Consumers or beneficiaries of these products (government ministries and agencies, community-based organizations and nongovernmental organizations, private-sector tourism and hospitality groups, and media sources).

1 These were the latest climate projections available at the start of the project.

Achievements

The Gambia project achieved success in three separate areas: improving the resources and capability of hydrometeorology personnel; engaging stakeholders to interpret and disseminate information; and integrating climate change into national policies and protocols.

Improved resources and capability of hydrometeorology personnel

As an initial step to improve the provision of climate information to communities in The Gambia, the project worked to strengthen the capabilities and technology of the NMHS through training and technology enhancement.

In order to enhance the capacity of hydrometeorological services, the project supported a number of training activities. For example, the project sent three meteorologists to the United Kingdom's Met Office for an initial forecasting course. The project also trained NMHS staff, increasing the number of personnel with weather forecasting and hydrometeorological skills.

The Met Office conducted in-country training for forecasters to enhance their use of numerical weather products. The training sessions covered weather prediction, dynamics and thermodynamics of the atmosphere, aviation meteorology, and climate modeling. A hydrological technician also took part in an 18-month course in hydrology. At the local level, the project conducted training sessions for hydrometeorological technicians in the Department of Water Resources Training School.

The project also worked to improve technologies used by the Hydrometeorology Service. Infrastructure such as synoptic automated weather stations and high-capacity data processing and storage equipment were repaired, upgraded, or installed (Figures 1–5). An automatic weather station was installed in the Banjul International Airport to monitor wind and air pressure, enhancing the accuracy of measurements for the airport and Greater Banjul area. A new water-level recorder and flow monitor were installed on The Gambia River, marking the first time such flow data were collected.

Engaged stakeholders to interpret and disseminate information

The project worked with a number of stakeholders to educate them on the importance of climate information services, assess what communication methods were best for their respective groups, and begin disseminating climate information. As a first step, two studies were conducted on approaches for cost-effective, sustainable, and efficient ways of communicating

Figure 1. Existing weather station, prior to project implementation.

Credit: Thabisisani Ndhlovu.

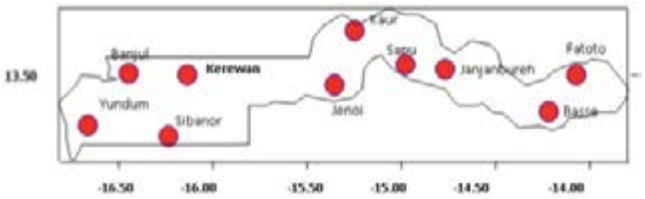
Figure 2. Conventional and Automatic Weather Station at Sapu Agricultural Station.

Credit: UNEP.

Figure 3. Hydrological Station at Pakaliba.

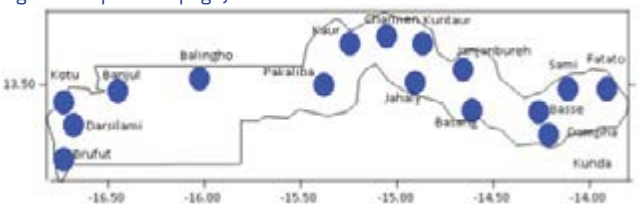
Credit: UNEP.

Figure 4. Synoptic Meteorological Network of the Gambia. The project enhanced the available technology at the sites.



Source: UNEP (2011).

Figure 5. Hydrological Network of The Gambia. This figure shows the 17 hydrological stations, most of which are not operating due to obsolete and broken-down equipment and infrastructure. Under Phase I of the project, some of these stations were rehabilitated and equipped (see Figure 3 on previous page).



Source: UNEP (2011).

early warning information to national and local stakeholders. These studies produced specific recommendations for an effective EWS, including identifying the need to translate meteorological terms into four local languages (Mandinka, Wollof, Fulah, and Jola). The Non-Formal Education Unit of the Ministry of Education, Media Houses, Communities and the Project Coordination Unit of the Climate Change Early Warning project collaborated to carry out the translations. The studies also determined that radio is one of the preferred information-sharing mechanisms. As a result, the project implemented agreements with community radio stations and established radio listening groups. These community-based groups received and disseminated climate change early warning products (forecasts, warnings, advisories, and bulletins) in a timely manner (Figure 6).

The project also worked to train communication agents such as community-based organizations, radio stations, and other media entities (television and print) to convey weather and climate information to local stakeholders in a timely and user-friendly manner and in local languages. These training sessions focused on day-to-day agro-meteorological and hazard information, particularly information regarding the risk of drought and floods. Roughly 45 representatives from various media agencies were trained to report climate change and scientific information.

The project trained farmers to access and use weather and climate information for improved agricultural decision-making, and developed early-warning response protocols in collaboration with community groups. In the North Bank region, the project trained more than 150 young farmers, male and female, to use weather and climate information to make informed agricultural decisions. The agro-meteorological consultant, the team of experts, extension agents, and communities held a dialogue on the indicators, benchmarks, and traditional references the farmers use in the field of meteorology and climate change. Accordingly, the experts delivered presentations providing simple terminology on the weather and agro-meteorological practices that link science to the traditional considerations of weather phenomena. General information on meteorology and climate change, agro-meteorology, measurement of rainfall, and comments on crops were part of the presentations. The dialogues helped participants to better understand certain changes that occur in their immediate environment and, at the same time, their contribution in the degradation of their land resources. Some of the farmers were trained on measuring rainfall from rain gauges installed in the villages (Figures 7–8).

Responding appropriately to such information could increase the resilience of agricultural production to changes in climate and allow adjustments in the timing of certain practices. Special efforts were made to integrate local climate knowledge with more advanced climate prediction methods.. Farmers showed great interest in using both approaches. The project's open communication with farmers strengthened the relevance of early warning information products.

The private sector was engaged through a one-day training and sensitization workshop on the climate change EWSs, the science of climate change, the vulnerability of the national economy to climate change, climate change response strategies, and related risks and opportunities for business investments. Over 50 private-sector entities participated in the workshop.

Mainstream climate change into national policies and protocols

At the national level, the project facilitated the integration of climate information into policies and decision-making processes. Climate change was considered in policies governing agriculture and natural resources management such as the Agriculture and Natural Resources (ANR) Policy, the Forestry Sub-Sector Policy (2010–2019), and the Fisheries Strategic Action Plan (2012–2015) [Republic of the Gambia, Undated (a), Undated (b)]. For example, as a strategy to manage the impacts of climate change, the ANR Policy states it will "Mainstream climate change considerations in all activities of the ANR sector and support the institutionalization of adaptation capacities

Figure 6. Example of a daily weather forecast broadcast over the national television and radios and also uploaded on the website (http://www.mofwr.gov.gm/).

REPUBLIC OF THE GAMBIA
MINISTRY OF FISHERIES AND WATER RESOURCES
DEPARTMENT OF WATER RESOURCES

WEATHER MONITOR

THURSDAY 09TH JULY 2015

Widespread thunderstorms with rain affected the country last night onto the morning hours. Rainfall amount measured in millimeters at 0600 UTC are as follows:
Banjul: 42.0; Yundum: 29.7; Sibanor: 61.0; Kerewan: 17.1; Kaur: 25.2; Jenoi: 17.1; Sapu: 37.8; Janjanbureh: 35.5; Basse: 55.4 and Fatoto: 47.1

Tonight, the atmosphere will be humid and generally cloudy.

Tomorrow, the weather is expected to be humid and variable cloudy with slight to moderate rain and or thunderstorms during the period.

Surface wind flow will be mainly south-southwesterly veering later from the west with speed ranging between 14 – 20km/hr.

The sun will rise over URR at around 6:35 AM and over Greater Banjul area at about 6:45 AM

The sun will set over URR at about 7:28PM and over Greater Banjul at around 7:38 PM.

Temperatures: The lowest minimum is expected to be 23°C over West Coast Region; whereas, maximum will vary between 31°C over Greater Banjul and 34°C over Central River Region.

EXPECTED EXTREME TEMPERATURES FOR FRIDAY 10TH JULY 2015

REGION	TEMPERATURE (°c) EXTREMES	
	Minimum	Maximum
BANJUL	24	31
KANIFING	23	31
WEST COAST	23	31
NORTH BANK	25	33
LOWER RIVER	24	32
CENTRAL RIVER	25	34
UPPER RIVER	24	33

OUTLOOK FOR SATURDAY 11TH JULY 2015
The atmosphere is expected to be generally warm, humid and partly cloudy.

OUTLOOK FOR SUNDAY 12TH JULY 2015
An outbreak of isolated to scattered thunderstorm and rain is expected during the early hours, becoming partly cloudy and warm thereafter.

Figure 7. Photos of theoretical sessions of agro-meteorology and data collection.

Credit: UNEP.

Figure 8. Practical sessions on agro-meteorology and rainfall measurements.

Credit: UNEP.

through partnerships with non-governmental organizations, civil societies, private sector and concerned government organizations." (Republic of the Gambia, 2009, p. 65) Climate change was also incorporated in the 2011 Gambia Plan for Accelerated Growth and Employment. This plan includes the need to mainstream climate change considerations into decision-making, but also points to at least one adaptation measure, "to enhance the use of weather and climate products in farming decisions." (Republic of the Gambia, 2011) In order to achieve integration of climate change in national policies, the project conducted training sessions for nearly 40 senior-level stakeholders in the agriculture, fisheries, and forestry sectors.

Challenges

Limited technical capabilities. The project faced challenges finding qualified individuals to recruit and train as forecasters. In order to maintain a qualified set of personnel, trainees agreed to serve the government for a set period of time after completing their training. They were also invited to attend continuing education sessions to maintain and update their knowledge. The project also engaged the government's personnel management office and the Ministry of Finance to ensure that the national hydrometeorological services remain adequately resourced after the project ended.

Slow course corrections. The project did not have an effective process to incorporate recommendations and good practices from consultants, or from monitoring and evaluation findings. Additionally, the Project Task Manager in charge of integrating such changes left the position well into the project. These factors slowed the integration of some mid-course corrections to the project.

Indirect website management. The website of the Ministry of Fisheries and Water Resources where meteorological and climate information is uploaded for stakeholders (www.mofwr.gov.gm/ccews) is remotely managed by the Ministry of Information and Communication Infrastructure (MoICI), as are all government websites in The Gambia. The website operator at the Ministry of Fisheries and Water Resources has to obtain permission and be provided with a code in order to upload much of the information and documents on the website. This adds an extra layer of complication because in many cases MoICI staff have not been available to provide the necessary permissions. Despite this, however, at the time of publication of this case

study, the website is being used and forecasts are being uploaded (the website operator does not need permission from the MoICI to upload forecasts).

Analysis

Institutional arrangements matter. The project's accomplishments were in part due to the Project Steering Committee and its Chair, who was the permanent Secretary and Technical Head of the Ministry of Fisheries and Water Resources. Embedding the management of the project within the ministry increased communication with the hydrometeorological community. As a result, the hydrometeorological community provided key feedback and input on project activities. The Chair regularly briefed the Minister who provided reports in cabinet sessions and bi-annual cabinet retreats. Additionally, tasking a single ministry to lead project execution simplified project coordination and management. Finally, the presence of a Chief Technical Adviser with extensive experience dealing with climate issues ensured successful implementation.

Identify appropriate communication methods. Radio listening groups were established within project sites. These groups received and disseminated climate change early warning products (forecasts, warnings, advisories, and bulletins) in a useful and timely manner. Messages were crafted to ensure that community members could easily understand and use the information. Positive feedback on the usefulness of the products was documented during project-monitoring efforts.

Next Steps

There are still significant gaps in The Gambia's hydrometeorological observation network, including the need for additional hydrological, coastal, and marine observations. To further enhance the services of the project, work is now underway to establish the NMHS as an autonomous, income-generating agency. For example, the service could create specialized, fee-based products for airports or other commercial enterprises. These products could help to sustain the generation of free weather and climate information for national interests such as agriculture, natural resources, fisheries, forestry, or other applications.

The automatic weather station acquired through the project is expected to boost aviation safety and generate a sustaining source of funding for future meteorological services. New fee-based aviation services were generated as a result of the project. This income should help sustain the project's investments in weather and climate services, and allow for future investments in technology and training.

Additionally, the GEF and UNEP have partnered to design and implement a second phase of the project, "Strengthening Climate Services and Early Warning Systems in The Gambia for Climate Resilient Development and Adaptation to Climate Change." This new project has a similar goal to support climate-resilient development and adaptation by strengthening weather and climate monitoring, and EWSs in The Gambia. This work builds on additional needs identified in the first phase of the project. For example, more capacity needs to be built in-country to maintain the hydrometeorological equipment and to create a business plan for the NMHS

Also, under the Second Phase, the project hopes to address some of the website challenges by nominating a representative from MoICI for the Project Steering Committee, with the ultimate goal of transitioning the management of the website to the Ministry of Fisheries and Water Resources.

There is interest from the private sector for ongoing engagement, particularly the tourism sector. During training sessions, several community-based organizations representing groups that could benefit from climate information or early warning messages in the North Bank region requested that similar sessions be carried out with their respective stakeholder communities. The Gambia Chamber of Commerce and Industry also requested a closer working relationship with the Climate Change Focal Point to continue to build the capacity of the private sector for climate change adaptation.

On a similar note, project personnel expect ongoing demand for weather and climate services from extension agents and farmers.

Conclusion

Overall, the success of the project will be determined by the extent to which it facilitates continued action to strengthen The Gambia's hydrometeorological, climate information, and EWSs, which enable improved decision-making by the national government, local communities, households, and individuals in the face of climate change. Still, in many ways, piloting climate change early warning in The Gambia had several accomplishments. As demonstrated by this project, multiple sectors need to come together to develop useful climate information for the user-community. Simultaneously, communities need tailored climate change information in their local languages. As a result of this project's efforts to integrate

and share appropriate information from various sectors, The Gambian communities have become more aware of climate change risks, impacts to their livelihoods, and measures to adapt such as using weather and climate information to make informed agricultural decisions. This increased awareness helps to improve prospects for long-term climate change adaptation.

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Case Study 7

Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought-Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach

Satya Priya (Food and Agriculture Organization of the United Nations)[1] and
Chibulu Luo (Global Environment Facility)[2]

1 Until October 2014

2 Until August 2015

Case Study Overview

The project, *Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought-Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach,* or Strategic Pilot on Adaptation to Climate Change (SPACC), focused on increasing the knowledge and capacity of farming communities in Andhra Pradesh and Telangana to adapt to climate change impacts. More than 210,000 people inhabit the project area and roughly 10,000 individuals directly benefited from participating in the project, including women, who frequently suffer from limited access to educational resources and livelihood support (Das et al., 2015). From 2010 to 2014, the project helped participants monitor climate variability; complete courses on climate change adaptation, sustainable water use, and sustainable land-use practices through Farmer Climate Schools (FCSs); develop climate change adaptation plans; and take part in weather and climate awareness-raising activities through local media and text messaging. These activities increased the resilience of poor farming communities to future climate impacts.

Project Background and Brief History

Approximately 60% of the 83 million people who live in Andhra Pradesh and Telangana depend on agriculture as their primary livelihood. Many reside in rural areas affected by periods of drought (Reddy, 2011). The region has a harsh socioeconomic environment characterized by high poverty and infant mortality, reliance on child labor, and low literacy levels. Past droughts and insufficient irrigation have led to food scarcity and limited availability of grain. At the beginning of the project, the area experienced average annual yield reductions of 3–6% due to drought (World Bank, 2008).

Even without considering the further challenges of climate change, these communities need support to improve their land- and water-management practices so that they can increase or even sustain current levels of productivity (Reddy et al., 2014). Three-quarters of Andhra Pradesh farmers who do not own the land they farm have no strategy to sustain their agricultural income during droughts (Das et al., 2012). While many climate models project increases in the Indian monsoon, there is still the potential for increased variability and increased drought intensity (IPCC, 2013).

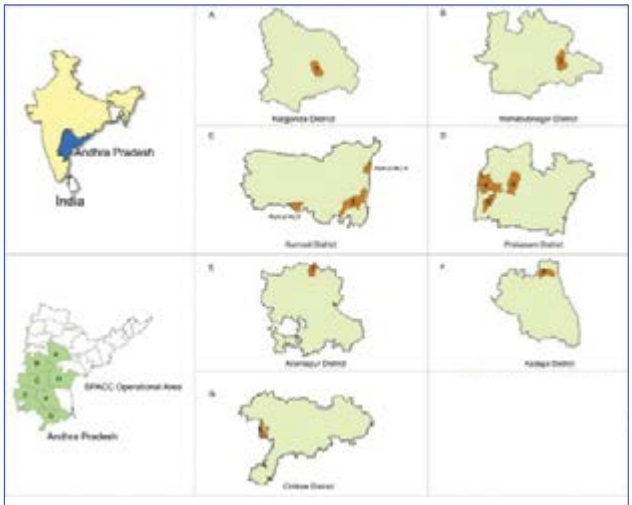
The Andhra Pradesh Farmer-Managed Groundwater Systems (APFAMGS) project provided a foundation for participatory hydrological monitoring and crop water budgeting in the region. Building on the success of that project, which worked with local Climate Change Adaptation Committees (CCACs) and nongovernmental organizations (NGOs), the GEF and FAO developed the SPACC project. The target beneficiaries of the project were farmers in 143 communities in 7 drought-prone districts of Andhra Pradesh and Telangana: Anantapur, Kadapa, Kurnool, Chittoor, Mahabubnagar, Nalgonda, and Prakasam (Figure 1).

The ultimate objective of the SPACC project was to strengthen the capacity of local communities to respond to climate impacts by equipping them with the relevant tools, skills, and knowledge to integrate adaptation into farming practices and decisions.

Specifically, the project aimed to integrate climate change adaptation into farming practices through sustainable land and water management (SLWM). The project supported participants by increasing local institutional capacity, integrating adaptation measures into SLWM practices, and scaling up climate change adaptation measures suitable for drought-prone areas.

Climate change projections that guided the project were drawn from a 2008 World Bank study (World Bank, 2008). This study used the Hadley Center Regional Climate Model, which provides

Figure 1. Operational Area of SPACC.



1 SAID–Nathiganichervu pilot HU
2 CARE–Mallappavagu pilot HU
3 BIRDS–Chinneru pilot HU
4 DIPA–Narsireddipallevagu pilot HU
5 CARVE–Yadalavagu pilot HU
6 SAFE–Ampaleru pilot HU
7 SYA–Upparavanka pilot HU
8 PARTNER–Bokkineru pilot HU
9 GVS–Rommonivagu pilot HU

Source: Reddy, 2011.

projections at a 50-km scale through the year 2060. The study researchers tested two climate change scenarios: the IPCC scenarios A2 and B2. Both scenarios projected increased temperature (2.4– 3.8°C) and increased rainfall (4–8%), but with greater rainfall variability, reducing yields of most crop varieties.

Financing and partners

The GEF allocated US$909,000 ($987,000 in 2014) and the FAO co-financed approximately US$1.3 million ($1.4 million in 2014); in-kind contributions from a network of nine partner NGOs totaled approximately US$1.6 million ($1.7 million in 2014).

Project Achievements

The SPACC project was part of the Sustainable Land and Ecosystem Management program of the Government of India, and was implemented through the Ministry of Environment and Forests. At the state level, the Department of Rural Development was the primary stakeholder agency. The Bharathi Integrated Rural Development Society (BIRDS) was the executing agency responsible for the implementation of project activities, with the support of a local Project Management Unit, consultants, and partner NGOs with officers in the field.

The SPACC project built on the foundation of the FAO-supported APFAMGS project, which focused on sustainable groundwater

management. The SPACC project broadened its scope to SLWM, with a focus on adapting to observed and projected climate variability or change using innovative, community-led approaches. The project design helped engage and empower local farmers to manage their land and water resources effectively, taking into account the latest climate science. The project had six main activities:

Baseline study: Assessment of the local context

Project personnel kicked off the project with a study to assess community understanding and impacts of climate variability and change, and current adaptation practices. Project staff interviewed 450 farmers at nine hydrologic units (HUs), in consultation with the partner NGOs and other members in the network of HUs (Das et al., 2012).

The survey asked a variety of questions related to understanding climate impacts and current responses. For example, in response to the question, "What measures do you take to save crops during drought?," 46% of respondents indicated drilling and deepening wells, 18% indicated "don't know/can't say," 11% indicated using chemical pesticides, 9% indicated using water-saving methods and equipment, 7% indicated switching to less water-intensive crops, 5% indicated using chemical fertilizers, 3% indicated insuring crops, and 1% indicated harvesting rainwater. The survey results also summarized community responses to climate variability and change, including changes to agricultural, animal husbandry, soil nutrient management, and water management practices, as well as migration to different communities (Das et al., 2012).

Participatory climate monitoring

The project focused on building capacity and institutions in the project districts. By the end of the project, farmers in the project areas were actively engaged in crop management decision-making using participatory climate monitoring (PCM) data, soil fertility and moisture measurements, and groundwater data. Farmers also evaluated various adaptation technologies and practices through pilot testing water harvesting and storage, water conservation, intercropping and border cropping, mulching, integrated and non-chemical pest management, and fodder cultivation. The PCM data were collected daily by 295 trained volunteers and shared through village display boards; text messages; and local television, radio, and press. The project created a dedicated website, featuring monthly updates on project events and daily climate data (BIRDS, 2011). These efforts reduced farmers' input costs and helped sustain their yields.

Climate Change Adaptation Committees

A key feature of the project was the close involvement of the stakeholder communities through CCACs. Each CCAC built on an existing community-based organization, sharing information and tools to help farmers make informed decisions concerning land and water management using localized scientific knowledge that considered climate variations. Through CCACs, the project institutionalized various core project activities, such as PCM data collection, operation and maintenance of the PCM equipment, FCSs conducted by trained farmers, and periodic meetings. A climate change adaptation fund was established at the HU level.

Both the Project Management Unit and partner NGOs worked closely with the CCACs to identify community information needs and to deliver that information. The CCACs established Memoranda of Understanding with the partner NGOs describing mutual roles and responsibilities in the project. The Project Management Unit and partner NGO levels delivered information through the CCACs concerning SLWM, PCM, and other topics through training sessions, strategy papers, and field visits.

SLWM pilot projects

The most significant accomplishment of the project was the successful integration of SLWM climate change adaptation projects into drought-prone areas through innovative, farmer-driven action. More than 130 farmers — including 68 women, who often have limited access to education and livelihood support — participated in the SLWM pilot projects (Figure 2). Pilot projects included implementing more efficient irrigation and water-harvesting systems, conducting systematic observations on crop growth, measuring pest and disease incidence, and improving soil moisture retention. Personnel also developed four manuals concerning climate adaptation specific for four distinct agricultural/climate zones. All of these activities helped farmers improve soil organic matter and soil organic carbon, sustain or grow agricultural productivity, strengthen livelihoods, and increase ecosystem health.

Farmer Climate Schools

The FCSs helped farmers learn about selecting crop varieties; adjusting planting seasons; improving pest management; and considering weather, rainfall, soil moisture, and runoff data in their decision-making. FCSs focused on a learn-by-doing approach, teaching farmers to understand or test climatic parameters for various crop stages; observe PCM data; and select, pilot, and evaluate relevant SLWM measures. As a result

Figure 2. Project beneficiaries participating in a SPACC meeting.

Credit: FAO.

of FCSs, farmers gained skills and knowledge in climate variability and adaptation. The FCS program was advertised through the project website, television, radio, and newspapers. To date, more than 1,100 farmers — 56% of them women — graduated from FCSs. In addition, the top 10% of women graduates became paid, "Farmer Resource Persons," and taught at the schools. This approach helped create a "train-the-trainer" model for the project, growing women-to-women support, and helping recognize women and their importance in agricultural leadership.

In an analysis of four HUs, project plots and SPACC farmers tended to have higher yields than their relative controls. For example, SPACC farmers in Kharif had a better average yield of groundnut, and the groundnut pilot plot had a slightly higher yield than its control. Also in Kharif, napier grass and castor pilot plots performed better than control plots. In Rabi, tomato yields among SPACC farmers were below the district average, but the tomato pilot plot yielded more than the control plot. In terms of profits, groundnut cultivation, castor cultivation, tomato cultivation, and fodder cultivation (through the sale of milk) profited relatively more than their controls (Das et al., 2015).

Climate Change Adaptation Plans

The CCACs developed Climate Change Adaptation Plans for nine of the HUs, with support from project technical staff and local researchers. To develop these plans, CCACs in each HU listed activity stages for each crop, from seed sowing to harvesting; identified the risks at each stage in both dry and wet scenarios; and identified adaptation strategies to cope with each of the identified risks. The final plans included season- and crop-specific adaptation strategies, including pest and disease management, soil moisture and irrigation management, and soil nutrient management. The plans focused on improving the ability of farmers to cope with climate variability.

Project Challenges

Demystifying climate variability, climate change, and adaptation. Finding the right way to approach these complex topics was a challenge for project personnel. The first FCS curriculum was broad: it covered the hydrological unit; climate change variability, and the impacts of climate change and variability on agriculture, water availability, and human and animal life; community-operated weather stations; water management; soil management; sustainable agriculture; animal husbandry; and field lessons (Das et al., 2015). It also discussed adaptation measures, such as soil water conservation, nutrient management, and pest management.

After teaching the initial curriculum, project personnel realized they needed to make climate adaptation more relevant and concrete for FCS participants; later FCS curricula were tailored to the needs of participants and offered crop- and season-specific information.

Sustainability. A key challenge for the project as it came to a close was the continued involvement of the CCACs in PCM, and sustained planning, testing, adoption, and promotion of adaptation measures. Ultimately, the project succeeded in institutionalizing PCM data collection and operation and maintenance of the PCM equipment, and holding periodic CCAC meetings to encourage farmers to continue implementing adaptation strategies. Project personnel helped ensure this

institutionalization through agreements with CCACs and the creation of HU-level climate change adaptation funds. Communities and project partner agencies joined together to support these funds, which were used to operate and maintain PCM assets, promote project-piloted agricultural practices, and support experimentation with adaptation strategies (BIRDS, 2011).

Timeframe. Implementing the project in a three-year timeframe was challenging. For example, three years was insufficient to implement, monitor, and adjust strategies as new information brought clarity to what activities would work best for specific districts and farmers. A longer timeframe would have given project personnel room to consolidate and stabilize programming, as well as to work toward strengthening end-of-project transfer activities.

Analysis

PCM actively engaged farmers in seeking and using weather data. Although this required substantial community involvement and capacity-building, this was a tactic to get more buy-in and ownership of the data, and eventually a greater appreciation of the data's value.

FCSs helped implement the project's activities. FCSs helped the project participants analyze and use PCM data for farming decisions, evaluate and select adaptation technologies and practices, and develop the CCACs. Farmer Resource Persons were trained to conduct FCSs on their own, with limited, external facilitation support.

Building on existing capacities worked. The project grew on the foundation of the APFAMGS project. In addition, the CCACs and the organizations that spawned them, together with the NGOs, had a history of partnering on activities such as participatory hydrological monitoring and crop water budgeting. This partnership model continued with the SPACC project, bringing with it the advantages of technical capacity, long-term association with the project communities, and proven working relationships. Building on past successes gave SPACC project personnel a head start to secure community involvement and to demystify climate variability, climate change, and climate adaptation into concrete actions to help real-world farmers.

