Risk Financing for Rural Climate Resilience in the Greater Mekong Subregion

GREATER MEKONG SUBREGION
CORE ENVIRONMENT PROGRAM

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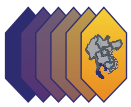

ADB

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Abbreviations

ADB	Asian Development Bank
BCC	Biodiversity Conservation Corridors Project
CDF	community development fund
CEP	Core Environment Program
EOC	Environment Operations Center
GMS	Greater Mekong Subregion
Lao PDR	Lao People's Democratic Republic
NDVI	normalized difference vegetation index
NGO	nongovernment organization
NTFP	nontimber forest product
PPP	purchasing power parity
VAR	values at risk

Executive Summary

Rural communities in the Greater Mekong Subregion (GMS) are particularly vulnerable to climate-related disasters.[1] Their agrarian livelihoods are often beset by damaging floods and droughts that have significant economic implications. Such climate events are expected to increase in both intensity and frequency given a changing climate in the coming decades. Many rural communities in the subregion already face considerable socioeconomic challenges, and climate hazards, particularly major events, can tip many into extreme poverty. While most rural households have some means of managing climate and other risks through diversified farming practices, social capital networks, and reliance on public assistance, on the whole they are ill-equipped to cope with climate shocks.

In recent years, risk financing strategies have been explored in many parts of the world to build the climate resilience of rural communities. Incentivized savings initiatives, disaster funds, and crop and livestock insurance schemes are among the approaches being applied. By providing financial protection against the impacts of climate-related shocks, these strategies can enable rural communities to better safeguard income and productive assets from climate shocks without resorting to costly coping strategies that compromise long-term welfare. The risk protection effect could provide an incentive for risk-averse households to borrow for higher-risk, higher-return livelihood strategies, contributing both to poverty reduction and development of rural credit markets. In the GMS, however, risk financing strategies targeting rural communities are few and far between and should therefore be more developed.

In 2014, the GMS Core Environment Program commissioned a rapid assessment of climate risk financing opportunities for rural communities in Cambodia, the Lao People's Democratic Republic, and Viet Nam. Covering 28 rural communities in the three countries, the study assessed their livelihood strategies, how they manage climate risks, the frequency and severity of climate-related disasters and the impact of these on their livelihoods. It also looked at what climate risk financing strategies could be applied and the potential costs and benefits as well as how local financial institutions such as community development funds cope with climate risks.

The aim of the study was to provide information and analyses to contribute to the knowledge base on rural climate risk financing in the GMS and be the basis for more comprehensive feasibility studies. This publication is a synthesis of the study report.[2]

The following summarizes the key messages from the report:

(i) The 28 rural communities are exposed to a variety of climate-related hazards.

(ii) To cope with climate hazards, the communities and households use a combination of risk management strategies, both before climate events occur (*ex ante*) and after they strike (*ex post*).

(iii) Current risk management strategies, including limited use of climate risk financing mechanisms, may not provide the communities and households with effective protection against the impacts of climate hazards.

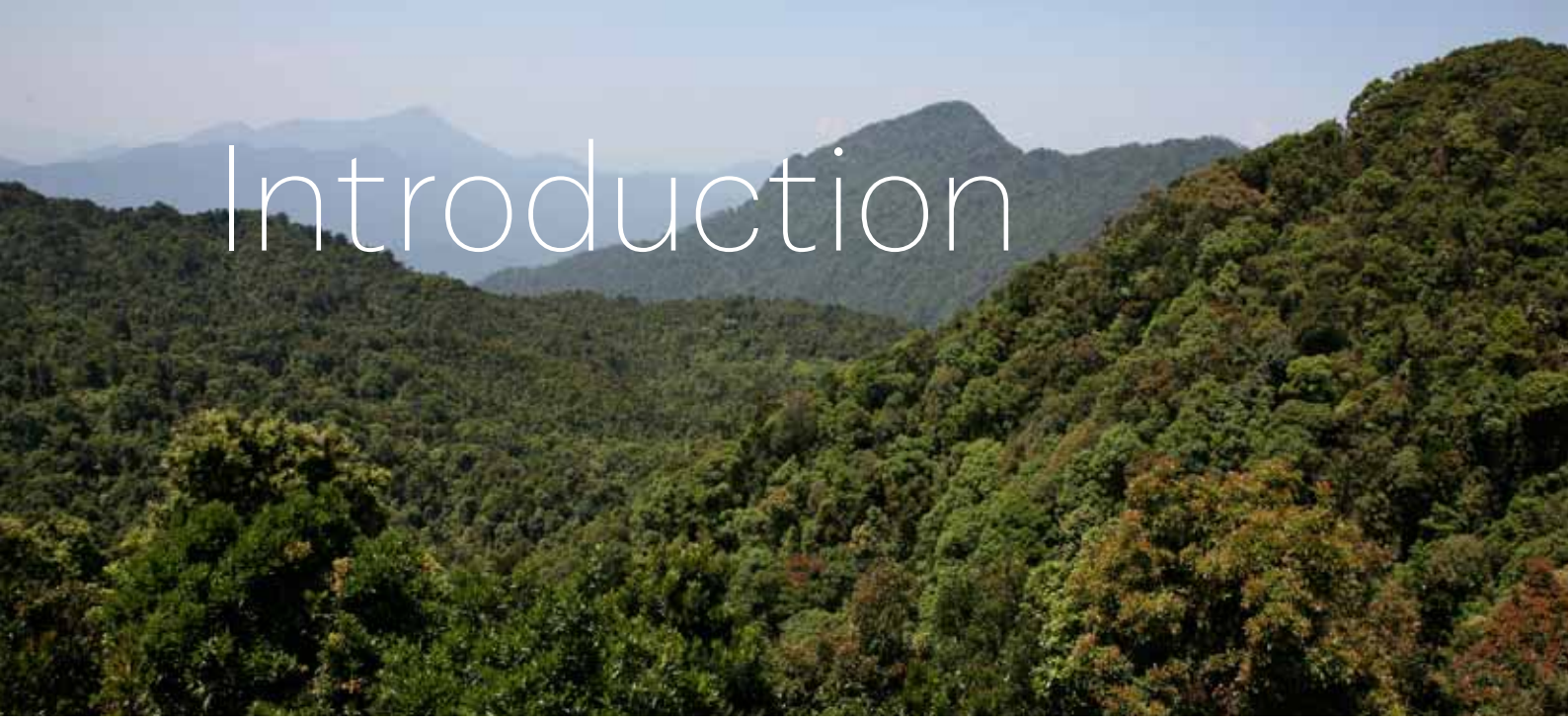
(iv) Strengthening climate risk financing could help improve climate resilience within the study communities.

(v) Effective climate risk financing for the study communities requires a combination of risk retention, risk sharing, and risk transfer mechanisms.

(vi) National governments and the donor community can play an important role in supporting risk financing mechanisms.

1 The GMS is composed of Cambodia, the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam.

2 ADB. 2015. *Risk Financing for Climate Resilience: An Assessment of Opportunities to Strengthen Climate Risk Financing for Rural Communities in the Greater Mekong Subregion.* Consultant's report. Manila (TA 7987-REG). http://www.gms-eoc.org/uploads/resources/253/attachment/CC%20Risk%20Financing%20Report.pdf



Introduction

The Greater Mekong Subregion (GMS) is vulnerable to climate-related disasters. In 2008, the tropical cyclone Nargis caused catastrophic destruction and loss of life in Myanmar, killing around 84,500 people and impacting the livelihoods of up to 2.4 million people.[3] In 2011, large-scale floods in Thailand affected almost 14 million people, resulting in an estimated $45.7 billion in damages.[4]

As a result of climate change, the GMS could experience an increased magnitude and frequency of climate-related disasters. Shifting temperature and rainfall patterns and sea level rise are also expected in the coming decades. Four GMS countries— Cambodia, Myanmar, Thailand, and Viet Nam—are ranked among the 15 countries most vulnerable to climate change in the world.[5]

Rural people comprise nearly 67% of the GMS population and are particularly vulnerable to climate-related disasters and climate change due to their underlying poverty, dependence on natural resources, and tendency to locate in remote areas with poor infrastructure and access to services. For rural households, floods and droughts can severely impact farming, causing the loss of crops and productive assets such as fruit trees and livestock. Extreme events, such as tropical storms, tend to affect whole communities by causing widespread damage to infrastructure and disrupting rural economic activities.

Rural communities use various risk management strategies to deal with climate-related disasters but they are often inadequate. Rural households typically diversify income sources before disaster events occur. After disasters strike, they help each other within the community with food and money and also rely on external assistance. While these strategies help rural households cope with disasters, they do not fully protect them, especially from the impacts of extreme events. Current coping strategies can also contribute to households having long term vulnerability to disasters. For example, poorer households are often forced to reduce consumption and sell productive assets in response to natural disasters. In some cases, children are taken out of school to provide extra labor. Several studies in Bangladesh, Cambodia, India, Indonesia, Mali, and Tanzania found that rural households, especially those with few assets, increase their use of child labor by 30–50%, typically by substituting children for adult labor in activities such as gathering firewood and water and herding livestock. This, in turn, results in significant decreases in school attendance (Dillon 2013, Guarcello et al. 2008, Beegle et al. 2006, Thomas et al. 2004). These strategies have long-term negative impacts on the welfare and human capital of the households and contribute to trapping them in poverty.

3 International Federation of Red Cross and Red Crescent Societies. 2011. Myanmar: Cyclone Nargis 2008 Facts and Figures. 3 May. http://www.ifrc.org/en/news-and-media/news-stories/asia-pacific/myanmar/myanmar-cyclone-nargis-2008-facts-and-figures/

4 World Bank. 2011. The World Bank Supports Thailand's Post-Floods Recovery Effort. 13 December. http://www.worldbank.org/en/news/feature/2011/12/13/world-bank-supports-thailands-post-floods-recovery-effort

5 New Scientist. 2010. Asia tops climate change's 'most vulnerable' list. 20 October. https://www.newscientist.com/article/mg20827832.400-asia-tops-climate-changes-most-vulnerable-list/

Climate-related disasters can also take a heavy toll on financial institutions that support rural households and hamper the development of credit markets necessary to foster rural economic development. On the demand side, risk-averse rural households may have less incentive to invest in productive economic activities and thus exhibit lower demand for credit. On the supply side, climate-related disasters can induce widespread loan defaults for lenders such as agricultural banks and potentially reduce their willingness to lend in climate-sensitive areas. At the country level, disasters take tolls on public finances by reducing government revenue and leading to high expenditure on disaster relief and reconstruction at the expense of other public investments.

Effective climate risk management in rural communities requires climate risk financing, which is a systematic approach to manage the financial consequences of climate variability and extremes. Climate risk financing makes use of a combination of strategies and instruments, such as saving, credit, insurance, and disaster funds and can target households, communities, and institutions. Climate risk financing requires a comprehensive risk assessment, selection of appropriate financial instruments, and development of institutional arrangements and partnerships. Climate risk financing is not a stand-alone solution. It should be designed to complement other nonfinancial risk management measures such as water management infrastructure, early warning systems, and restoration of ecosystems that support local livelihoods. A combination of physical and risk-financing measures, supported by conductive policies and capacity building, will enable rural communities to better manage present climate risks and adapt to future climate change.

More developing countries in Asia are testing climate risk financing strategies in rural contexts. For example, Mongolia developed an index insurance scheme to protect semi-nomadic herders from large-scale losses of livestock caused by extreme winter temperatures. The scheme applies a systematic risk financing approach which combines self-insurance, market-based insurance, and a social safety net financed by the government.[6] In India, various index insurance schemes protect more than 30 million farmers, a large portion of which access the coverage through insurance-linked agricultural loans.

In the GMS, several countries are testing new climate risk financing schemes targeting agricultural incomes of rural populations. The Government of the People's Republic of China (PRC) has supported several index insurance schemes for crops including rice, tea, tobacco, and vegetables. Cambodia, Thailand, and Viet Nam have piloted similar schemes for rice with the involvement of the insurance sector, agricultural banks, and the donor community. The Government of Thailand is currently exploring the potential of mandatory crop insurance.[7] Apart from raising awareness about the role of risk financing in climate risk management for the rural sector, these initiatives are developing public-private partnership models and generating valuable lessons learned for wider replication.

Despite these pilot initiatives, most rural communities in the GMS lack effective climate risk financing. Introducing or scaling up climate risk financing schemes requires extensive investments in research and development, which pools expertise from natural and social sciences and applies tools such as catastrophe and financial modelling. A first step is to conduct studies to gain more in-depth understanding of climate impacts on rural livelihood assets and their financial consequences. These studies will allow relevant institutions to assess the effectiveness of current risk management mechanisms and determine how a systematic approach to risk financing could fill any gaps. As vulnerability to climate hazards is context-specific, the studies are needed for a wide range of GMS rural locations. The studies need to be conducted with an appropriate conceptual framework and methodology designed to inform climate risk financing strategies.

In 2014, the GMS Core Environment Program (CEP) of the Asian Development Bank (ADB) commissioned a study on climate risk financing. Administered by ADB and overseen by the six GMS environment ministries, CEP provides technical assistance to GMS

6 World Bank. 2009. Mongolia: Index Based Livestock Insurance Project. 24 September. http://www.worldbank.org/en/news/feature/2009/09/23/index-based-livestock-insurance-project

7 Asia Insurance Review. 2016. Thailand: Reform panel proposing mandatory crop insurance. 11 March. http://www.asiainsurancereview.com/News/View-NewsLetter-Article/id/35280/Type/eDaily?utm_source/Edaily-News-Letter/utm_medium/Group-Email/utm_campaign/Edaily-NewsLetter

countries to improve environmental management. Included in its work portfolio are initiatives to improve biodiversity conservation and strengthen climate resilience in seven major transboundary biodiversity landscapes.[8] CEP-supported activities include developing climate-integrated management strategies for these landscapes as well as assessing the climate vulnerability and adaptation options of rural communities within the landscapes.

The study—conducted intermittently from February 2014 to March 2015—aimed to assess the potential role of risk financing in strengthening the climate resilience of rural households and community-based financial institutions. It assessed climate risk financing opportunities and challenges for 28 rural communities in Cambodia, the Lao People's Democratic Republic (PDR), and Viet Nam. These communities are dispersed within four transboundary biodiversity landscapes: the Cardamom Mountains, the Central Annamites, the Eastern Plains Dry Forest, and the Triborder Forest.

The study was designed to conduct the following activities:

(i) Identify key livelihood strategies, vulnerability to climate hazards, and the impacts of these hazards on rural households in the study communities.

(ii) Gather information on existing risk management strategies and their effectiveness in helping households deal with climate-related disasters.

(iii) Gain a preliminary understanding of the current level of access to financial services of households in the study communities.

(iv) Assess the implications of climate-related hazards on households' use of financial services as well as on the sustainability of financial institutions that provide the services, using community development funds as a case study.

(v) Identify climate risk financing strategies that could be potentially applied to strengthen climate resilience of rural households and community development funds.

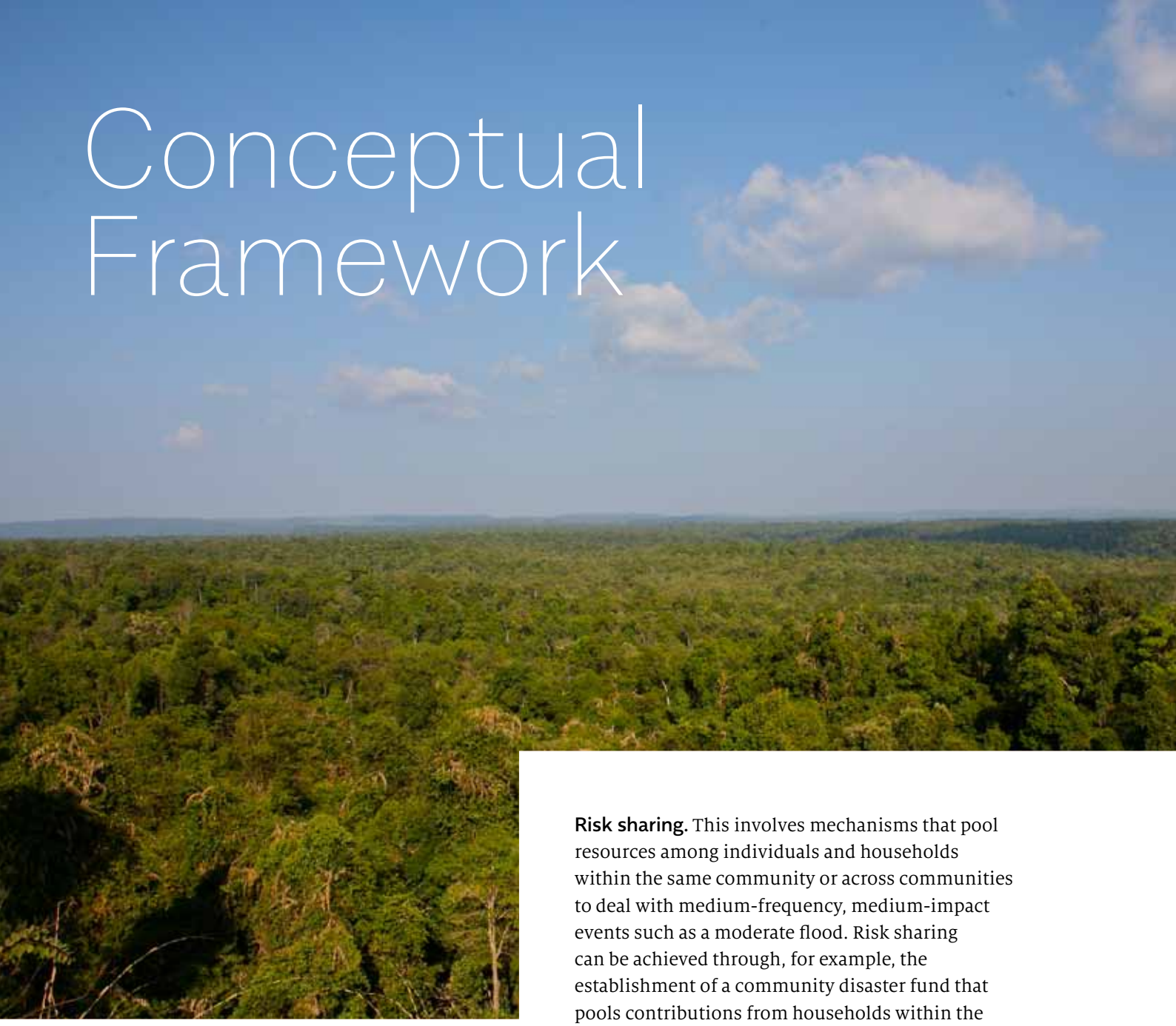
(vi) Assess the impacts of climate risk financing options on livelihoods and conduct a preliminary analysis of costs and benefits of the options.