Local support has ensured sustainability. Community-based climate change adaptation funds, relying on community contributions, have institutionalized the continuation of PCM data collection, operation and maintenance of the PCM equipment, and periodic CCAC meetings after the project's end.

Picking the right indicators of project success was key. Project personnel looked at specific capacity-building indicators to gauge project success: (1) process and institutional indicators, such as tools developed, climate change adaptation plans completed, FCS curricula applied, and manuals on best adaptation technologies written; and (2) the success of capacity-building measures, including new CCAC development, SLWM adaptation measure training sessions, FCS graduation rates, and farmer participation in testing pilot adaptation measures. However, the true test of sustainability will be whether these outputs are continuing to support adaptation efforts. This includes, for example, whether the tools are being used, and if they are being updated as the climate changes, based on most recent scenarios.

Next Steps

The SPACC project has improved farmers' ability to adapt to climate. However, building adaptive capacity is not a milestone, but an ongoing process. The following activities will help support the CCACs' work on climate adaptation, bolster adaptive capacity, mainstream climate adaptation, and share project successes with communities beyond the project area.

Link CCACs with existing state and central government activities. CCACs may be able to tap into existing government resources to support climate adaptation interventions. One way to do this could be to establish links with and actively participate in local self-government organizations, called Gram Panchayats, and to work through other CCACs operating at the village level. For example, CCACs could work with Gram Panchayats to incorporate climate adaptation projects as part of India's National Rural Employment Guarantee Act. This social security and public works program provides at least 100 days of pay per year to adults who provide unskilled labor; projects could include such climate adaptations as digging or improving irrigation channels, assisting with pest management, or applying compost and mulch to crops.

Facilitate relationships between NGOs and India's designated National Implementing Entity. The Adaptation Fund Board of the UNFCCC accredited India's National Bank for Agricultural and Rural Development as the National Implementing Entity for the country. As the National Implementing Entity, the National Bank for Agricultural and Rural Development accepts project submissions from NGOs who seek adaptation funds; SPACC project partners can help facilitate these submissions.

Federate CCACs. The CCACs have standing histories and are strong entities; federating the CCACs at a district or state level

has promise. The federations would be able to negotiate with government departments, private businesses, and NGOs to connect technical expertise with needs, to network, and to support climate-resilient agriculture.

Investigate insurance options for extreme events. Many of the project sites have yet to develop weather- and index-based insurance and micro-insurance measures. This important next step will help protect subsistence farmers who struggle to survive when they lose crops to climate-related events.

Share successful interventions outside of the project area. PCMs have been proven to be both relevant and important to India's farmers, in part because of strong relationships with stakeholders, from farmers to relevant national and district- level government officials. Anecdotal evidence suggests that farmers and communities in non-project areas seek access to the SPACC project's successful interventions. An obvious next step is to expand the project area to include additional communities and farmers with successful SPACC project activities.

Ongoing measurement and monitoring. Measuring on-the-ground indicators of project success, with the participation of farmers, is a key next step; indicators could include average crop yields, annual groundwater balance, volume of water harvested or saved, soil moisture, and organic carbon content. Establishing a baseline for each pilot project would help evaluate specific SPACC project adaptation technologies and practices. A related next step would be conducting a follow-up survey to compare to the baseline study discussed in Section 3.1; a similar study was not completed at the end of the project to understand potential changes in views or practices.

Conclusion

The SPACC project demonstrated the value of climate variability monitoring and adaptation practices for farmers and local agriculture in India. The SPACC project's successful approaches and interventions, particularly the PCM and SLWM pilot projects, could be replicated elsewhere in India.

Government and development entities. In many cases, SPACC project activities could augment existing government programs concerning rural livelihoods, agriculture, and natural resources management. The project laid the groundwork for replication at the local, state, and national levels by (1) providing technical advice to the Department of Rural Development on the integration of PCM in to watershed management programs, (2) sharing the PCM concept and practice at various workshops, (3) facilitating SPACC and GEF Small Grants Programme information exchanges, (4) building connections among HUs, and (5) establishing PCM stations and SLWM pilots.

Other current projects, both inside and outside government, are replicating some aspects of the SPACC project. For example:

- The GEF is supporting the "Sustainable Livelihoods and Adaptation to Climate Change" project through the Ministry of Rural Development's National Rural Livelihood Mission.
- The Community-Managed Sustainable-Agriculture Society for Elimination of Rural Poverty is planning to implement World Bank-supported "Rural Inclusive-Growth" projects through the Andhra Pradesh and Telangana Departments of Rural Development.
- The Andhra Pradesh and Telangana Departments of Rural Development have integrated their watershed management programs across the two states.

Private sector. Knowledge products and a large pool of trained stakeholders provide a means for scaling up SPACC beyond government programs. The private sector is already making inroads into agriculture and allied-sector programs through initiatives such as contract farming. Various SPACC project approaches, particularly PCM, could also apply to related sectors such as animal husbandry, dairy production, and poultry farming. Another example of a pathway through the private sector could be through private, weather-based index insurance companies. Such companies could help pay for the PCM data services; the data would then help them settle insurance payouts to farmers.

Online materials for easier dissemination within new areas. Easy, centralized access to the SPACC project's materials and to new partners and networks should support new pathways in building on the project's successes. SPACC created an online platform for disseminating methods, tools, and institutional approaches that address drought (Das et al., 2015). This platform should be useful to other existing and emerging adaptation programs. Other knowledge products, such as agricultural/climatic zone manuals, curricula for FCS training, strategy papers, and progress reports could benefit adaptation activities in other contexts.

SPACC project personnel believe that other NGO- or government-based efforts could successfully borrow, adapt, and apply elements of the project to help farmers in India and beyond address the challenge of drought and the reality of climate change.

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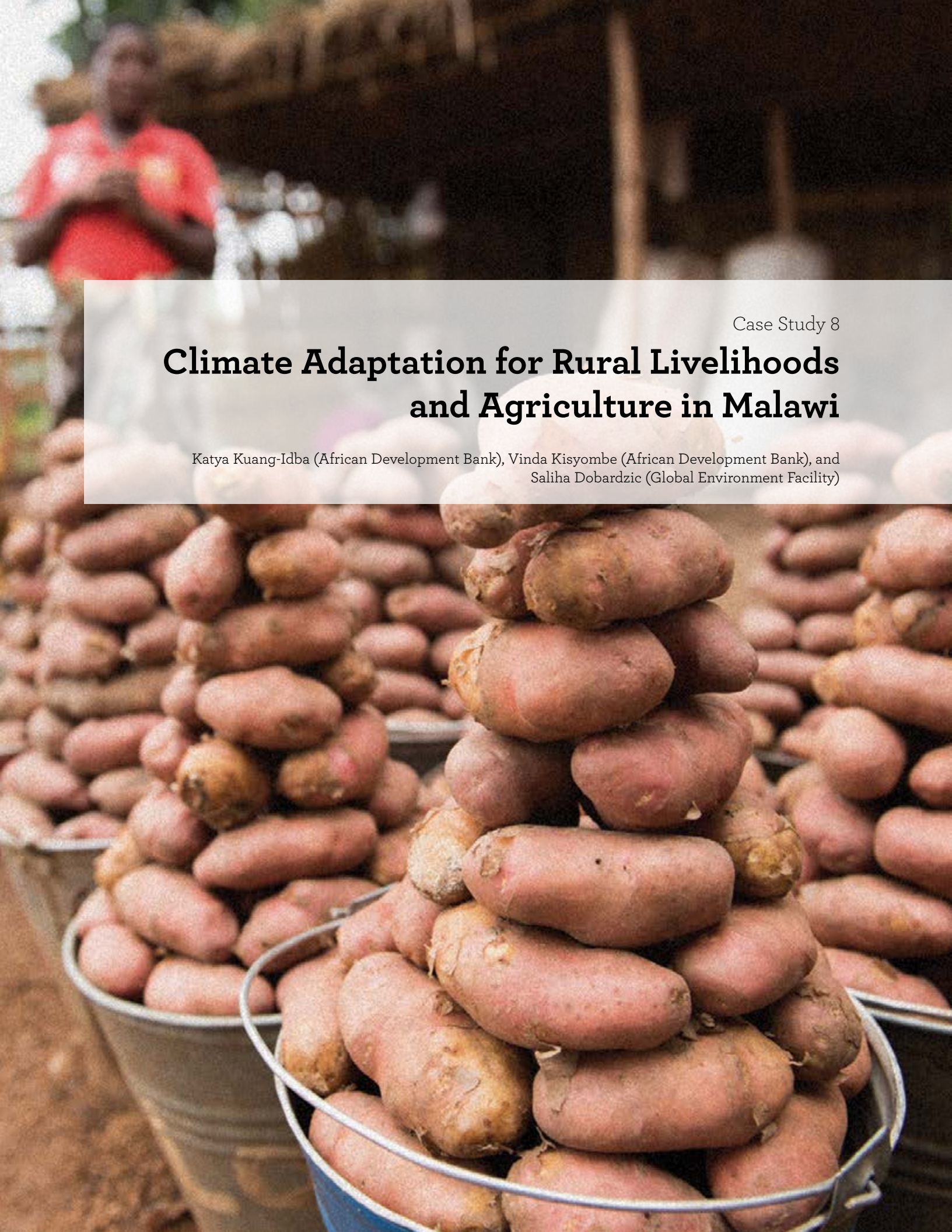

Case Study 8

Climate Adaptation for Rural Livelihoods and Agriculture in Malawi

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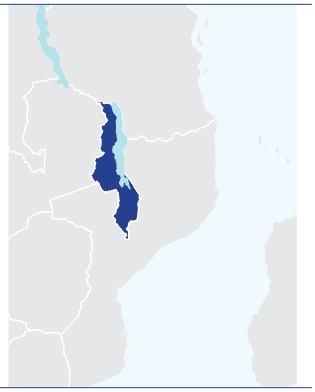

Case Study Overview

Malawi, a country of 16.7 million people, ranks as one of the poorest in the world. With an annual per-capita gross domestic product of US$857, it is estimated that nearly one-third of the population lives in extreme poverty. Agriculture accounts for 37% of the gross domestic product, and employs roughly 80% of the labor force (World Bank, Undated). The most important cash crop is tobacco, produced primarily for export, while maize is the most important food security crop. The country's prospects for economic development are hindered by poor infrastructure and services in the transportation, health, and education sectors. The socioeconomic state of the country contributes to its climate vulnerabilities (Magrath and Sukali, 2009).

The *Climate Adaptation for Rural Livelihoods and Agriculture* (CARLA) project was the first project to work on climate change adaptation in Malawi's agricultural sector. The project was implemented in the Karonga, Dedza, and Chikwawa districts, identified in Malawi's NAPA as highly vulnerable to climate change:. To help rural agriculture communities adapt to changes in precipitation and temperature, CARLA financed projects to implement adaptation measures at the community level, and enhanced the adaptive capacity of the national government on community-based adaptation to provide lasting support for community-level work. The project's adaptation activities were designed to complement a broader set of development interventions associated with rural poverty reduction.

BENEFICIARY STATEMENT

According to Mr. Abraham Simkonda, one of the CARLA Lead Farmers from the Karonga District, "as one of the beneficiaries of the CARLA project, I feel very grateful for the assistance it has provided. As you are aware, this area of Karonga District has continued to suffer from severe drought conditions this season. Thanks to CARLA, which has allowed me to plant my own orchard, I don't expect to feel the impact as much. I can sell bananas and paw paws to generate income to cover basic household needs. As a way of showing my appreciation to the project, I have so far established part of my garden as a nursery for issuing out seed materials to other interested farmers in the area for free. So far I have issued banana suckers to 15 farmers for their own orchards. After issuing the fruit trees, I follow up with training in their gardens using skills that Officers from CARLA taught me. I have little doubt that within the next few years, most farmers in this area will have fruit trees in their homesteads."

Project Background and Brief History

Climate change and farming in Malawi

The weather in Malawi is erratic, with frequent droughts. Even in years of adequate rainfall, periods of dry weather can interrupt plant growth and greatly reduce agricultural productivity. Poor land management, including clearcutting of nutrient-rich native species, further undermines crop productivity. These factors are major contributors to the current vulnerability of smallholder farmers.

More than 90% of the people of Malawi engage in subsistence, rain-fed agriculture. About 60% of the population lacks access to sufficient food on a year-round basis. Female- and children-headed households are among the most vulnerable. These problems are compounded by rapid environmental degradation as a result of agricultural expansion to marginal lands and deforestation, inadequate knowledge and skills in the productive use and management of land and natural resources, inadequate access to land and credit, poor health services, and gender inequalities. Extreme weather events due to climate variability, and low capacity to adapt to the adverse impacts of climate change, exacerbate these problems (GEF, 2007). Current climate extremes are already pushing people further into poverty; economically marginalized populations are and will continue to be the most vulnerable to the effects of climate disruptions (IPCC, 2014).

Climate change in Malawi is expected to exacerbate weather extremes, including higher temperatures, more variable weather patterns, more intense storms, and shorter growing seasons with less rainfall in many locations. These climate changes can strain agriculture and livestock, damage infrastructure and housing, disrupt livelihoods, and — when severe enough — displace vast numbers of people. In Malawi, new approaches to agricultural production are required to ensure and improve productivity in the face of climate change.

Successful farming under increasing climate variability requires the adaptation of farming systems.

The CARLA project

To help rural communities adapt to climate change, CARLA financed projects that implemented adaptation measures at the community level in order to enhance the resilience of those communities to climate change, and enhanced the adaptive capacity of the national government on community-based adaptation to provide lasting support for the community-level work. These projects improved agriculture, land conservation, and land management that benefited the livelihoods of people

in rural communities and created more resilient farming practices. Specific measures included enhanced afforestation, fish farming, livestock rearing, conservation agriculture, drought-tolerant crop introduction, fruit tree propagation, water distribution, irrigation efficiency, groundwater capture, water recycling, and water system rehabilitation. These adaptation activities were also designed to help achieve broader development objectives associated with rural poverty reduction, which were pursued through an existing African Development Bank effort, the Smallholder Crop Production and Marketing Project (SCPMP).[1] By developing an enabling environment for adaptation, CARLA aimed to foster replication of these interventions beyond its direct project activities.

Building on previous efforts and coordinating with NAPA priorities

CARLA complemented the SCPMP, which promoted the use of improved irrigation technologies and practices to increase the agricultural productivity of small-scale farmers in Malawi. The aim of SCPMP was to reduce poverty, improve food security, and reduce vulnerability to climate change.

Both the SCPMP and CARLA aimed to address the first two priorities identified in Malawi's 2006 NAPA: (1) improving community resilience to climate change through the development of sustainable rural livelihoods; and (2) improving Malawi's preparedness to cope with droughts and floods. CARLA financed climate change activities that were not addressed by SCPMP, including both long- and short-term strategies to build resilience to climate extremes, improvements to agricultural production, and betterment of rural livelihoods.

The NAPA also identified six districts as adaptation priorities in Malawi and the CARLA project conducted adaptation activities in three of these districts: Karonga District, in the north; Dedza District, in the central portion of the country; and Chikwawa District, in the south. Best practices from these three model districts have been disseminated to additional communities and to the three remaining high-priority districts.

Project financing and partnerships

A GEF LDCF grant of US$3 million supported the project. Partners leveraged an additional US$6.5 million in co-financing. Project partners included the African Development Bank, which implemented the SCPMP and the CARLA project; and the Malawi Ministry of Agriculture, Irrigation and Water Development, which served as the project's Executing Agency. The Ministry's Department of Irrigation was responsible for project implementation and monitoring. A team of technical staff carried out the day-to-day coordination and monitoring of project activities. The project targeted communities who, prior to the project, were engaged in maize cultivation.

Project Achievements

The CARLA project emphasized the implementation of adaptation measures in model villages. The community selected each measure based on local conditions, in accordance with adaptation measures identified in the NAPA. These measures helped beneficiary communities and supported climate change adaptation by:

- Helping communities and community members use resources in a sustainable manner, which conserved scarce resources and improved ecosystem resiliency to climate variability.
- Diversifying livelihoods to help community members gain alternate sources of income in order to improve their resilience to future changes.
- Increasing production and productivity of crops, fish, and livestock; and reducing post-harvest loss, which puts farmers in a better position to absorb seasonal crop loss.

The project has seen the strongest progress in four adaptation areas: livestock rearing, fish farming, fruit tree propagation, and irrigation enhancement.

Livestock rearing. The communities involved in the CARLA project hailed the success of the small stock livestock program. The program used a "pass-on" system, where livestock offspring were passed onto subsequent beneficiaries. Goats were the primary livestock species; they are well-adapted to the area and can survive extended periods of dry weather. They are easy to manage with appropriate training or supervision.

Because of the pass-on system, the program had a wider impact than other adaptation activities. By 2014, the first set of beneficiaries received 989 goats. The goat pass-on program exemplified an additional-livelihood activity that can provide a safety net for the household, should climate changes jeopardize other sources of income.

Fish farming. In Kafulama in the Dedza District, farmers have had some success with newly developed fish ponds and have begun harvesting fish from them. The project also constructed fish ponds in the Karonga and Chikwawa districts, but the outcomes of the ponds are not yet clear in those districts.

1 The SCPMP was financed by a US$21 million grant of the Africa Development Fund, a fund of the African Development Bank.

INDIVIDUAL SUCCESS STORIES

Anonymous beneficiary in Moses, Chikwawa District

"Our family has been vulnerable to climate change variability, as we had no quick way of generating alternative income so as to adapt to the harsh realities of weather patterns. In our area, every year we experience droughts and floods, which resulted in our family having food only three months out of the year. We did not even have the financial capacity to buy maize, which is a staple in our meals, resulting in some family members seeking ganyu[2]; a reduction in the number of daily meals; and some even resorting to begging. This has often impacted our integrity and standing in the community and caused us shame.

Since the beginning of the CARLA project, we have received two goats and have already given the offspring to other members of the community – there are now seven goats in our community in Khola. By the end of the project, we expect to own at least 20 goats, which we will be able to sell in the case of an emergency and during rough times."

Ms. Eti Nankhonde, Karonga District

Ms. Nankhonde received two female goats from the project's livestock committee; the goats have had three rounds of offspring. At the end of the program, Ms. Nankhonde had five goats and had given two to other beneficiaries.

"I am so happy that I have received five goats, which I never dreamt of having, thanks to the CARLA project. With my goats, hunger will soon be a thing of the past – they will reproduce and give me more goats. I urge my friends who have received the goats to take good care of them so that they may also benefit from the project's activities."

Credit: AfDB

2 I.e., "temporary labor."

Project personnel have introduced fish farming as part of an integrated farming system that diversifies sources of household income. However, during the course of the project, it became apparent that climate change may increase risks associated with this particular development intervention (such as potentially spreading invasive aquatic species during increasingly frequent and intense catastrophic flood events, or altering the local dynamics of malaria in an adverse way).

Fruit tree propagation. The project's fruit tree propagation activities have had greater success than expected. By 2014, 615 farmers had received training on fruit tree propagation methods and practices, together with a number of different types of trees, including banana, paw paw, orange, and mango trees. In Karonga, bananas were most successful in terms of local adoption and fruit production. In Chikwawa, mango tree production was most successfully taken up by farmers. In Dedza, lemon and mango trees were most readily taken up by farmers and have successfully produced fruit.

There has also been a growing demand from neighboring communities to take part in fruit-tree activities related to the project. The fruit-tree program is an example of an additional livelihood activity that has the potential to improve households' resiliency to climate change by diversifying their food and income sources. Additionally, fruit trees can help minimize flood potential by reducing runoff during rain events.

Irrigation enhancement. Typical Malawi irrigation relies on hand-watering with watering cans and buckets. Enhanced irrigation has the potential to help communities access, manage, and convey scarce water resources and therefore help to conserve water resources in times of drought. Several villages in the three districts piloted the use of a treadle pump irrigation system and solar pumping technology. In Karonga and Chikwawa, pumps moved water from shallow wells that were constructed by local farmers with financial support provided by the CARLA project. In Karonga, farmers also used treadle pumps to refill fish ponds from groundwater wells and a nearby lagoon. Treadle pumps increased the size of irrigated areas. Through CARLA's irrigation activities, agricultural productivity increased on average from 1 ton per hectare to 3.5 tons per hectare.. This increase improved food stability by helping generate a surplus from irrigated crops. Because irrigation activities increase production and incomes, community members will be better positioned to absorb potential climate-related crop losses.

Co-benefits of the CARLA project. The CARLA project generated several co-benefits. For example, the creation of six boreholes addressed water-supply shortages that affected fruit tree nurseries and also improved villagers' access to clean drinking

Figure 1. Engaging the beneficiaries is a critical part of the process.

Credit: AfDB

water. Other examples were farmers' new understanding of climate change concepts, their ability to share their knowledge of cause-and-effect relationships, and their successful identification of adaptation measures suitable for their areas. The farmers were able to articulate both short- and long-term strategies for addressing the challenges of climate change; this was a measure of the project's ongoing sustainability, as peer-to-peer learning is important venue in bringing about behavior change in this particular context.

Project Challenges

Extreme weather event. In January 2015, Malawi experienced some of the most devastating floods in its history. The pilot sites of the CARLA project were not immune to this disaster. Of the three project districts, Chikwawa was the most severely affected. Nearly 100% of crops were washed away in 6 villages, with 11 more reporting 50% crop losses. The project team mobilized quickly to respond to this event, distributing additional planting materials to affected households.

Institutional issues. The CARLA project was bundled with SCPMP and assigned to the same oversight entity, the Ministry of Irrigation. However, while this arrangement appeared beneficial, the project had to first overcome another challenge, that of the lack of capacity at the Ministry of Irrigation. The Ministry of Irrigation had to overcome the challenges of handling an agricultural climate change adaptation project with little climate change experience. In an attempt to build capacity within the relevant government departments, CARLA facilitated training workshops on climate change adaptation and the Model Village Approach to increase awareness of the project. The training sessions emphasized the link between climate vulnerability and livelihoods, and how CARLA would allow local communities to adapt to a changing climate. The project also engaged agricultural experts on the ground.

Dependency on the program. Local communities made progress in their understanding of climate change, and how they could adapt to it. Many members of the project communities grasped the concept of climate change and its negative effects, and villagers showed strong momentum to increase their efforts to adapt. However, the project team observed that beneficiaries began to expect help, which could pose a serious challenge. The original idea of training beneficiaries was that they could learn to do things on their own. Instead, project beneficiaries began relying on the project support and seemed to expect continued support.

The project attempted to overcome this dependency challenge by promoting partnerships with nongovernmental organizations and foundations that could ensure the sustainable use of finances and continued training. During the 2014–2015 production season, the project emphasized building the capacity of beneficiaries to do things on their own. For example,

project personnel procured and issued most seedlings for afforestation, agroforestry, and fruit production to farmers during the 2012–2013 and 2013–2014 seasons; however, community members themselves produced the majority of the seedlings during the 2014–2015 season.

Sustainability of funding. The sustainability of funding for the project also became a concern. The revolving fund for livestock medication kits did not grow as expected. This was largely due, first, to a lack of understanding by some government officials. These officials thought that the project would continue providing resources and support to farmers even after the project ended.

To correct this problem, the concept of sustainability was highlighted in relevant trainings and interactions with the community. Farmers and implementing staff began to understand what sustainability means in the context of project funding. The second contributing factor in the slow growth of the revolving funds was that the service fees were too low, particularly taking into consideration the increasing cost of veterinary drugs. Subsequently, project personnel encouraged farmers to establish more sustainable fee structures, without the expectation of cash injections in the future. The same principle also applied to establishing revolving funds for irrigation. The project continues to place a heavy emphasis on sustainability mechanisms for all interventions.

Adaptation activity challenges. Some of the adaptation activities have experienced setbacks, including:

- Crop planting and afforestation have suffered from financial mismanagement.
- Livestock rearing in the Dedza and Chikwawa districts saw mortality rates of roughly 8%. This is because the project prematurely sold and delivered goats to unprepared or untrained caretakers.
- Fish pond productivity has remained fairly low in all locations — 75 kilograms for each 200 square meters of pond — because of poor-quality feed, low availability of water during the dry season, theft, and predators.

Analysis

Institutional arrangements are of utmost importance. The executing agency matters; the CARLA project suffered because it was directly overseen by an institution that lacked agricultural and climate change knowledge and capacity. This could have been mitigated if there had been closer coordination between agencies with proper subject matter expertise in both climate change adaptation and agriculture. Close coordination between teams is essential to ensure proper and timely implementation of a multi-disciplinary project.

PIU designation is key. In a similar vein, the entity overseeing project management needs to have the appropriate knowledge and skills to issue and account for project funds. During the CARLA project, an independent PIU was much more effective than its government counterpart. The government-based PIU did not have sufficient skills or human resources to disburse funding in a timely manner. From this experience, the importance of having the right administrative arrangements in place emerged clearly.

Ensure sustainability. It is important to share substantial responsibilities in implementing project activities with the beneficiary communities. Development assistance is limited and it is a significant challenge to overcome the perception of ongoing project support. However, sustained improvement to the community's socioeconomic well-being and resilience to climate stressors is at stake. CARLA serves as an example of the time needed to establish adequate community structures for project sustainability. Furthermore, sharing current understanding about climate vulnerabilities and climate change impacts is needed for a successful outcome; it will take time and can be challenging. To prevent dependency, projects should emphasize that support is temporary, even if the challenges may increase in severity. Projects should therefore stimulate beneficiaries to internalize new skills and training to become autonomous. Training programs should be innovative, interactive, and constructed in a way that encourages autonomy and pro-active agency, which, at least in this case, appears to be at the core of achieving successful and sustainable adaptation. However, CARLA's three-year implementation period may not be adequate for ensuring the long-term adoption of adaptation practices by the community.

Use integrated strategies. Project personnel should not implement even successful activities as standalone initiatives. Integration among activities maximizes adaptation benefits. For example, integrated fish farming strategies should also include activities related to irrigation and seed multiplication. This also serves as a hedge against risk, whereby there is a greater chance of securing some income even under generally unfavorable climatic conditions. More thought needs to go into which portfolio of activities, at individual and community levels, optimizes risks and rewards.

Broaden the dialogue across sectors. As a mitigating measure, mainstreaming climate adaptation and instituting a broader dialogue across sectors can potentially safeguard against risks

that come with implementing project measures that may have been a relatively low-level risk historically, but that may increase with climate change. As with any development project, there are safeguards that need to be considered. However, the safeguards, and how they apply to any intervention, need to be considered in light of a changing climate. For example, in the case of establishing fish ponds, more thought needs to go into what fish species are appropriate for farming given the risk of extreme flooding (e.g., this may necessitate the involvement of biosafety expertise in project supervision and course-correction), or how the fish ponds, in combination with more frequently occurring extreme weather, will alter the malaria dynamic in the communities (e.g., this may benefit from the involvement of public health expertise).

Aim for robust implementation. Much of practical adaptation has focused on the design of intervention, whereby the effort is to select the scope, target area, choice of technology or technique, and specifications of the intervention (e.g., "how tall the wall should be") based on current and future climate change, and not the historical record, as has been the usual practice. However, given that some manifestations of extreme weather, consistent with climate change, are occurring more frequently, it is time to consider how to conduct implementation in a way that "immunizes" it from any adverse climate change. In the future, more consideration should be given to the risk of extreme weather events when designing such interventions in Malawi.

Time is of the essence. The window of opportunity is narrow, and the high cost of delays and inaction while the frequency of catastrophic events increases is perhaps best exemplified by the river bank afforestation effort. The trees planted along river banks can provide some physical defenses against floods. The effectiveness of this defense will depend on the severity or the force of the flood, and the strength of the buffer. If the next flood occurs before the trees will have had a chance to become established, further erosion and damage are the likely outcomes (in addition to wasted funds and effort), and this intervention will not count as a success.

Next Steps

As of 2015, the CARLA project is ongoing. Immediate next steps were focused on activities that could be started, and potentially completed, before the initial project implementation period ends in December 2015 (African Development Bank Group, 2011).

Longer implementation timeline. Challenges with the PIU, staff turnover, and other issues delayed implementation progress. As a result, the Malawi government recognized that climate change practices have not been fully adopted and additional time might be needed to reach CARLA's goals. Therefore, it was recommended to extend the project end date by one year to allow adequate time to disseminate best practices to the wider community.

Shift to solar-powered water pumps. The government requested the use of solar energy for small-scale irrigation schemes instead of diesel pumps. Diesel pumps traditionally have higher capital and operating costs than solar pumps. Additionally, solar pumps emit less carbon dioxide, producing a climate change mitigation advantage over diesel. Unfortunately, the procurement of solar pumps was slow because of higher-than-expected costs. The project team considered other configurations and options to overcome this issue.

Sustainable financing mechanisms. To overcome the financial and institutional challenges experienced thus far, the government could encourage mechanisms to ensure the sustainability of investments. This could include establishing revolving funds and civic education activities to support communities in establishing foundations that generate ongoing benefits.

Linkages to related efforts. Efforts by a number of agencies clearly link to and build on CARLA's work:

- The World Bank is spearheading a project in the Shire River Basin to develop a planning framework to improve land and water management, and to pilot activities that will help people use wetlands more sustainably.
- UNDP is working on three projects aimed at a variety of climate change adaptation measures in Malawi. The first seeks to reduce the vulnerability of rural and urban populations living in the Machinga and Mangochi districts through a combination of ecological, physical, and policy measures. The second project is working to strengthen the climate monitoring capabilities of Malawi, integrate this information into development plans, and use it to develop early-warning systems. The third project focuses on a decentralized approach to adaptation that will help to empower communities to take ownership of adaptation measures, building upon previous adaptation projects.
- FAO is working on climate change adaptation in the fishery sector. It is integrating climate change adaptation by conducting vulnerability assessments for Lake Malawi and Lake Malombe to explore future risks in the fishery sector.

Conclusion

Observed outcomes and testimonies of beneficiaries show that the CARLA project had some early success, with the potential to reduce the vulnerability of the people of Malawi to climate change. The participating communities began to adapt to climate change through the every-day integration of new livelihood activities. For example, many farmers that never owned livestock before this project now have three or more animals. Others were able to increase agricultural productivity as a result of irrigation activities and, hence, some were able to harvest twice in one season. Afforestation activities had similar success. Overall, households are now more aware of climate change, its impacts, and potential strategies to cope, such as by engaging in more than one livelihood activity.

Flooding in early 2015 presented an immediate challenge for Malawi going forward. In these floods, 276 people were killed (Guha-Sapir et al.), and approximately 200,000 were displaced (The Guardian, 2015). Entire villages were washed away. As a result, half of the country was declared a disaster zone. The devastating damages to infrastructure and agricultural lands guarantee a slow recovery and potential economic disaster.

The experience of these floods demonstrates a reality that no project can make a community completely immune to all extreme events. However, adaptation projects can help to reduce a disaster's impacts and shorten the recovery time by improving communities' adaptive capacity though education and experience. They can help increase a community's overall resilience by helping the community rebound more quickly and better plan for the future following a disaster.

Torrential rains like those that caused the flooding are likely to increase in frequency and intensity as a result of climate change. This underscores the urgent need for adaptation across all sectors of the government, environment, and economy in Malawi. The GEF, along with its partner institutions, is working to address this need, with total project investments of over US$114 million.

Although the presence of CARLA and other projects is a positive development, securing the livelihoods of the people of Malawi in the face of climate change is an all-encompassing endeavor. It will require sustained action on the part of the Malawian government to incorporate climate risks into development planning. It will also require action on the part of the beneficiaries of these international aid projects, and their communities, to continue to implement measures deemed as effective methods of adaptation.

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Case Study 9

Project for Market and Pasture Management Development in Mongolia

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Case Study Overview

Half of Mongolia's 2.7 million residents rely on herding as their main source of income. Together with ongoing challenges to their traditional way of life, Mongolian herders also face a changing climate, including the potential for increasing annual mean temperatures; increasing precipitation; more frequent and more intense extreme events, such as drought, *dzuds,*[1] heavy snow falls, floods, and desertification.

In 2011, in response to these challenges, the International Fund for Agricultural Development (IFAD) and the Government of Mongolia initiated a five-year project, the *Project for Market and Pasture Management Development* (PMPMD). This project focuses on increasing the resilience of the Mongolian livestock system to climate change by strengthening the adaptive capacity of herders, organized into community-level Pasture Herder Groups (PHGs). The project conducts special training sessions concerning pasture conditions, pasture management techniques, and climate change impacts. The PHGs then carry out specific activities to address climate change, including developing water harvesting points, fencing spring sources, storing hay and fodder, constructing winter shelters, distributing sprinklers, and repairing broken wells. These activities will help improve the herders' resilience to climate change by improving the long-term sustainability of rangeland and water resources in order to maintain livestock production.

1 A *dzud* is a climate event that frequently results in large losses of livestock. It occurs because of a combination of natural events: a summer drought followed by heavy winter snow and abnormally low temperatures, which may fall to -50°C in certain areas. *Dzuds* are devastating to livestock, who die of exposure to cold temperatures or of starvation because they cannot find grass or fodder.

Project Background and Brief History

Mongolia and the nomadic lifestyle of herders

Mongolia stretches across the Gobi Desert and the grasslands of the Central Asian Steppe to the southern edge of the Siberian Taiga. Mongolia's population density is the lowest in the world, with an average of only 1.7 people per square kilometer. The vastness of Mongolia has helped sustain its traditionally nomadic lifestyle, in which one-quarter of its population are roving herders who migrate to seasonal camps as they raise sheep, cattle, yaks, goats, horses, and camels (Asia and the Pacific Division Programme Management Department, 2013).

Seasonal camps, which are established by community agreement and historical precedent (Honeychurch, 2014), are a traditional necessity for migratory herders because of Mongolia's starkly contrasting seasonality. Winter camps are perhaps the most important sites for herders, enabling them to seek protection from harsh winter conditions and to access good pastures. Winter camp sites are in the same location, year after year, and are normally used over generations with specific user rights. While herders have the same sense of ownership for areas they keep for winter grazing land and hay fields, land regulations do not specify user rights of the winter grazing land, which often creates a conflict among herders over user rights. In contrast, summer camps vary from one year to the next, in both location and participation; they often consist of multiple households, with people joining together based on kinship or mutual benefit in sharing resources, labor, and information (Goulden and Fox, 2011). More recently, herders have not adhered as strictly to historical precedent and have moved between camps less frequently (Ykhanbai, 2004). Some experienced herders have testified that the reduced movement is also contributing to the rapid degradation of land beyond its carrying capacity; herders are staying in one location and not letting the land recover from season to season.

Like many nations, in the aftermath of the fall of the Soviet Union in the early 1990s Mongolia transformed from a centrally planned, socialist system to a market economy. Collectively owned livestock was privatized, causing the number of herders to double as some of the unemployed population migrated to join in this aspect of the burgeoning economy (Notaras, 2011). By 2008, almost 35% of the economically active population was engaged in herding, an activity that accounted for approximately 16% of Mongolia's gross domestic product.

Many of these new herders did not have adequate skills and knowledge in livestock and pasture management; they also lacked access to resources and seasonal camps (National Statistical Office of Mongolia, 2008).

With the shift away from collective management, each herder began to focus on increasing his or her own livestock numbers. As a result, the number of livestock in Mongolia increased dramatically, from 22 million in 1990 to 43.3 million in 2008 (National Statistical Office of Mongolia, 2008), while inequalities in livestock distribution grew. In 2009, for example, the richest 9% of households in the soum (district) of Bugat owned 37% of the total livestock, while the poorest 40% of households owned 10% of the total livestock (Jamsranjav, 2009). Although 8.5 million livestock had died during the 2009–2010 *dzud*, the livestock population had grown back to 45 million by the end of 2013. The new herders did not have a place within the traditional and historical agreements regarding pastureland and seasonal camps and have put pressure on the collective pasture management system (Ykhanbai, 2004). The collapse of the traditional nomadic system continues to threaten to tear apart the longstanding traditions that have helped Mongolian herders adapt to the harsh climate of their region (National Statistical Office of Mongolia, 2013).

Threats to livestock herding: The demise of traditional practices and the onset of climate change

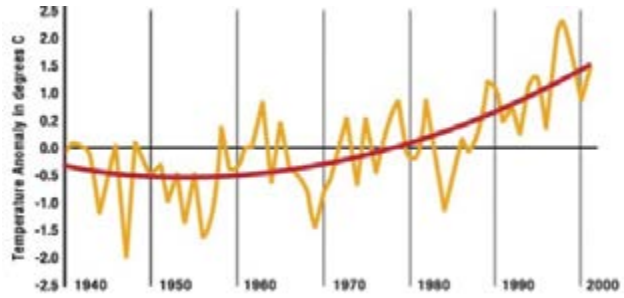
Mongolian herders depend on the country's fragile ecosystem for their livelihoods. Mongolia's dry and harsh weather conditions mean that herders have traditionally responded to low temperatures, a short growing season, low rainfall, and soil degradation through a number of measures. These include extensive nomadic pastoral grazing, seasonal rotation of pastures to increase production, fodder conservation through deferred use and haymaking. (Palutikof et al., 2013). However, these traditional practices subsided as privatization dismantled collective livestock and pasture management. By 2001, more than half of all soums in Mongolia were 150–200% over the maximum carrying capacity for livestock. This has resulted in overgrazing and poor protection of the ecosystems. According to the Ministry for Nature and the Environment, "some estimates show that more than 76% of the nation's pastureland is subject to overgrazing and desertification," (Ministry for Nature and the Environment, 2002) and grassland yield has decreased by 20–30% over the last 40 years (Bolortsetseg, 2003).

Pastureland degradation accounting, calculated by the net price of additional fodder for exceeded number of livestock, was about 9.5 billion Mongolian Tugrik (MNT) per year (Ykhanbai, 2000).

Today, together with changing livestock practices, Mongolian nomads, livestock, and pastures also face the effects of climate change. According to Mongolia's Institute of Meteorology and Hydrology, the annual mean temperature has increased by 2.14°C between 1940 and 2001 (see Figure 1).The average precipitation has decreased (World Bank, Undated) but the change has been

uneven: Central Mongolia has experienced the highest decrease in precipitation since 1961 and the Gobi and Eastern Mongolia have experienced an increase (Ministry of Nature, Environment and Tourism, 2010). Climate change projections show that the partial increase of precipitation will not be sufficient to offset the impact of temperature increase in Mongolia (Ministry of Nature and the Environment of Mongolia, 2006).

Figure 1. Annual mean temperature increase between 1940 and 2001.



Source: Notaras, 2011.

The frequency and magnitude of extreme climate and weather events, such as drought, *dzuds*, floods, and desertification, is also increasing, as are thunder, hail, snow, and dust storms. The socioeconomic losses associated with extreme events have roughly doubled since 1990. Climate change is one of the main factors contributing to hot and dry weather in the summer and to the greater risk of *dzuds* and increased snowfalls in the winter (Ministry of Nature and the Environment of Mongolia, 2006).

These projected future changes will put even more pressure on the country's sensitive ecosystems and on those who depend on these ecosystems for their livelihoods. The need for mainstreaming climate adaption is clear: climate change has the potential to create profound challenges for nomadic herders and their livestock as grasslands become less productive, animals have difficulty locating and accessing food, and more livestock die because of hazardous weather conditions.

Government pasture management challenges

The combination of reduced collective pasture management, rising numbers of herders and livestock that rely on limited pasturelands, and changing climate have compounded the difficulties that local government entities face in managing Mongolia's nomadic herders and pasturelands. Local government entities have limited capacity and resources to address herders' needs in terms of water supply and other infrastructure. Local governments are therefore unable to enforce policies that seek to control the number of animals and reduce pasture degradation. Herders need flexibility so that they can move their livestock seasonally and during emergencies.

Project for market and pasture management development

The previous IFAD program in Mongolia focused on the three interventions — market-access development, rural finance, and natural resources management — without a specific focus on climate change-induced constraints. The new project design stage highlighted, the impact of extreme weather events and climate change on the livelihood of the poor. To help improve the resilience of the Mongolian livestock system to changing climate conditions, SCCF funded the program, which began in 2011 and will run for five years. The SCCF funded activities to strengthen the adaptive capacity of the livestock system and its herders at a grassroots level. The combined IFAD and SCCF project areas included a total of 15 *soums* from five *aimags* (provinces) (see Figure 2).

Financing and program components

The US$13 million PMPMD has two main components: (1) pasture management and climate change adaptation, and (2) market development.

Figure 2. PMPMD Areas.

Please note that this map does not imply the endorsement or expression of any opinion concerning the delimitation of frontiers or the authorities thereof on the part of the authors of this report.

Pasture management and climate change adaptation. Initially implemented through an NGO, the responsibility for implementing this component now rests with Mongolia's Project Management Unit (PMU) in order to strengthen harmonization

with government policies and strategies. Direct implementation of the project through local *soum* facilitators who are recruited by the PMU has proven effective, as those facilitators are trained by the project, and support *soum* officers (Asia and the Pacific Division Programme Management Department, 2013). Funding for this component comes from a US$1.5 million grant from SCCF, a US$11.5 million IFAD loan, and co-financing totaling US$0.9 million from the Government of Mongolia.

Market development. The market and rural finance development component of the project was envisaged to promote poverty reduction and livelihood improvement through economic development. Funding for this component is solely based on the IFAD loan and Mongolian government co-financing. However, this component of the project is not a focus of this case study.

Project Achievements

Establishing effective pasture herder groups

The PMPMD project strategy for pastureland management is to (1) build the capacity of herder-level institutions at the *soum* level to manage the common pasture unit, or *belcheeriin negj*, which herders depend on for the annual cycle of seasonal livestock activities; and (2) provide support for the ecological knowledge and physical inputs necessary for effective management. This strategy complements the government's proposed legal and regulatory framework for pastureland management; the Second Livelihoods Project, supported by the World Bank; and the Green Gold project, supported by the Swiss Agency for Development and Cooperation. PMPMD's strategy will help create grassroots organizations and provide additional resources to help prepare and implement *soum*-level pasture management plans (PMPs).

The PMPMD strategy focuses on developing new grassroots organizations, PHGs, that a national pasture management system can eventually recognize and integrate. These PHGs help to organize herders who are outside existing, government-recognized herding cooperatives. PHGs are herder-level institutions that herders form based on common interests, with the support of a project facilitator. Thus far, the program has helped create 120 PHGs, 60 in 2014 alone. The central objectives of PHGs are to generate effective PMPs for the groups' pasture areas, obtain herder approval of the PMPs, and monitor the PMPs' implementation, including their investment and pasture-use guidance. Examples of PMP activities include delineating boundaries for pasture utilization such as grazing rotation, resting of pasture, and haymaking areas.

The first step in creating a PHG is for, the PMPMD facilitators introduce the concept to herders. For example, the facilitators explain how PHGs have the potential to manage livestock and pastures in a more sustainable manner, and improve pasture and livestock productivity. Specifically, establishing clear pasture boundaries and coordinating with local government fosters better management of natural resources in the region (e.g., limiting over grazing) and decreases livestock mortality. The facilitators then formalize the PHGs and help each group name a PHG leader. Facilitators also work with *soum* governors and officers and a local NGO to organize trainings for PHGs under the leadership of the *soum* government. In 2014, PMPMD conducted a mid-term review of the project that underscored the importance of the facilitator's role within the government system and in familiarizing cooperatives with the project.The facilitator helps herder groups coordinate with cooperatives that focus on material processing, industry, credit union services, construction, and other economic activities.

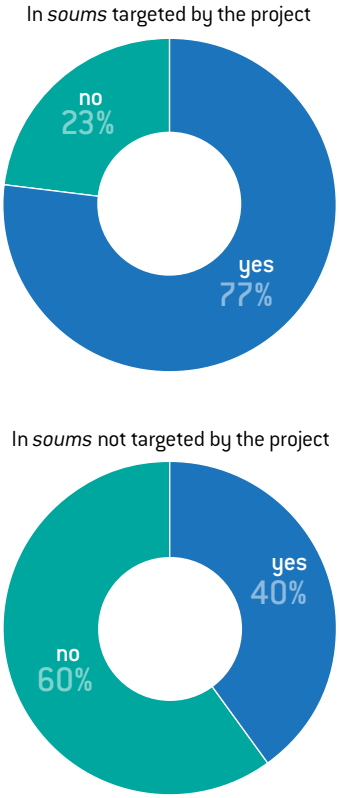
Improving pasture management

Since PMPMD's inception, the management of pastures has improved and the attitude of herders and local authorities to collective pasture management has been changed in project target *aimags*. Interviews and outcome survey results confirm that PMPMD's PHGs, PMPs, trainings, and investment have resulted in communal management of 77% of pastureland in target *soums*, compared to only 40% in the non-target soums (see Figure 3). The training on pasture management for herder groups seems particularly effective. Nearly all (96%) of the project herders said that PMPMD helped achieve better pasture rotation, and 85% indicated that pasture-use rotation had improved compared to the past. This is compared to 51% of non-project herders who indicated an improvement (Annual Outcome Survey Report: PMPMD Mongolia , 2014).

The project's collective approach to pasture management has been well received by the local *soum* authorities: 94% of project beneficiaries indicated that PMPMD helped improve the pasture management policies and activities of the government. During mid-term review interviews, several PHGs volunteered that their members were starting to cooperate beyond the project activities and that their social ties have been strengthened (Annual Outcome Survey Report: PMPMD Mongolia).

During site visits, *soum* governors repeatedly expressed that PMPs are formalized through participatory meetings at the *bag*, or subdistrict, level and will be consolidated with the district-level *soum* PMP to be approved by the *Soum* Parliament. Because of this local-to-regional consolidation, integrating PMPs with *bag*-level plans is critical. Accordingly, PMPMD expanded the

Figure 3. Outcome Survey Result (2014) to the Question, "Is your pasture access regulated?"



training and knowledge-management workshops on pasture management, climate change impacts, and adaptation to include all herders, even those who did not participate in the project.

Strengthening pasture management institutions

Working through Mongolian officials. Another way that PMPMD seeks to institutionalize a sustainable pasture management system in Mongolia is by focusing on delivering many of its programs through *soum* and *bag* governors and officials, and by tailoring some programming directly to their needs. To strengthen the growing awareness of pasture management and knowledge among *bag* officers and to increase their understanding of PHGs, project facilitators plan to offer *bag* and *soum* officials a tour of the country's best pasture management practices.

Joint project delivery. PMPMD is actively seeking joint delivery of the project with relevant national-level Mongolian institutions. For example, the Ministry of Environment and Green Development is helping develop the curriculum for the training on climate change and adaptation technologies.

A second example of joint project delivery are efforts to work with the National Agency for Meteorology, Hydrology and Environment Monitoring (NAMHEM), which is helping monitor pasture conditions, disseminate data concerning pasture carrying capacity, and upgrade nationwide local weather recording and forecasting capacity through new automated weather stations. The new stations enhance local capacity to analyze data and provide accurate information directly to herders, rather than first having to send data to NAMHEM for analysis. Through a Memorandum of Understanding, NAMHEM has agreed to provide data that are relevant for PMPMD to monitor rangeland health.

In a related effort, the PMU is seeking ways to provide weather information to herders in the form of text messages through a contract with mobile phone companies. This concept was tested through a project financed by the United Nations Democracy Fund (UNDEF) and implemented by Globe International, a Mongolian NGO, in 20 *soums*. Of those, three were part of the PMPMD; their officials indicated that the most useful way to deliver weather forecasts to herders at an affordable price was through the UNDEF mobile data. Through a partnership between PMPMD and Globe International, herders from 12 additional project *soums* will also benefit from text, message-based weather information.

Achieving results: On-the-ground improvements, investments, and loan achievements

The project's climate change adaptation investment strategy is to be in line with the PMPs agreed to by the PHGs and to support their implementation. To date, the project has helped construct water harvesting points, fence spring sources and hay-making areas, provide hay/fodder storage, construct winter shelters, distribute sprinklers, repair broken wells, and provide tractors.

The outcome survey results confirm that the PMPMD activities and investments support PHGs' capacity to cope with climate change variability and extreme events (Annual Outcome Survey Report: PMPMD Mongolia). PHGs identified areas for investment and used preliminary funding to implement their PMPs. These investments enabled herders to extend grazing areas, prepare more hay, and improve livestock access to water. The provision of tractors and the project's training in making and storing hay and fodder have been particularly effective. Several *soum* representatives indicated that hay yields have increased by a factor if three over previous years, when tractors were not available.

By May, 2014, herder groups had established the PHG Revolving Fund (PHGRF), which offers loans to PHG group members.

As of May 2014, a total of 106.3 million MNT (approximately US$54,500) have been loaned to 185 PHG members for the purchase of tractors, sprinklers, and other investments; a total of 148 million MNT, equivalent to approximately US$77,400, remains in the fund. When these investments are repaid, the PHGRF will reach 314.8 million MNT (approximately US$161,400). Up to now, the PHGRF has not financed any collective activities; however, the project is interested in targeting the PHGRF to support poor PHG members.

Project Challenges

The PMPMD, although it has had ongoing success, also faced some challenges. Some of these were unique to Mongolia's individual circumstances, while others could be common across developing countries.

Non-PHG herders. The behavior of non-PHG members is a threat to the project. Interviewees commonly highlighted the need to expand the coverage of project trainings and to promote the PMP concept among non-PHG members. In response, the PMPMD opened the project trainings to all herders, expecting to see strong numbers of herders not affiliated with PHGs participating in PMP discussion.

Facilitator continuity. The long distances between herder group members pose significant challenges to the project. Moreover, *bag* governors lack the time, capacity, and budget to involve all herders in *bag* meetings. These challenges reinforced the importance of the *soum*-level project facilitators' role in strengthening PHGs and pasture management planning at the *bag* and *soum* levels. However, a key issue with the facilitator role is that it is a project-paid, temporary position. To ensure continuity after PMPMD's end, the project is seeking a way to secure the facilitator role as a permanent position paid under the GOM's budget.

Lack of data on pastures and related resources. Another challenge to sustainable pasture management in Mongolia is the lack of available pasture-related data at soum and bag levels. Although *bag* parliament members are the most influential people in the official pasture management program, they do not have updated data on pasture conditions and water. Currently, *soum* weather officials consolidate any pasture- condition data that they collect and transfer these data to NAMHEM, which then transforms the data into geographic information systems-based information. However, NAMHEM does not disseminate the final data back to *bag* officials and herders. Following the mid-term review, PMPMD focused on developing participatory pasture monitoring (e.g., monitoring based on simple photograph-based observation); and periodic information-sharing with *soum* officials, bag officials, and PHG leaders.

Analysis

Grassroots organization works for Mongolia. The sense of social inclusion, trust, and regular communication promoted by the PHGs is successful because it works within the context of Mongolian society. Project participants indicated that PHGs are reminiscent of the traditional herder society. This is important because successful climate change adaptation in Mongolia will likely benefit from the traditional knowledge and behaviors that have helped herders and their society flourish in the region for thousands of years. The effect of the PHGs on the *soum*- and *bag*-level adaptation planning process is evident when comparing PHG to non-PHG areas.

Funding: flexible equals effective. Blending disparate sources of funding has proved to be vital to the project; this approach has allowed for greater flexibility in filling resource gaps that did not become evident until implementation began. For example, project personnel initiated the purchase of an automated weather station to transmit forecasts to the herders, only to realize that the identified source of funding for the purchase would be inadequate. Because of their flexibility in being able to blend funding streams mid-implementation, project personnel were able to proceed with the purchase of the weather station.

Strategic use of resources. As part of the PMPMD efforts to understand Mongolia's unique needs, project personnel had to weigh its strategy: distribute project investments equitably across PHGs, or target investments based on *soum*-level conditions, with the understanding that some PHGs and *soums* would then receive no investment from the project. The benefits of equitable distribution were that directly distributing funds to PHGs for their efforts would be highly motivating and would assist in developing group cohesion; however, direct distribution could mean that the efforts chosen would be less effective, on a broad scale, than they could have been. In contrast, targeted investments, although they were more effective on a broad scale, were less effective in evenly generating group cohesion across PHGs. Project personnel began with equitable distribution, but in the end, they decided that targeted investment was nonetheless the best use of project resources. Personnel based their investment strategy on *soum*-level, rather than PHG-level, discussions about which water sources and catchment areas to protect; this meant more effective use of personnel and funding.

PHGs versus cooperatives. The PHGs focus on establishing and monitoring the PMPs, as well as managing pasture areas. The cooperatives focus on material processing, industry, credit union services, construction, and other economic activities. While cooperatives are nationally recognized entities and foreseen by some as a future destination of PHGs, it seems that cooperatives and PHGs have distinctive objectives and require their own operational arrangement and institutional support. A strong and active PHG system is key to the success of herder cooperatives. Where PHGs are established and trust between members has grown rapidly, interest in cooperatives is greater and actual participation is higher. As of 2014, for example, the only active cooperative in the *aimag* of Khuvsghul was based on a PHG. Therefore, PHGs seem to be an efficient first step toward cooperatives, and *soum* facilitators can play a greater role in supporting PHG members to join the cooperatives. Indeed, given that cooperatives are nationally recognized, some project personnel see PHGs as eventually combining with or living within the cooperative system. However, for now, cooperatives and PHGs have distinctive objectives and require their own operational arrangement and institutional support to get underway.

Next Steps

One clear next step for the PMPMD is to extend the benefits of the project to non-beneficiary populations. Although the project has taken some steps toward opening its training to non-PMG herders, personnel do not yet know if the formation of PHGs, themselves, is necessary for participant success. Effective use of government resources to provide insurance, marketing support, or veterinarian support may also rest on the platform that the PHG system offers.

That said, even if project personnel determine that the project can effectively assist non-PMG herders, such an extension would create a financial gap. One possibility for bridging this funding gap would be to link PMPMD services for pasture management and adaptation to Mongolia's cooperative system.

All target *soums* of the project have been allocating the GOM budget for pasture management from the Local Development Funds (LDFs); these funds come from the GOM and are primarily distributed as grants to recipients (Reeves, 2014).