Designed as a rapid technical assessment, the study was intended to broadly inform CEP's potential engagement in the study communities and contribute to the emerging knowledge base on rural climate risk financing in the GMS. As a rapid assessment, the study was not intended to be adequate for project design and implementation. Instead, it could be used to catalyze discussion among GMS stakeholders on climate risk financing for rural communities and be a basis for more comprehensive feasibility studies. The study's conceptual framework and assessment methodology are commonly used for climate risk financing diagnostics.[9]

8 The seven transboundary biodiversity landscapes are the Cardamom Mountains, Central Annamites, Eastern Plains Dry Forest, Mekong Headwaters, Sino-Viet Nam Karst, Tenasserim Mountains, and Triborder Forest. Greater Mekong Subregion Core Environment Program. Transboundary Biodiversity landscapes. http://www.gms-eoc.org/transboundary-biodiversity-landscapes-

9 The conceptual framework and assessment methodology have been applied in several diagnostic assessments conducted by the World Bank for the purpose of policy advice and project design in the areas of disaster risk financing and agricultural risk management. See for example: O. Mahul and J. Skees. 2007. Managing Agricultural Risk at the Country Level: The Case of Index-Based Livestock Insurance in Mongolia. World Bank Policy Research Working Papers. World Bank; S. Chantarat et al. 2013. Designing Index-Based Livestock Insurance for Managing Asset Risk in Northern Kenya. Journal of Risk and Insurance. 80 (1). pp. 205–237; World Bank. 2014. Kenya: Agriculture Insurance Solutions Appraisal. World Bank Technical Report; World Bank. 2015. Promoting Access of Smallholder Farmers to Agricultural Insurance. World Bank Technical Report.

Conceptual Framework



Climate risk financing strategies are "the application of financing strategies and instruments as part of a systemic approach to manage the financial consequences of climate variability and extremes" (ADB 2013). Such strategies can be categorized into three complementary mechanisms.

Risk retention. This involves mechanisms that deal with high-frequency, low-impact events, such as localized flooding, through the use of one's own resources such as savings and borrowing (for households) and reserves (for lending institutions). This mechanism is a necessary first line of defense against shocks but is less effective when extreme events create financial impacts beyond the coping capacity of one's own resources.

Risk sharing. This involves mechanisms that pool resources among individuals and households within the same community or across communities to deal with medium-frequency, medium-impact events such as a moderate flood. Risk sharing can be achieved through, for example, the establishment of a community disaster fund that pools contributions from households within the same community. A national or regional disaster fund can also be established to pool risk from the community funds. Risk sharing mechanisms are needed to complement risk retention but can be less effective when extreme events are largely "covariate." A covariate event affects a large number of households, communities, and sometimes regions at the same time and would therefore overwhelm the risk-sharing mechanisms.

Risk transfer. This involves mechanisms to deal with extreme events by shifting the burden of large financial losses or the responsibility for financing those losses to another party, and at a cost. Risk transfer often involves the international financial market through mechanisms such as insurance, reinsurance, and catastrophe bonds. In some cases, governments—as well as providing support through a range of risk retention and risk sharing

instruments such as matching funds to saving groups and community disaster funds—can also act as the insurer of last resort by financing the costs of this layer of extreme risk.

In other cases, governments can support risk transfer by subsidizing access to insurance, such as in the case of rice insurance pilot initiatives in Thailand and Viet Nam. While providing more effective financial protection against highly covariate risks, risk transfer is costly and requires strong technical and institutional capacity and thus can be challenging to implement in developing countries. While more developing countries today successfully make use of international risk transfer for financial protection against extreme events,[10] access to risk transfer schemes in the Asia-Pacific region remains very low.

A combination of these risk financing mechanisms can increase the effectiveness of risk protection. For example, incentivizing households to save could be complemented by the establishment of a community disaster fund. Such funds allow households to pool savings together into a common community reserve and distribute part of this reserve to households affected by disasters based on clearly specified rules. However, within the confines of an individual community, such a fund could still be very small and in practice may only work for very localized events. In this case, a national or regional disaster risk pool could also be established to allow community disaster funds in different geographical areas to pool resources together to better manage extreme events. Insurance and reinsurance can be designed to transfer a portion of financial losses of catastrophic events that overwhelm disaster funds to the international market. Effective public-private partnerships are often key to these successful risk transfer schemes.

Developing an effective climate risk financing strategy requires comprehensive risk assessments and risk pricing. In turn, the price of risk, such as one indicated by an insurance premium, can communicate to rural households the true cost of climate variability and change and guide their investment decisions. For example, increased premiums for an insurance product that covers rainfall deficit could signify an increase in drought risk, and therefore incentivize farmers to

10 For example, see the Caribbean Catastrophe Risk Insurance Facility. http://www.ccrif.org

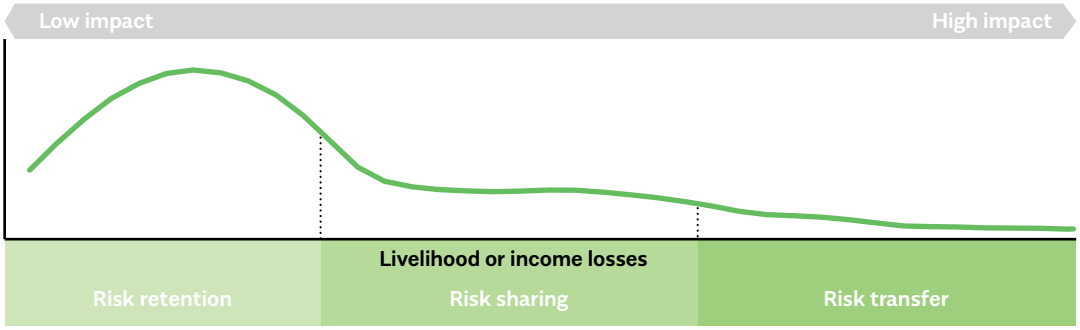
adopt drought tolerant seeds and invest in water management technologies and practices. For financial institutions, loan-linked insurance could help expand agricultural credit to farmers who would otherwise be considered by banks as too risky to lend to.

For climate change, insurance is one among a broad suite of risk management approaches that, if implemented together with disaster risk reduction measures, can facilitate climate change adaptation (Warner et al. 2009). However, designing an insurance scheme in the context of climate change requires care as subsidized insurance may distort the true cost of risk to farmers and could have the unintended consequence of slowing down climate change adaptation.

Identifying and combining appropriate climate risk financing options is embedded in the concept of "risk layering." In this context, risk layering refers to segmenting climate risks by degrees of severity and frequency to allow for efficient financing and management of risks (Cummins and Mahul 2009). Risk layering also guides the development of necessary institutional arrangements, including public-private partnerships, to integrate risk financing into a sustainable disaster risk management framework. Figure 1 illustrates the concept of risk layering and examples of applicable risk financing options for each layer, and for each of the different segments of society. The figure distinguishes three types, or layers, of loss events: (i) high-frequency, low-impact events; (ii) medium-frequency, medium-impact events; and (iii) low-frequency, high-impact events, which are also often referred to as "extreme events" or catastrophic events." Appropriate risk financing strategies for each layer and for each of segment of society will differ but be complementary.

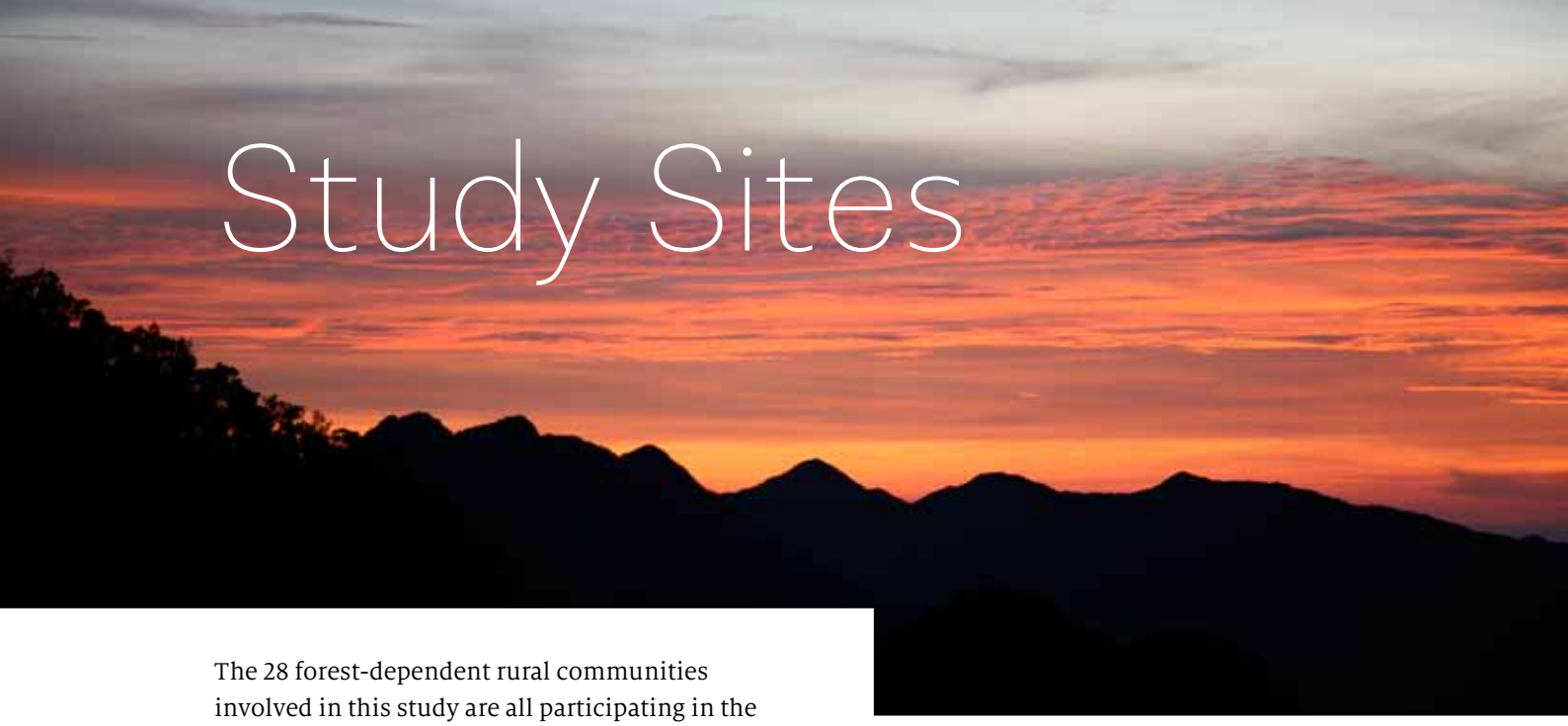
FIGURE 1

A Conceptual Framework for Risk Layering



Households	Savings	Social insurance	Microinsurance
Communities	Community disaster funds	National/regional risk pool of disaster funds	Insurance, reinsurance
Lending institutions	Reserves	National/regional pool of loan portfolio reserves	Insurance, reinsurance
Governments	Disaster funds, contingent credit	National/regional disaster risk pool	Insurance, reinsurance, catastrophe bonds

Sources: Authors; D. Hofman and P. Brukoff. 2006. *Insuring Public Finances Against Natural Disasters: A Survey of Options and Recent Initiatives*. IMF Working Paper 06/199 (illustration).



Study Sites

The 28 forest-dependent rural communities involved in this study are all participating in the Biodiversity Conservation Corridors Project (BCC) financed by the Asian Development Bank (ADB) (Figure 2).[11] Building on pilot work by the Greater Mekong Subregion (GMS) Core Environment Program (CEP), the BCC aims to reduce forest fragmentation and associated losses of ecosystem services in key transboundary biodiversity landscapes in the GMS through an integrated conservation and development approach. A major BCC intervention is the scaling up of "biodiversity conservation corridors" to maintain and enhance forest connectivity between protected areas within the landscapes. Most of the BCC communities are located within these corridors, while a small number are located within the protected areas. All BCC communities are participating in project activities such as reforestation, forest patrolling, and managing seedling nurseries. The BCC project also invests in community infrastructure and has established community development funds (CDFs).

In Cambodia, nine BCC communities were involved in the study. Four of these were in Koh Kong Province (Cardamom Mountains Landscape) and five were in Modulkiri Province (Eastern Plains Dry Forest Landscape). Eight communities in the Lao People's Democratic Republic were involved, four of which were located in Champasak province, three in Sekong province, and one in Attapeu province (all Triborder Forest Landscape). In Viet Nam, 11 communities were involved, four each in Quang Nam and Quang Tri provinces, and three in Hue province (all Central Annamites Landscape). A list of the 28 study communities is provided in Appendix 1.

The BCC communities were selected for this study for the following reasons:

(i) Livelihoods in these communities are largely climate sensitive as they rely on agriculture and nearby forests for income and food security. Their livelihood strategies are exposed to various climate hazards including floods, droughts, storms, and, in the case of coastal communities in Koh Kong, seawater intrusion. Risk financing has a potential to improve climate risk management in these communities but remains underdeveloped.

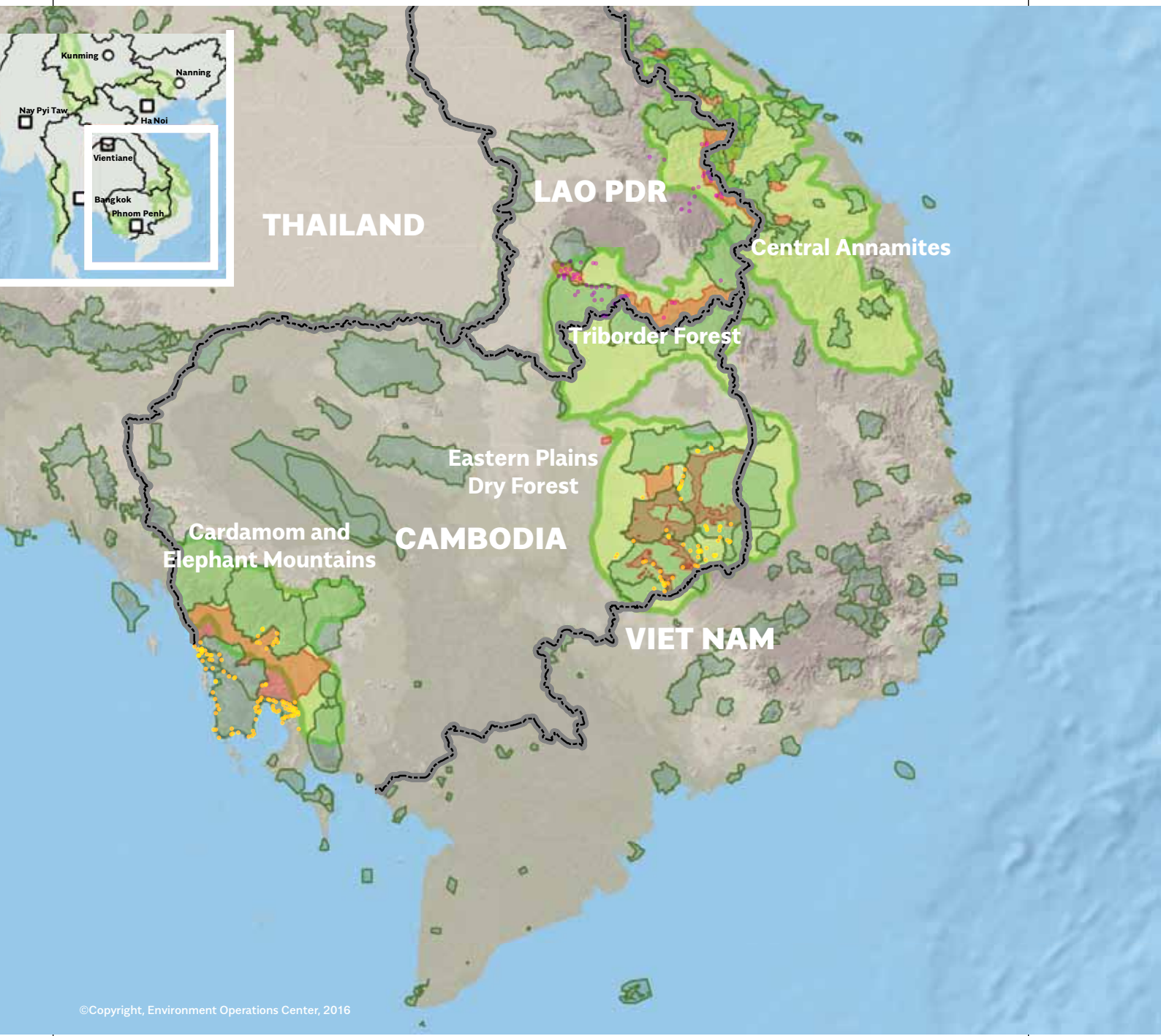
(ii) These communities all have, or are in the process of establishing, CDFs, which are a community managed revolving fund that lends money to members for livelihood development investments such as purchasing seeds and livestock (CDFs are explained in more detail on page 26). The CDFs provide a case study of a grassroots rural financial institution with exposure to climate risks. Insights from an analysis on the impact of climate hazards on CDFs could inform how to improve their sustainability and provide insights for larger community-based funds, microfinance institutions, and agricultural banks serving rural communities in the GMS.