LDFs support a range of activities, from rehabilitating and constructing broken wells to helping establish birds of prey to control rodents that damage livestock feed. These types of activities are similar to those that the PMPMD supports through its PHGs and PMPs. However, when the beneficiaries of LDFs are selected, PMPMD-supported PHGs are often excluded from receiving funds, even though project-supported PHGs would be better able to manage the funds and generate benefits. Because of the obvious similarities in activities, co- financing could be a means to scale up the project and improve efficiencies. However, this would require project personnel to communicate regularly with local governors and prepare long- term investment guidelines at the local level. These actions would help avoid adversely disadvantaging project-supported beneficiaries.

Conclusion

PMPMD provides an example of creating a common pasture management system that is owned by local herders within the government pasture management structure at the *soum* and *bag* levels. The project's adaptation and collective natural resource management system requires an intensive participatory approach that relies on stable and easily applicable policies and strategies. Support is growing in Mongolia for grassroots organizations, such as PHGs, that are created through the local government structure. PMPMD's strategy of relying on district-level facilitators and providing pasture management and adaptation technology trainings to herders and regional government officials could be tailored to other countries that need to strengthen the adaptive capacity of their herders in the face of a changing climate.

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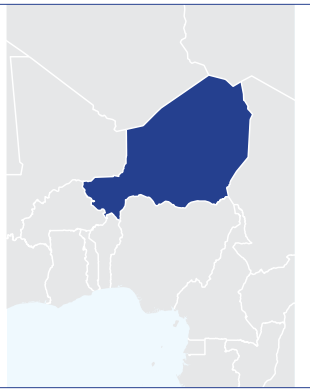
Case Study 10

Implementing National Adaptation Program of Action Priority Activities in Niger to Build Climate Change Resilience and Adaptive Capacity in the Agriculture and Water Sectors

Mame Dagou Diop (UNDP), Henry Diouf (UNDP), Solange Bakoye (UNDP), Abdoulaye Issa (UNDP)



Case Study Overview

Beginning in 2009, the GEF, UNDP, and key local partners worked together to improve food security in response to drought in Niger. The project, *Priority Action under the National Adaptation Programme of Action to Strengthen the Resilience and Adaptability of the Agricultural and Water Sectors in Response to Climate Change in Niger*, distributed drought-resilient seeds; developed and promoted fruit and vegetable gardens; created sewing centers to generate income for women; constructed cereal, fertilizer, fodder, and pesticide banks; and restored degraded plateaus. The project also expanded the use of meteorological data for agriculture via text and radio, built the adaptive capacity of the producers, and restored natural ecosystems. The project-supported agricultural yields were higher than those of traditional farming.

Project Background and Brief History

Niger's endemic poverty, dry climate, and economic dependence on agriculture have adversely impacted its development for decades. Droughts in the region have always resulted in complications for agricultural production, food security, and water resources; however, climate change will likely exacerbate these issues throughout the nation, according to the IPCC (Niang et al., 2014).

Compounding existing and expected conditions in Niger are additional pressures, stemming from rapid population growth and an underdeveloped rural economy. Rural areas lack critical infrastructure such as roads, schools, and hospitals (USGS, 2012).

The confluence of these circumstances suggests that Niger's 6 million inhabitants will be vulnerable to climate change from environmental, ecological, social, and economic standpoints. However, much of the population of Niger lacks resilience and the capacity to adapt to current variations in climate, such as the arid conditions and droughts prevalent throughout the region (Mohamed et al., 2002).

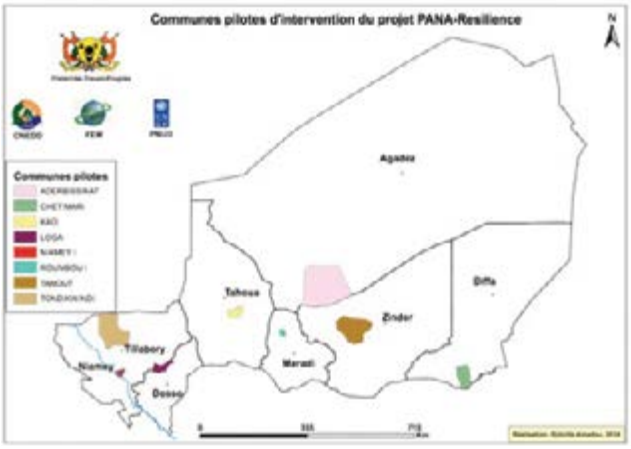
In 2006, Niger submitted its NAPA according to the UNFCCC. The NAPA identified the sectors, communes (in Niger, communes are municipal-level jurisdictions; throughout we use the terms "communities" and "communes" interchangeably), and areas that are most vulnerable to climate variability and change, relying on extensive participatory consultations with local communities, elected local officials, and other groups (National Environmental Council for Sustainable Development, 2006).

In 2009, the Government of Niger initiated this NAPA follow-up project, with funding from the LDCF. The project intervened in eight communities vulnerable to the impacts of climate change — one in each of Niger's eight regions (Figure 1). These communities were identified based on the vulnerability and adaptation assessment carried out for the NAPA (Republic of Niger, 2006). A primary focus of the project was increasing the adaptive capacity of women through income-generating activities, because women are the principal caregivers and supply most of the food in these communities.

Project Objectives

The primary project objective was to strengthen the capacity of the agriculture and water sectors in Niger to cope with climate change. This was accomplished by:

Figure 1. Map of Niger indicating the locations of the eight selected communities for NAPA Resilience Intervention.



Source: CNEDD – Niger's National Council for the Environment for Sustainable Development.

- Strengthening the resilience of food production systems and the communities whose livelihoods depend on them.
- Strengthening the institutional capacity of the agriculture and water sectors.
- Compiling and transferring lessons learned to support the implementation of adaptation measures.

Observed and Projected Climate Changes in Niger

Between 1990 and 2006, Niger experienced increasing temperatures, longer droughts, and decreased precipitation, with disastrous effects on the food security of millions of people. For example, in 2004, a drought and an infestation of invasive species led to a food deficit of 250,000 tons; the deficit affected 2.5 million people in Niger, 20% of the total population (USAID, 2005).

Projections indicate that the average annual temperature in the Sahel (including Niger) will continue to increase by 2°C to 6°C over the next 100 years (Hulme et al., 2001). Climate models disagree on whether precipitation will increase or decrease. However, increased temperatures can increase evapotranspiration rates, which, unless accompanied by large increases in precipitation, will decrease available water resources. This will have a direct effect on agriculture and livestock in Niger. Additionally, the recharge rate of surface and groundwater sources is likely to decrease because of the increased frequency of drought and higher temperatures, and this will have a greater effect on water availability in rural areas.

The net effect will be a decline in agricultural productivity and therefore food security, as well as reduced drinking water supplies for rural communities.

Project Partners

A variety of organizations worked together with the GEF and UNDP in each of these communities.. The project's key partners and their roles were:

- Niger National Agricultural Research Institute (INRAN) — oversaw communal agricultural development activities in seven municipalities and supervised producers and seed multipliers.
- Direction de la Météorologie Nationale (DMN); — installed rain gauges in villages and shared agro- meteorological information at agriculture and gardening sites.
- Ministry of Planning, Land Management, and Community Development (MP/AT/DC) — supported the integration of climate change in local development plans.
- Ministry of Elementary Education, Literacy, Promotion of National Language, and Civic Education (MEP/PLN/EC) — organized training sessions for supervisors on climate change and adaptation.
- NGOs — supported gardening and animal feed micro-projects. The four organizations educated beneficiaries about the effects of climate change on agriculture and potential adaptation strategies.

Project Achievements

By its end in 2013, the project had:

- **Strengthened sustainable agriculture techniques.** These techniques included distributing drought-resilient seeds, creating grain banks, building erosion-control measures, testing organic fertilizers and pesticides, and establishing sustainable farming practices. Furthermore, the project expanded irrigable areas to ensure water availability for crops.
- **Enhanced institutional capacity in the agriculture and water sectors.** The project provided climate information and risk management tools to farmers and regional technical service agents to guide the integration of climate change risks and adaptation into relevant agriculture and water management plans.
- **Supported alternative livelihoods and empowered women and youth.** To support women's role in household food security, the project focused on helping women generate sustainable income, become socially empowered, and improve their economic status.
- **Compiled and disseminated experiences from project activities to other communities and municipalities.** Project communities benefited from sharing knowledge and lessons learned to foster ownership and enable replication in other localities. Educational booklets were developed and distributed to integrate climate change topics into school curricula.

Figure 2. Example of a project extension site in Tondikiwindi.

Credit: UNDP.

Figure 3. Program beneficiaries selling their surplus harvest in a market in Tondikiwindi.

Credit: UNDP.

Strengthening of sustainable agriculture techniques

Drought-resilient seeds

The project organized the distribution of drought-resilient cowpea, millet, and sorghum seeds to address food-security needs in the seven communities. At least 9,820 farmers have used the improved seeds contributing to significantly increased agricultural yields, with the yields of some varieties being doubled or tripled. Activities included:

- A communal agricultural development training on agriculture practices reached approximately 280 seed producers, 70 of whom were women. These producers were organized into management committees, which supervised producers and seed multipliers. Seed inspectors at the regional and departmental levels controlled for and inspected the quality standards for seed multiplication and certification. The local farmers who were in the project communities were trained, planting at least 555 hectares of millet, sorghum, and cowpea.
- The dissemination of approximately 15,000 kilograms of millet, sorghum, and cowpea seed varieties to farmers in other villages successfully resulted in 3,000 hectares of planted fields. This seed distribution was led by the Ministry of Agriculture extension agents at municipal and departmental levels, town representatives, United Nations volunteers, and village leaders.

Socioeconomic resilience increased in households, with estimated profits of US$22,840 earned from the multiplication and sale of improved seeds. These profits have been distributed across 70 seed multipliers, including 14 women who were trained in the production of improved seeds. This money contributed significantly to the food security of the beneficiaries: no famine has occurred in communities where the project was implemented.

Grain and input banks

Grain and input banks have also played a critical role in improving food security among project beneficiaries. Grain banks contribute to ameliorating food crises when shortages occur because of variations in climate or other issues. As of the time of this report, more than 15 tons of seeds and fertilizer inputs were being stored in agricultural input banks in the project's pilot communities.

Each bank was managed by a cooperative that appoints a five-member committee, which must include at least two women. These committee members received administrative training, and helped connect producers to their supply chains and risk management inputs. The banks provided farmers with a single location where they could purchase seeds, fertilizers, and pesticides. As a result, farmers avoided higher purchasing costs while also having a nearby source of drought-resilient seeds. Typically, stored seeds were sold after the first rains, during the time of year when farmers begin to sow their crops. The cooperative set the price for its highly productive seeds, typically in the range of US$0.50–1.00/kilogram — or three times higher than that of standard seeds used in the region. Prices of fertilizers and pesticides matched the region-wide price.

Irrigation expansion

Increasing temperature and reduced rainfall frequently causes increased evapotranspiration during Niger's growing season.[1] The NAPA process recommended that areas under irrigation be expanded at the village level. The project supported the construction of four small-scale wells and the distribution of water to crop fields through appropriate technologies (e.g., drip irrigation at some sites). Additional measures for ensuring the success of the irrigated lands included construction of fences and planting of tree/shrub hedges.

As part of the co-financing of projects, 158 modern wells were constructed or are under construction in Loga, Chetimari, Niamey, Aderbissinat, Tondikiwindi, and Soudouré (CNEDD, 2012c). In 2013, the Government of Niger mobilized additional funds to construct two multi-purpose well-drilling systems for human and livestock consumption, provided pumps and solar kits for transporting and filtering water, established drinking water supply networks, and constructed 21 irrigation wells to supply water to small-scale vegetable gardens.

Desertification and soil erosion are other key environmental vulnerabilities affecting the population of Niger. The combination of these two trends is contributing to increased runoff and the consequent destabilization of riverbanks in many parts of the country. Climate change is likely to exacerbate these effects as a result of increased intensity of heavy rain events and the loss of vegetative surface cover because of drought. Both of these factors can result in increased erosion. As riverbanks erode, agricultural land is lost and entire villages are at risk of having buildings and roads engulfed by flooding rivers (UNDP BCPR, 2013). Under the LDCF project, four feasibility studies have been completed to propose technical solutions for long-term erosion problems in Soudouré, Aderbissinat, Badoko, and Roumbou.

1 1st and 2nd National Communications and the NAPA.

Enhancing institutional capacity in the agriculture and water sectors

Information-gathering and sharing

To improve farmers' capacity to respond to climate change, the project supplied climate information and new instruments to gather weather data to 5,000 farmers. The National Directorate of Meteorology installed 225 rain gauges and provided farmers with relevant information on planting dates and the cumulative rainfall required to plant crops. The National Directorate of Meteorology trained two farmers in each project site to read the rain gauges. The farmers were given reporting sheets and mobile numbers for representatives of the Ministry of Agriculture, the town, and the prefecture; they transmitted their rainfall data to the representatives, who then transmitted the data to the national level. The National Meteorological Service then processed the data to provide information about planting dates to farmers.

Planning and policy change

Local authorities are a key component of development and poverty alleviation in Niger. Communal Development Plans exist in all municipalities, but most have not taken climate change into account (IMF, 2013). Municipal councils do not have the information and the tools needed to integrate climate change concerns into these plans. Through the UNDP African Adaptation Project, CNEDD developed the 2012 guide, *Integrating Climate Change Dimensions*, and incorporated it into community planning. The guide supplemented national guidelines on creating Communal Development Plans and identified ways to introduce dimensions of climate change into these guidelines. This tool was used to mainstream climate change adaptation into development planning at the local level.

By the end of the project, and for the first time ever in Niger, all eight communities adopted development plans that integrated climate change. The project established a firm enabling environment for adaptation that was replicated across the country. Training packages were developed to support the use of these tools. As a result, 66 local development plans, covering a quarter of the country, included climate change priorities.

Supporting alternative livelihoods and empowering women and youth

Many women in Niger lack decision-making power in households and communities, especially in rural areas. Many women also lack formal education, which inhibits their ability to access information. Beyond these challenges, practical obstacles such as household chores, child care, and agricultural work overburden rural women. Also, girls often marry at a young age, which perpetuates these obstacles.

This project implemented 49 income-generating micro-projects focused on women. Of these, 24 involved gardening, 14 involved small-scale livestock rearing and husbandry, and 11 involved food processing to transform agriculture products. About 1,200 women from roughly 50 villages and hamlets participated in communal decision-making processes. Young people were also involved. Town authorities led a participatory and iterative approach to select the micro-projects, involving a combination of upstream assessments and the identification of the needs of target communities. Selected activities included training and supervision so participants could operate water pumps for vegetable and fruit production, construct mesh fences, and distribute vegetables and fruit seeds. A significant quantity of potatoes, tomatoes, cabbages, and lettuce were produced in all gardening sites, which led to increases in household income ranging from US$250 in the urban community of Tanout to US$500 in the rural municipality of Tondikiwindi. The revenue from fruit and vegetable gardening was estimated to be US$220 per woman per season. This revenue has enabled women to pay for their children's health- related expenses and thus has had positive effects on the general welfare of their families.

Unemployed women in the communities also requested that sewing centers be created to provide them with livelihoods.[2] The sewing centers provided a training program in sewing, tailoring, machine maintenance, management, and accounting. After the training, the women used the sewing centers to repair and make new clothes for sale. In addition to sewing, the centers have also hosted literacy training and hands-on learning

2 In target sites, most women are homemakers, but engage in small business or trade activities.

TESTIMONY FROM A BENEFICIARY IN SAKABAL VILLAGE

"By selling my cowpea crop I have, for the first time in my life, not just got my hands on an XOF [West African Francs] 10,000 note, but on several XOF 10,000 notes. This money has enabled me to meet my own needs and some of my husband's too."

Credit: UNDP.

initiatives for at-risk youth. As a result, the centers have led to social and economic empowerment among participating women. In particular, it has helped reduce their home workloads: the new income has allowed women to buy water and firewood, rather than collect it by hand; and to bring millet to the mill, rather than pound the grain by hand. These activities have also helped improve negotiation skills among participants, and enabled women to participate in the community development process.

Project Challenges

High level of requests for project support from surrounding communities. Because it was difficult for the project to support more than one village per region, the project adopted a strategy to incorporate neighboring communities in as many of the training activities as possible, and involving them in management committees established through the project.

However, this high level of interest in the project placed a burden on the original communities. To date, insufficient technical, institutional, and financial capacities remain at the local and regional levels; this may strain the project's sustainability.

Although the project served as a successful pilot, it has not yet generated a critical mass of climate-resilient rural producers capable of inspiring and promoting transformative change across communities and across regions. Most communities still lack sufficient capacity to implement identified climate-resilient activities and practices across landscapes, agro-climatic areas, and adjoining municipalities.

Limited staff management and capacity. The management of a countrywide project with limited staff also presented difficulties. The small project team was responsible for coordination, monitoring, evaluation, administration, and finance for the eight targeted communities. Establishing partnerships with regional and departmental extension services, as well as the NGOs who were involved in supervising communities, was critical to helping reduce the workload of the project team, and to ensuring the successful implementation of project activities. The support of United Nations volunteers based in target communities constituted an important element of project management. These volunteers were able to provide close monitoring of the project implementation, served as liaisons between the project team and local authorities, and provided decentralized technical services, thus allowing for the transmission of information from the local level to the national level and to the project management unit.

Severe weather. There were also unforeseen weather challenges that arose during the implementation of this project, such as severe floods during the 2012 rainy season. The flooding resulted in significant effects on some of the project communities, especially the village of Chetimari and the populations living along the Komadougou and Yobé streams.Many of the crops that were being cultivated were unable to withstand the extreme water levels. As a response, people living in these areas diversified the fruit and vegetable crops they were growing.

Infrastructure challenges. Another challenge that the project faced was aging or inadequate infrastructure. For example, in the urban community of Tanout, a cracked dam caused a gardening pond to empty much earlier than anticipated. After conducting a site visit, the project's Steering Committee committed to repairing the dam with a swift mobilization of funding from the Nigerians Nourish Nigeriens Initiative. However, many villages lacked the resources to fund and maintain the infrastructure necessary. In general, water resources infrastructure throughout Niger is not adequate.

Additional challenges occurred over the course of the project. Some locations had limited access to water for gardening activities and insufficient resources to expand irrigated areas. In Loga, for example, 400 women shared one well for gardening activities. Additionally, many women lacked formal education or basic literacy skills. Some management committee members found it difficult to access or understand technical training or rural finance sessions, which created communication and information-sharing obstacles.

Analysis

Local NGOs are important project implementers. Involving a range of stakeholders was integral to the successful implementation of the project. The partners included national institutions and NGOs with a diverse array of experience in climate-resilient activities, which led to the success of activities on the ground. In particular, NGOs formed a critical component of the project. They had the ability to access the remote project sites and to inform beneficiaries about the effects of climate change on agriculture and potential adaptation strategies. This provided a valuable opportunity for participants to understand the rationale and approach of the project, and establish increased ownership in project activities.

Local and national involvement in adaptation is critical. The involvement of communities in the implementation of the project activities, clear dialogue between partners, and adaptive management made it possible to successfully implement

project's development activities, even in the context of political insecurity and fragile ecosystems. At each project site, a management committee was created and members trained for each project activity. The project benefited from strong community support, and from the interest of administrative authorities in the areas of intervention. The Executive Secretary of the CNEDD and members of the Steering Committee, UNDP, and MP/AT/DC were responsible for centralized supervision, while the administrative and traditional leaders provided local supervision.

Climate variability and climate change affect project implementation. The success of the project depends on whether climate conditions allow for the implementation to occur as planned. Relying on a more diversified set of crops is a risk-diversifying strategy that helps ensure that there are at least some crop yields under unfavorable weather conditions.

Low level of basic development needs to be addressed in tandem with adaptation. While empowering women proved effective, there were limits to what women and men could understand, adopt, and communicate because of low literacy levels and more general capacity constraints.

Next Steps

Much of Niger experienced food shortages in 2012 because of a drought across the Sahel. A survey conducted that year by the Emergency Capacity Building Project in Niger found that one-third of the population was affected by the famine. Before this project, such an event exposed many of these communities to severe risks. However, the combination of the project activities helped participating communities to cope with these shortages much more successfully than their non-participating counterparts. The project was successful in helping develop the adaptive capacity and resilience of the participating communities. There are a number of positive signs of the project's potential to grow and expand. However, because of limited finances and geographic scope, there are still vulnerabilities to address.

Boosting water-supply capacity. Boosting water-supply capacity is still a fundamental problem at all pilot sites (Report of Project Terminal Evaluation, 2014). There is too much demand for water, which causes "traffic jams" at the project's water supply sites. New beneficiaries were added without adding new water supply sources. The resources allocated by the project were insufficient to meet those of the entire project population. Additional funds are expected from the LDCF, with a new project under development to realize the multi- purpose productive use of rural water supply systems that would ensure the development of economically viable activities.

Addressing erosion problems. Under the LDCF project, four feasibility studies have been completed to propose technical solutions to long-term erosion problems in Soudouré, Aderbissinat, Badoko, and Roumbou. A group of partners, including the World Bank Community Action Program 2 (PAC2), the Food Crisis Management Body, and the UNDP African Adaptation Programme, will be engaged in erosion control in Niamey koris (i.e., the temporary stream gullies of Hausa). Erosion control will also be conducted in Badoko koris (in the Loga, Dosso site) by the World Bank PAC2, the International Committee of the Red Cross, and GEF through the NAPA project. The Canadian government is providing funding for erosion control; projects will be implemented in Roumbou by constructing gabions and weirs to build latrines and filtering dykes, as well as by developing the watershed through walls, stone barriers, and green infrastructure. This work will reduce the effects of flooding and stabilize river banks. The technical studies mentioned previously will be conducted and will take into account the long-term variability of climate change. In addition, the management of water catchments will be improved by restoring the plant cover to degraded riverbanks, removing invasive riverine plant species, and managing water basins in an ecologically appropriate manner.

Replicating the project work. This project has established a foundation for adaptation and has been replicated across the country. Training packages were developed to support the use of these tools. As a result, 66 local development plans, covering a quarter of the country, include climate change priorities. With the support of the World Bank Pilot Program for Climate Resilience, the Health Development Plan has also been revised to integrate climate change. The agriculture and water sectors are in the process of integrating climate risk, with the support of the Canadian government, aimed to scale-up the results of the LDCF-funded project.

Furthermore, this project has the potential to be scaled up to reach additional communities. In early 2014, the Government of Niger acquired additional funds through the LDCF to scale up community-based adaptation, focusing on the Maradi region. This work aims to establish community-based, climate-resilient, agro-pastoral systems and practices at sub-national and regional levels to catalyze climate-resilient development. The work will build on this original project's outcomes and lessons learned.

Conclusion

CNEDD established a platform to share experiences on adaptation with national and international partners. Through this platform, practitioners shared a series of reports on the project's lessons learned, income-generating activities, and best practices.

With GEF resources, communication products such as films, articles, posters, and reports have been developed to inform wider audiences about project activities and share lessons learned from disseminating seeds of drought-resilient crops and developing climate information networks. The CNEDD website, newspapers, national television, exhibitions, and national workshops — organized by the Interstate Committee for Drought Control in the Sahel (with funding from Italy) and CARE — help disseminate information. With the ongoing support of Canada, sharing knowledge and lessons learned will be further improved for local communities.

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Case Study 11

Pacific Adaptation to Climate Change

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Case Study Overview

The *Pacific Adaptation to Climate Change* (PACC) program brought together 14 Pacific nations between 2008 and 2012 to respond to the shared concerns of sea level rise, storm surges, changes in precipitation, and extreme weather events.

UNDP worked in 14 countries — the Cook Islands, Micronesia, Fiji, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu — to train national officials to consider climate change in development decisions and policymaking. Program personnel worked in pilot communities to introduce interventions that enhance water resources management, develop secure food production, and improve coastal zone management.[1] Country governments, UNDP, the Secretariat of the Pacific Regional Environment Programme (SPREP), the GEF, and the Australian Agency for International Development (Australian AID) supported the PACC program.

1 The Australian Department of Foreign Affairs and Trade funded activities in Tokelau.

Project Background and Brief History

The communities, livelihoods, infrastructure, and national economies of the Pacific Islands are highly vulnerable to climate change. Sea level rise, storm surges, changing rainfall patterns, and extreme weather events are severe threats because the majority of the population live in coastal areas and rely on rainfall for livelihoods and water.

The small island developing states of the Pacific are among the most vulnerable in the world to the effects of climate change. The Third Assessment Report of the IPCC confirmed that small islands have inherent characteristics such as limited size, proneness to natural hazards; as such, external shocks enhance the vulnerability of islands to climate change. In many cases, islands have low adaptive capacity and adaptation costs are quite high relative to gross domestic product (IPCC, 2007). Given the common risks and opportunities across the region, the focus of the PACC program was to establish a coordinated approach to reduce the Pacific Island nations' vulnerability to climate change and to build their adaptive capacity.

Beyond assisting with climate change adaptation, the program also sought to improve people's livelihood options. To address this goal, national governments, with technical support from UNDP and SPREP, developed adaptation activities that aligned with their specific national development priorities. The activities included three main components: local adaptation measures, mainstreaming knowledge of climate risks into development planning and activities, and sharing knowledge to build adaptive capacity. The program also helped countries create approaches to address adaptation needs over the medium- and long-term. Adaptation measures focused on three key economic and climate-sensitive sectors: water resources management, food security and food production, and coastal zone management.

Working in Pacific Island countries and territories and across the three critical climate-sensitive sectors, the program provided a comprehensive, multilayered framework for adaptation in the region. The cross-regional and international approach of the PACC program promoted knowledge-sharing among peers so that successful adaptation techniques could continue to spread, even after the project's completion. In particular, the PACC website has continued knowledge-sharing beyond the project lifetime. Practitioners in the region use its resources (e.g., guidelines, technical reports, training materials, case studies) to design and guide the implementation of new initiatives around the Pacific.[2]

2 PACC website: http://www.sprep.org/pacc.

Financing and partnerships

In support of the PACC program, the SCCF provided US$13 million ($14.3 million in $2015); co-financing from the Australian AID totaled US$7.8 million ($8.6 million in $2015). National governments from the 14 countries, as well as SPREP and UNDP, also supported the program.

Project Achievements

The PACC program had a number of achievements, ranging from mainstreaming national policymaking to community-based project implementation in support of improved water resources, food security, coastal zone management, and roles for gender and youth in adaptation.

Policy mainstreaming

The project directly engaged officials from approximately 150 government institutions in climate change adaptation processes across the participating Pacific Island countries. These institutions included central ministries and departments, such as the Office of the Prime Minister, and the Ministries of National Planning, Finance, and Foreign Affairs; line agencies managing water, agriculture, infrastructure, and public utilities; and educational institutions at the national and regional levels. Program personnel trained officials to analyze links among climate trends, national and sectoral planning, and community-level adaptation interventions, as well as how to use cost-benefit and economic analysis tools (Buncle, 2013). Specifically, these training programs covered socioeconomic assessment with an emphasis on data collection (e.g., household surveys), participatory three-dimensional modeling (SPREP, 2014h), climate-related socioeconomic assessment (Anderson, 2010; Wongbusarakum, 2010a, 2010b), vulnerability and adaptation planning (SPREP, 2014i, 2014j), and cost-benefit analysis with application to the PACC pilot demonstration projects (Buncle, 2013). For seven countries, these skills resulted in the ability to develop and review demonstration projects, which informed the implementation, monitoring, and process used to scale-up interventions.

As further explained below, the program began the process of mainstreaming climate change into sectoral and national development policies throughout the region, and to develop a strong enabling environment for adaptation and a means to replicate and scale-up successes. Through the development of new policies, regulations, and coordination mechanisms, countries in the program took steps to effectively manage climate risks and improve livelihoods. In addition, policy

processes were tied to community-level interventions. Inter-ministerial and cross-sectoral coordination was also greatly enhanced. Examples of the PACC program's policy achievements include:

- Eight of the program countries' national project teams served on national climate change committees, working groups, or advisory boards.
- In Micronesia, the PACC program supported the development of an integrated legislative framework for climate change (Federated States of Micronesia, 2013a). At the national level, a climate change policy now provides a foundation for climate-resilient planning across the country. In 2013, Micronesia passed the Climate Change Act that implements the Nationwide Integrated Disaster Risk Management and Climate Change Policy (Federated States of Micronesia, 2013b).
- In Tafitoala, Samoa, communities developed nine water resource bylaws to support integrated coastal management (see text box). The bylaws applied a "ridge-to-reef" approach to manage environmental resources from the mountain to the sea, recognizing that land-based activities have a significant impact on coastal and marine resources (Ministry of Natural Resources and Environment, 2010, 2011). Using participatory approaches, the bylaws were formulated, endorsed, and enforced by the villagers. This promoted community ownership, which was particularly important considering that the majority of land in Samoa is not legally held by occupants. The bylaws supported the implementation of national policy, the Water Resource Management Act of 2008, which demonstrated a successful case of national policies reflecting local priorities.
- In Nauru, the PACC program supported the creation of the National Water, Sanitation, and Hygiene Policy, which incorporated climate change. Nauru previously had no national climate change policy, other climate-sensitive water policy, or government institution to address water issues. The government formed an inter-agency steering committee to create the policy and to establish a strong coordination mechanism to support integrated decision-making. With the policy in place, the government established a Water Unit to tackle water and sanitation issues, and to systematically address climate risks.

WATER RESOURCE BYLAWS IN TAFITOALA, SAMOA (MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, 2010, 2011)

1. Removal of vegetation and forests near rivers and water sources is strictly prohibited.
2. Encourage a buffer zone of five meters from the river for plantation in watershed areas.
3. Discontinue the use of dangerous chemicals in areas close to rivers or water resources.
4. Livestock farming is prohibited near or in the vicinity of rivers and other water sources.
5. Current livestock farming relocated to more appropriate vicinity.
6. Disposing of any kind of rubbish, wastewater or other harmful substances into or around the vicinity of Tafitoala water resources is prohibited.
7. Water abstraction activities by individuals or organizations without permits/licenses issued by the Ministry of Natural Resources and Environment, or approval by the Tafitoala Council of Chiefs are prohibited.
8. Access to near water sources or intakes should be strictly prohibited to only the authorized people such as water committee members.
9. Any other developments along the river side or near the vicinity of the spring which may pose a threat to the safety or sustainability of water resources cannot be undertaken unless a Development Consent and approval by the Tafitoala Village is granted.

Community-based adaptation initiatives in three sectors

The PACC program supported demonstration adaptation activities and on-the-ground measures in 80 pilot communities across the 14 countries. Comprehensive technical guides were created to aid in replicating techniques across the region. Below, three categories of community-level adaptation interventions — water resources management, food security and production, and coastal zone management — are described in more detail.

Water resources management

Program countries worked to adapt their water resources to reduce climate risks, including risks from drought and saltwater intrusion into groundwater. Many interventions were selected with the help of cost-benefit analyses, as mentioned in Section 3.1. The types of interventions, and the countries that implemented them, included:

- Capture and storage of rain and groundwater resources (individual household and community storage capacities) — Tuvalu (SPREP, 2014a), Tonga (SPREP, 2015e), Nauru, Papua New Guinea, Marshall Islands, Tokelau (SPREP, 2015d), and Niue (SPREP, 2015c).
- Leak reduction in reticulated systems and water storage facilities — Tonga, Tuvalu, Marshall Islands (SPREP, 2014b), Tokelau, and Niue.
- Water conservation (e.g., introducing composting toilets, demand-management through awareness-raising) — Tuvalu, Tonga, and Niue.
- Water-quality enhancement and assurance – Nauru, Marshall Islands (solar water purifier), and Tonga (groundwater quality monitoring).
- Saltwater reticulation — Nauru.

TUVALU COMMUNITY-LEVEL WATER INTERVENTIONS

Tuvalu is one of the smallest nations in the Pacific. In 2011, the country experienced a severe drought. Because of limited water resources in many regions, water was rationed to 40 liters per person per day. To ensure such drastic measures would not be needed again, Tuvalu officials introduced a policy of integrated water resource management and conservation actions. These actions, when implemented and brought to full capacity, will reduce national vulnerabilities to changing precipitation patterns. The actions include demand-management innovations such as self-composting toilets that use leaves instead of water to manage waste, and actions to increase water supply such as rainwater harvesting. For example, in the Town of Lofeagi, residents attached gutters to a chapel to direct rainwater into a reservoir. The hope was that, given the visibility of the chapel, people would recognize the effectiveness of this idea and attach gutters to their homes.

Food security and production

Countries also acted to adapt their food supply systems to address climate issues, including drought, extreme rain events, and saltwater intrusion. Most climate change projections were drawn from the Pacific Climate Change Science Program (Australian Bureau of Meteorology and CSIRO, 2011). These projections are available for the years of 2030, 2055, and 2090. They span three greenhouse gas emissions scenarios from the Fourth Assessment Report of the IPCC: B1 (low), A1B (medium), and A2 (high) (IPCC, 2007; Australian Bureau of Meteorology and CSIRO, 2011). In most cases the PACC program considered the A1B scenario.

The types of interventions and the countries that implemented them, included:

- Introduction of climate-resilient crop species and varieties that are resilient to drought, waterlogging, saltwater intrusion, pests, and other issues; and techniques for consistent supply, including germ-plasm collections and nurseries — Solomon Islands, Palau, Fiji (SPREP, 2015a); and Papua New Guinea.
- Soil and water conservation farming and land-use techniques (e.g., mulching, organic farming, mixed cropping, drainage) — Solomon Islands, Palau, and Fiji
- Food storage and processing techniques — Solomon Islands and Palau.
- Aquaculture techniques — Palau and Vanuatu.

Coastal zone management

Program countries also acted to adapt to the degradation and erosion of their coastal zones and coastal infrastructure to address climate risks, including those from extreme events and sea level rise.

Types of interventions and the countries that implemented them included:

- Coastal vegetation — Samoa, Vanuatu, and Fiji.
- Changing coastal resource use (e.g., reducing sand mining by local communities; conserving reefs, coastal wetlands, and forests as natural protection barriers) — Samoa.
- Relocating coastal infrastructure to less-exposed areas — Vanuatu (landing strip and road sections).
- Reinforcing existing coastal infrastructure (climate-proofing roads and harbors) — Federate States of Micronesia (SPREP, 2015f), Vanuatu, and Cook Islands (SPREP, 2015b).

COMMUNITY-LEVEL FOOD SAFETY AND SECURITY INTERVENTIONS IN FIJI

Climate events are already beginning to affect Fiji, with an increase in the incidence and intensity of extreme rain events. In 2009, UNDP and the United Nations International Strategy for Disaster Reduction noted that high-intensity floods would become more frequent in western Fiji. In the Nadi area, for example, these types of floods used to occur every 190 years. With the influence of climate change, they are predicted to occur every 25 years by 2100 (Hay, 2009). This increase is having an adverse impact on food security throughout the country. Many Fijians rely on subsistence farming for their livelihoods, but heavy rains overwhelm existing drainage systems. When the excess rainwater does not drain properly, crops are ruined, with cascading effects. Without enough food from the harvest, people must buy food. As a consequence they do not have the money to pay for other needs, such as their children's school fees. To help Fijians adapt, the program helped introduce an array of measures to improve food security in the villages of Namsori and Nauvua. These interventions included the construction of drainage channels and excavating creeks so that water can drain from farmlands into the sea, as well as constructing floodgates where these channels meet the sea. These floodgates stay open during low tide so that water is able to flow out, but close during high tide to prevent saltwater intrusion upstream. For further protection, government officials worked with local research institutions to develop saltwater-tolerant crops, as well as crops that withstand waterlogging. The selected crop varieties ultimately varied by location, depending on local climate change projections and other parameters.

- Developing protective coastal structures — Samoa, Vanuatu, and Fiji.

Gender and youth in adaptation

It is important to involve a mix of people to ensure successful adaptation to climate change; thus, the PACC program developed a PACC gender assessment and action plan supported by regional experts and organizations. The plan included the development of a Pacific Regional Gender and Climate Change Toolkit (Leduc et al., 2013). Examples of how the PACC gender assessment and action plan (SPREP, 2014c), together with the toolkit (Leduc et al., 2013), helped in some of the program countries, include:

COMMUNITY-LEVEL COASTAL AREA AND INFRASTRUCTURE INTERVENTIONS IN VANUATU

Vanuatu faces a number of climate risks associated with more frequent and intense precipitation and resultant flooding, sea level rise, and coastal erosion, as well as the impact of intense waves along the coast. For the nation's coastal communities, particularly those on islands, these climate risks have degraded the condition of vital infrastructure, especially roads. One example of such an island community is Epi, with a population of 7,000. Many Epi farmers rely on the island's roads to transport inputs to support crop production and goods to market. Furthermore, the two airports located on the island are important for evacuating people suffering from medical emergencies. The options identified in Vanuatu to reduce the vulnerability of its road system were relocation, improved drainage, revegetation to limit coastal erosion, and soil compaction and road leveling. These options would help to reduce the vulnerability of roads to a range of current and future climate conditions. Of these options, Vanuatu revegetated land, constructed sea walls, built embankments, and relocated roads and one airport landing strip away from vulnerable coastal areas. Vanuatu national and community decision-makers also mainstreamed adaptation into policy actions such as the National Roading Plan to incorporate climate change and resiliency planning into future infrastructure investments.

- In Fiji, the project coordinator worked closely with Community Facilitators to provide training, based on toolkit resources, to involve women, men, and youth in discussions of climate change adaptation. Program staff trained Community Facilitators to ensure that the needs of men and women were considered equally in the implementation of the project and to reflect these needs in the community work plans. These PACC program training sessions helped communities gain a double benefit: clearing creeks to reduce waterlogging on taro farms benefited mostly men, who operate the farms; and clearing creeks also provided more space for prawn and aquaculture — a livelihood that primarily benefited women.
- In Nauru, the PACC project increased youth participation in community processes through an awareness program that engaged youth spokespersons for water management and adaptation issues. The project also supported the preparation of a gender-sensitive guideline for climate change mainstreaming processes.
- In the Marshall Islands, the PACC program team participated in the Ministry of Internal Affairs committee for the development of a national gender policy with a climate change lens. The national organization that partnered on the effort, Women United Together Marshall Islands, played an active role in the PACC national core group, and PACC supported the Women United Together Marshall Islands conference in 2012.
- In the Solomon Islands, PACC program demonstration activities targeted both men and women, especially concerning the introduction and operation of solar hybrid driers to support food preservation and storage, as well as activities focusing on cassava production and farming.
- In the Cook Islands, PACC raised awareness on gender and the benefits of climate change adaptation programs; in particular, these activities emphasized the role of gender in adaptation planning, governance, and decision making.

These activities resulted in the mayor of Mangaia Islands (a PACC pilot site) creating a woman-led women's council. The council is at the highest decision-making level.

Project Challenges

Communicating broadly across levels. The PACC was a multilayered program with regional, national, sub-national, and local activities. It targeted both specific capacity areas and broader awareness-raising on climate change, so systematic communication was challenging. This challenge was addressed by developing a PACC program regional communication strategy, as well as supporting PACC countries to develop national communication plans with support from international, national, and regional specialists. This multi-faceted approach to communication resulted in the high visibility of the program, both nationally and regionally.

Facing implementation challenges. The PACC project developed a wide range of solutions to adapt to climate change. In some cases, these interventions had never been tested and did not turn out as expected because the technology was not appropriate or the Pacific context was not properly factored into the project design. As a pilot project, these experiences were folded into a learning process. Both successes and failures were captured in knowledge products that provide lessons for practitioners of what works and what does not work in the Pacific and possibly elsewhere.

Maintaining a strong and consistent pace across program countries. The participating countries relied on a broad spectrum of implementation processes and institutional capacities. Maintaining a consistent pace through the key steps and stages in the adaptation planning and implementation processes across the countries was challenging. This challenge was addressed through a combination of regional, sub-regional, and sector training sessions on key tools such as the Vulnerability and Adaptation Assessment and the Cost-Benefit Analysis; follow-up in-country mentoring; and setting up a pool of retainer technical experts in the three sectors to allow rapid mobilization for country-specific interventions.

Ensuring project sustainability. As the program neared the end of its funding cycle, program personnel struggled to ensure the sustainability of the increased capacity that was created and the long-term maintenance of on-the-ground installations. For the PACC project, the challenge of sustainability was addressed and supported by the policies, institutional structures, and technical tools created by the project; examples include linking with existing government budgetary processes and related donor-funded initiatives. Specific examples by program country include:

- In the Cook Islands, the maintenance of Mangaia Harbor was secured formally by including related costs in the Cook Islands Infrastructure Business Plan.
- In Tonga, the program supported water usage and demand-monitoring equipment, water storage infrastructure, and distribution facilities as part of a local water management plan led by the community. To calculate household user fees, which support ongoing maintenance costs of the water supply system, the program installed water meters.
- In Niue, the PACC program held a rainwater tank molding workshop to help households and businesses address the additional storage needs of families and individuals. The workshop provided the skills and equipment to build other types of containers, which is expected to generate ongoing revenue for equipment maintenance and staff salaries.
- In the Marshall Islands, the involvement of government resulted in strong buy-in, leading to the creation of a climate change unit tasked with implementing all climate change projects.
- In Palau, crab farming as a livelihood diversification strategy has proven successful and sustainable thanks to strong linkages to the private sector (tourism industry), which has a high demand for such products.

Analysis

During the course of its implementation, PACC program personnel had a number of experiences that could benefit other, similar projects.

Harnessing traditional community leadership and decision-making processes was key for local project management arrangements. For example, in Tonga and Samoa, village fonos, or councils, included representatives of women and youth groups. The councils supported setting up a District Water Committee in Hihifo, Tonga, and an Environment Committee in Tafitoala, Samoa. In Tonga, the District Water Committee played an important role in developing and interpreting the results of the socioeconomic assessment that was conducted to better design water projects. The committee's inputs on the governance of natural resources in the Hihifo district were key to improving the management of groundwater in the community.

Partnerships and collaboration across sectors led to integrated success. It was critical to actively promote partnerships among different government entities, nongovernmental organizations, and academia. In addition, it was important to enhance the skill sets of the technical officers working in line ministries on sector-focused adaptation interventions, and also to ensure the broader application of techniques and results developed through the project. For example, in the Cook Islands, engineers from the Ministry of Infrastructure and Planning enhanced their understanding of climate science by collaborating with the Climate Change Division under the Office of the Prime Minister. In the Marshall Islands, water engineers at the Ministry of Works learned applied economics and cost-benefit analysis by working collaboratively with central government planning and finance agencies.

Regional partnerships supported project success at the national and local levels. Promoting partnerships proved to be vital, at the regional level, to deliver systematic support at the national and local levels. A good example was the regionally coordinated training sessions and country case studies developed for the application of cost-benefit analysis for the PACC demonstration projects. Training sessions to PACC country teams were delivered through a collaborative effort of technical experts and economists from key regional agencies, such as SPREP, the Secretariat of the Pacific Community, the Pacific Islands Forum Secretariat, and development partners, including Germany's Agency for International Cooperation (GIZ) and UNDP, with additional support from the USAID's ADAPT Asia-Pacific program and the Asian Development Bank.

The community-level adaptation interventions produced additional benefits to local livelihoods and ecosystems, which were important to capture to provide further incentives and impetus for continuing the adaptation process. For example, retrofitting the Quaraniki Creek at the pilot community site in Fiji resulted in the reduction of flooding and waterlogging in farms, but also provided fishing and recreation activities for local communities. In Palau, traditional taro farms enhanced with a dyke system to reduce saltwater intrusion, together with contour planting introduced in ridge areas to aid soil enhancement, also resulted in sediment trapping. This reduced sediment in the lagoon and reefs supported a healthier coastal and marine ecosystem. The dyke system and plantings are expected to last beyond the project timeline as these interventions are socially accepted and owned by the communities; the community members are prepared to conduct ongoing maintenance.

Next Steps

The PACC program produced tangible results in terms of enhancing institutional capacity at the national level and reducing vulnerabilities in more than 80 pilot communities across the 14 countries through demonstration adaptation measures. As the project neared its end, program personnel focused on completing policy revisions, community demonstrations, and a set of projects to replicate successful on-the-ground measures. Program personnel dedicated intensive efforts to knowledge management and communications to ensure that project experiences and lessons were fully captured and broadly disseminated. Personnel pursued these efforts through a broad set of materials, including comprehensive technical guidelines, technical reports, a "PACC experience" series, further articles on success stories, videos, and photo stories that will live beyond the project lifetime (SPREP, 2014d, 2014e, 2014f, 2014g).

Conclusion

The PACC program could be scaled-up and disseminated for greater impact in the program countries and beyond. Overall, the PACC program assisted 80 pilot communities in 14 program countries implement climate change adaptations that supported meeting national development goals. Because of the program's success, future programs may be able to replicate many of the program's efforts — both in terms of national-level policymaking and community-based adaptation interventions. Lessons learned and technical evaluations conducted for demonstration projects could serve as a basis for scaling up actions in the Pacific or other regions. Already, this project has set the baseline for other possible work through Japan Aid, UNDP, the World Bank, the GEF Least Developed Countries Fund, and others:

Additional funds are being sought from Japan Aid to provide solar-powered water purifiers to 20 more houses in Nauru. The technology has also been so successful that it was transferred to the Marshall Islands, where training and installation were completed at the Jaluit Hospital Center.

- The PACC Samoa guides on coastal protection are linked to a nationwide program to review and implement Coastal Infrastructure Management Plans through a UNDP-implemented Adaptation Fund initiative aligned with the World Bank-funded Pilot Programme on Climate Resilience.
- In Vanuatu, technical guidelines established on climate-proofing infrastructure through the PACC demonstration site on Epi Island are being upscaled through a GEF Least Developed Countries Fund and a UNDP-supported initiative aiming at coastal infrastructure and flood management in various islands of the country.
- In Micronesia, the replication of the Kosrae State Policy and legal framework developed to support climate-resilient coastal roads and related infrastructure work is currently under discussion. With financing from bilateral and multilateral sources, the government wants to transfer this institutional system to the other three island states in the country.
- The cost-benefit analysis training materials are being applied through a wider economic analysis and decision-making processes, the Pacific Cost-Benefit Analysis Initiative. These materials are also being integrated into the University of the South Pacific's academic curricula.
- The Solomon Islands Water Sector Adaptation project is developing water plans for several communities across the country. The project is using cost-benefit analysis training and lessons to include cost-effectiveness considerations in initial analyses, which have the potential to help policymakers make more sensible decisions.
- In Marshall Islands, the government is developing a new project proposal for the GEF and the Green Climate Fund to upscale water improvement solutions piloted through the PACC project, such as the airport reservoir relining and solar water purifiers.

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Case Study 12

Southeast Europe and Caucasus Catastrophe Risk Insurance Facility

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Case Study Overview

Southeast Europe is highly exposed to climate-related natural disasters, particularly flooding. Climate change is further expected to increase the frequency and severity of hydro-meteorological disasters. As a response, the GEF supported a project aimed at creating catastrophe and weather risk–insurance markets in three countries: Albania, the Former Yugoslav Republic (FYR) of Macedonia, and Serbia. Risk sharing and transfer mechanisms such as insurance have been recognized by the international community as an important aspect of adapting to climate change (Sixteenth Conference of the Parties to the UNFCCC, 2010).

The *Southeast Europe and Caucases Catastrophe Risk Insurance Facility* (SEEC CRIF) project supported catastrophe-risk mapping and modeling; design and pricing of innovative catastrophe risk insurance products; collection of data to support parametric weather insurance; and assistance for local insurance regulators in developing new regulatory requirements for the catastrophe insurance market. By the end of 2014, homeowners, farmers, and small and medium enterprises (SMEs) in the participating countries benefited from the opportunity to insure against financial damages caused by climate change and geological hazards. Additional adaptation benefits created through this project included public access to property-based flood risk information, as well as a new damage assessment and claims system. These new types of information and tools can serve as a foundation to inform national climate change adaptation plans, disaster risk management, and disaster risk financing strategies.

Project Background and Brief History

To address climate change risks, the governments of Albania, FYR of Macedonia, and Serbia established the Europa Reinsurance Facility (Europa Re), with technical assistance from the World Bank. This special catastrophe reinsurance company served to promote the development of national catastrophe and weather-risk insurance markets in the participating countries, enabling local businesses and populations to purchase affordable catastrophe and weather-risk insurance products that were unavailable in the commercial market.

Project Financing

The three participating countries became the first shareholders of Europa Re. To finance the countries' equity contributions to the company, the World Bank provided individual country loans under the SEEC CRIF program, offering a total of US$12 million to finance membership contributions. The World Bank also provided US$3 million to strengthen Albania's national hydrometeorological service and disaster-management system. A US$4.5 million grant from the Swiss State Secretariat for Economic Affairs (SECO) and a US$5.5 million GEF Special Climate Change Fund (SCCF) grant financed the remaining country-specific technical work required for the launch of Europa Re, including early-stage technical assistance and preparatory work. Because the SECO funding arrived first, it primarily supported the development of risk models and other technical activities. The GEF SCCF funding, in turn, supported data acquisition, the development of modern remote sensing-based methods of damage assessment, and important insurance regulatory work. Although GEF funding ended in 2015, additional project funding was expected to run through 2018.

Project Impetus

Ninety per cent of Southeast Europe is located within trans-boundary river basins. This often simultaneously exposes adjacent nations to flooding (Europa Re, Undated). In addition, the region has strong economic dependency on agricultural exports. These facts make Southeast Europe particularly vulnerable to climate variability and to the adverse economic impacts of climate change. The limited financial capacity of governments in this region exacerbates the climate challenge, making them less able to help their populations regain lost assets and productive capacity after natural disasters. At the same time, homeowners, businesses, and farmers often have no access to reliable insurance coverage for climate hazards; before the project began, only 1–2% of home owners had private catastrophe insurance and only 1% of farmers had crop insurance (Europe Re, 2012).

Because of the underdeveloped catastrophe and weather-risk insurance market in this region, most financial exposure to climate-related hazards had been retained by individual households, businesses, and respective governments. The demand for insurance products was low because consumers did not understand the need for catastrophe or weather-risk insurance, relying instead on their governments to compensate them in the event of a natural disaster. Yet, governments' fiscal constraints sometimes prevent them from offering compensation for losses, leaving individuals to cope on their own with little or no assistance. The supply of catastrophe insurance was also limited because local insurers were reluctant to offer it for three reasons: (i) countries in the region had relatively small markets with low premium volume and undiversified risks; (ii) reinsurance for catastrophe and weather risk was not affordable; and (iii) modeling risk and developing relevant insurance products is a time-consuming and expensive endeavor that would have required technical capabilities beyond the reach of local insurers.

Project Achievements

As of this writing, project implementation is ongoing; however, three significant achievements have already been accomplished.

Public access to property-based flood-risk information. The project created a novel, open-access website that enables the general public to view and inform themselves about the risk of natural hazards to their own property, as well as to community facilities, such as schools and hospitals (Europa Re, forthcoming). Flood risk models that were developed with GEF grant funding served as the foundation for this tool, which estimates flood risk for individual properties with a 25-meter resolution.[1]

The assessment of catastrophe risk to individual properties is a complex and knowledge-intensive process, based on advanced risk modeling. For example, the project's model accounts for the complex hydrological features of flood prone areas, the effects of precipitation runoff, and existing flood defenses. To understand the level of flood risk to a particular property, the model must address unique features such as location, elevation, construction, occupancy type, and whether or not the property has a basement.

The availability of risk information at the household-level is important because it enables the development and provision of insurance policies that are tailored to the individual needs of the beneficiaries. If all policy holders were to pay the same

1 The risk models included tectonic risks, as well, which were financed by non-GEF sources.

premium regardless of risk, the insurance product would be counterproductive because it would encourage them to take risk. The project's model results, however, informed Europa Re's risk-based premium rates and flood risk maps; these essential tools educate members of the general public on their relative risk. Knowledge about their relative risk can help the public make informed risk reduction decisions, such as taking action to reduce localized flooding or better protect their property, deciding whether to carry additional insurance, or determining that the relative risk is too great and that selling their property is the best option. As such, this information has the potential to encourage the public to adapt to climate change before, rather than after, catastrophic floods.

Damage assessment and claims system. The project's second big achievement was the development of a highly innovative damage assessment and claims system. This system has already been applied to assess damages following the May 2014 floods in Serbia. Based on a combination of aerial photography, satellite imagery, digital elevation models, flood damage functions, databases of property replacement costs, and empirically observed flood depths, Europa Re's small staff was able to estimate flood damages to properties and their contents in Serbia accurately within five days of the flood event. In the past, such high-quality damage assessments might have required much larger institutions, months of damage-collection surveys, hundreds of people on the ground, and millions of dollars. Figures 1 and 2 show examples of the aerial overlays that Europa Re produced and used to quickly and accurately assess flood damages in Serbia.

Figure 1. Examples of remotely sensed images of flooded a flooded area.

Credit: Europa Re, 2014.

Figure 2. An integrated exhibit of all airborne and satellite images of flooded areas in the Sava River Basin, overlaid on the Property Exposure Database developed under the project, May 2014.

Credit: Europa Re, 2014.

Thanks to cutting-edge actuarial underwriting and the involvement of Swiss Re, a well-established reinsurance company, Europa Re faces little risk that claims will exceed expectations and collected premiums. In the event of large catastrophes with extraordinary damages, reinsurance would compensate for lack of immediate liquidity by Europa Re.

Fully automated, modern insurance market infrastructure; risk-based insurance regulations; and dedicated reinsurance capacity. To increase the market demand, insurance against climate-induced hazards needs to be promoted further. However, several milestones have already been achieved. In particular, Europa Re has developed and launched several innovative catastrophe insurance products, such as flood-risk insurance and agricultural area-based yield insurance. Since late 2014, these products have been available for purchase through a phased approach in participating countries. Serbia was the first country to pilot the introduction of flood risk insurance for individual households in October, 2014 with an advertising campaign that included television and radio broadcasts. By the end of 2015, it was expected that all participating countries would offer a diverse range of catastrophe risk insurance products.