(iii) The diversified locations of BCC communities in the three countries enable an assessment of opportunities and constraints for risk sharing and risk transfer across geographical locations.

11 Greater Mekong Subregion Core Environment Program. Biodiversity Conservation Corridors Project (2011 onwards). http://www.gms-eoc.org/resources/biodiversity-conservation-corridors-project-2012-onwards-

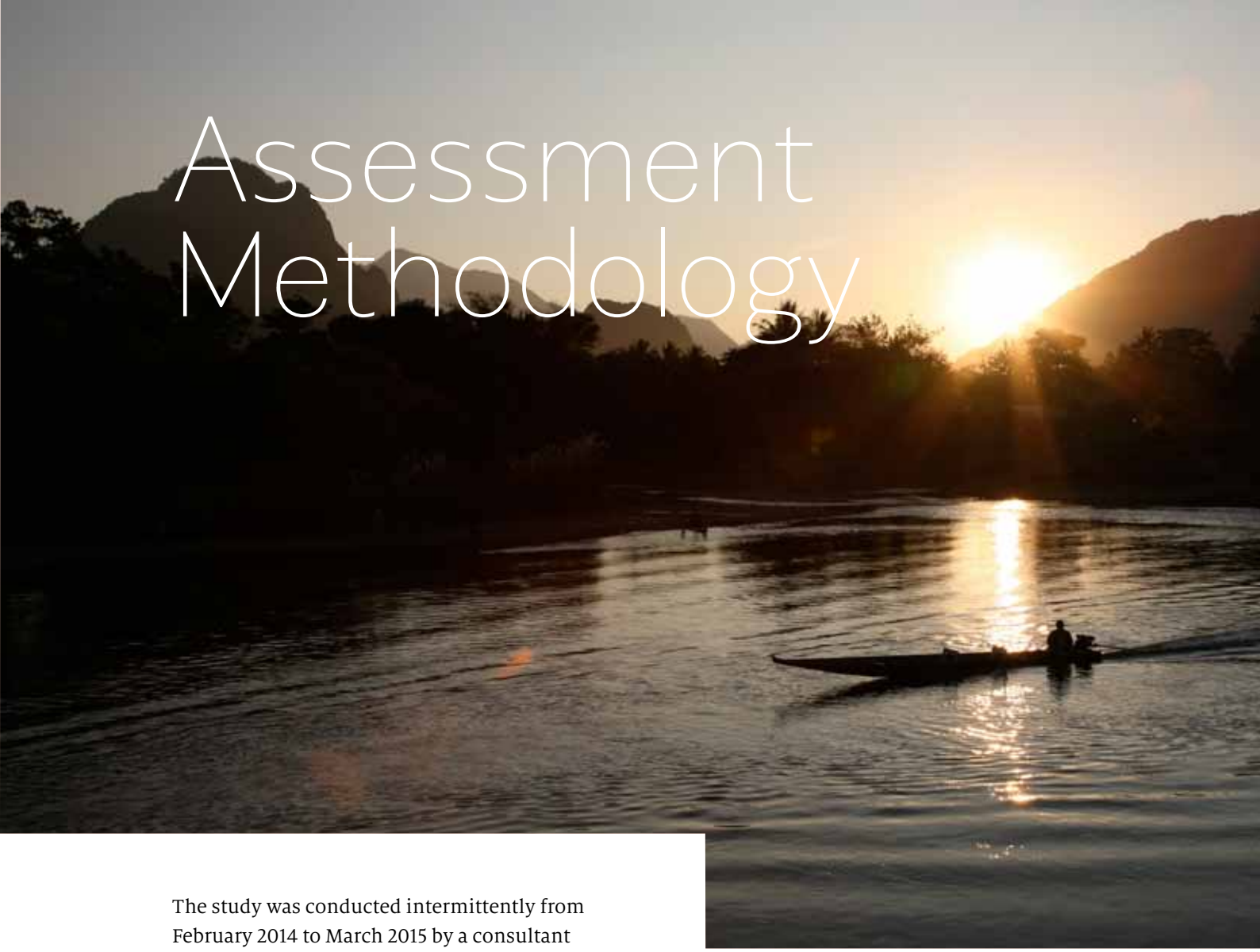
FIGURE 2

Biodiversity Conservation Corridors Project Communities in Cambodia, the Lao People's Democratic Republic, and Viet Nam



Lao PDR = Lao People's Democratic Republic. Boundaries are not necessarily authoritative.
Source: Greater Mekong Subregion Environment Operations Center.

Assessment Methodology



The study was conducted intermittently from February 2014 to March 2015 by a consultant with international expertise in development economics, climate risk financing, and economic and financial modeling. Applying experience from similar assessments in Africa and Asia, the expert conducted this study with technical support from the Asian Development Bank (ADB) the Greater Mekong Subregion (GMS) Environment Operations Center (EOC);[12] government officials in Cambodia, the Lao People's Democratic Republic (PDR), and Viet Nam; and team members of the ADB-financed Biodiversity Conservation Corridors Project (BCC) in the three countries.

During the study period, the expert conducted five field visits to the study communities for data collection and verification. In Cambodia, the expert was also supported by a team of student research assistants from a local university in conducting household surveys. In addition, EOC partners shared valuable data that strengthened the analyses.

The assessment methodology comprised the following steps:

Step 1: Mapping and clustering livelihood-climate risk zones

For every study community, data was collected on spatial and socioeconomic characteristics, livelihood strategies, and climate risks. A BCC project database provided information on spatial characteristics. The socioeconomic and livelihood data came from the Lao PDR's 2009 census and household surveys in all three countries. Indicators of climate risks were developed from a combination of rainfall data from ground weather stations (with varying temporal availability) and the remotely-sensed Normalized Difference Vegetation Index (NDVI) covering 2001–2015.[13] A summary of key data is provided in Appendix 2.

12 Greater Mekong Subregion Core Environment Program. About the GMS Environment Operations Center. http://www.gms-eoc.org/GMS-eoc

13 The NDVI measures both the state of vegetation over a landscape. NDVI values range from 0 (no vegetation) to 1 (very vegetative). NDVI can be used as a proxy for crop losses as a result of climate and non-climate related perils.

Based on the data, a cluster analysis grouped the study communities into 11 distinct livelihood-climate risk zones. Livelihood strategies, exposure to climate hazards and availability of risk management strategies are relatively homogenous within each zone and differ between the zones. These zones then became the main unit of analysis to identify variations in vulnerability to climate hazards and the degree by which these hazards are covariate within and across the zones. As a rapid assessment study could not cover all BCC communities, the zones also provide a framework by which representative communities within each zone were selected for interviews. Climate change projections were not integrated into the cluster analysis.

Step 2: Conducting participatory focus group discussions with households

Focus group discussions were held to gather more, or validate existing, information on:

(i) livelihood strategies and income sources;

(ii) incidents and impacts of historical climate hazards;

(iii) current climate risk management strategies and their effectiveness;

(iv) current use of financial services including saving, credit, and insurance; and

(v) current functioning of saving groups and community development funds (CDFs) especially following extreme climate events.

The participants were also asked to share their opinions on the potential usefulness of new climate risk financing strategies such as contributing into a community disaster fund and establishing a risk pool of disaster funds across communities. Representing each livelihood-climate risk zone, each focus group ranged from 10–20 people and comprised villagers that pursue different livelihood strategies, community leaders, participants of saving groups and CDFs, and representatives of local government. In providing answers on incidents and impacts of climate events, participants were asked to recall a 10-year period (2005–2014).

Step 3: Simulating the frequency of extreme climate events and their impacts

The relatively short historical coverage of both the household survey and focus group data mean they do not necessarily capture the occurrence of infrequent extreme climate events. Therefore, the study conducted three-stage simulations to assess the probability of infrequent extreme events and understand their potential impacts on livelihoods in each zone.

First, the study simulated 1,000 years of historical zone-specific flood and drought events using probabilistic catastrophe risk modeling. Second, the simulated drought and flood events were linked to livelihood losses within each zone through a formula based on information gathered from the focus groups. Third, the simulated drought and flood events were linked to potential loan defaults experienced by CDFs based on a conservative assumption of households' repayment behavior following climate-induced livelihood losses. Climate change scenarios were not included in the modeling due to time constraints.

Step 4: Identifying climate risk financing options and simulating cost-benefits.

Based on the information from the previous steps, the international consultant analyzed risk financing options that could be potentially applied to increase the climate resilience of the households and their communities. As financial institutions are more likely to increase lending to climate-sensitive activities if they have some form of protection from climate events, the possibility of increasing credit to rural households was also simulated in combination with the climate risk financing options identified. The consultant performed a preliminary cost-benefit analysis on different combinations of these options. This analysis took a public policy perspective by looking at options that could yield the most benefits to the rural households per dollar of public money.

Key Findings and Implications

This section presents key findings from the study and provides an overview of their implications for climate risk financing.

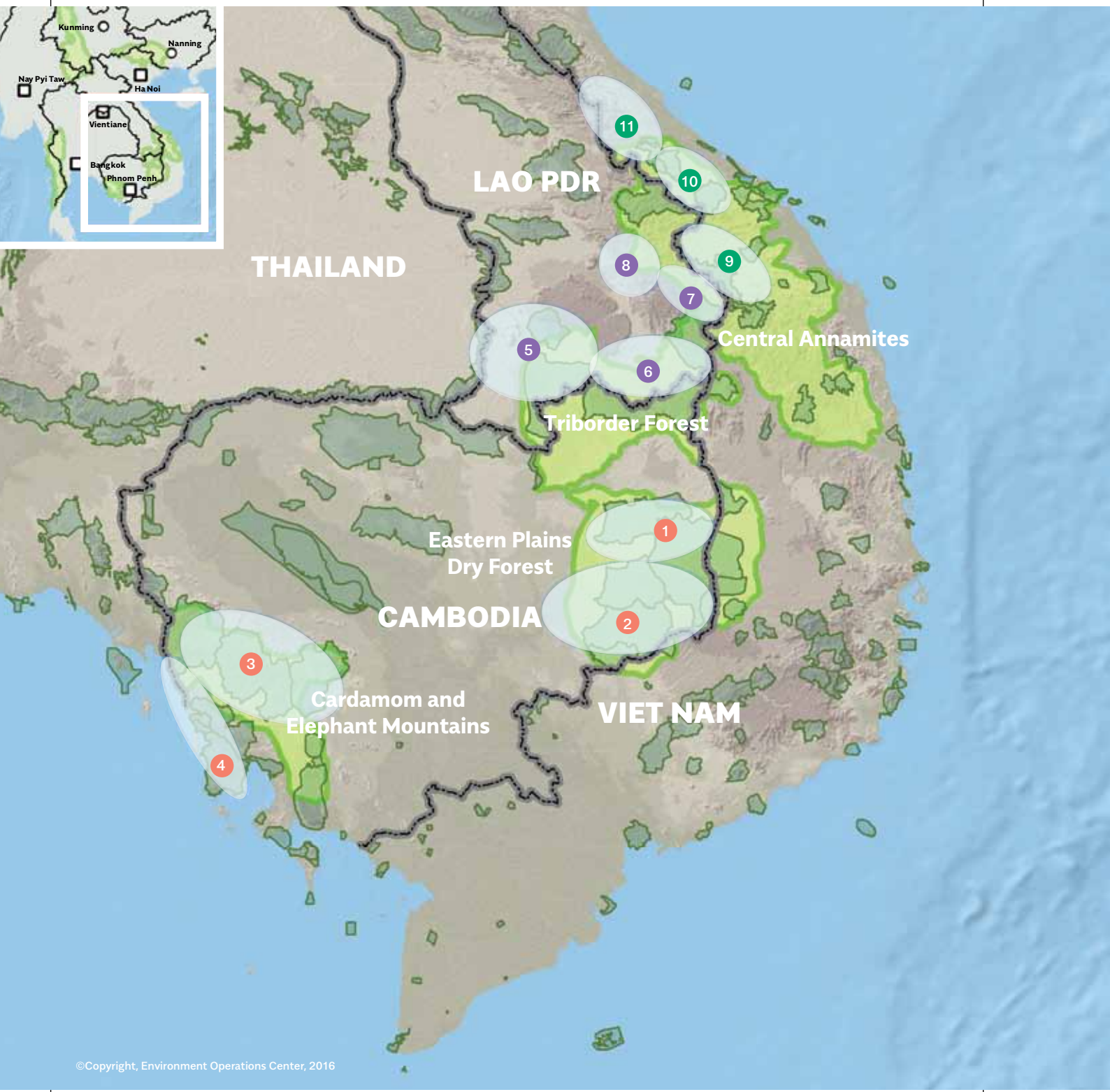
Cluster Analysis of Livelihood–Climate Risk Zones

Livelihood portfolios and exposure to climate hazards vary across the three countries and also between zones within the same country. Based on a cluster analysis of socioeconomic conditions, livelihood options, and exposure to climate hazards, the 28 study communities in the three countries were classified into 11 distinct zones (Figure 3).

Subsistence rice production was identified as the most common livelihood source among all 28 study communities. Although the majority of households grow rice for their own consumption, most are still net buyers of rice. Cassava is another major subsistence crop. The main sources of cash income for the communities are seasonal cash crops such as beans, corn, and peanuts as well as perennial cash crops including coffee, rubber, acacia, and cinnamon. Fisheries, nontimber forest products (NTFPs), and nonfarm activities are common in communities that have market access such as those in Quang Nam in Viet Nam (Zone 9) and Coastal Koh Kong in Cambodia (Zone 4). NTFPs are an important source of food for more remote communities such as those in Phatumphone and Sanamxai Districts in the Lao PDR (Zone 5).

FIGURE 3

Eleven Livelihood Climate Risk Zones



National border

Livelihood-climate risk zones

Protected area

Transboundary biodiversity landscape

0 50 100 150 200 km

Lao PDR = Lao People's Democratic Republic.
Source: Authors.

Cambodia

Zone		Main livelihood	Main climate risk
1	North Mondulkiri	Rain-fed paddy rice	Floods
2	South Mondulkiri	Shifting cultivation of cassava and upland rice and perennial cash crops	Droughts
3	Inland Koh Kong	Rice paddy, fishing and aquaculture, nonfarm income, and NTFPs	Floods, Droughts
4	Coastal Koh Kong	Fishing and subsistence aquaculture (such as small fish ponds) and nonfarm income	Storms, Seawater intrusion

Lao People's Democratic Republic

Zone		Main livelihood	Main climate risk
5	Phatumphone District of Champasak Province and Sanamxai District of Attapeu Province	Rice paddy, livestock, NTFPs, and nonfarm income	Floods
6	Phouvong District of Attapeu Province	Upland rice, livestock, and NTFPs	Droughts
7	Dakchaung District of Sekong Province	Livestock and NTFPs	Droughts
8	Kaleum District of Sekong Province	Upland rice, livestock, NTFPs	Floods, Droughts

Viet Nam

Zone		Main livelihood	Main climate risk
9	Quang Nam Province	Diversified upland crops (such as upland rice, acacia, rubber) and nonfarm income	Floods, Droughts
10	Thua Thien Hue Province	Irrigated paddy rice, livestock, and nonfarm income	Floods, Storms
11	Quang Tri Province	Shifting cultivation of cassava and livestock	Floods, Storms

As shown in Figure 4, livelihoods in the study communities are quite diverse as total rice production (paddy and upland rice) accounts for less than 50% of total economic income (Box 1) for households except those in North Mondulkiri, Cambodia (Zone 1).

While nonfarm activities and NTFPs are important livelihood diversification strategies across all zones, they are particularly important in some. For example, nonfarm activities including petty trade (e.g., local convenient stores) and cross-border labor, comprise, on average, around 41% of total economic income for the study communities in the Coastal Koh Kong zone. Small businesses and cross-border trade comprise a similar percentage for communities in the three zones in Viet Nam (Zones 9, 10, and 11). NTFPs have considerable economic importance in nearly all zones in Cambodia and the Lao PDR, while make a very minor contribution in the Viet Nam zones. In Phatumphone and Sanamxai Districts (Zone 5), NTFPs contribute an average of 40% of the total economic income in the study communities.