Ongoing Project Efforts

In addition to the project successes above, a number of project efforts are ongoing.

Institutional and regulatory frameworks. Both market players and insurance regulators; often have poor understanding of the complex business of catastrophe risk insurance. This lack of understanding can result in inadequate payment of claims following a natural disaster. Hence, a major component of this project was to develop and reform institutional and regulatory frameworks in the three participating countries. Introducing and enforcing risk-based insurance regulatory frameworks is crucial to successfully developing national catastrophe insurance markets. Because of the importance of these frameworks, the project assisted insurance regulators in the three participating countries with developing modern, risk-based insurance supervision of the type that was also expected to be introduced in the European Union countries in 2016.

Flood insurance for homeowners, enterprises, and farmers. Europa Re developed several innovative insurance products specifically designed to address local climate adaptation needs, including flood insurance. Although the pricing of the products is actuarially sound, the premium rates were set to accommodate local affordability constraints. Europa Re accomplished this by designing customized coverage packages

offering full or basic insurance protection against climate hazards. The main clientele for these insurance products are homeowners, SMEs, and farmers. Homeowners receive basic insurance against natural disasters, most importantly flooding. SMEs, as well as farmers, are offered similar products tailored to their business needs, including coverage for inventory, premises, or business interruption.

Agricultural area-yield index insurance. Weather volatility represents a key business risk for farmers. Because farmers may encounter crop losses from a variety of different weather events, single-peril parametric insurance products are typically ineffective and less suitable for farmers. For this reason, flood insurance alone is insufficient for farmers who need comprehensive all-risk coverage. To address this problem, Europa Re developed an area-yield index insurance product that offers comprehensive coverage of yields for a dozen locally grown crops against all weather-related perils. This product compensates farmers for a pre-agreed drop in the average annual yield of a given crop, relative to the historic average for their area, regardless of the weather peril that caused the loss. Over 10,000 ha of sown land were insured against multiple climate perils during the course of the project, with plans to increase this number.

Benefits for the market at large. In addition to working on big-picture frameworks and on-the-ground insurance programs, the project also promoted the catastrophe insurance market, at large, by supporting an insurance culture and raising the disaster-risk awareness of the general public. In Albania, for example, the government began working to make catastrophe insurance compulsory based on the project risk model outputs that showed the country's extreme vulnerability to natural disasters.

Reduced government fiscal vulnerability. Another important outcome was the reduction of governments' fiscal vulnerability to natural disasters. In the three participating countries, government is often the only source of compensation for people affected by natural disasters. This situation leaves national budgets in a state of major distress in the wake of catastrophic events and may be unsustainable, given that disasters are becoming more frequent and severe. For example, the May, 2014 floods in Serbia caused nearly US$2 billion in damages, compared to Serbia's gross domestic product (GDP; 2012) of US$37 billion (Cerkez, 2014).

Fiscal sustainability. Europa Re was designed as an institution that was expected to become financially self-sustaining after the project's external funding came to an end, within three years of the start of the GEF-supported project. The vision was that local insurance companies would sell catastrophe insurance policies under the SEEC CRIF program and Europa Re would reinsure them, continuing to provide market infrastructure and insurance services. However, to achieve this vision of sustainability, the governments of all three countries have to stimulate adequate demand for catastrophe insurance.

Grass-roots changes to decision-making. Increased awareness of climate-related risks will trigger changes to decision-making and behavior at the grass-root level. For example, a homeowner or enterprise with property in a flood-prone area may discover that the insurance premium for the newly required catastrophe-risk insurance policy is high. The property owner can then decide which options to pursue, most obviously whether to pay the premium or sell the property. The same concept could apply to farmers who seek weather-risk insurance. Farmers who choose to grow crops that are vulnerable to climate change would face higher insurance premiums, or they could choose to grow crops more suitable to changing conditions and pay a lower premium.

Changes to national-level crop subsidies. The project also sought to encourage new thinking concerning nationwide policies that relate to climate, such as continuing to offer crop subsidies to farmers who grow high-risk crops in high-risk areas. For example, several areas across a particular country may experience conditions that are particularly harsh for growing grapes — conditions that would then lead to a higher insurance premium for a farmer who chooses to grow grapes in those areas. However, because grape subsidies per hectare of land may be equal across the country, that farmer may still continue to grow grapes. A municipality that systematically suffers from weather that is adverse to growing grapes may find that its farmers continually claim the most subsidies for losses to grape crops. Adjusting the national subsidy allocation criteria so that farmers who grow high-risk crops will be unable to claim subsidies for climate-induced losses presents governments with an important policy option that will help reduce the country's vulnerability to climate change.

Factors in Project Success

Several important factors have contributed to the success of the project so far. One factor has been a rise in the policy importance of catastrophe insurance as more-frequent adverse weather conditions have led to decreasing crop yields and resulting post-disaster costs, as demonstrated following the May, 2014 flood events in Southeast Europe.

Another central factor that contributed to the project's success was the involvement of the World Bank, the GEF's main partner on this project. The GEF's funding enabled the World Bank to provide extensive, hands-on technical assistance to Europa Re.

The World Bank also brought to the project a background of solid sectorial research work carried out before the project began.

A final factor in the project's success was the emphasis on numerous feedback mechanisms, which enabled timely inputs from multiple project stakeholders and enhanced oversight. For example, to obtain regular feedback from its country shareholders, Europa Re held and continues to hold annual shareholder meetings and bi-annual meetings of its Policy Advisory Board. These meetings bring together senior government representatives from all of the participating countries. In addition, to ensure close day-to-day cooperation with and across participating governments, Europa reestablished resident missions in each of the three countries. These resident missions help the three national governments prepare sound national strategies pertaining to insurance and climate change adaptation. In Albania, for example, Europa Re resident mission staff contributed heavily to drafting the country's national climate change adaptation strategy and advising the government on the design of the national mandatory catastrophe insurance program.

Project Challenges

The project had to overcome numerous significant technological challenges in the early stages of implementation. For example, the project design relied heavily on the acquisition of ready-to-use, "out-of-the-box" insurance systems and technologies available from vendors in North America. These acquisitions included highly sophisticated catastrophe risk models and a fully integrated web-based technology platform that enables the sale of insurance products by numerous Europa Re insurance partners, automated risk pricing and underwriting, and fast claims management.

However, in the middle of project implementation, the project team became aware that the risk model could not produce risk quotes within seconds, as originally anticipated, because of inherent limitations in its overall architecture. At the same time, the technology that was presented as ready-to-use software at the contract bidding stage actually required numerous and lengthy customizations to fit the specific business requirements of the Europa Re business model. These technological setbacks necessitated a complete redesign of the project's technical specifications. Europa Re and World Bank technical experts had to implement these changes in close cooperation with both vendors. Although ultimately successful, these redesigns cost the project unanticipated time and resources.

Although the GEF grant provided sufficient funding for technical experts, it covered only a small fraction of the operating costs of the newly established institution. To overcome the problem, Europa Re had to rely on funding from its three participating countries, without which the continuous project implementation may have been in jeopardy.

Analysis

Direct transfer of insurance technology to beneficiary countries is likely to fail without proper customization that accounts for specific country circumstances and project requirements. A major challenge in this project was to achieve smooth transfer of technology from West to East. The project team saw the need to transfer three key technology components: 1) risk models, 2) an automated technology insurance production platform, and 3) a claims-management system based on remote sensing. However, successful transfer of technology was possible in only one instance, and even then with considerable input from the project team. Only a highly skilled technical project team was able to overcome the challenges and successfully launch the two lagging components by eventually adjusting them to the project's technical specifications. Every project and country is unique. Technology transfer is unlikely to be successful unless the project team closely considers country and project-specific requirements.

Catastrophe-risk insurance products must address existing voids in the commercial insurance market and must be priced to be attractive to the targeted clientele without government subsidies. Catastrophe-risk insurance products must be tailored to the needs and requirements of local insurance markets. For example, the project team anticipated designing weather risk-insurance for farmers based on a single peril; however, the team soon realized that such products would not be able to meet the multi-peril risk-management needs of local farmers at an affordable price. As a result, the team instead opted for developing a multi-peril area-yield index insurance product (see Section 3.1). A second example is that a property insurance policy designed for SMEs may need to go beyond office premise insurance to include insurance coverage for business inventory or against business interruption caused by catastrophic hazards.

Ongoing consultations with multiple project stakeholders, including the governments of participating countries, significantly increases the project's chances for success. Project implementation demonstrated that multi-stakeholder consultation processes and shareholder engagement reduced the likelihood of failure. Annual shareholder meetings for governments and high-level consultations through Europa Re's Policy Advisory Board complemented each other and

contributed to the appropriate program oversight. Europa Re's resident missions in the member countries further enabled fruitful on-the-ground collaboration with governments and contributed to mainstreaming climate change adaptation into government policy and decision-making.

A "buy-in" from the participating countries at a high political level is essential for success and must be continuously maintained. With ongoing changes in government cabinet appointments because of national political processes, political support should not be taken for granted. For example, in the case of Serbia, the World Bank's loan agreement was signed with one government, but implemented by three subsequently elected governments over the course of three years. Whenever governments change, a new project-related dialogue must be restarted with a new administration. The World Bank offers a stabilizing role in maintaining ongoing, effective relationships with new national governments involved in GEF projects.

Developing catastrophe-risk insurance markets entails multiple climate adaptation benefits. Benefits include the development of a national weather-risk insurance market that can help enterprises and homeowners reduce the adverse financial impact of climate change, reduction of governments' fiscal vulnerability to extreme weather events, and increased resilience of national agriculture to extreme weather.

To be successful, projects pursuing catastrophe insurance solutions should develop a comprehensive catastrophe-insurance market strategy. A fully integrated market strategy includes proper insurance market regulation; institutional and governmental capacity to understand and support catastrophe risk insurance markets; development of catastrophe risk models and actuarial pricing of the risk; design of innovative and affordable insurance products; modern and efficient technology systems to support mass sales and efficient claims management; and availability of claims-paying capacity, either in the form of reinsurance or equity capital. Any attempts to deliver catastrophe-insurance solutions in isolation from other essential and frequently non-existing components of the catastrophe-insurance market are likely to prove unsustainable in the long run.

Next Steps

Because the risk models, the technology platform, and the claims management system have already been developed and are currently in use, ongoing project work will focus on public education and outreach, improved distribution of insurance products, and increased collaboration with national governments in promoting the demand for catastrophe insurance. In addition, there is a possibility of expanding the project to other countries in Southeast Europe and beyond. The Caucasus region has been considered fertile ground for further developing and expanding the catastrophe insurance market, and formal demand and country support has already been expressed from the Caucasus for expanding this initiative.[2]

Conclusion

GEF primarily expects transformational outcomes from this project in the agricultural sector, where governments can learn how to better allocate subsidies to farmers to make agriculture more climate resilient.

However, governments can also gradually improve flood-risk management in their countries by using project information concerning the likelihood of flood occurrence in a specific area for land zoning purposes. Climate change is already adversely affecting the traditional spatial patterns of flood occurrence; governments must use this information to prepare national climate change adaptation plans, disaster risk management, and disaster risk financing strategies.

To achieve sustainability in the long-term, Europa Re must reach a certain threshold of product sales in each participating country so that the institution can finance its operating costs without further donor support. A total of approximately 25,000 insurance policies need to be sold to reach that level. In Albania, alone, where the government is expected to make catastrophe insurance compulsory, the threshold could be easily exceeded. Once the company is able to sustain itself, it will mark a milestone in leveraging private capital toward adaptation in this region.

Developing a catastrophe insurance market is beyond the capacity of private insurers in most emerging-market economies. However, private insurers can help scale up the sales of innovative, well-designed catastrophe insurance products that the market infrastructure under the project already supports. These efforts will, in turn, help the SEEC CRIF build further momentum, increasing the affordability of catastrophe insurance coverage and its availability to the public in the countries of Southeast Europe and beyond.

2 In October 2015, project Southeast Europe and Central Asia Catastrophe Risk Insurance Facility in Kazakhstan ($5 million) was approved for financing by the SCCF.

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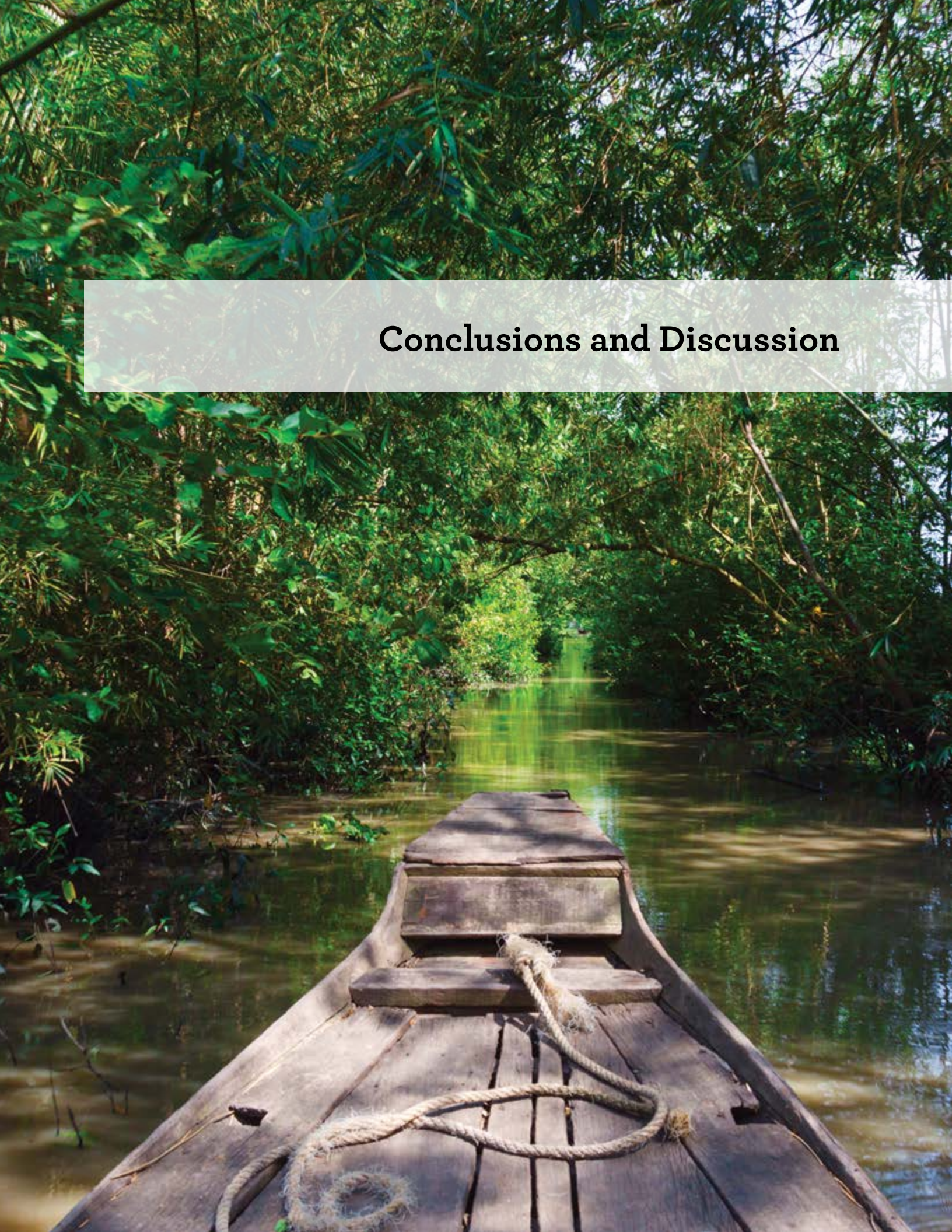
Conclusions and Discussion



Conclusions and Discussion

Climate change adaptation is a multidimensional problem with unique challenges. While the 12 projects highlighted in this study are but a small subset of the US$1.4 billion GEF adaptation program portfolio, taken together they reveal a set of emerging insights.

The case studies provide and illustrate two major groupings of insights: the first are specific to adaptation, and the second are more general in nature. The case studies also highlight a number of ideas concerning the way forward, including the areas where additional efforts appear to be both likely and potentially fruitful.

Adaptation-Specific Insights

Adaptation Solutions are Highly Context-Sensitive

There are no one-size-fits-all adaptation solutions. Adaptation vary considerably depending on circumstances. In Ethiopia, for example, community ownership was strengthened by requesting substantial in-kind contributions from the beneficiaries, which is not unusual in that context, but may not be feasible elsewhere. In Southeastern Europe, transferring technology was a greater challenge than had been anticipated, and it emerged that, in order to successfully transfer technology, the project team had to carefully consider country- and project-specific requirements.

Concrete Assistance and Local Benefits of Adaptation are Powerful Incentives

Improving livelihoods, resource bases, human capacity, and managing risks to lives and assets are all attractive prospects to the beneficiaries of adaptation aid. The projects in Niger, Ethiopia, Malawi, Bangladesh, and other countries demonstrate measures with visible, near-term benefits, which help to improve livelihoods and buy-in at the local level. For example, in Ethiopia the livestock pass through program provided the immediate benefit of livestock, but generated ongoing benefits for additional community members. In Armenia, establishing forest fire early-response teams, along with providing equipment and tools, had immediate positive effects on the wildfire management capacities in the region, and learning-by-doing ensured sustainability of the outcomes, through embedding the learned practices in the institutional policies and practice.

Projects Benefit from Building on Existing Efforts

GEF adaptation projects have been successful when they build upon existing initiatives or serve as building blocks for the initiatives that follow. For instance, the project featured in the India case grew on the foundation of a preceding project and a partnership history among Climate Change Adaptation Committees and activities such as participatory hydrological monitoring and crop water budgeting. Building on past successes gave the project personnel a head start to secure community involvement and to demystify climate variability, climate change, and climate adaptation into concrete actions to help farmers.

Moreover, mainstreaming climate change adaptation into broader development efforts plays a critical role when bringing adaptation to scale. Mainstreaming entails the inclusion of climate change considerations in development planning and practice throughout all sectors and levels of decision-making. For instance, in China, policy mainstreaming of adaptation in Anhui Province's Comprehensive Agriculture Development program investment guidelines paved the way for scaling-up and expanding adaptation efforts.

Adapation Requires Robust Theories of Change

Diversifying livelihoods is a core strategy for building resilience, as evidenced by most of the case studies, but it is critical to consider these alternatives carefully in light of a changing climate. This is where conventional development differs from adaptation. Certain circumstances might require solutions that quickly improve the conditions of the beneficiaries, without consideration of their suitability over the longer run; however, adaptation should take due consideration of the best available knowledge on climate change when developing projects. In this respect it is important to note that while some case studies showcase the continuous challenge of assessing climate risks and the need for such assessments to be routine and rigorous across all adaptation efforts, the body of knowledge on climate change and adaptation is rapidly growing, allowing project proponents to develop increasingly robust theories of change.

Flexibility in Implementation Leads to Better Adaptation Interventions

The need for flexibility in implementing adaptation interventions came up in several instances. This includes flexibility in how projects were carried out as well as how quickly they were implemented. Such flexibility was especially useful in Armenia, given that this was the first adaptation project in the country, and the first of its kind (specifically, adaptation in forest fire management) financed by the GEF. In this regard, the Armenia project served as a foundation for learning. In India, project personnel found that implementing the project in a three-year timeframe was challenging. Three years was insufficient to implement, monitor, and adjust strategies as new information brought clarity to what activities would work best for specific districts and farmers. A longer timeframe would have given project personnel room to consolidate and stabilize programming, as well as time to work toward strengthening end-of-project transfer activities.

Practicing Sound Natural Resource Management and Safeguarding Nature's Services are Important for Lowering Risks of Climate Change

This theme emerges across Niger, Ethiopia, Malawi, India, China, and Bangladesh. In Bangladesh, maximizing the productivity of available land is fundamental. This case also highlighted how ecosystem-based adaptation practices transformed conventional monoculture into a more complex, managed forest that fosters ecosystem resilience by increasing plant densities

per unit area, enriching and sustaining biodiversity of coastal vegetation, and providing adjacent vulnerable communities with natural layers of protection. In the Pacific, traditional taro farms were enhanced with a dyke system to reduce saltwater intrusion, and contour planting aided in enhancing soils and trapping sediments. The reduced sediments in the lagoon and reefs supported a healthier coastal and marine ecosystem. In Malawi, project teams employed ecosystem-based adaptation interventions including "river training" or planting along the banks and soil conservation techniques for preventing erosion.

Climate Change-Resilient Implementation is Needed

Projects must generate outcomes that will function in a changed or changing climate. However, project implementation itself is increasingly hampered by extreme and unpredictable weather conditions. Factoring risks that may undermine successful implementation of projects, and managing them, will become increasingly necessary. A flexible approach to implementation can help, especially for projects implemented over longer timeframes.

Long-Term Adaptation Faces Additional Challenges

Near- and long-term adaptation strategies can be starkly different. This is illustrated particularly well with the melting of glaciers: an initial oversupply of water from the melting will gradually give way to water scarcity as glaciers disappear. In the case of the Andes project, there is a need in the near-term to cope with an increase in water flow. In the long-term, seasonal water flows will shift, decrease flows, and a different set of adaptation actions will be required.

A key strategy for long-term adaptation is using an iterative approach that works within a coordinated framework process and allows for initiatives to contribute to long-term adaptation efforts in a coordinated and reflexive way. The approach, however, presents challenges given the need to sustain long-term monitoring, evaluation, and learning. The success of the project in India was achieved in institutionalizing data collection, ensuring proper operation and maintenance of the equipment procured by the project, and holding periodic meetings to encourage farmers to continue implementing adaptation strategies. This was supported through agreements with key institutions and creation of local-level climate change adaptation funds, which were used to operate and maintain project assets, promote project-piloted practices, and support experimentation with adaptation strategies, beyond the life of the project.

Another long-term adaptation challenge is managing natural resources for resilience. Such management requires integrating the best available knowledge and strategically protecting those existing natural defenses that, if lost, may result in a greatly increased severity of short- and long-term climate-related hazard and vulnerabilities. While the same logic applies to man-made defenses against climate risks, such defenses are thought to be much better understood in terms of the relative costs and values of the services they provide. The value of man-made defenses is therefore unlikely to be significantly underestimated, unlike nature's services.

General Insights

Community Ownership is Critical to Success and Sustainability

Engaging stakeholders and partners can contribute significantly to the success of adaptation projects. A number of lessons from various case studies fit under this broad rubric. Getting the buy-in at the community level was emphasized by some projects such as in the Bangladesh case study, whereas project ownership at high political levels was emphasized in the Southeast Europe case study. For Southeast Europe, this high-level buy-in also helped gain support and stability for the implementing agency, in a politically dynamic environment, and was also important in seeing the project through.

The role of stakeholders is critical because climate change adaptation will only succeed in the long-term if they can be incentivized to support adaptation. In Armenia, government agencies, donors, forest managers, fire fighters, and other key stakeholders understood that the project's resources would not be sufficient on their own. They identified partners working in the same sector, and joined with them to work toward shared pragmatic and beneficial goals, which led to improved effectiveness as well as higher levels of co-financing.

Nongovernmental institutions play different roles in supporting implementation. In the Andes, the upfront involvement of CARE was crucial to facilitate all of the social interactions with rural communities and to ensure that the project had a strong local community-based adaptation component. CARE's ability to leverage resources also provided continuity beyond the end of the project for monitoring and evaluation.

In Niger, nongovernmental organizations' involvement was critical. They had the ability to access the far-reaching project sites and informed educated beneficiaries about the effects of

climate change on agriculture and potential adaptation strategies. This provided a valuable opportunity for beneficiaries to understand the rationale and approach of the project, and establish increased ownership in project activities.

In India, participatory hydrological monitoring and crop water budgeting relied on a partnership model in which nongovernmental organizations' role was prominent, bringing with it the advantages of technical capacity, long-term association with the project communities, and proven working relationships.

Institutional Arrangements Matter

A number of case studies highlight the importance of establishing appropriate institutional arrangements to manage the project. One of the positive aspects of the project in The Gambia was attributed to the Project Steering Committee and its chair, who was the permanent secretary and technical head of the Ministry of Fisheries and Water Resources. Embedding the management of the project within the ministry, which houses the National Meteorological and Hydrological Service, increased communication with the hydrometeorological community. This allowed for a flow of feedback and other input on project activities, as well as regular ministerial briefings. Tasking a single ministry as a lead of the execution of the project simplified project coordination and management.

In China, the State Office of Comprehensive Agricultural Development was able to facilitate coordinated action among government ministries and specialized agencies, climate scientists, agricultural and water resources experts, over a million farming households, and also to ensure close interaction and information flows across the key stakeholders.

Conversely, the Malawi project suffered because it was directly overseen by an institution that lacked agricultural knowledge and capacity. This could have been mitigated if there had been closer coordination between agencies with proper subject matter expertise in both climate change adaptation and agriculture. Close coordination between teams is essential to ensure proper and timely implementation of a multi-disciplinary project.

Information Exchange Occurs at Various Scales and Across Scales

In a number of projects, diffusion of practices through the use of demonstration plots, model farmers, "pass-on" or "revolving" systems for livestock and seedlings, and other types of peer-to-peer learning demonstrated new techniques and technologies, and allowed for knowledge exchange on adaptation. In Ethiopia, the phased-model farmer system worked well in terms of project sustainability and cost-effectiveness, and allowed for the expansion of project resources to increase the numbers of beneficiaries. The second- and third-round beneficiaries learned practical experiences from their predecessors, providing a systematic means to spread knowledge.

In the Andes, climate change adaptation communities of practice within the project countries were well-established before the project began. However, few opportunities existed to exchange information among the countries. Building momentum around topics of interest, even with limited resources, was a powerful way to promote information exchange The Andes project demonstrated that glacial retreat and multi-national collaboration are suitable subjects for regional project work. The Andes project successfully promoted shared databases on glacier dynamics and fostered collaboration between different groups and centers of excellence in the region, while discussing how lessons from this context are relevant for other geographic locations.

The Way Forward

Replication and Scaling Up

All the project case studies involve replication and scaling up to ensure that practices are disseminated. A number of projects discuss replication not just within, but outside the country and region as well. In the Pacific, the success of solar-powered water purifiers has led to the transfer of this technology to the Marshall Islands. In the Andes, the potential for replication and scaling up is evidenced by accumulated experiences, as well as data, models, and methodologies that will be useful elsewhere. The Andes project's contribution to the global community of practice on high-mountain hydrology and glaciology has been significant. Additionally, media attention and other published efforts have helped trigger interest from other glaciated regions, such as the Himalayas.

Pathways to Engaging the Private Sector

When an adaptation intervention results in profitable practices, the project can lead to replication dissemination very quickly through the private sector. This is seen in a number of projects dealing with smallholder agriculture and farming. In the case of India, new knowledge products and a large pool of trained stakeholders provided a means for scaling up the outcomes beyond government programs and into the private sector through initiatives such as contract farming. Other project approaches, particularly participatory climate monitoring, have the potential to take hold in the animal husbandry, dairy production, and poultry farming sectors.