BOX 1

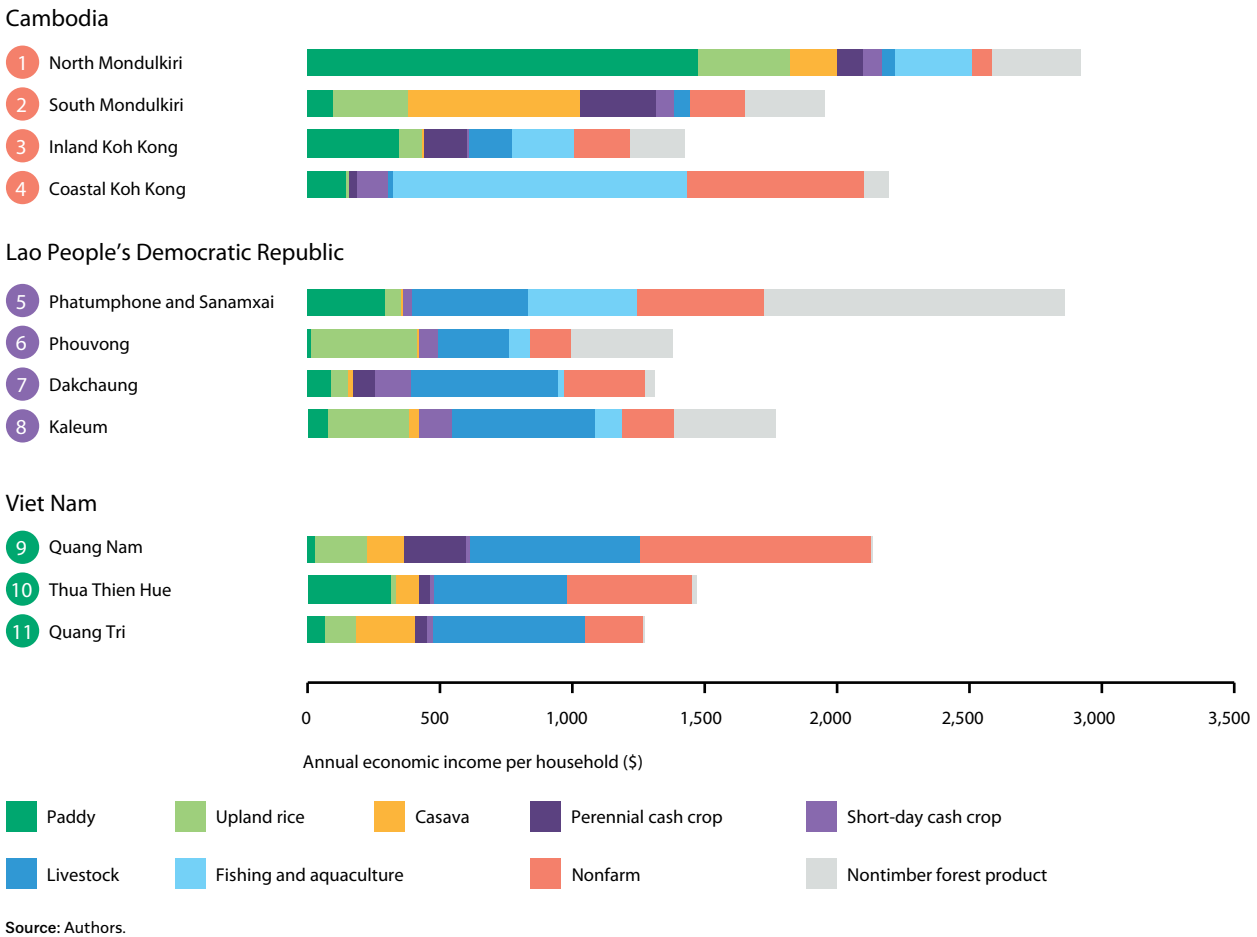
What is Economic Income?

Economic income is the total value of income from cash activities and monetized noncash activities (such as production for home consumption). For this study, economic income was calculated in the country currency then converted to a dollar equivalent using Purchasing Power Parity adjusted exchange rates to allow for international comparison.

Source: A.Deaton.1997. The analysis of household surveys: a microeconometric approach to development policy. Washington, D.C.:The World Bank. http://documents.worldbank.org/curated/en/593871468777303124/The-analysis-of-household-surveys-a-microeconometric-approach-to-development-policy

FIGURE 4

Household Economic Income Sources in 2014



Source: Authors.

Focus Group Discussions

The main findings from the focus group discussions are presented in this section. The findings cover the type, frequency, distribution, and impacts of climate hazards as well as how risk management strategies are currently used by the study communities. Discussions also included their access and use of financial services with additional focus on community development funds (CDFs).

Type, Frequency, and Distribution of Climate Hazards

Households from multiple communities in each zone participated in focus group discussions. The discussions identified floods, storms, and droughts as climate hazards faced by all the communities through a recall survey (Figure 5).

Droughts—described as severely delayed rain and long dry spells exceeding one month during the growing season—typically occur every 3 to 5 years in all zones in the three countries, but as high as every 2.5 years in South Mondulkiri, Cambodia (Zone 2).

Floods, especially flash floods, are the most frequent climate hazard followed by storms and droughts.

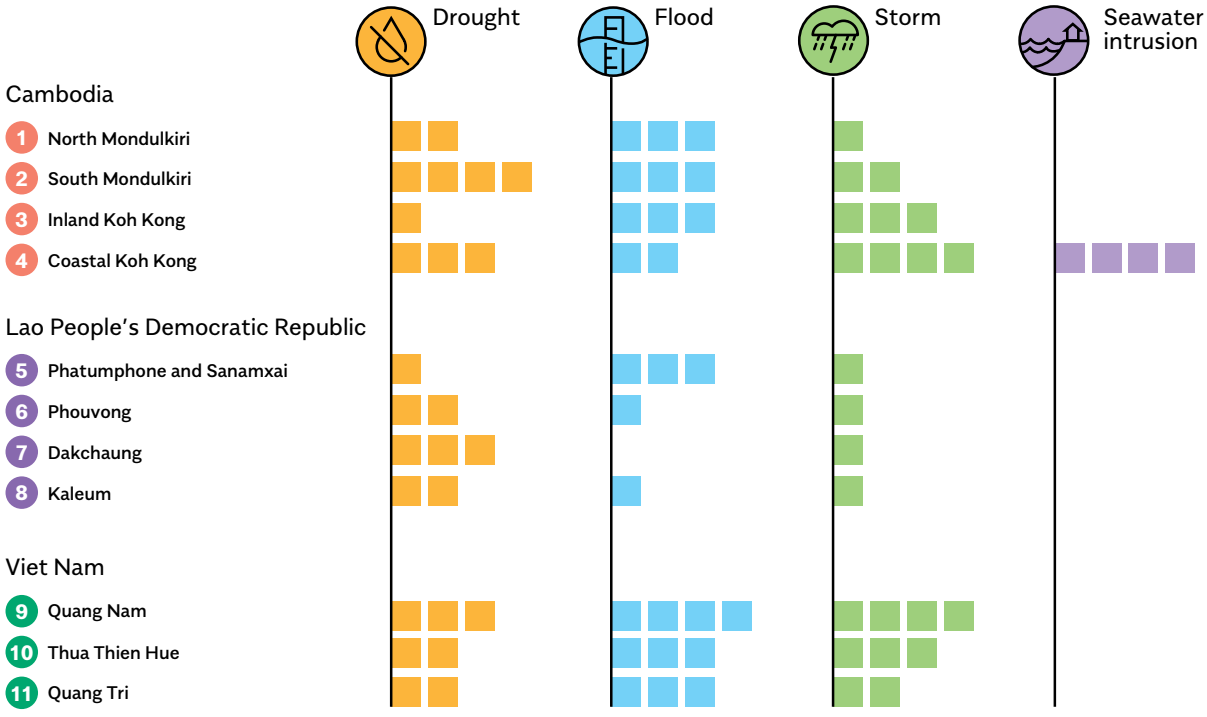
Flash floods—typically a localized event commonly described by the interviewed households as flooding that is a consequence of heavy rain over a short period of time—usually occur once every 3 years in most of the study communities in Cambodia and Viet Nam. In Quang Nam (Zone 9), communities face flash floods more often, on average every 2.5 years. Communities in the Lao People's Democratic Republic (PDR) reported less flash floods than were reported in the other two countries.

Storms—described as very strong winds followed by heavy rain with damages on crops and community infrastructure—typically occur every 3 to 5 years in the study communities in the Cambodia and Viet Nam zones, but with as high frequency as every 2.5 years in the communities in Quang Nam (Zone 9) and Coastal Koh Kong (Zone 4). Communities in all zones in the Lao PDR reported being affected by storms only once during 2005–2014.

Seawater intrusion typically happened every 2.5 years, as reported by communities in Coastal Koh Kong (Zone 4), who were the only ones who experienced this type of climate hazard.

FIGURE 5

Type and Frequency of Climate Hazards



Number of years that each type of climate hazard occurred 2005-2014

Source: Authors.

Based on the recall survey (Box 2), the study communities in the Lao PDR are generally less prone to climate hazards compared to the other two countries.

Some of the zones faced multiple types of climate hazards within the same year. In many zones, climate hazards also occurred in consecutive years. Spatially, some climate events affected multiple zones in each country, while extreme events, such as floods in 2009 and droughts and storms in 2014, affected all zones in the three countries at the same time. This shows the highly covariate nature of extreme events and is summarized in Figure 6.

The temporal and spatial distribution patterns of climate hazards have implications for climate risk financing. While providing the necessary first line of defense, risk retention and risk sharing mechanisms within each zone could be overwhelmed by the high frequency of multiple types of hazards. Extreme events such as the 2009 floods and 2014 storms could render risk sharing mechanisms ineffective even if they affect zones across the three countries. To provide financial protection against extreme events, risk retention and risk sharing mechanisms would need to be complemented by risk transfer mechanisms, for example, through insurance and reinsurance.

BOX 2

How Accurate are People's Recollection of Past Events?

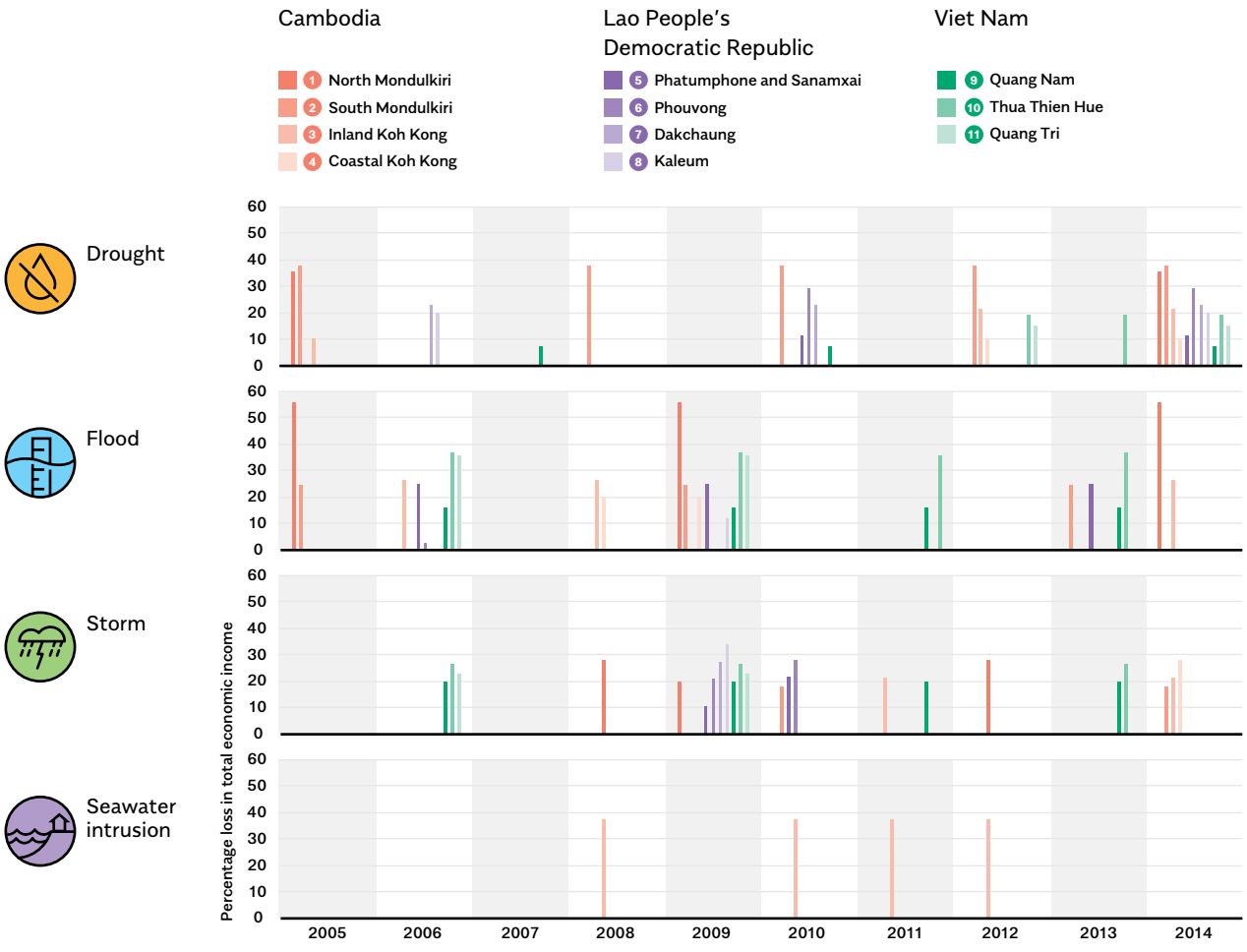
Retrospective surveys require people to recall their past experiences and are commonly used when multiyear surveys are not an option and multiyear data is not available. Research to compare the accuracy of retrospective surveys of climate-related disasters has been undertaken to compare their findings with those from objectively measured data such as from weather stations. The general conclusion of this research is that: (i) retrospective surveys provide accurate indications of key disaster years; (ii) accuracy declines the further back in time it targets; (iii) anchoring the timing of the event of interest to other events in the village improves accuracy; and (iv) accuracy is higher when people recall the impacts of disasters on variables that matter most to their livelihoods, for example, livestock for pastoralists, crop yield for farmers, and fish yield for fishermen.

The recall data from the Core Environment Program study matches key disaster events well documented in the three countries, for example, the floods and storms associated with Typhoon Ketsana in 2009.

Sources: Authors; M. Beckett et al. 2001. The Quality of Retrospective Data: An Examination of Long-term Recall in a Developing Country. *The Journal of Human Resources*. 36. pp. 593–625; K. Beegle, C. Calogero, and K. Himelein. 2011. *Reliability of Recall in Agricultural Data*. World Bank Policy Research Working Paper Series; R. K. Q. Akee. 2011. Errors in Self-Reported Earnings: The Role of Previous Earnings Volatility. *Journal of Development Economics*. 97 (2). pp. 409-421; and F. De Nicola and X. Gine. 2014. How accurate are recall data? Evidence from Coastal India. *Journal of Development Economics*. 106. pp. 52-65.

FIGURE 6

Temporal and Spatial Distribution of Climate Hazards and Impacts on Economic Income, 2005–2014



Source: Authors.

Impacts of Climate Hazards

According to household recall, climate hazards caused considerable economic losses in the study communities in the three countries, particularly for three main types of livelihood assets: rice crops; cash crops, including seasonal and perennial cash crops; and livestock (Figure 7).

Rice crops, including both paddy rice and upland rice, are the most important livelihood asset at risk across all livelihood zones in the three countries. In all zones, rice is mostly grown as a subsistence crop and is a major source of food security. Interviewed households recalled suffering a high percentage loss in economic income from rice production as a result of extreme climate events during 2005–2014.

For paddy rice, droughts caused an estimated 40% loss in economic income from reduced production across all zones in the Lao PDR, a 50% loss across zones in Viet Nam, and a 70% loss across all zones in Cambodia. Households from the Koh Kong coastal zone reported as much as a 90% loss in economic income from paddy rice due to seawater intrusion events. Floods also caused a similar range of losses in the three countries. An average loss in economic income from floods for paddy rice production was estimated at 42% across all zones in the Lao PDR, 65% in Viet Nam, and 72% in Cambodia.

Upland rice production across all zones in the three countries was also considerably affected by droughts and floods. Droughts caused an average loss of 58% in economic income from upland rice production across all zones in the Lao PDR, of 65% across all zones in Viet Nam, and of 75% across all zones in Cambodia. The estimates for flood losses were 20% in Viet Nam, 30% in the Lao PDR, and 39% in Cambodia.

Cash crops are also highly exposed to climate hazards. There are two types of cash crops cultivated in the study communities in the three countries: seasonal cash crops and perennial cash crops. Growing seasonal cash crops is a productive activity that requires seasonal investment and generates seasonal income. They are important for generating short-term cash income for the communities. On the other hand, perennial cash crops are productive assets that require long-term investments and generate recurrent income for rural communities.