When growing climate risks threaten to undermine profit margins, the private sector can be motivated to mobilize resources and invest in protecting key resources. For example, Syunik in Armenia has an interest in improved forest management because healthier forests can lead to increased ecotourism. In other regions of Armenia, mineral water companies might also wish to support forest management to ensure the continuation of the water-conserving services that forests ecosystem provide.

The Insurance Sector is Key

Among the different pathways to engaging the private sector, engaging the insurance sector is key. The Southeastern Europe case highlights how, in order to achieve sustainability in the long-term, insurance providers must reach a certain threshold of product sales in the participating countries. For instance, Europa Reinsurance Facility Ltd. (Europa Re) must reach an estimated total of approximately 25,000 sales of insurance policies to finance its operating costs without further donor support. Once an insurance company is able to sustain itself, it will mark a milestone in leveraging private capital toward adaptation in the targeted region.

In many vulnerable areas, catastrophe and weather-risk insurance products are still unavailable in the commercial markets. Initial steps towards climate risk insurance provision therefore include the development of national catastrophe and weather-risk insurance markets. This may require technical assistance to support regulatory reform, climate risk modeling, data acquisition and remote sensing-based methods of damage assessment. Beneficiaries also need to be educated to better understand the level of risk they are facing and to act accordingly.

In the context of adaptation, national insurance programs have raised concerns about potentially supporting beneficiary activities in highly exposed and risk prone areas, encouraging rather than discouraging risky behavior. With insurance, the perceived risk to property owners, for instance, equals the amount the property owner pays for the insurance policy premium. If the premium is too low, high risk actions will be encouraged and insurance essentially subsidizes the risk. Sophisticated risk modeling, based on hydrological data and climate forecasts helps alleviate this issue by providing risk information at the household-level that enables insurance providers to charge risk-based premiums. Accessible risk information and awareness can also enable transformational outcomes in the agricultural sector, by helping governments to better allocate agricultural subsidies to farmers in a way that strengthens climate resilience.

Monitoring and Evaluation

Defining success, determining when success has been achieved, identifying good adaptation indicators, the sometimes long timeframe to see successful results, attributing success to adaptation interventions alone, and defining a theory of change is difficult. Consequently, monitoring and evaluation of adaptation efforts are challenging. Simple conceptual models may not be appropriate for adaptation given the dynamic nature of the adaptation interventions and the adaptation-development duality. Instead, it may be more appropriate to look for systemic outcomes. The challenge is to find indicators that are measurable but also can be aggregated to provide meaningful results at higher levels, which could mean that simple indicators, popular for development work, may not work as well in monitoring and evaluation frameworks for adaptation.

Uncertainty about future climate creates challenges in both adaptation planning and evaluation; as such, defining and determining success in adaptation can be difficult. With adaptation, conventional development projects must take into account the potential future impacts of climate change. These impacts are often uncertain or unknown at the relevant geographic and temporal scales. This dimension of uncertainty compounds other risks, uncertainties, and information gaps that projects would normally face. All of these challenges are manifested in the difficult task of tracking and measuring success in adaptation.

Learning from Adaptation

This book was an effort to begin to tackle some of the unknowns of adaptation in practice. There are many questions that practitioners grapple with in ongoing and planned climate adaptation efforts. Some of the key questions include:

- How do we determine the cost and benefits of adaptation in an uncertain and complicated world?
- How does adaptation differ in practice from development that has not considered climate change?
- What is successful adaptation in practice, and how and when do we know that we have achieved it?
- How to better mainstream adaptation into national planning and budgeting and what are the key factors for success?
- How can we know that adaptation has or has not helped avert a disaster and how can we attribute it, with confidence, to any one adaptation intervention that may have been carried out years prior to the event?

- What are the implications for learning from these types of experiences?

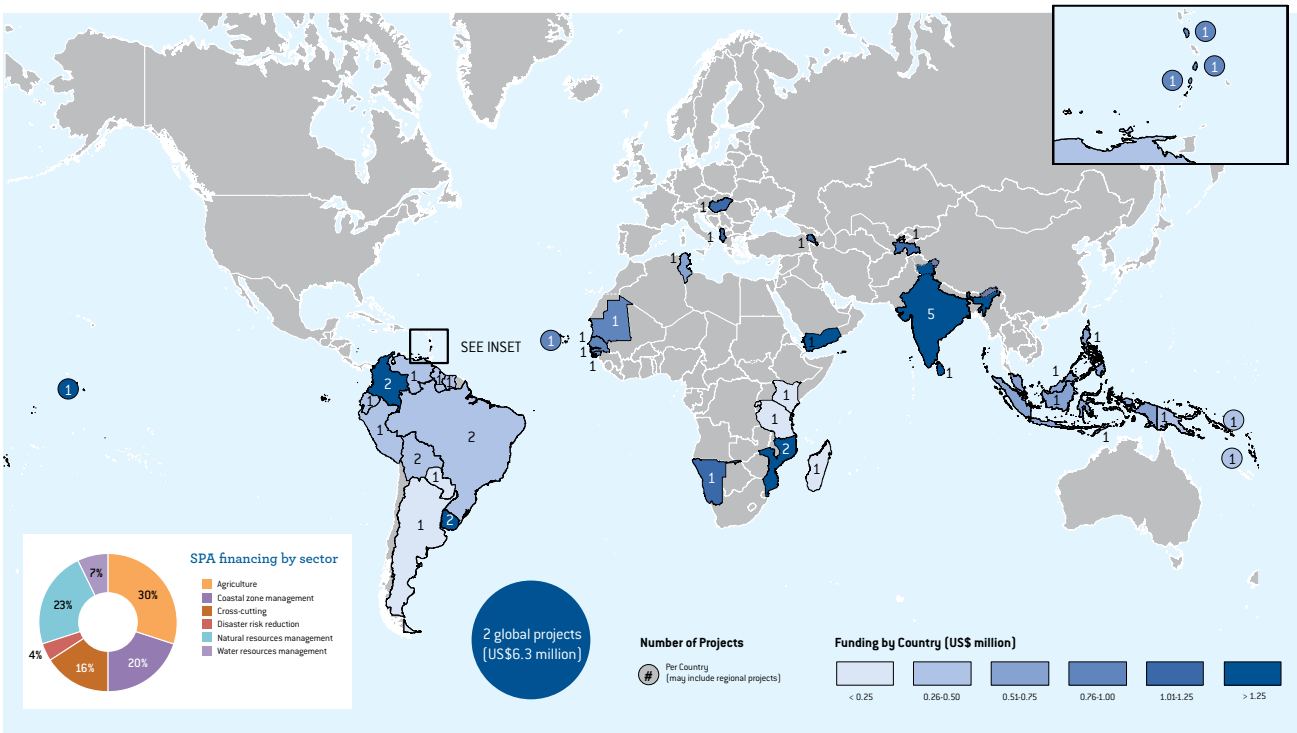
These questions remain largely unanswered in part because it is simply too early to do so. As these case studies demonstrate, many governments are still in the early stages of testing climate adaptation strategies at broad scales. The primary difficulty related to learning and adaptation is that it takes a long time to assess the impacts of adaptation. For many projects, the full impact of these interventions — whether they were ultimately successful or not — will not be known for years. In the meantime, there is an increasing need to adapt and to act based on best available data and evidence.

Adaptation is contextual and dynamic, and requires constant learning at all scales and across scales. Evaluative thinking must be embedded into day-to-day conversations and actions. Response strategies depend on the context, conditions, and timeframes. It is crucial to try and inform the theory of change with practice-tested knowledge, especially since adaptation as a practice is no longer in its infancy and as empirical evidence grows.

The evidence emerging from these case studies make a compelling argument to direct more attention toward the issue of knowledge management. Learning from adaptation experiences is an urgent and important endeavor. While knowledge is being generated, it is not always clear how systematic this effort is, where this knowledge can be found, and how it can be readily accessed. This is yet another important area where investing more attention is likely to produce significant dividends in the future. As these projects collectively demonstrate, making adaptation tools and strategies widely applicable and available will be essential to turn adaptation successes into truly transformational outcomes.

Annexes

Annex I: Approved Projects and Programs Under the SPA[1]



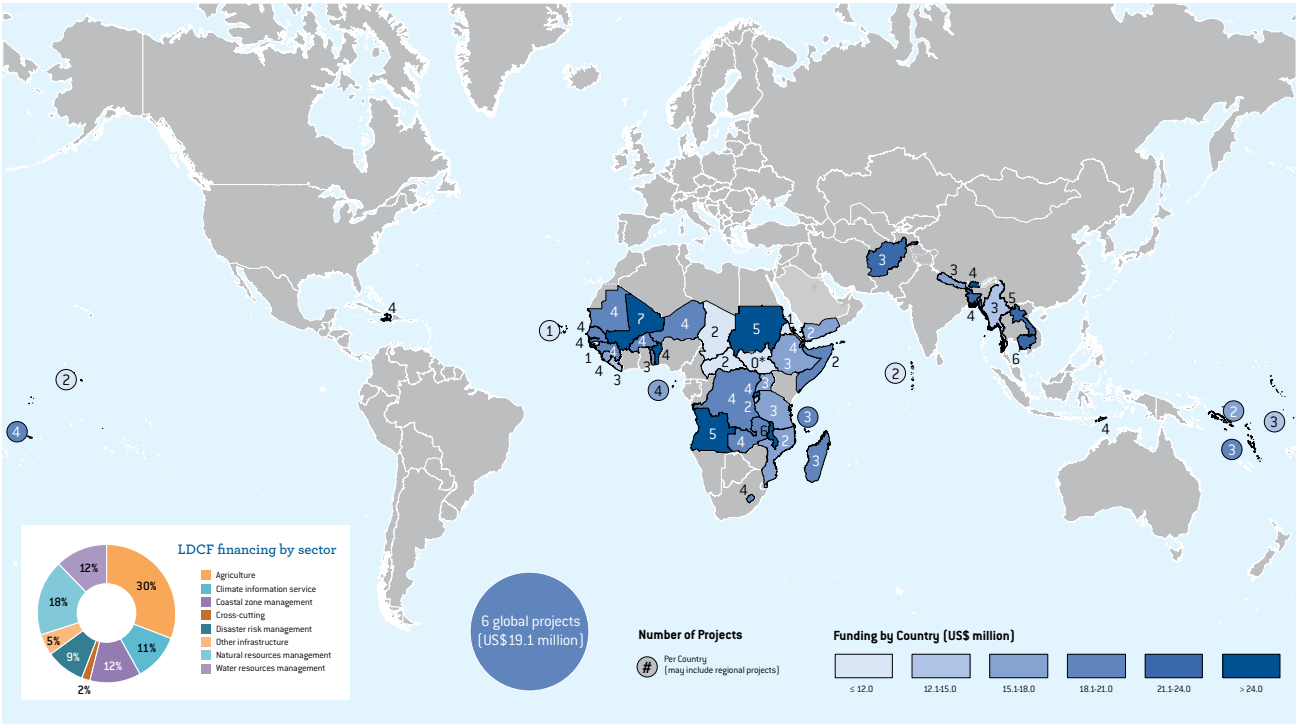
GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
2019	Colombia	Integrated National Adaptation Plan: High Mountain Ecosystems, Colombia's Caribbean Insular Areas and Human Health (INAP)	World Bank	6,171,300	9,500,000
2095	Regional	Sustainable Management of the Water Resources of the la Plata Basin with Respect to the Effects of Climate Variability and Change	UNEP	1,090,000	51,914,711
2364	Regional	Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin Considering Climate Variability and Climate Change	UNEP	2,200,000	45,590,000

1 November 2015 figures

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
2543	Kiribati	Kiribati Adaptation Program - Pilot Implementation Phase (KAP-II)	World Bank	2,070,019	4,800,000
2552	Regional	Implementation of Pilot Adaptation Measures in coastal areas of Dominica, St. Lucia and St. Vincent & the Grenadines	World Bank	2,616,000	3,370,000
2557	Global	Adaptation Learning Mechanism: Learning by Doing	UNDP	788,724	645,000
2614	Regional	Adaptation to Climate Change - Responding to Shoreline Change and its human dimensions in West Africa through integrated coastal area management.	UNDP	4,360,000	9,729,517
2630	Hungary	Lake Balaton Integrated Vulnerability Assessment, Early Warning and Adaptation Strategies	UNDP	1,131,000	3,090,000
2752	Regional	Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa	UNEP	1,090,000	1,265,000
2753	Sri Lanka	Participatory Coastal Zone Restoration and Sustainable Management in the Eastern Province of Post-Tsunami Sri Lanka	IFAD	2,101,447	7,569,450
2774	Global	Community-based Adaptation (CBA) Programme	UNDP	5,510,516	4,525,140
2889	Mozambique	Zambezi Valley Market-Led Smallholder Development	World Bank	1,689,500	21,200,000
2915	Namibia	CPP Namibia: Adapting to Climate Change through the Improvement of Traditional Crops and Livestock Farming (SPA)	UNDP	1,090,000	5,795,806
3024	India	SLEM - Sustainable Participatory Management of Natural Resources to Promote Ecosystem Health and Resilience in the Thar Desert Ecosystem	UNDP	250,000	14,070,000
3129	Tajikistan	Sustaining Agricultural Biodiversity in the Face of Climate Change	UNDP	1,100,000	4,000,000
3134	Uruguay	Implementing Pilot Climate Change Adaptation Measures in Coastal Areas of Uruguay	UNDP	1,100,000	2,922,900
3267	Yemen	MENARID - Adaptation to Climate Change Using Agrobiodiversity Resources in the Rainfed Highlands of Yemen	World Bank	4,620,000	31,838,000
3415	Albania	Identification and Implementation of Adaptation Response Measures in the Drini-Mati River Deltas	UNDP	1,099,890	984,525

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3417	Armenia	Adaptation to Climate Change Impacts in Mountain Forest Ecosystems of Armenia	UNDP	1,045,000	900,000
3470	India	SLEM/CPP-Sustainable Rural Livelihood Security through Innovations in Land and Ecosystem Management	World Bank	2,959,000	88,000,000
3471	India	SLEM - Sustainable Land Water and Biodiversity Conservation and Management for Improved Livelihoods in Uttarakhand Watershed Sector	World Bank	346,000	90,000,000
3472	India	SLEM-CPP-Integrated Land Use Management to Combat Land Degradation in Madja Pradesh	UNDP	220,000	95,523,750
3589	Regional	CTI Coastal and Marine Resources Management in the Coral Triangle: Southeast Asia under Coral Triangle Initiative	ADB	2,000,000	28,950,000
3591	Regional	PAS Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific - under the Pacific Alliance for Sustainability Program	ADB	2,000,000	24,774,000
3669	Tunisia	Second Natural Resources Management Project	World Bank	699,600	58,380,000
3882	India	Reversing Environmental Degradation and Rural Poverty through Adaptation to Climate Change in Drought Stricken Areas in Southern India: A Hydrological Unit Pilot Project Approach (under India: SLEM)	FAO	1,000,000	2,878,563

Annex II: Approved Projects and Programs Under the LDCF[1]



GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3219	Bhutan	Reducing Climate Change-induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha-Wangdi and Chamkhar Valleys	UNDP	3,987,555	4,286,224
3287	Bangladesh	Community-based Adaptation to Climate Change through Coastal Afforestation in Bangladesh	UNDP	3,740,000	7,150,000
3302	Malawi	Climate Adaptation for Rural Livelihoods and Agriculture (CARLA)	AfDB	3,601,923	6,488,250
3358	Samoa	Integrating Climate Change Risks in the Agriculture and Health Sectors in Samoa (ICCRA&HSS)	UNDP	2,255,000	2,150,000
3404	Cambodia	Promoting Climate-Resilient Water Management and Agricultural Practices in Rural Cambodia	UNDP	2,145,000	2,340,350
3408	Djibouti	Implementing NAPA Priority Interventions to Build Resilience in the Most Vulnerable Coastal Zones in Djibouti	UNEP	2,359,500	2,425,000

1 October 2015 figures

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3430	Sudan	Implementing NAPA Priority Interventions to Build Resilience in the Agriculture and Water Sectors to the Adverse Impacts of Climate Change in Sudan	UNDP	3,740,000	3,560,000
3581	Cape Verde	Building adaptive capacity and resilience to climate change in the water sector in Cape Verde	UNDP	3,410,000	63,989,027
3684	Burkina Faso	Strengthening Adaptation Capacities and Reducing the Vulnerability to Climate Change in Burkina Faso	UNDP	3,300,000	20,194,595
3689	Zambia	Adaptation to the effects of drought and climate change in Agro-ecological Regions I and II	UNDP	4,284,500	9,904,000
3694	Tuvalu	Tuvalu: Increasing Resilience of Coastal Areas and Community Settlements to Climate Change	UNDP	3,696,000	4,560,000
3701	Burundi	Enhancing Climate Risk Management and Adaptation in Burundi (ECRAMB)	AfDB	3,526,171	15,798,000
3703	Guinea	Increasing Resilience and Adaptation to Adverse Impacts of Climate Change in Guinea's Vulnerable Coastal Zones	UNDP	3,377,000	162,985,000
3704	Benin	Integrated Adaptation Programme to Combat the Adverse Effects of Climate Change on Agricultural Production and Food Security in Benin	UNDP	3,839,000	7,959,900
3716	Sierra Leone	Integrating Adaptation to Climate Change into Agricultural Production and Food Security in Sierra Leone	IFAD	3,019,280	8,736,000
3718	Congo DR	Building the Capacity of the Agriculture Sector in DR Congo to Plan for and Respond to the Additional Threats Posed by Climate Change on Food Production and Security	UNDP	3,410,000	4,150,000
3728	Gambia	Strengthening of The Gambia's Climate Change Early Warning Systems	UNEP	1,164,350	1,605,000
3733	Haiti	Strengthening adaptive capacities to address climate change threats on sustainable development strategies for coastal communities in Haiti	UNDP	3,960,000	9,880,000
3776	Mali	Enhancing Adaptive Capacity and Resilience to Climate Change in Mali's Agriculture Sector	UNDP	2,684,000	8,577,300

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3798	Vanuatu	Increasing Resilience to Climate Change and Natural Hazards	World Bank	6,303,000	6,067,000
3838	Rwanda	Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in flood- prone areas	UNEP, UNDP	3,999,600	12,557,000
3841	Lesotho	Improvement of Early Warning System to Reduce Impacts of Climate Change and Capacity Building to Integrate Climate Change into Development Plans	UNEP	1,963,500	2,771,500
3847	Maldives	Integrating Climate Change Risks into Resilient Island Planning in the Maldives	UNDP	4,999,500	4,911,211
3857	Comoros	Adapting water resource management in the Comoros to expected climate change	UNDP, UNEP	4,224,000	9,316,318
3885	Liberia	Enhancing Resilience of Vulnerable Coastal Areas to Climate Change Risks In Liberia	UNDP	3,300,000	4,753,420
3890	Cambodia	Vulnerability Assessment and Adaptation Programme for Climate Change within the Coastal Zone of Cambodia Considering Livelihood Improvement and Ecosystems	UNEP	1,853,500	4,245,000
3893	Mauritania	Support to the adaptation of agricultural production systems that are vulnerable to climate change	IFAD	3,960,000	10,588,550
3916	Niger	Implementing NAPA priority interventions to build resilience and adaptive capacity of the agriculture sector to climate change in Niger	UNDP	3,960,000	10,950,000
3979	Mali	Integrating Climate Resilience into Agricultural Production for Food Security in Rural Areas	FAO	2,400,000	4,575,000
4018	Sao Tome and Principe	Sao Tome and Principe: Adaptation to Climate Change	World Bank	4,873,330	13,458,600
4019	Guinea-Bissau	Strengthening adaptive capacity and resilience to Climate Change in the Agrarian and Water Resources Sectors in Guinea-Bissau	UNDP	4,543,000	20,084,431
4034	Lao PDR	Improving the Resilience of the Agriculture Sector in Lao PDR to Climate Change Impacts	UNDP	4,999,995	7,818,548
4068	Kiribati	Increasing resilience to climate variability and hazards	World Bank	3,300,000	7,800,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4141	Tanzania	Developing Core Capacity to Address Adaptation to Climate Change in Productive Coastal Zones of Tanzania	UNEP	3,801,930	67,878,498
4216	Samoa	Integration of Climate Change Risks and Resilience into Forestry Management in Samoa (ICCRIFS)	UNDP	2,695,000	2,630,000
4222	Ethiopia	Promoting autonomous adaptation at the community level in Ethiopia	UNDP	5,950,324	24,856,020
4227	Afghanistan	Building adaptive capacity and resilience to climate change in Afghanistan	UNEP	6,039,000	14,509,000
4234	Senegal	Climate Change adaptation project in the areas of watershed management and water retention	IFAD	5,632,000	10,333,000
4268	Liberia	Enhancing Resilience to Climate Change by Mainstreaming Adaption Concerns into Agricultural Sector Development in Liberia	UNDP	2,702,040	6,420,122
4274	Sao Tome and Principe	Strengthening the adaptive capacity of most vulnerable Sao Tomean's livestock-keeping households	AfDB	2,321,275	6,316,000
4276	Mozambique	Adaptation in the coastal zones of Mozambique	UNDP	4,976,400	9,786,000
4318	Central African Republic	Integrated Adaptation Programme to Combat the Effects of Climate Change on Agricultural Production and Food Security	UNDP	3,135,000	42,060,000
4431	Maldives	Increasing Climate Change Resilience of Maldives through Adaptation in the Tourism Sector	UNDP	1,815,482	1,650,438
4434	Cambodia	Strengthening the adaptive capacity and resilience of rural communities using micro watershed approaches to climate change and variability to attain sustainable food security	FAO	5,691,800	25,728,477
4447	Haiti	Strengthening Climate Resilience and Reducing Disaster Risk in Agriculture to Improve Food Security in Haiti Post Earthquake	FAO	2,999,700	9,329,724
4453	Lesotho	Adaptation for Smallholder Agricultural Programme (ASAP)	IFAD	4,892,074	21,500,204
4511	Regional	Sahel and West Africa WB/GEF Program in support of the Great Green Wall Initiative	World Bank	16,000,000	125,829,640

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4551	Nepal	Community-Based Flood and Glacial Lake Outburst Risk Reduction	UNDP	6,999,850	20,416,010
4554	Lao PDR	Effective governance for small-scale rural infrastructure and disaster preparedness in a changing climate	UNDP	5,302,000	31,134,396
4568	Madagascar	Adapting coastal zone management to climate change in Madagascar considering ecosystem and livelihood improvement	UNEP	6,013,865	12,189,900
4570	Togo	Adapting Agriculture Production in Togo - ADAPT	IFAD	6,000,000	11,329,000
4585	Samoa	Enhancing the resilience of tourism-reliant communities to climate change risks	UNDP	2,200,000	17,338,500
4599	Sierra Leone	Building adaptive capacity to catalyze active public and private sector participation to manage the exposure and sensitivity of water supply services to climate change in Sierra Leone	UNDP	3,311,000	10,220,000
4625	Malawi	Shire Natural Ecosystems Management Project	World Bank	1,650,000	11,736,000
4692	Guinea	Strengthening resilience of farming communities' livelihoods against climate changes in the Guinean Prefectures of Gaoual, Koundara and Mali	UNDP	4,198,000	29,440,000
4696	Timor Leste	Strengthening the Resilience of Small-Scale Rural Infrastructure and Local Government Systems to Climatic Variability and Risk	UNDP	5,192,000	52,510,399
4700	Bangladesh	Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh	UNDP	6,270,000	47,375,000
4701	Niger	Scaling up Community-Based Adaptation (CBA) in Niger	UNDP	4,180,000	15,676,000
4702	Niger	Integrating Climate Resilience into Agricultural and Pastoral Production for Food Security in Vulnerable Rural Areas through the Farmers Field School Approach	FAO	4,234,750	14,008,871
4714	Tuvalu	Effective and responsive island-level governance to secure and diversify climate resilient marine-based coastal livelihoods and enhance climate hazard response capacity	UNDP	4,757,500	19,995,880

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4724	Gambia	Enhancing Resilience of Vulnerable Coastal Areas and Communities to Climate Change in the Republic of Gambia	UNDP	9,955,000	41,538,000
4725	Solomon Islands	Solomon Islands Water Sector Adaptation Project (SIWSAP)	UNDP	7,700,000	43,772,462
4797	Malawi	Climate proofing local development gains in rural and urban areas of Machinga and Mangochi Districts – Malawi	UNDP	6,015,020	36,650,000
4822	Mali	Strengthening Resilience to Climate Change through Integrated Agricultural and Pastoral Management in the Sahelian zone in the Framework of the Sustainable Land Management Approach	FAO	2,499,500	14,347,259
4950	Liberia	Strengthening Liberia's capability to provide climate information and services to enhance climate resilient development and adaptation to climate change	UNDP	7,513,000	12,282,112
4952	Rwanda	Landscape Approach to Forest Restoration and Conservation (LAFREC)	World Bank	4,499,000	5,696,000
4958	Sudan	Climate risk finance for sustainable and climate-resilient rainfed farming and pastoral systems	UNDP	6,380,000	18,920,000
4971	Burkina Faso	Reducing vulnerability of natural resource dependent livelihoods in two landscapes at risk of the effects of climate change in Burkina Faso: Boucles du Mouhoun Forest Corridor and Mare d'Oursi Wetlands Basin	UNDP	7,831,400	30,822,541
4974	Comoros	Enhancing adaptive capacity and resilience to climate change in the agriculture sector in Comoros	UNDP	9,999,981	38,409,621
4976	Bhutan	Addressing the risk of climate-induced disasters through enhanced national and local capacity for effective actions	UNDP	12,750,320	54,939,829
4990	Burundi	Community disaster risk management in Burundi	UNDP	9,663,500	27,070,000
4991	Tanzania	Strengthening climate information and early warning systems in Eastern and Southern Africa for climate-resilient development and adaptation to climate change – Tanzania	UNDP	4,510,000	23,659,749

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4992	Ethiopia	Strengthening climate information and early warning systems in Eastern and Southern Africa for climate-resilient development and adaptation to climate change – Ethiopia	UNDP	5,500,000	33,759,879
4993	Uganda	Strengthening climate information and early warning systems in Eastern and Southern Africa for climate-resilient development and adaptation to climate change – Uganda	UNDP	4,510,000	26,861,600
4994	Malawi	Strengthening climate information and early warning systems in Eastern and Southern Africa for climate-resilient development and adaptation to climate change – Malawi	UNDP	4,510,000	11,722,907
4995	Zambia	Strengthening climate information and early warning systems in Eastern and Southern Africa for climate-resilient development and adaptation to climate change – Zambia	UNDP	4,510,000	13,156,656
5002	Benin	Strengthening climate information and early warning systems in Western and Central Africa for climate-resilient development and adaptation to climate change – Benin	UNDP	4,510,000	14,963,724
5003	Burkina Faso	Strengthening climate information and early warning systems in Western and Central Africa for climate-resilient development and adaptation to climate change – Burkina Faso	UNDP	4,510,000	61,698,149
5004	Sao Tome and Principe	Strengthening climate information and early warning systems in Western and Central Africa for climate-resilient development and adaptation to climate change – Sao Tome and Principe	UNDP	4,510,000	40,741,249
5006	Sierra Leone	Strengthening climate information and early warning systems in Western and Central Africa for climate-resilient development and adaptation to climate change – Sierra Leone	UNDP	4,510,000	20,807,034
5014	Burkina Faso	Integrating Climate Resilience into Agricultural and Pastoral Production for Food Security in Vulnerable Rural Areas Through the Farmers Field School Approach.	FAO	4,300,500	19,535,000
5015	Malawi	Implementing urgent adaptation priorities through strengthened decentralized and national development plans	UNDP	5,060,000	7,090,841
5021	Djibouti	Implementing adaptation technologies in fragile ecosystems of Djibouti's Central Plains	UNEP	8,182,350	14,264,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5037	Regional	Climate Proofing Development in the Pacific	ADB	15,012,000	51,220,000
5049	Vanuatu	Adaptation to Climate Change in the Coastal Zone in Vanuatu	UNDP	9,108,000	31,397,253
5056	Timor Leste	Strengthening Community Resilience to Climate-Induced Natural Disasters in the Dili to Ainaro Road Development Corridor, Timor Leste	UNDP	5,880,150	37,656,780
5071	Gambia	Strengthening climate services and early warning systems in the Gambia for climate resilient development and adaptation to climate change – 2nd Phase of the GOTG/ GEF/UNEP LDCF NAPA Early Warning Project	UNDP, UNEP	8,910,000	21,632,000
5075	Lesotho	Reducing Vulnerability from Climate Change in the Foothills, Lowlands and the Lower Senqu River Basin	UNDP	9,195,998	27,600,000
5111	Nepal	Reducing Vulnerability and Increasing Adaptive Capacity to Respond to Impacts of Climate Change and Variability for Sustainable Livelihoods in Agriculture Sector in Nepal	FAO	2,999,750	12,990,000
5113	Regional	Enhancing Climate Change Resilience in the Benguela Current Fisheries System	FAO	1,891,900	6,846,973
5124	Lesotho	Strengthening Capacity for Climate Change Adaptation through Support to Integrated Watershed Management Programme in Lesotho	FAO	3,999,700	8,437,000
5133	Regional	Senegal River Basin Climate Change Resilience Development Project	World Bank	13,080,000	49,600,000
5174	Yemen	Rural Adaptation in Yemen	IFAD	11,037,600	55,146,200
5177	Angola	Promoting climate-resilient development and enhanced adaptive capacity to withstand disaster risks in Angolan's Cuvelai River Basin	UNDP	9,143,250	46,865,004
5184	Sao Tome and Principe	Enhancing capacities of rural communities to pursue climate-resilient livelihood options in the Sao Tome and Principe districts of Caué, Me-Zochi, Principe, Lemba, Cantagalo, and Lobata (CMPLCL)	UNDP	4,462,125	16,361,281

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5190	Mauritania	Improving climate resilience of water sector investments with appropriate climate adaptive activities for pastoral and forestry resources in southern Mauritania	AfDB	7,258,750	14,814,000
5192	Mali	Strengthening the resilience of women producer groups and vulnerable communities in Mali	UNDP	6,116,000	16,600,000
5194	Rwanda	Building resilience of communities living in degraded forests, savannahs and wetlands of Rwanda through an ecosystem management approach	UNEP	6,132,000	10,844,000
5202	Afghanistan	Strengthening the resilience of rural livelihood options for Afghan communities in Panjshir, Balkh, Uruzgan and Herat Provinces to manage climate change-induced disaster risks	UNDP	9,964,500	103,100,000
5203	Nepal	Catalyzing ecosystem restoration for resilient natural capital and rural livelihoods in degraded forests and rangelands of Nepal	UNEP	5,854,390	11,139,000
5204	Uganda	Building resilience to climate change in the water and sanitation sector	AfDB	9,438,900	38,250,000
5209	Sierra Leone	Building resilience to climate change in the water and sanitation sector	AfDB	4,599,000	28,965,000
5211	Yemen	Integrated Water Harvesting Technologies to Adapt to Climate Change Induced Water Shortage	UNDP	5,496,900	19,721,596
5226	Congo DR	Building the resilience and ability to adapt of women and children to changing climate in Democratic Republic of Congo	UNDP	5,283,375	15,600,000
5228	Regional	Rural livelihoods' adaptation to climate change in the Horn of Africa (RLACC)	AfDB	5,700,000	42,730,034
5230	Angola	Addressing Urgent Coastal Adaptation Needs and Capacity Gaps in Angola	UNDP, UNEP	6,931,350	11,520,000
5231	Angola	Integrating Climate Change into Environment and Sustainable Land Management Practices	AfDB	5,000,000	19,995,000
5232	Benin	Flood Control and Climate resilience of agriculture infrastructures in Oueme Valley	AfDB	8,157,750	67,904,000
5233	Madagascar	Enabling climate resilience in the agriculture sector in the southwest region of Madagascar	AfDB	7,009,199	37,434,000

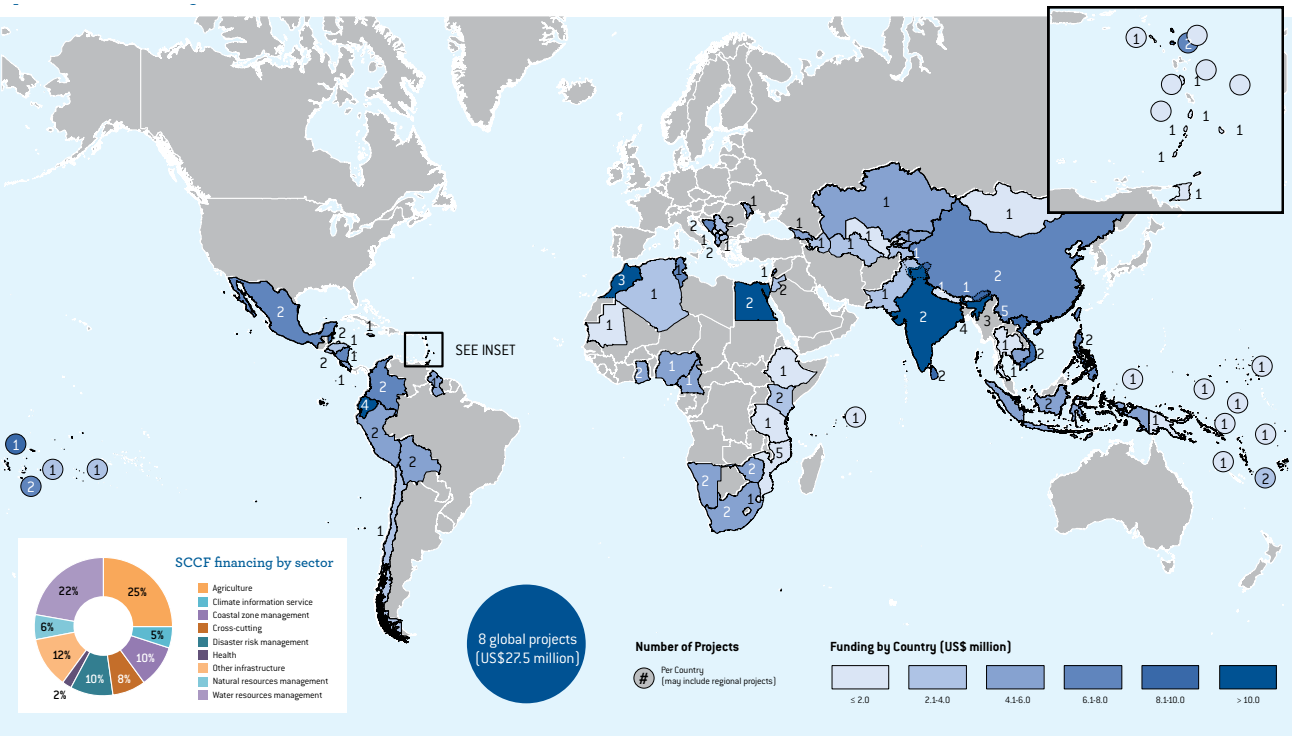
GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5279	Togo	Strengthening climate resilience of infrastructure in coastal areas in Togo	AfDB	10,000,000	90,000,000
5280	Congo DR	Resilience of Muanda's communities from coastal erosion, Democratic Republic of Congo	UNDP	5,973,225	11,500,000
5318	Cambodia	Strengthening climate information and early warning systems in Cambodia to support climate-resilient development and adaptation to climate change	UNDP	5,541,012	21,884,540
5320	Global	Assisting Least Developed Countries (LDCs) with country-driven processes to advance National Adaptation Plans (NAPS)	UNDP, UNEP	2,187,810	8,400,000
5328	Malawi	Building climate change resilience in the fisheries sector in Malawi	FAO	6,110,100	4,480,000
5332	Djibouti	Supporting Rural Community Adaptation to Climate Change in Mountain Regions of Djibouti	UNDP	6,000,000	28,630,000
5376	Chad	Enhancing the resilience of the agricultural ecosystems (Projet d'amélioration de la résilience des systèmes agricoles au Tchad) - PARSAT	IFAD	8,000,000	24,500,000
5380	Haiti	Increasing resilience of ecosystems and vulnerable communities to CC and anthropic threats through a ridge to reef approach to BD conservation and watershed management	UNDP	6,000,000	25,446,145
5382	Guinea	Ecosystem-Based Adaptation targeting vulnerable communities of the Upper Guinea Region	UNDP	8,979,000	27,600,000
5394	Zambia	Climate Resilient Livestock Management Project	AfDB	7,000,001	20,832,000
5395	Regional	Pacific Islands Ridge-to-Reef National Priorities – Integrated Water, Land, Forest and Coastal Management to Preserve Biodiversity, Ecosystem Services, Store Carbon, Improve Climate Resilience and Sustain Livelihoods	FAO, UNDP, UNEP	13,650,000	90,000,000
5414	Kiribati	Enhancing national food security in the context of global climate change	UNDP	5,000,000	7,140,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5419	Cambodia	Strengthening the resilience of Cambodian rural livelihoods and sub-national government system to climate risks and variability	UNDP	5,165,663	15,860,000
5431	Benin	Strengthening the resilience of the energy sector in Benin to the impacts of climate change	UNDP	8,979,000	30,000,000
5432	Angola	Integrating Climate Resilience into Agricultural and Agropastoral Production Systems through Soil Fertility Management in Key Productive and Vulnerable Areas Using the Farmers Field School Approach	FAO	7,465,909	25,325,000
5433	Mozambique	Strengthening Capacities of Agricultural Producers to Cope with Climate Change for Increased Food Security through the Farmers Field School Approach	FAO	10,074,000	27,344,657
5435	Zambia	Promoting Climate-Resilient Community-based Regeneration of Indigenous Forests in Zambia's Central Province	UNDP	4,363,575	29,030,090
5436	Niger	Disaster Risk Management and Urban Development Project	World Bank	7,500,000	100,000,000
5451	Congo DR	Strengthening Hydro-Meteorological and Climate Services	World Bank	6,000,000	30,000,000
5456	Bangladesh	Ecosystem-based Approaches to Adaptation (EbA) in the drought-prone Barind Tract and Haor wetland area	UNEP	5,803,500	17,000,000
5462	Lao PDR	Strengthening Agro-climatic Monitoring and Information Systems to Improve Adaptation to Climate Change and Food Security in Lao PDR	FAO	6,164,250	16,755,500
5489	Lao PDR	Climate Adaptation in Wetlands Areas (CAWA)	FAO	5,329,999	16,905,000
5495	Rwanda	Increasing the Capacity of Vulnerable Rwandan communities to adapt to adverse effects of Climate change: Livelihood diversification and investment in rural infrastructures	AfDB	9,882,100	45,386,000
5503	Senegal	Mainstreaming Ecosystem-based Approaches to Climate-resilient Rural Livelihoods in Vulnerable Rural Areas through the Farmer Field School Methodology	FAO	6,985,000	20,895,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5504	Central African Republic	Reducing Rural and Urban Vulnerability to Climate Change by the Provision of Water Supply	AfDB	8,037,300	21,469,000
5531	Haiti	Ecosystem Approach to Haiti's Cote Sud	UNEP	3,524,628	10,915,000
5566	Senegal	Strengthening land and ecosystem management under conditions of climate change in the Niayes and Casamance regions – Republic of Senegal	UNDP	4,653,750	13,200,000
5567	Myanmar	Adapting Community Forestry landscapes and associated community livelihoods to a changing climate, in particular an increase in the frequency and intensity of extreme weather events	UNEP	5,570,813	19,211,000
5580	Mauritania	Development of an improved and innovative delivery system for climate-resilient livelihoods in Mauritania	UNEP	5,584,500	11,900,000
5581	Solomon Islands	Community Resilience to Climate and Disaster Risk in Solomon Islands Project	World Bank	7,993,500	7,330,000
5592	Somalia	Enhancing Climate Resilience of the Vulnerable Communities and Ecosystems in Somalia	UNDP	8,979,000	64,820,000
5603	Uganda	Reducing Vulnerability of Banana-Producing Communities to Climate Change Through Banana Value Added Activities – Enhancing Food Security and Employment Generation	UNIDO	3,182,800	7,737,533
5615	Global	Building capacity for LDCs to participate effectively in intergovernmental climate change processes	UNDP, UNEP	4,544,250	15,232,380
5632	Madagascar	Enhancing the adaptation capacities and resilience to climate change in rural communities in Analamanga, Atsinanana, Androy, Anosy, and Atsimo Andrefana	UNDP	6,600,000	34,300,000
5636	Bangladesh	Community-based Climate-Resilient Fisheries and Aquaculture Development in Bangladesh	FAO	6,050,000	15,200,000
5651	Sudan	Livestock and Rangeland Resilience Program	IFAD	9,415,970	32,349,000
5664	Afghanistan	Building Resilience of Communities Living Around the Northern Pistachio Belt (NPB) and Eastern Forest Complex (EFC) of Afghanistan through an EbA approach	UNEP	7,665,000	7,000,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL LDCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5671	Timor Leste	Building Shoreline Resilience of Timor Leste to Protect Local Communities and their Livelihoods	UNDP	7,829,250	27,526,090
5694	Comoros	Building Climate Resilience through Rehabilitated Watersheds, Forests and Adaptive Livelihoods	UNEP	5,737,800	12,634,000
5695	Tanzania	Ecosystem-Based Adaptation for Rural Resilience	UNEP	8,400,000	21,550,000
5702	Myanmar	FishAdapt: Strengthening the Adaptive Capacity and Resilience of Fisheries and Aquaculture-dependent Livelihoods in Myanmar	FAO	6,734,250	12,385,000
5703	Sudan	Enhancing the resilience of communities living in climate change vulnerable areas of Sudan using Ecosystem-based approaches to Adaptation (EbA)	UNEP	4,800,480	11,100,000
5710	Regional	Rural livelihoods' adaptation to climate change in the Horn of Africa –Phase II (RLACC II)	AfDB	18,433,000	30,000,000
5782	Gambia	Adapting Agriculture to Climate Change in The Gambia	FAO	7,050,000	21,794,528
5815	Regional	Building Climate Resilience of Urban Systems through Ecosystem-based Adaptation (EbA) in the Asia-Pacific region	UNEP	6,734,250	8,700,000
5855	Mali	Flood Hazard and Climate Risk Management to Secure Lives and Assets in Mali	UNDP	9,937,125	27,000,000
5868	Global	Expanding the Ongoing Support to Least Developed Countries (LDC) with Country-driven Processes to Advance National Adaptation Plans (NAPs)	UNDP, UNEP	6,953,250	8,400,000
5872	Bhutan	Climate Resilient Villages	UNDP	10,500,000	26,000,000
6923	Eritrea	Mainstreaming climate risk considerations in food security and IWRM in Tsilima Plain	UNDP	10,014,975	27,500,000

Annex III: Approved Projects and Programs Under the SCCF[1]



Approved projects and programs under the SCCF Adaptation Program (SCCF-A)

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
2553	Global	Piloting climate change adaptation to protect human health	UNDP	5,466,654	16,588,559
2832	Tanzania	Incorporating Climate Change in integrated Water Resources Management in Pangani River Basin (Tanzania)	UNDP	1,090,000	1,574,875
2902	Regional	Adaptation to the impact of rapid glacier retreat in the tropical Andes Project	World Bank	9,297,700	25,542,000
2931	Ecuador	Adaptation to Climate Change through Effective Water Governance in Ecuador	UNDP	3,685,000	16,335,432
3101	Regional	Pacific Adaptation to Climate Change (PACC)	UNDP	14,822,500	44,703,799
3103	Vietnam	Promoting Climate-Resilient Infrastructure in Northern Mountain Provinces of Vietnam	ADB, UNDP	3,850,000	145,270,000

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GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3154	Ethiopia	Coping with Drought and Climate Change	UNDP	1,084,550	1,866,667
3155	Mozambique	Coping with Drought and Climate Change	UNDP	1,046,400	929,840
3156	Zimbabwe	Coping with Drought and Climate Change	UNDP	1,071,470	1,156,000
3159	Mexico	Adaptation to Climate Change Impacts on the Coastal Wetlands in the Gulf of Mexico	World Bank	5,280,000	19,000,000
3218	Ghana	Integrating climate change into the management of priority health risks in Ghana	UNDP	2,000,000	55,783,146
3227	Guyana	Conservancy Adaptation Project	World Bank	4,142,000	16,200,000
3242	Egypt	Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management	UNDP	4,510,000	12,905,060
3243	Philippines	Philippine Climate Change Adaptation Project	World Bank	5,782,700	50,580,000
3249	Kenya	Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL)	UNDP, World Bank	7,401,100	42,618,000
3265	China	Mainstreaming Climate Change Adaptation in Irrigated Agriculture Project	World Bank	5,847,600	51,000,000
3299	Thailand	Strengthening the Capacity of Vulnerable Coastal Communities to address the Risk of Climate Change and Extreme Weather Events	UNDP	1,000,000	2,744,772
3679	Global	Economic Analysis of Adaptation Options	UNEP	1,100,000	3,500,000
3695	Mongolia	Mongolia Livestock Adaptation Project (Project for Market and Pasture Management Development)	IFAD	1,787,500	11,605,000
3934	South Africa	Reducing disaster risks from wildfire hazards associated with climate change in South Africa	UNDP	3,999,996	31,140,100
3967	Morocco	Integrating Climate Change in the Implementation of the Plan Maroc Vert	World Bank	4,779,999	26,950,000
4255	Swaziland	Adapting national and transboundary water resource management in Swaziland to manage the expected impacts of climate change.	UNDP	1,893,750	5,876,400
4261	Azerbaijan	Integrating Climate Change Risks into Water and Flood Management by Vulnerable Mountainous Communities in the Greater Caucasus Region	UNDP	3,080,000	7,360,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4340	Indonesia	Strategic Planning and Action to Strengthen Climate Resilience of Rural Communities in Nusa Tenggara Timor province (SPARC)	UNDP	5,599,000	74,764,690
4366	Moldova	Climate Resilience through Conservation Agriculture	IFAD	4,807,000	24,071,900
4368	Ghana	Promoting a Value Chain Approach to Climate Change Adaptation in Agriculture	IFAD	2,860,000	9,105,390
4422	Tajikistan	Increasing Climate Resilience through Drinking Water Rehabilitation in North Tajikistan	EBRD	3,219,774	23,896,400
4492	Nicaragua	Adaptation of Nicaragua's Water Supplies to Climate Change	World Bank	6,600,000	31,250,000
4511	Regional	Sahel and West Africa WB/GEF Program in support of the Great Green Wall Initiative	World Bank	5,000,000	293,930,000
4512	Regional	Pilot Asia-Pacific Climate Technology Network and Finance Center	ADB, UNEP	2,000,000	15,000,000
4515	Regional	Southeast Europe and Caucasus Catastrophe Risk Insurance Facility	World Bank	6,050,000	21,500,000
4536	India	Climate-Resilient Coastal Protection and Management	ADB	2,000,000	54,334,000
4609	Sri Lanka	Strengthening the Resilience of Post-Conflict Recovery and Development to Climate Change Risks in Sri Lanka	UNDP	3,499,999	57,155,000
4610	Colombia	Adaptation to Climate Impacts in Water Regulation and Supply for the Area of Chingaza–Sumapaz–Guerrero	IADB	4,637,325	23,709,000
4616	El Salvador	Climate Change Adaptation to Reduce Land Degradation in Fragile Micro-Watersheds Located in the Municipalities of Texistepeque and Candelaria de la Frontera	FAO	1,135,000	3,835,545
4620	Regional	MENA - Desert Ecosystems and Livelihoods Program (MENA-DELP)	World Bank	3,000,000	11,500,000
4649	Regional	Greater Mekong Subregion Forests and Biodiversity Program (GMS-FBP)	ADB	500,000	7,000,000
4657	Honduras	Competitiveness and Sustainable Rural Development Project in the Northern Zone	IFAD	3,412,751	19,085,580

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
4775	Ecuador	Promotion of Climate-smart Livestock Management Integrating Reversion of Land Degradation and Reduction of Desertification Risks in Vulnerable Provinces	FAO	1,642,500	2,912,822
4901	India	Sustainable Livelihoods and Adaptation to Climate Change (SLACC)	World Bank	8,800,000	52,200,000
4960	Zimbabwe	Scaling up adaptation in Zimbabwe, with a focus on rural livelihoods, by strengthening integrated planning systems	UNDP	4,487,500	12,827,000
4967	Philippines	Scaling up Risk Transfer Mechanisms for Climate-Vulnerable Farming Communities in Southern Philippines	UNDP	1,210,000	16,250,000
5105	Tunisia	Addressing climate change vulnerabilities and risks in vulnerable coastal areas of Tunisia	UNDP	6,160,000	74,048,000
5113	Regional	Enhancing Climate Change Resilience in the Benguela Current Fisheries System	FAO	3,431,525	12,419,027
5115	Kyrgyz Republic	Promoting Climate Resiliency of Water Supplies in Kyrgyzstan	EBRD	5,500,000	35,220,000
5125	Lebanon	Sustainable Agricultural Livelihoods in Marginal Areas (SALMA)	FAO	7,862,398	26,100,000
5147	Georgia	Enhancing Resilience of Agricultural Sector in Georgia (ERASIG)	IFAD	5,928,550	27,620,000
5228	Regional	Rural livelihoods' adaptation to climate change in the Horn of Africa (RLACC)	AfDB	2,892,000	21,556,633
5343	Namibia	Scaling up community resilience to climate variability and climate change in Northern Namibia, with a special focus on women and children	UNDP	3,504,000	20,017,263
5386	Albania	Building the resilience of Kune-Vaini Lagoon through ecosystem based adaptation (EbA)	UNEP	2,193,285	11,528,872
5523	Antigua and Barbuda	Building climate resilience through innovative financing mechanisms for climate change adaptation	UNEP	5,584,500	6,290,000
5667	Regional	Climate Change Adaptation in the Eastern Caribbean Fisheries Sector	FAO	6,142,950	34,850,000
5681	Regional	Building Climate Resilience of Urban Systems through Ecosystem-based Adaptation (EbA) in Latin America and the Caribbean	UNEP	6,734,250	21,910,000

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
5683	Global	Assisting non-LDC Developing Countries with Country-driven Processes to Advance National Adaptation Plans (NAPs)	UNDP, UNEP	5,091,750	41,800,000
5685	Morocco	Increasing Productivity and Adaptive Capacities in Mountain Areas of Morocco (IPAC-MAM)	IFAD	7,198,450	28,000,000
5687	Belize	Energy Resilience for Climate Adaptation	World Bank	3,285,000	1,800,000
5723	Regional	West Balkans Drina River Basin Management Project	World Bank	5,000,000	99,700,000
5814	Regional	Pacific Resilience Program	World Bank	6,000,000	40,217,000
6915	Kazakhstan	Southeast Europe and Central Asia Catastrophe Risk Insurance Facility	World Bank	5,000,000	15,000,000
6924	Viet Nam	Promoting Climate Resilience in Viet Nam Cities	ADB	5,150,000	124,000,000
6927	Egypt	Integrated Management and Innovation in Rural Settlements	IFAD	8,624,143	38,132,600
6945	Costa Rica	Strengthening Capacities of Rural Aqueduct Associations' (ASADAS) to Address Climate Change Risks in Water-Stressed Communities of Northern Costa Rica	UNDP	5,639,250	26,850,000
6951	Morocco	Enhancing the climate resilience of the Moroccan ports sector	EBRD	7,000,000	48,900,000
6955	Chile	Strengthening the Adaptive Capacity to Climate Change in the Fisheries and Aquaculture Sector	FAO	2,847,000	15,600,000
6960	Turkmenistan	Supporting Climate-Resilient Livelihoods in Agricultural Communities in Drought-prone Areas	UNDP	3,500,000	20,000,000
9107	Sri Lanka	Resilient and Integrated Urban Development for Greater Colombo	ADB	4,600,000	128,000,000

Note: All amounts are in US dollars.

Approved projects and programs under the SCCF Program for Technology Transfer (SCCF-B)

GEF ID	COUNTRY	TITLE	GEF AGENCY	TOTAL SCCF AMOUNT (GRANT + FEES) ($)	CO-FINANCING ($)
3907	Global	Technology Needs Assessments	UNEP	9,000,000	2,855,000
4036	Jordan	dRHS Irrigation Technology Pilot Project to face Climate Change impact in Jordan	IFAD	2,365,020	5,716,000
4880	Regional	Climate technology transfer mechanisms and networks in Latin America and the Caribbean	IADB	1,998,150	6,650,000
4904	Regional	Pilot African Climate Technology Finance Center and Network	AfDB	5,775,000	27,200,000
4934	Global	Enhancing Capacity, Knowledge and Technology Support to Build Climate Resilience of Vulnerable Developing Countries	UNEP	5,500,000	34,850,000
4956	Regional	Finance and Technology Transfer Centre for Climate Change (FIN-TeCC)	EBRD	2,000,000	12,601,667
5263	Cameroon	Enhancing the Resilience of Poor Communities to Urban Flooding in Yaounde	AfDB	4,551,915	156,280,000
5384	Regional	Adaptation to the impact of climate change in water resources for the Andean Region	World Bank	9,450,000	18,470,000
5604	Bosnia-Herzegovina	Technology Transfer for Climate-Resilient Flood Management in Vrbas River Basin	UNDP	5,639,250	77,260,000
5666	Pakistan	Mainstreaming Climate Change Adaptation through Water Resource Management in Leather Industrial Zone Development	UNIDO	3,723,000	14,450,000
5687	Belize	Energy Resilience for Climate Adaptation	World Bank	5,475,000	3,000,000
9103	Cambodia	Building Adaptive Capacity through the Scaling-up of Renewable Energy Technologies in Rural Cambodia (S-RET)	IFAD	5,201,250	23,000,000

Abbreviations

CER	Certified Emissions Reduction
CDM	Clean Development Mechanism
COP	Conference of the Parties
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LDCF	Least Developed Countries Fund
NAPA	National Adaptations Programme of Action
SCCF	Special Climate Change Fund
SPA	Strategic Priority for Adaptation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

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