Economic income losses from seasonal cash crop production from droughts were estimated at 30% across all zones in Cambodia, at 32% across all zones in Viet Nam, and 41% across all zones in the Lao PDR. The estimates for flood losses were 20% in the Lao PDR, 22% in Cambodia, and 32% in Viet Nam, respectively. In Coastal Koh Kong (Zone 4), seawater intrusion was estimated to cause up to a 90% loss of economic income for seasonal cash crops.

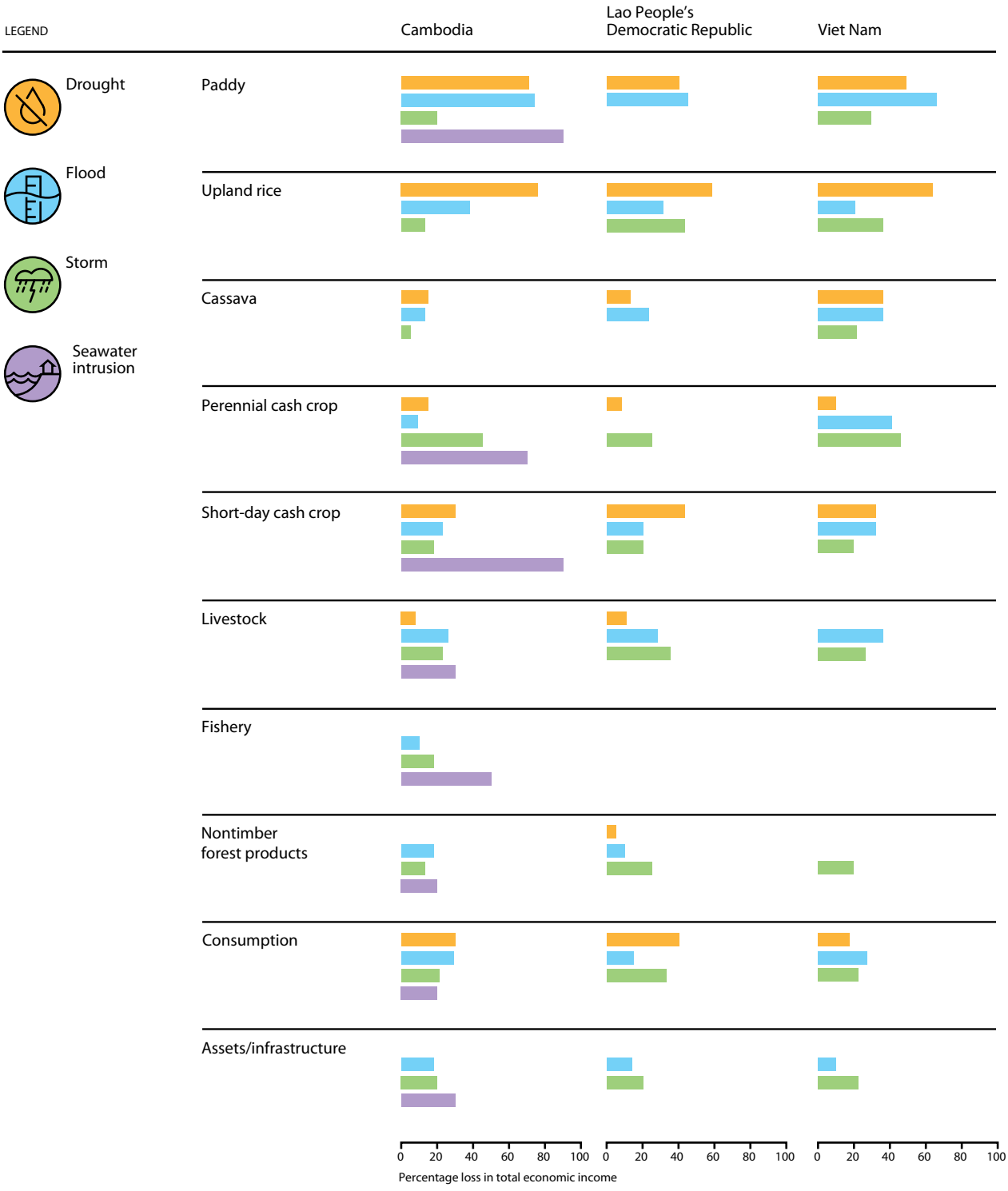
The most common hazard affecting perennial cash crops in the three countries was storms. The postdisaster asset value loss for perennial crops from storms was estimated at 25% across all zones in the Lao PDR, 45% across all zones in Cambodia, and 47% across all zones in Viet Nam. In Coastal Koh Kong, the asset value loss from perennial crops due to seawater intrusion was up to 70%. Income losses stemming from these asset losses were not calculated by the study team.

Livestock was identified as the other important asset at risk across all the zones in the three countries. Like perennial crops, livestock is a key productive asset owned by the study communities. Livestock was mostly affected by storms and floods. Livestock losses from floods were estimated at 27% across all zones in Cambodia, 28% across all zones in the Lao PDR, and 38% across all zones in Viet Nam. Livestock losses from storms were estimated at 22% in Cambodia, 27% in Viet Nam, and 35% in the Lao PDR.

To get a sense of the likely impacts of climate hazards on the above key livelihood assets in financial terms, total values at risk (VAR) were calculated for each asset type—i.e., rice crops, cash crops (seasonal and perennial), and livestock—per livelihood zone within each country and per country. As a rapid assessment, the VAR for a particular asset was estimated by multiplying the mean economic income that representative households in each zone reported receiving from each asset during a production season by the total number of households from all Biodiversity Conservation Corridors Project (BCC) communities in each zone. The Purchasing Power Parity (PPP) approach was again used to convert local currencies into a dollar value.

FIGURE 7

Average Economic Income Losses from Climate Hazards by Livelihood Assets, 2005–2014



Note: All losses are reported as percentage loss in household economic income from that particular type of asset at risk (such as paddy, upland rice, cassava, etc). Only losses of perennial crop and livestock, which are productive assets, and other forms of community assets and infrastructure, are reported as percentage loss of the total value of assets. The percentage losses for each asset type are averages across all the zones within a country.
Source: Authors.

Across all the zones, rice crops are the livelihood asset with the highest aggregated VAR, totaling nearly $14 million. Rain-fed paddy rice in North Mondulkiri (Zone 1) had the highest rice VAR, totaling over $4 million, followed by South Mondulkiri (Zone 2) at around $2.7 million.

Cash crops, comprising both perennial and seasonal crops, recorded the second highest VAR, totaling $13.5 million. South Mondulkiri accounted for over half of this at $7.2 million, followed by Quang Nam (Zone 4), at $2.3 million.

Livestock was the third highest VAR at $11.5 million across all zones. The Viet Nam zones accounted for the highest VARs, including $3.8 million in Quang Nam and $2.5 million in Thua Thien Hue (Zone 10).

The above VAR estimates are very preliminary but provide an initial picture of where the highest exposure to climate hazards lie within each zone and enable a comparison of potential impacts across zones and countries (Table 1). More work is needed to further expand this VAR analysis to fully translate the potential impacts of climate hazards on these livelihood assets into probable losses in dollar values and determine the level of uncertainty associated with the estimated losses.

The above distinction between asset types, as well as the VAR analysis, can have significant implications for climate risk financing.

(i) A climate risk financing strategy should be appropriate for what it aims to protect, but the relationship between the strategy and the protected asset should be considered in a dynamic way. For example, subsistence crops, such as rice crops in all zones in the three countries, are very important for food security

TABLE 1

Estimated Total Values at Risk of Key Livelihood Assets by Zone

Zone		Value at risk		
		Rice	Cash crops (perennial and seasonal)	Livestock
1	North Mondulkiri	4,128,419	793,461	104,451
2	South Mondulkiri	2,714,085	7,248,697	433,505
3	Inland Koh Kong	1,064,410	443,053	407,761
4	Coastal Koh Kong	679,809	609,408	80,632
5	Phatumphone & Sanamxai	1,317,451	149,605	1,628,654
6	Phouvong	79,904	14,796	51,870
7	Dakchaung	72,027	114,148	264,603
8	Kaleum	122,370	52,478	172,317
9	Quang Nam	1,367,192	2,354,187	3,864,431
10	Thua Thien	1,657,266	691,553	2,530,887
11	Quang Tri	619,191	1,026,236	1,963,954
	Cambodia (Zones 1-4) Total	8,586,723	9,094,618	1,026,349
	Lao PDR (Zones 5-8) Total	1,591,752	331,027	2,117,443
	Viet Nam (Zones 9-11) Total	3,643,649	4,071,976	8,359,272
	Total	**13,822,124**	**13,497,622**	**11,503,064**

BCC = Biodiversity Conservation Corridors Project, Lao PDR = Lao People's Democratic Republic.
Note: Losses are reported as a percentage loss in household economic income from that particular type of asset at risk (such as paddy, upland rice, cassava, etc). Only losses of perennial crops and livestock, which are productive assets, are reported as percentage loss of the total value of assets that households own. The cash income losses from perennial crops and livestock were not calculated.
Source: Authors.

of the poor but do not generate cash income. A purely market-based insurance scheme that requires poor households to pay premiums to protect their subsistence crops may be hard to apply. In such a case, governments could look to develop a social safety net program that uses the public budget to assist poor households after disasters but then use market-based risk transfer, such as insurance and catastrophe bonds, to manage the government's own budget liability.[14] While safety nets can play a key role in protecting households suffering from the loss of subsistence crops, insurance options should not be ruled out entirely. For example, the availability of crop insurance might change the production behavior of subsistence farmers toward farming higher-yielding and more hazard-tolerant crop varieties. This could see farmers produce more rice than their subsistence needs, enabling them to sell this excess for cash income.

Livestock, perennial cash crops, and seasonal cash crops are productive activities that generate income but require upfront financial investments, such as for seed or fertilizer purchases. The loss of seasonal crops due to climate hazards reduces short-term cash income to households and can compromise repayments of loans taken to invest in the activities. Risk averse households could be discouraged from borrowing to invest in these activities in the first place. The loss of livestock and perennial crops reduces the household's productive asset base and is often hard, especially for poorer households, to re-accumulate. Losing productive assets can thus contribute to trapping households in poverty.

For income-generating activities, market-based insurance schemes could play a greater role in climate risk financing. Such insurance should enable households to replace productive assets after disasters (such as through livestock insurance) and facilitate increased access to credit (for example, structuring insurance payouts to cover loan repayments in part or full). However, poor rural households may be unable to afford market-based insurance premiums. Government support will likely be needed to tailor suitable insurance products and, in some cases, subsidize premiums.

(ii) In determining the need for risk financing and specific use of instruments such as insurance, it is important to look at household activities as a whole and to identify higher risk activities. The calculation of VAR assists such analysis and the size of aggregate VAR could serve as an indication to help prioritize key livelihood assets for risk protection in a given zone. For example, the VARs indicate that rice crops are an important asset across all livelihood zones in all countries, while livestock is a particularly important asset for risk protection in the communities in Viet Nam. Among the Cambodian communities, the VAR for cash crops stood out in South Mondulkiri (Zone 2), indicating that it is a livelihood strategy of particular importance in this area and could be considered as a priority for risk protection.

(iii) As individual savings and community-based risk pools are unlikely to cope with extreme climate hazards alone, communities require a higher level of financial protection through out-of-community risk sharing and risk transfer schemes. When combined with vulnerability and hazard data, the VAR provides an indication of the needed financial capacity of such schemes.

14 For example: Global Facility for Disaster Reduction and Recovery. 2013. FONDEN--Mexico's National Disaster Fund: An Evolving Inter-Institutional Fund for Post-Disaster Expenditures. https://www.gfdrr.org/sites/gfdrr.org/files/documents/Mexico_FONDEN_final_GFDRR.pdf

Current Disaster Risk Reduction and Coping Mechanisms

Disaster risk reduction refers to strategies implemented before disasters while coping strategies refer to strategies implemented postdisaster. According to the focus group participants, households and communities in the study zones utilize several disaster risk reduction mechanisms to address climate hazards (Figure 8).

For households, livelihood diversification is the most common strategy implemented before disasters strike. In the Cambodia and Viet Nam zones, households reported more diversification opportunities than were reported in the Lao PDR. Households across all zones in the three countries reported that they have adopted new agricultural practices as a risk management strategy, such as changing planting dates. At the community level, the main risk reduction strategy reported was investments to protect infrastructure such as dikes and irrigation canals.

After a disaster, households in all zones cope with the consequences by increasing dependence on NTFPs, with the exception in Kaleum District in the Lao PDR (Zone 8) where households turn to paid labor work. Households in all zones, except Dakchaung (Zone 7) and Kaleum District, also resort to selling productive assets, such as livestock.

In addition, households utilize some climate risk financing measures, mainly for risk retention through savings and borrowings. Borrowing from informal financial institutions (such as saving groups) was predominant in households in the Cambodia zones, while borrowing from banks was most common for households in the Viet Nam zones.

The primary risk coping strategy at the community level is the sharing of food, shelter, and money, followed by relying on social safety net systems in the form of disaster responses of governments and nongovernment organizations (NGOs).[15]

The variation of disaster risk reduction and postdisaster coping strategies across the countries and zones appears to be driven by the availability of options rather than by risk preference (i.e., the level of risk they prefer to accept). For example, diversification into nonfarm activities occurred in the zones with cross-border trading and tourism opportunities, and rarely in more remote zones. Similarly, the use of financial instruments as a coping strategy is also determined by what is readily available. Hence in the Cambodia zones, savings groups were utilized, while households in the Viet Nam zones accessed government banks for postdisaster borrowing. Despite the existence of formal banks and informal financial institutions in the Lao PDR, few interviewed households reported that they access these. Many study households in the Lao PDR that have savings do not use bank accounts and save by keeping the money at home. Given the low use of formal financial institutions in the Lao PDR, future research may need to explore this in more depth, especially informal borrowing, such as from money lenders, as a disaster coping mechanism.

Despite these risk reduction and coping mechanisms, it is likely that households are not fully protected from the financial consequences of climate hazards. Interviewed households reported consumption losses across all zones of up to 40% following droughts, 28% following floods, and 32% following storms. Households in Coastal Koh Kong (Zone 4) reported 20% consumption loss following seawater intrusions. This suggests that the households in communities across all zones were unable to maintain their level of consumption as a result of economic income losses during these climate hazards even though they have employed risk reduction and coping mechanisms. However, such an assessment is preliminary. More research is needed to fully understand the effectiveness of current risk management strategies and inform the design of climate risk financing measures.

15 The Governments of the Lao PDR and Viet Nam and NGOs (e.g., Red Cross in Cambodia) provide disaster responses to affected households in the form of a maximum of 10-day rice and food supplies per household. The Government of Cambodia provides rice seeds for the next growing season.

FIGURE 8

Risk Reduction and Coping Strategies

Source: Authors.

Financial Services Access and Use

In assessing current access to financial services by the study communities, the focus group discussions concentrated on the households' use of banks, informal saving groups, and community development funds (CDFs). These were looked at not just in the context of climate-related disasters but more broad usage for livelihood purposes. While the findings detailed in this section and summarized in Figure 9 are preliminary, they do provide a sense of the maturity of the financial institutions environment in these communities as a context for climate risk financing.

The use of bank loans varies considerably among the 11 study zones. The highest use was reported in Viet Nam, where more than 60% of interviewed households access bank loans. Some 80% of the households in Quang Nam (Zone 4) borrow from banks and other formal institutions such as microfinance institutions. In Cambodia, the numbers range from 5% in South Mondulkiri (Zone 2) to 37% in North Mondulkiri (Zone 1) while in the Lao PDR less than 5% of the households reported borrowing from banks. Noncollateralized group loans exist in all three countries. To put these numbers in perspective, the national-level shares of the adult population who borrow from a financial institution are 28% in Cambodia (2014), 11% in the Lao PDR (2011), and 18% in Viet Nam (2014).[16] Understanding why interviewed households in Viet Nam recorded a much higher usage of bank loans than the national average requires further investigation, but could be a result of government social policies targeting poor households in remote areas or perhaps some other characteristics of the Viet Nam zones.

The average loan repayments across all zones was estimated at 40%, although this does not necessarily suggest that 60% of the loans were defaulted.[17] Having a higher usage of formal loans compared to households in Cambodia and the Lao PDR, the majority of the interviewed households in Viet Nam have more debts outstanding, which, if lending ceilings apply, could limit their capacity to get more loans in the short-term.

While demand for more loans among the interviewed households is large, less than 10% of the households across all zones take loans for productive investments. Most households use loans to finance subsistence crop production, household consumption, and cope with shocks such as illnesses and disasters. These loans are usually smaller in size compared to productive investment loans. The focus group participants reported that

16 Global Financial Inclusion Database. http://databank.worldbank.org/data/reports.aspx?source=1228

17 The loan repayment rate was calculated from the percentage of households which paid back the loan in full plus the percentage of households which have not repaid in full. The result was multiplied by the percentage of loan already paid back on average. While repayment rates vary across the 11 zones, 40% was the averaged number. Unpaid loans do not necessarily imply default as it could be that repayments of that portion of the loan is simply not due or it has gone through a restructured payment schedule.

FIGURE 9

Household Access to and Use of Financial Services

CDF = community development fund, Lao PDR = Lao People's Democratic Republic, MFI = microfinance institution.
Source: Authors.

a fear of not being able to repay, due to reasons that include climate hazards, was the most important cause of not getting loans for productive investments (Figure 10).

The focus group discussions revealed that banks play a key role in the Viet Nam communities. The discussions also showed that informal saving groups dominate rural lending and saving in the Cambodia communities, and only play a small role in some zones in the Lao PDR and Viet Nam (Box 3). In Cambodia, many NGOs have helped communities set up saving groups of 15–30 persons, with each contributing around $1.30 to $6.40 equivalent (KR5,000 to KR25,000) every month. As group capital is accumulated, members can borrow from the saving groups at interest rates of 2% to 3% per month. The loans are used to finance subsistence crop production and to buffer shocks including from illness and climate hazards. The interviewed households in the Cambodia zones reported having participated in a saving group to a varying degree, ranging from 20% in Inland Koh Kong (Zone 3) to 55% in Coastal Koh Kong (Zone 4). These households also save more compared to households in the Lao PDR and Viet Nam. However, overall savings are still very low among the vast majority of the study households. As for barriers to savings, the focus group participants commonly cited a lack of money, low financial literacy, low returns on savings, and high transaction costs.

The Biodiversity Corridors Conservation Project (BCC) financed by the Asian Development Bank has established or is in the process of establishing community development funds (CDFs) in each of the 28 study communities. The CDFs provide poor households credit for livelihood investments that also bring conservation benefits, and in the Lao PDR, also to finance illness-related expenses. To set up the CDFs, the BCC project provided $5,000 seed capital to each community (village) in the Lao PDR and $20,000 to each community (commune) in both Cambodia and Viet Nam. All of the seed capital for the CDFs in the Lao PDR can be used for lending, while this is capped at 60% in the Cambodia and Viet Nam CDFs.

Each CDF is managed by a committee elected by community members. According to CDF regulations, households can borrow up to $465 equivalent (D10 million) in Viet Nam and $1,265 equivalent (KN10 million) in the Lao PDR. Loan interest rates are comparable to group loans from formal banks in each country. Actual lending has started in the Lao PDR and Viet Nam, while CDFs in Cambodia are to be fully established. From the focus group discussions, households in the Lao PDR reported that CDF loans are predominantly used to finance rice production and livestock purchases, while in Viet Nam, households often used the funds to finance cash crop production as well as livestock purchases. The majority of these households reported that repayment of CDF loans was difficult during the years with extreme climate hazards.

Focus group participants were also asked about their use of insurance. The discussions revealed that awareness and utilization of insurance was extremely limited across all zones in the three countries. Less than 5% of the interviewed households are aware of how insurance works. Very few households reported having actual insurance coverage with exceptions being some health insurance via the saving groups in Cambodia, and through health insurance provided by the government in Viet Nam. Information gathered on uptake rates of insurance was limited. More in-depth research in this regard would help indicate the likely uptake of potential disaster insurance schemes and what premiums would be manageable from a household perspective.

The following key implications for climate risk financing emerged from the study.

(i) Vulnerability to climate hazards can act as a disincentive for households to borrow for productive investments even when the credit is available. Risk-financing strategies that can help address this vulnerability could therefore contribute to reducing impediments to credit demand.

(ii) Savings and borrowings are already being used as a risk retention mechanism in some study communities, however, savings in these communities remain very low and greater saving should be further encouraged. Lessons learned from microfinance in well-established saving groups in other countries suggest that a saving behavior can be stimulated with good incentives and financial education.

(iii) While both saving groups and CDFs are much smaller than banks, they also need to take climate risk management into consideration. For the saving groups, savers might not be able to take out their funds during disaster years if the borrowers affected by the same events cannot repay their loans to the groups, thus causing a liquidity problem.

FIGURE 10

Reasons for Low Household Utilization of Financial Services

MFI = microfinance institution.
Source: Authors.

By financing climate-sensitive livelihood strategies (such as crops and livestock), the CDFs are also a *de facto* aggregator and financier of climate risks. In an event of a major flood or drought, CDFs are potentially exposed to sizable losses as a large number of borrowing members may default on their loans at the same time, thereby transferring the financial costs of climate risks from individuals in the community to the CDFs. The degree of such exposure depends on how diversified each CDF's portfolio is and what risk management measures are in place. Without adequate financial protection at the institutional level, the values at risk (VAR) in the capital base of these CDFs is potentially large. A sizable loss in this capital base from extreme climate events could compromise their ability to serve the communities in the long run.

Overall, risk-financing strategies that enable repayments from borrowers even in bad years could potentially enhance the functioning and sustainability of community-based financial institutions such as the saving groups and CDFs. In addition, loan portfolio insurance could also be considered by CDFs as a risk financing option.

Simulation of Extreme Climate Events and Potential Impacts on Livelihoods and Community Development Funds

The study conducted a simulation of extreme climate events and the potential impacts on communities using a probabilistic catastrophe risk model approach.[18] This information is useful to project the possibility of extreme climate events that tend to be infrequent and thus not necessarily captured by the short historical coverage of recall surveys or a cluster analysis.

BOX 3

Can the Poor Save?

Savings allow people to turn irregular cash flows into lump sums for larger purchases, productive investments and emergencies, which is especially important when there is no insurance or safety nets. Saving has thus been promoted worldwide as a relatively cheap and low risk approach to help the poor get out of poverty. In many settings, engaging in savings can improve household financial literacy and stimulate access to a larger productive credit.[a]

Increasing empirical evidence shows that poor people do have surplus money to save—even those living on less than $1 a day spend one-third of their earnings on many nonessential items.[b] Among these people, there is also demand for more saving.c However, key impediments that undermine savings among the poor include: (i) limited availability and awareness of cost-effective and low-risk saving products; (ii) strong pressures for social spending (such as being asked by others for financial help) that reduce capacity to accumulate savings; and (iii) general psychological factors that often affect the saving behavior of both poor and nonpoor such as preference for short-term consumption at the expense of long-term well-being (present-biased preference) and self-control problems (such as impulsive buying), etc.[d]

Saving products and supporting interventions can be designed and marketed to overcome the above impediments and provide the right incentives to the poor. Many ongoing research projects are currently focusing on innovative designs to address the impediments.[e]

a D. Karlan et al. 2014. Saving by and for the Poor: A Research Review and Agenda. Review of Income and Wealth. 60 (1). pp. 36–78; S. Rutherford. 2000. The Poor and Their Money. Delhi: Oxford University Press; M Yunus and A. Jolis.1999. Banker to the Poor. Public Affairs.
b A. Banerjee and E. Duflo. 2007. The Economic Lives of the Poor. Journal of Economic Perspectives. 21 (1). pp. 141–167.
c D. Karlan et al. 2014.
d D. Karlan et al. 2014 and R. H. Thaler and C. R. Sunstein. 2008. Nudge: Improving Decisions about Health, Wealth, and Happiness. New Haven, CT: Yale University Press.
e E. Duflo, M. Kremer, and J. Robinson. 2011. Nudging Farmers to Use Fertilizer: Theory and Experimental Evidence from Kenya. American Economic Review. 101 (4). pp. 2350–2390; P. Dupas and. J. Robinson. 2013. Why Don't the Poor Save More? Evidence from Health Savings Experiments. American Economic Review. 103 (4). pp. 1038–1071; N. Ashraf, D. Karlan, and W. Yin. 2006. Tying Odysseus to the Mast: Evidence from a Commitment Savings Product in the Philippines. Quarterly Journal of Economics. 121 (2). pp. 673–697.

18 See more explanation on this approach in Appendix 3 on catastrophe risk modelling in J. D. Cummins and O. Mahul. 2009. Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention. Washington DC: World Bank.

There were three analytical objectives of this exercise.

(i) Determine potential losses to household economic income and the probability of households falling into extreme poverty by simulating maximum probable losses from extreme climate events on livelihoods in each zone.[19]

(ii) Contribute to a better understanding of the variation of potential impacts within each zone by simulating a higher number of communities (100) per zone than the 28 covered by the recall surveys.

(iii) Analyze the capability of postdisaster households to repay CDF loans in the study communities. This in turn sheds light on the functionality and sustainability of the CDFs following extreme climate events.

Due to being a rapid assessment study, the simulation did not take account future climate change projections.

Potential Impacts of Extreme Events on Livelihoods

The simulations were conducted by combining historical rainfall and Normalized Difference Vegetation Index (NDVI) data for every zone.[20] Annual drought and flood indexes were constructed for each zone based on definitions developed by an ADB study.[21] An NDVI anomaly index, which measures how much the observed state of vegetation at a given period deviates from its long term average, was also constructed for each zone.[22] From this historical data, correlations were established between the flood and drought risks and between the risks across zones. The climate-related data was then combined with the focus group discussion data on the frequency and impacts of climate hazards to simulate 1,000 years of climate hazards and the resulting impacts on 100 communities in each of the 11 zones. The focus group discussions were also able to draw relevant critical thresholds that trigger extreme events from the generated flood and drought indexes in each zone. The simulation assumed that livelihood losses increase linearly as the drought and flood events became more extreme.

The simulation results, shown in Figure 11, emphasize the vulnerability of the study households and communities to extreme climate hazards. Based on the simulations, a 1-in-5-year flood or drought, which could be considered moderate frequency, moderate impact events in this simulation context, could result in losing over half of the total economic income for most livelihood zones. Some may suffer dramatically more, such as in Northern Mondulkiri (Zone 1) where a 1-in-5-year flood could mean more than a 70% loss of economic income. Household economic income could quickly reduce toward zero with the increasing severity of these events. Communities could also face extreme flood and droughts within the same year. Total losses of household economic income could be expected in all zones when both extreme droughts and floods occur in the same year, which simulations show as a 1-in-9-year event.

The probability of falling into extreme poverty can be used as an indicator of how resilient a household is to these extreme events. The simulation results show that a 1-in-3-year event of combined occurrence of flood and drought within 1 year could elevate the probability of households falling into extreme poverty in all zones by up to 55%. A more severe 1-in-7-year event would likely push all households in these communities across all zones into extreme poverty.

19 Extreme poverty is defined using the $0.75/day extreme poverty line.

20 For each zone, the study used rainfall data from one to two of the nearest representative weather stations in each livelihood zone. These rainfall data were available from the years 1980–2008. As the coverage of weather stations was sparse in the study zones, the study use satellite date to complement the station data. Therefore, a spatially and temporally rich set of satellite-based NDVI was extracted from the National Aeronautics and Space Administration's Moderate-resolution Imaging Spectroradiometer archive for each and every BCC community within a given zone. The data are available every 10 days from 2002 to 2015 and were extracted and filtered to represent agricultural areas in each community.

21 The drought index was constructed as maximum cumulative days with rainfall less than 1 millimeter (mm.) and the flood index as maximum amount of 5-day cumulative rainfall. ADB. 2012. Climate Change Vulnerability and Adaptation in Agriculture Areas in the BCI Pilot Sites. Consultant's report. Greater Mekong Subregion Environment Operations Center.

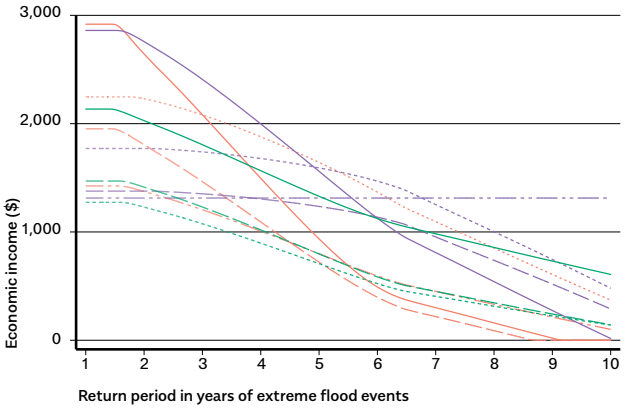
22 NDVI provides an indicator of the vegetative growth or plant rigor of any type of vegetation (e.g., annual crops, pasture, and forestry). NDVI thus gives a value assessing the "greenness" of the ground. A deviation of the current state of vegetative greenness from the long-term mean value of the area is an indicator of poor crop health. This study used biweekly NDVI data that are available all year round and compared variations during the rainy seasons.

FIGURE 11

Potential Impacts of Extreme Climate Hazards on Household Economic Income and Extreme Poverty

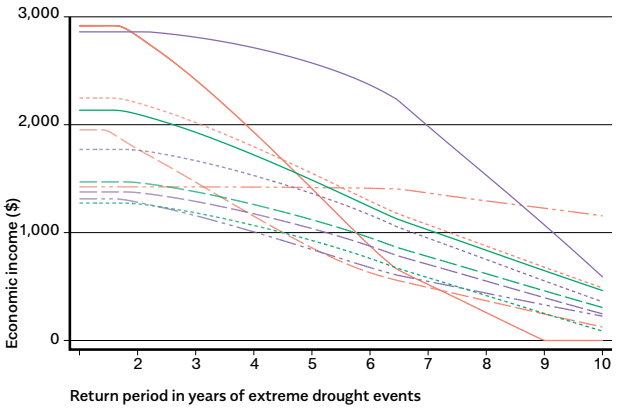
Flood

a Household income available for consumption by return period of extreme flood events



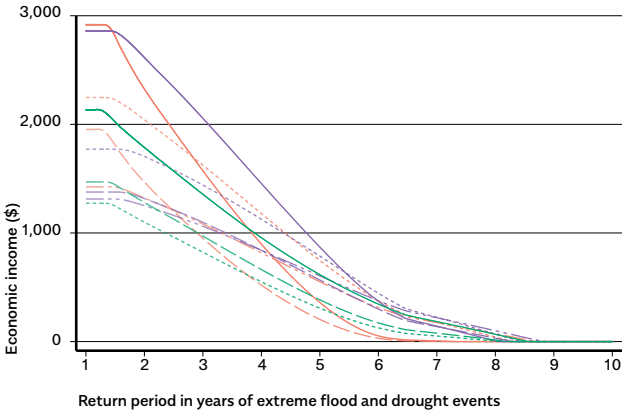
Drought

b Household income available for consumption by return period of extreme drought events



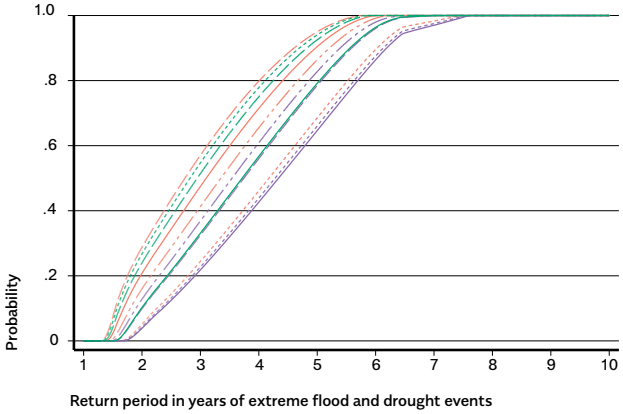
Flood and drought

c Household income available for consumption ($) by return period of combined flood and drought events



Flood and drought

d Probability of falling into extreme poverty by return period of combined flood and drought events



Cambodia

- 1 North Mondulkiri
- 2 South Mondulkiri
- 3 Inland Koh Kong
- 4 Coastal Koh Kong

Lao People's Democratic Republic

- 5 Phatumphone and Sanamxai
- 6 Phouvong
- 7 Dakchaung
- 8 Kaleum

Viet Nam

- 9 Quang Nam
- 10 Thua Thien Hue
- 11 Quang Tri

Note: Panels (a), (b), and (c) in this figure depict the potential impacts of extreme droughts and floods, and of their combined impacts of two events within the same year, on the levels of household economic income following these events after deducing consumption, as a function of the return period of these extreme events. Panel (d) depicts the probabilities of households in different zones falling into extreme poverty, as a function of the return period of these extreme events. The higher the return period, the less frequent the events, and the more severity. For example, a return period of 10 years would represent an extreme event that occur once in 10 years, whereas a return period of 2 would represent a low-impact event that occurs every 2 years, etc.
Source: Authors.

Potential Impacts of Extreme Events on Community Development Funds

When fully operational in the three countries, the total value of funds in all CDFs is estimated to be over $1.5 million ($540,000 in Cambodia, $340,000 in the Lao PDR, and $700,000 in Viet Nam). As CDFs finance climate-sensitive activities, CDF repayments could be affected by climate hazards that reduce households' ability to repay. Based on a review of records from two CDFs during the study,[23] it was observed that loan repayments declined in the years with extreme climate hazards (Table 2).

As this was a very limited sample, further simulations were conducted to develop a deeper understanding of potential CDF loan performance in climate hazard years. The simulations were calculated based on an assumption that $1.084 million of the $1.5 million total amount would be available for lending.[24] The study made the following assumptions: (i) of the amount available for lending, it was assumed that $704,600 or 65% would be lent to climate sensitive activities;[25] (ii) it was also assumed that a representative household in each and every livelihood zone takes a loan equivalent to 50% of their mean economic income at an average monthly

TABLE 2

Sample Repayment Records from Two Community Development Funds

	CDF location	Lao PDR	Viet Nam
CDF loan	Year established	2008	2008
	Total granted amount available for lending	KN24 million	D204 million
	Fund committee	Elected	Women's group
Portfolio statistics	Years of portfolio data	2008–2011	2009–2013
	Number of beneficiaries to date	31	70
	Loan size	KN1 million to 2 million	D5 million
	Monthly interest rate (%)	0.5% to 2%	0.63%
	Loan term	3 months to 1 year	6 months to 2 years
	Expected interest repayment period	Monthly	Monthly
Borrowing purposes	Food crop	50%	10%
	Cash crop production	0%	10%
	Livestock	0%	60%
	Business	10%	20%
	Illness	40%	0%
Loan repayment rate (%)[a]	Mean across all years	71%	91%
	Mean in years without climate hazards[b]	79%	97%
	Mean in years with climate hazards	63%	82%
	Fund available to loan at the end of each month	0	D91 million

CDF = community development fund, Lao PDR = Lao People's Democratic Republic.

a Loan repayment rate is percentage of actual interest and/or loan repaid as fraction of expected amount to be repaid in that year.

b The key climate hazard years in the Lao PDR are 2009 (storm and flood) and 2010 (drought) and in Viet Nam are 2009 and 2013 (storm and flood) according to the focus group discussions.

Source: Authors.

23 Repayment records were only available for a few years for a few CDFs.

24 The assumption is based on the background information that fund available for lending are 100% of the seed capital for CDFs in the Lao PDR and 60% of the seed capital for CDFs in Cambodia and Viet Nam.

25 Simple loan portfolio analysis of two CDFs in the Lao PDR and Viet Nam reveals that 50% to 80% of value in the lending portfolios are climate sensitive as the majority of borrowers invested in crop and livestock production. For the purpose of analysis, 65% is thus used here as a midpoint reference.

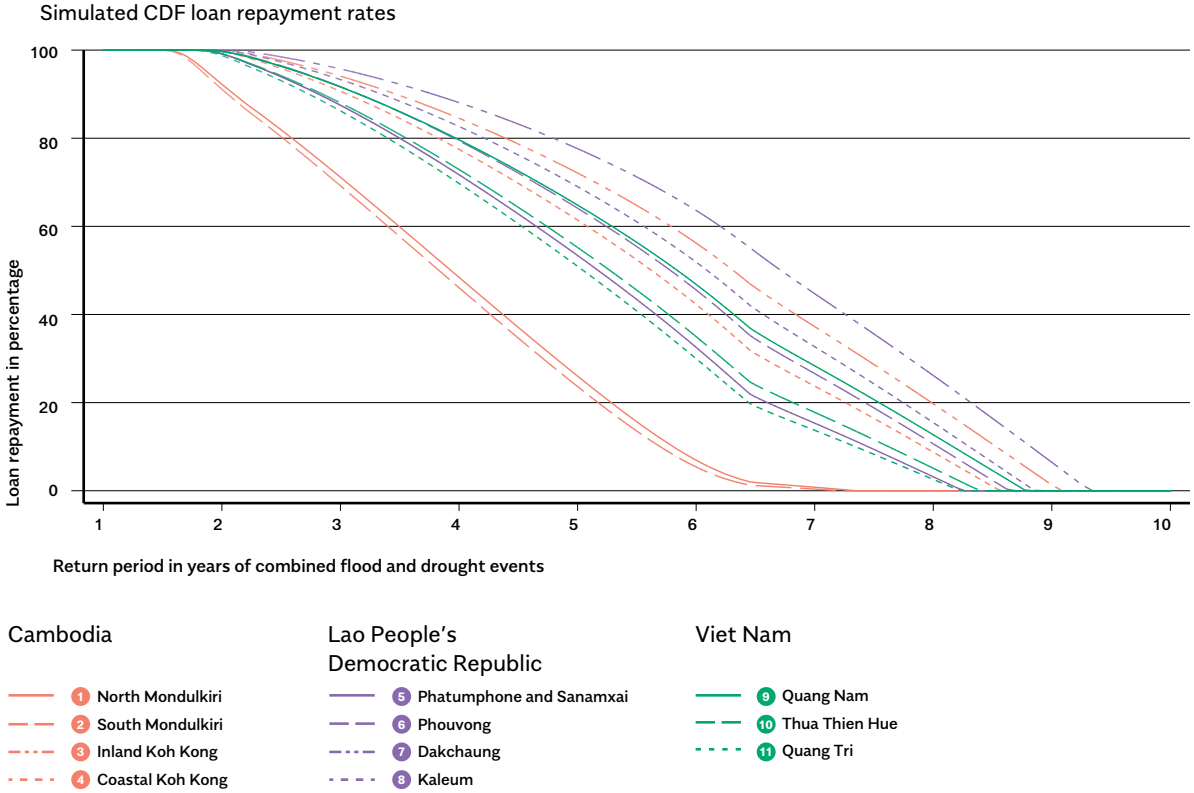
interest rate of 1% for livelihood investments; and (iii) it was assumed that the borrowing households will try to pay back their loans as much as they can, based on their total economic income available after financial losses from floods and droughts. This repayment assumption is optimistic given that in reality a household would likely first meet their consumption needs before using any remaining income to pay back loans. As a result, the simulated maximum possible repayment rates are also optimistic.

Simulation results show that CDF loan repayment rates could reduce substantially following the occurrence of extreme floods and droughts within the same year (Figure 12). This would be most apparent in the paddy dependent and shifting cultivation study sites of the two Mondulkiri zones. A 1-in-5-year event could lead to a 20% to 70% reduction in CDF loan repayments across all zones, which if averaged out would be nearly $400,000 or 36% of the total value of climate-sensitive lending. An extreme 1-in-9-year event could lead to zero repayments in all zones.

The simulations indicate the vulnerability of CDFs to climate hazards, thus the need to strengthen their climate resilience. However, these simulation results are preliminary and have not been compared with the actual performance of the CDFs due to the very limited information available on repayment records. CDFs in the study sites are in the process of establishing repayment tracking systems among other procedure.

FIGURE 12

Potential Impacts of Extreme Climate Events on Community Development Fund Repayments



CDF = community development fund.
Source: Authors.

Risk Financing Options

The information from the cluster analysis, focus group discussions, and simulations show that the study communities across all zones are exposed to floods, storms, and droughts. In addition, Coastal Koh Kong (Zone 4) faces seawater intrusion. The study also shows that climate hazards cause significant negative impacts on rural livelihoods in these communities and, potentially, for the financial institutions that support them such as community development funds (CDFs). While the study households and their communities make use of various risk reduction and coping mechanisms, it seems that they are not fully protected against the impacts of climate hazards, especially extreme events.

The study also shows that current climate risk financing strategies of the study communities are largely limited to household-level risk retention through the use of savings and borrowings. While these measures help households cope with small shocks, more effective climate risk financing for households, communities, and CDFs requires combining risk retention, risk sharing, and risk transfer. Together, these measures would provide the households, communities, and CDFs with better financial protection against the impacts of climate-related shocks, especially extreme events. For the households, these strategies could enable them to better safeguard income and productive assets after the shocks without resorting to short-term negative coping strategies that compromise long-term welfare. Protected households are also likely to have a greater incentive to borrow productive loans for investment in high-risk, higher-return livelihood strategies, contributing to income growth and

poverty reduction. For the CDFs, climate risk financing could help lessen the impacts of climate-related shocks on repayments.

This section considers several climate risk financing options that could potentially strengthen the climate resilience of the study households, communities, and CDFs. Table 3 summarizes the risk financing options applicable to different risk layers, prerequisites to their development, and the required support. In terms of priority for risk protection, this rapid assessment suggests that the study communities in Cambodia are most highly vulnerable to climate hazards, followed by those in Viet Nam and the Lao PDR. For actual program design, more comprehensive feasibility studies will be needed. Such studies could determine which communities will be prioritized by using more expanded data sets and analyses and considering broader issues related to the enabling environment for climate risk financing interventions.

TABLE 3

Potential Climate Risk Financing Options for the Study Communities

	Targeted sector				
Risk financing strategies	Households/ communities	Community development funds (CDF)	Prerequisites	Potential public supports	Feasibility timeframe
Risk retention	Incentivized saving	CDF reserve	More comprehensive technical assessments on the CDF loan portfolio to identify appropriate size of reserve	1 Matching fund to incentivize saving 2 Financial literacy programs	Short term
Risk sharing	Community disaster fund	Community disaster fund	More comprehensive risk assessments with high quality climate hazard and loss data to establish appropriate contribution of households to the disaster fund. Such assessments should also incorporate future climate change scenarios	1 Matching fund to incentivize contribution to the disaster fund 2 Financing for the catastropic risk layer 3 Financial literacy programs	Short term
	Disaster risk pool at national or regional level	Disaster risk pool of reserve at national or regional level	1 More comprehensive risk assessments that incorporate future climate change projections 2 Determination of institutional arrangements that could facilitate the national or regional risk pool 3 Establishment of rules for contributions and payouts of the risk sharing mechanism using objective indicators such as weather indexes	1 Establishment of public-private partnership to support the national or regional risk pool 2 Financing for the catastropic risk layer 3 Public support for research and development activities 4 Financial literacy programs	Medium term
Risk transfer	Macro-level index insurance to transfer extreme risk from the disaster risk pool	Macro-level index insurance to transfer extreme risk from disaster risk pool	1 More compresentative technical assessments to Identify appropriate aggregate loss indexes to form the basis of a macro-level insurance contract 2 Development of an actuarial pricing model for the insurance contract, using high quality climate hazards and loss data	1 Establishment of public-private partnership to support the risk transfer 2 Subsidize risk transfer costs 3 Financing the catastropic risk layer 4 Public support for research and design activities 5 Financial literacy programs	Longer term
Combined strategies	Risk layering approach to combine above strategies	Risk layering approach to combine above strategies	All of the above	All of the above	Longer term

Note: For all proposed options, prioritized targeted communities are listed by order as Cambodia (Zone 1, Zone 2, Zone 4, Zone 3), Viet Nam (Zone 10, Zone 12, Zone 11), Lao PDR (Zone 5, Zone 6, Zone 7).

Risk Financing Options for Households and Communities

Effective climate risk financing requires combining risk retention, risk sharing, and risk transfer. To improve risk retention, households should be incentivized and enabled to save more money securely and cost-effectively. Given the high level of poverty among the study households, increased savings will likely be very small, however they could provide a first line of defense and reduce reliance on risk financing options that are of higher cost. Apart from the climate risk financing benefits, savings can be utilized for other development benefits, such as funding preventative health measures and reducing the impacts of health shocks (Dupas and Robinson; 2013). Governments and the donor community can play an active role in incentivizing and enabling savings in rural communities. Practical ways to support include providing matching funds, advancing innovative and pro-poor saving technologies, and improving financial literacy.

However, as a climate risk financing mechanism, risk retention has inherent limitations in only being able to deal with small climate events and will have to be complemented by other risk financing strategies. On top of risk retention, efforts are needed to improve risk sharing mechanisms both within and between the communities to deal with medium frequency and medium impact climate events.

For example, a community disaster fund could be established for risk sharing within a community. The fund would pool resources from households and, based on well-specified rules, households could draw compensation from the fund when they experience financial losses from climate hazards. The compensation could help the households stabilize their incomes to meet consumption needs and maintain their ability to repay loans.

Prerequisites for establishing community disaster funds include strong social trust within the community and comprehensive technical assessments (more data than gathered in this

study would be required). Governments and the donor community could provide support by raising awareness, building capacity for community members to manage the fund, and contributing to the fund pool though matching grants.

Drawing on experience from countries including Mexico, Mongolia, and Turkey (Box 4), Greater Mekong Subregion policy makers could look at national or even regional disaster risk funds to pool risks from the community disaster funds. A risk sharing mechanism such as this could provide more effective financial protection from extreme events. Among the major considerations for national or regional disaster risk funds are the collective size of the pool and the nature of climate hazards, both in terms of frequency and severity against which compensation could be made. In addition, rules governing how each community disaster fund can contribute to and draw from a national or regional risk fund need to be based on objective parametric indicators such as weather indexes. These in turn require comprehensive technical assessments and sound institutional arrangements.

Establishing national or regional disaster risk funds would likely be a multiyear process requiring strong support from governments and donor communities. The private sector could also contribute expertise, such as advanced catastrophe risk modeling, risk pricing, and financial management.

BOX 4

Risk Pools with a Risk Transfer Component in Mexico, Mongolia, and Turkey

In Mexico, the state-owned nationwide Fund for Natural Disasters (FONDEN) was established in 1996 to provide disaster insurance coverage for the country's national risk pool of more than 240 agricultural self-insured funds, and for local governments' disaster insurance programs. Since 2006, the Government of Mexico has issued catastrophe bonds, purchased indemnity-based insurance, and allocated government budget to provide financing for the most catastrophic layer of FONDEN.[a]

Mongolia has developed an index-based livestock insurance program based on an average livestock mortality rate for different zones. Using the risk layering framework, the insurance program is a combination of self-insurance, market based insurance, and social safety net.[b] The risk layer that causes 6% to 30% losses is transferred to the insurance market, with the premium costs borne by households. The Government of Mongolia then provides protection against catastrophic loss beyond the 30% loss threshold, as part of the country's social protection program.[c]

The Government of Turkey has implemented a compulsory earthquake insurance program with insurance policies sold to individual homeowners in many regions of the country. Premium rates are actuarially sound, not subsidized, and vary with construction type and property location. Covered risks include earthquakes and fire. The Turkish Catastrophe Insurance Pool (TCIP) was established to pool risk from the insurance programs. The pool has the effect of reducing the costs of insurance to individual homeowners. The catastrophe risk financing strategy of the TCIP relies on both risk retention and reinsurance. The TCIP retains the first $80 million of losses through its reserves and transfers excess losses to international reinsurance markets. The government covers losses that would exceed the overall claims paying capacity of the TCIP, which is currently sufficient to withstand a 1-in-350-year earthquake.[d]

a Global Facility for Disaster Reduction and Recovery. 2013. FONDEN: Mexico's National Disaster Fund. http://siteresources.worldbank.org/EXTDISASTER/Resources/8308420-1357776325692/FONDEN_final_FCMNB.pdf
b World Bank. 2015. New Insurance Model Protects Mongolian Herders from Losses. 4 March. http://www.worldbank.org/en/news/feature/2015/03/04/new-insurance-model-protects-mongolian-herders-from-losses
c O. Mahul and J. Skees. 2007. Managing Agricultural Risk at the Country Level: The Case of Index-Based Livestock Insurance in Mongolia. World Bank Policy Research Working Papers. World Bank.
d Global Facility for Disaster Reduction and Recovery. 2011. Turkish Catastrophe Insurance Pool. http://www.gfdrr.org/sites/gfdrr.org/files/documents/DFI_TCIP__Jan11.pdf

Parametric indicators can also form the basis for a risk transfer strategy for catastrophic climate events. Weather indexes (for rainfall, temperature, and wind speed, etc.) can be designed to proxy the financial exposure of national or regional risk pools to extreme climate events. The indexes can then form the basis of a macro-level index insurance contract to transfer extreme climate risks from the risk pool to the international insurance market, or to national governments. Developing such a risk transfer scheme requires extensive technical assessments to inform catastrophe risk pricing and would require public-private partnerships between governments and the insurance sector for implementation. In addition, risk transfer solutions are costly and likely require public financing such as subsidies.

Risk Financing Options for Community Development Funds

Climate risk financing options for CDFs include risk retention by building reserves and risk sharing. Risk sharing could involve pooling reserves among the CDFs and linking these reserves with those of the community disaster funds, and transferring risk via loan portfolio insurance.

As the first line of defense, CDFs should maintain reserves at a predetermined percentage of the lending portfolio. The reserves could be kept in a bank and only be drawn down to provide liquidity to the CDFs in periods where climate hazards significantly reduce borrower repayment capacity. CDF reserves could comprise part of its initial seed capital and be augmented by regular contributions from borrowers at a percentage of the loans adequate to cover their protection. In return, when the borrowers experience financial losses from extreme climate hazards, the reserve could be used to help borrowers repay some predetermined part of the loan directly to the CDF. Governments or donors may need to contribute capital to ensure that the size of the reserve fund of the CDF is sufficient. Risk transfer via portfolio insurance could also provide an additional layer of protection against extreme climate hazards affecting the entire CDF portfolio within a country.

A CDF reserve could potentially be combined with community disaster funds and managed as part of that fund, thus increasing the effectiveness of the risk sharing mechanism at the community level itself. In this case, all the complementary risk financing options are similar to those discussed by the households and communities.

Practical Considerations

The following are the practical challenges that would need to be overcome in putting these risk financing options into practice in the study communities. Addressing these would require a multistage process, which would in effect, build an enabling environment for the future development of climate risk financing schemes.

Based on the focus group discussions, communities, even when they are located within the same zone, seem to have little experience working with each other. As a result, they are unlikely to have the requisite social trust required for a cross-community risk sharing arrangement. Prior activities will be required to build conditions for the trust, and therefore, a willingness for different communities to jointly develop a risk sharing mechanism with commonly acceptable rules.

Limitations of local weather stations and discontinuity of historical data from the study sites constitute a key limitation for more comprehensive climate risk assessments. It will be critical to collate climate-related data from alternative sources and use data reconstruction technologies when necessary to support future assessments. This, in turn, will require collaboration with both public and private data agencies.

Risk financing is not a total solution for risk management nor for climate change adaptation, and thus must be integrated with other resilience and development interventions. Efforts to develop climate risk financing options for the study communities should seek to embed these options within broader development objectives, such as development of a rural financial market and improved disaster risk reduction.

Potential Impacts of Adopting Risk Financing Options

To gain a preliminary understanding of the potential impacts of adopting risk financing options, the study simulated the impacts of proposed risk financing option combinations on household economic income growth, the probability of falling into extreme poverty, and expected CDF loan repayment rates. [26] Simulation results suggested the following positive impacts from adopting risk financing strategies.[27]

(i) When implemented together, risk retention via savings and risk sharing through community disaster funds could stabilize household economic income even against extreme events. For example, up to 40% economic income loss protection against 1-in-8-year event in some zones in the Lao PDR. In contrast, a community disaster fund by itself could only, at best, stabilize household economic income from less extreme events in the more vulnerable zones of Cambodia and Viet Nam (such as in Mondulkiri and Quang Nam). Across all zones, using savings and community disaster funds together resulted in an average 27% reduction in the probability of falling into extreme poverty.

(ii) Risk sharing—based on combining a community disaster fund with a national or regional disaster risk pool—could be effective in stabilizing income. Simulations showed this could see an average 50% reduction in the probability of households falling into extreme poverty across all zones. The benefits of this risk sharing strategy are larger for the less vulnerable zones of the Lao PDR such as Phouvong District (Zone 6). This strategy, however, will not yield growth in economic income for households.

(iii) When risk financing options stimulate a greater availability of productive credit to households (e.g., from CDFs), it could result to a growth in economic income in addition to a reduction in the probability of falling into extreme poverty. An example would be from a combination such as a community disaster fund, mandatory contributions to a CDF reserve for loan protection,[28] and a regional disaster risk pool. Across all zones, simulations showed this combination could result in a 20% average increase in mean economic income of households, a 74% reduction in the probability of falling into extreme poverty, and a 24% increase in CDF loan repayments relative to the case without any risk financing instrument. This would, however, still leave the study households uninsured against extreme climate hazards.

(iv) Adding risk transfer to other financing options could provide effective protection from the impacts of extreme events. Assuming a premium rate of 17%, the simulations suggest that risk transfer in the form of market-based insurance could result in 80% to 95% protection against economic income losses from a 1-in-8-year event.[29] This would eliminate the probability of falling into extreme poverty and maintain CDF loan repayments above 97% on average.

The simulations described in this section were conducted to gain preliminary insights into the potential impacts of different combinations of risk financing options. Future research could build on and expand this initial analysis by using different sets of assumptions such as on postdisaster loan repayments, different level of contributions to the disaster fund, different level of aggregated loss index that would trigger insurance payments, etc.

26 The simulations are based on the assumptions that the economic income of representative households could be affected by floods and droughts. If credit is available, households will borrow 50% of their expected economic income at a monthly interest rate of 1%. The model assumes that the borrowing households will try to pay back their loans as much as they can, based on their total economic income available after financial losses from floods and droughts. The model also assumes that, for risk transfer, index insurance was developed using an aggregated loss index—constructed from a combination of community-level drought and flood indices—to trigger compensation to the insured regional risk pool of community disaster funds.

27 The full simulation results are in the full report. Footnote 1.

28 This is equal to the actuarial fair premium rate to protect their loan.

29 The simulation assumed that the disaster pool pays a fair premium rate transfer risk using index insurance. The fair rate is the expected value of total compensation that an insurer will need to pay to the pool to compensate for losses when the pool loss is beyond 100% (e.g., 100% stop loss reinsurance). The fair rate is 17% in this simulation.

Preliminary Cost-Benefit Analysis of Different Combinations of Risk Financing Options

The study conducted a preliminary cost-benefit analysis to help determine the most cost effective risk financing options that public or donor funds could support. Taking a public policy perspective, the cost-benefit analysis was focused on identifying the options that could yield most benefits to the rural households given the same amount of money spent in supporting the development of these schemes.

The analysis was conducted in the context of two policy objectives. One aimed to increase the mean economic income of households, while the alternative policy objective was to avoid households falling into extreme poverty (Table 4). The analysis showed that for the increasing mean economic income policy aim, the most cost-effective option would be to provide financial incentives for households to save or contribute into a community disaster fund, such as through matching grants. Complementing this would be ensuring that the enhanced protection from the disaster fund can stimulate greater access and uptake of productive credit by households via CDFs and banks.

If the objective was to reduce the possibility of households falling into extreme poverty, the same actions outlined in this section would be needed combined with public support for risk sharing and risk transfer beyond the community level.

Future studies could expand on these findings by conducting a sensitivity analysis to identify the optimal basket of risk financing instruments for different levels of available public resources.

TABLE 4

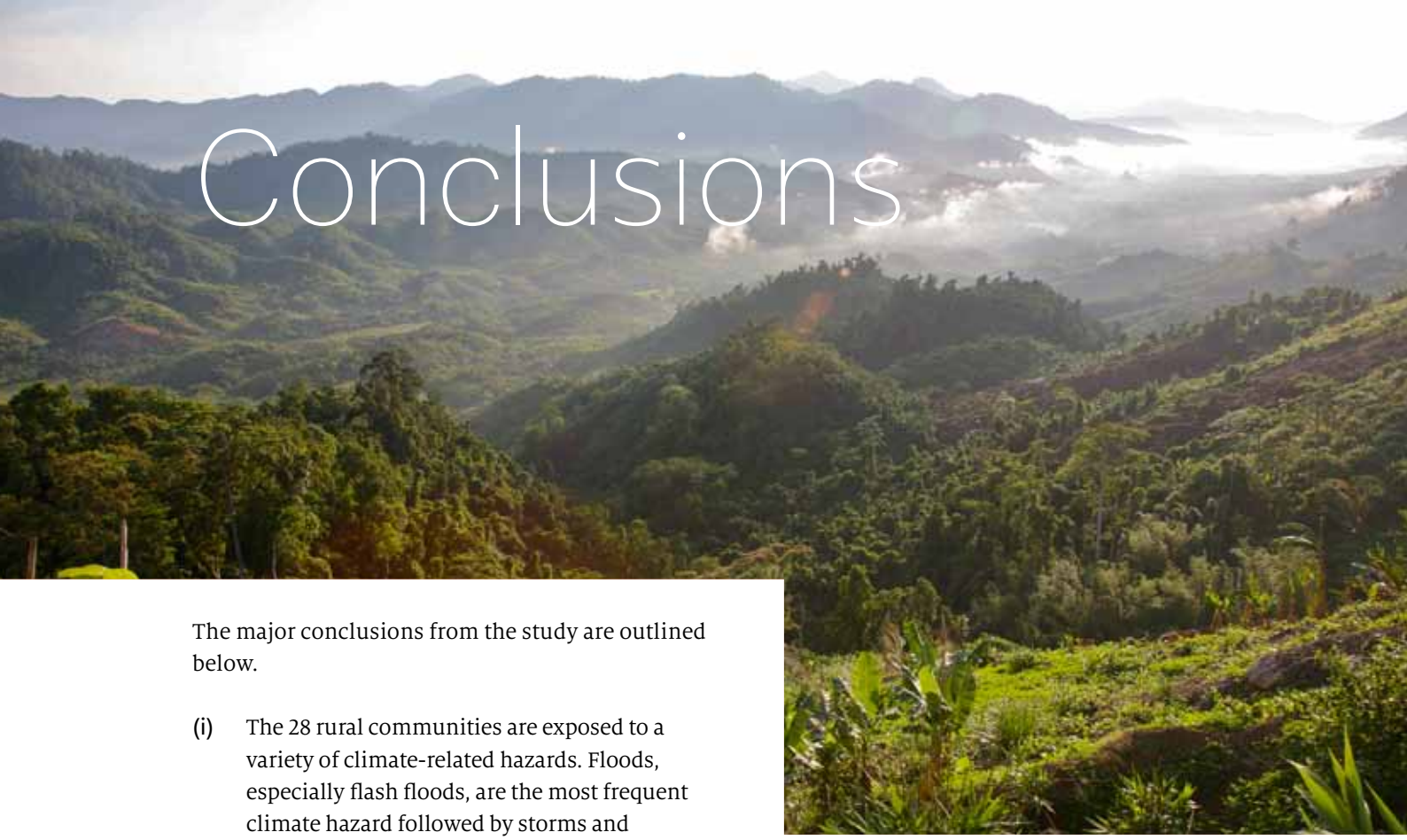
Preliminary Cost-Benefit Analysis of Risk Financing Options from a Public Policy Perspective

Risk financing options	No risk financing instrument	Saving or disaster fund	Disaster fund + National disaster risk pool	Disaster fund + Regional disaster risk pool	Crowding in loan + Disaster fund	Crowding in loan + Disaster fund + Regional risk pool	Crowding in loan + Disaster fund + CDF Loan protection	Crowding in loan + Disaster fund + Loan protection + Regional risk pool	Crowding in loan + Disaster fund + Loan protection + Regional risk pool + Market-based Risk transfer
Potential net beneficiary benefits with no public support[a]									
Mean income ($/household/ year)	1,885	1,697	1,697	1,697	2,337	2,337	2,232	2,232	1,572
Prob. of falling into poverty (%)	34%	29%	18%	17%	31%	27%	29%	9%	9%
Loan repayment rate (%)	74%	-	-	-	78%	79%	80%	92%	93%
Potential public support and costs[b]									
Incentivizing establishment of community disaster fund									
Incentivized contribution in community disaster fund (% income)		5%	5%	5%	5%	5%	5%	5%	5%
Insuring loan in disaster fund (% loan)[c]		-	-	-	-	-	10% (21%)	10% (21%)	10% (21%)
Protection against disasters as part of social safety net									
Insuring disaster funds (fair rate)[c]		28% (53%)	-	-	28% (53%)	-	28% (53%)	-	-
Insuring country risk pool (fair rate)[c]		-	18% (21%)	-	-	-	-	-	-
Insuring regional risk pool (fair rate)[c]		-	-	17% (16%)	-	17% (16%)	-	17% (16%)	17% (16%)
Potential public support costs (per household per year)[d]									
To increase mean income by 1%									
Incentivized contribution in community disaster fund		-	-	-	$2.14	$2.14	$2.14	$2.14	$2.14
Insuring loan in CDFs		-	-	-	-	-	$2.14	$2.14	$2.14
Insuring disaster funds		-	-	-	$12.00	-	$12.00	-	-
Insuring country risk pool		-	-	-	-	-	-	-	-
Insuring regional risk pool		-	-	-	-	$7.28	-	$7.28	$7.28
To decrease probability of falling into poverty by 1%									
Incentivized saving (e.g. matched fund)		$4.58	$1.78	$1.69	$6.41	$3.56	$3.56	$1.29	$1.30
Insuring loan in CDFs		-	-	-	-	-	$3.56	$1.29	$1.30
Insuring disaster funds		$5.28	-	-	$5.28	-	$5.28	-	-
Insuring country risk pool		-	$3.39	-	-	-	-	-	-
Insuring regional risk pool		-	-	$3.20	-	$3.20	-	$3.20	$3.20

CDF = community development fund

a Potential net beneficiary benefits with no public support estimates potential net benefits to households when various combinations of risk financing strategies are used without public support. b Potential public support and costs establishes costs of various forms of public support. c Average rate for all communities. Standard deviation in parenthesis. Fair rate equals average financial expenses for disaster protection. Fair rate equals expected insurance payouts for the case of risk transfer. d Potential public support costs per household estimates costs per year of the public support to various combinations of risk financing.

Source: Authors.



Conclusions

The major conclusions from the study are outlined below.

(i) The 28 rural communities are exposed to a variety of climate-related hazards. Floods, especially flash floods, are the most frequent climate hazard followed by storms and droughts. Many communities face multiple hazards within the same year, while some experience different climate-related shocks in consecutive years. Major hazards affect multiple communities within the same country, while very extreme events, such as floods in 2009 and droughts and storms in 2014, simultaneously affected all the communities in the three countries.

(ii) To cope with climate hazards, the communities and households use a combination of risk management strategies: risk reduction before disasters occur and coping mechanisms after disasters strike. Examples of risk reduction strategies include livelihood diversification, informal and formal savings, and investing to protect community infrastructure such as dikes and irrigation canals. The coping mechanisms include the sharing of food and money, increasing paid labor work, and selling off of assets. The current use of climate risk financing strategies is limited to risk retention by households relying on their own savings and borrowing from saving groups and banks after a climate-related shock. Climate risk sharing and transfer mechanisms remain under-utilized in these communities, including for community development funds (CDFs) which, apart from their general risk management practices, do not currently have specific strategies to manage climate risks.

(iii) Current risk management strategies may not provide the communities and households with effective protection against the impacts of climate hazards. As reported by the households, climate-related shocks have negatively impacted their livelihoods, causing substantial economic damage from the loss of subsistence crops and productive agricultural assets and reduction of postdisaster level of consumption. Such losses increase the probability of the study households falling into extreme poverty. CDFs are also vulnerable, as repayments by borrowers could fall considerably following climate shocks and reduce the capital base of CDFs, threatening their sustainability.

(iv) Climate risk financing could significantly improve climate resilience within the study communities. Preliminary simulations indicate that climate risk financing could significantly protect household economic income and thereby reduce the impact of climate shocks, minimize the likelihood of households falling into extreme poverty, and if linked to measures to stimulate expansion of rural credit, could promote income growth of the rural households. CDFs would also have better protection from climate risk financing, with higher repayment rates from borrowers and financial reserves to cope with defaults.

(v) Effective climate risk financing for the study communities requires a combination of risk retention, risk sharing, and risk transfer mechanisms. To improve risk retention, households should be incentivized, and enabled, to save more money securely and cost-effectively. Such savings are a valuable first line of defense that can lessen the need for costly coping options. They should therefore be promoted as much as possible, perhaps initially focusing on communities and households that have more financial resources. For risk sharing, a community disaster fund could be established within each community. Such a fund would pool resources from households and serve as a communal reserve fund. An effective risk retention strategy for CDFs would be to establish reserves based on a percentage of the lending portfolio, while risk sharing could occur by pooling these reserves with other CDFs.

The community-level risk retention and risk sharing mechanisms outlined in this report could only draw on the limited resources available within the communities. While this would provide protection against small to moderate shocks, they would likely be overwhelmed by a high frequency of climate hazards or by extreme events. Therefore, the potential of risk sharing mechanisms over broader geographies should be investigated, such as national or regional disaster risk pools. Even then, extreme climate events can be overwhelming, and risk transfer options will need to be in place, such as an index-based insurance schemes that tie into the international insurance market.

(vi) National governments and the donor community could play an important role in supporting the risk financing mechanisms. Examples could include supporting rural financing literacy programs, providing matching grants to incentivize household saving and community disaster funds, facilitating institutional arrangements for cross-community risk sharing, supporting the design of risk transfer schemes, and financing the costs of risk transfer.

(vii) The design of climate risk mechanisms for rural communities in the Greater Mekong Subregion will require more comprehensive information and analyses. As a rapid technical assessment, this study was merely a first step to build understanding about the impacts of climate shocks on rural communities and how climate risk financing could provide a safety net. To take this work further, future studies would need to undertake comprehensive risk assessments and incorporate future climate change projections into the analyses. Such assessments should include a bigger selection of rural communities and a better quality of climate hazard and loss data.

(viii) More research and consultation would also be needed to determine appropriate institutional arrangements for risk sharing and risk transfer mechanisms as well as for supporting policy frameworks and capacity building efforts. Future simulations would be strengthened by utilizing sensitivity analyses to better understand the impacts and cost-benefits of risk financing options. Future work on risk financing in this context should look to embed risk financing options within broader development objectives, such as development of a rural financial market and improved disaster risk reduction.

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APPENDIX 1

Participating Communities in Cambodia, the Lao People's Democratic Republic, and Viet Nam

Country	BCC provinces	BCC Sites
Cambodia	Mondulkiri	Sre Huy Commune Pouchey Commune Romnear Commune Dak Dam Commune Srae Khtum Commune Chi Khor Lue Commune
	Koh Kong	Andoung Teuk Commune Ta Tai Krom Commune Peam Krasaob Commune
Lao PDR	Champasak	Ban Tha Hou Ban Khet Ngong Ban Sanod Ban Thong Pha
	Attapue	Ban Khunmarknao
	Sekong	Ban Tangao Ban Vongkaew Ban Songkon
Viet Nam	Quang Nam	Blahee Commune A Vuong Commune Tahbing Commune Ca Dy Commune
	Hue	Hong Lam Commune Hong Kim Commune Hong Ha Commune
	Quang Tri	Huang Lap Commume Huang Hiep Commune Ba Nang Commune Huc Nghi Commune

BCC = Biodiversity Corridors Conservation Project, Lao PDR = Lao People's Democratic Republic.
Source: Authors.

APPENDIX 2

Summary Statistics of Data Used in this Study

Country	Cambodia				Lao PDR				Viet Nam		
Livelihood zones	North Mondulkiri	South Mondulkiri	Inland Koh Kong	Coastal Koh Kong	Phatumphone & Sanamxai	Phouvong	Dakchaung	Kaleum	Quang Nam	Thua Thien Hue	Quang Tri
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11
Demographics											
Household member	5.5	4.9	4.5	5.5	5.9	5.6	5.7	5.1	5.0	6.3	4.9
Head with primary edu (%)	0.3	0.5	0.7	0.7	0.7	0.6	0.5	0.5	0.7	0.7	0.5
Livelihoods											
Agricultural land (ha)	2.9	2.8	1.6	0.5	1.4	1.6	1.5	1.6	1.4	2.4	2.2
Total household income per year ($)	2,918.38	1,953.03	1,424.56	2,247.24	2,860.45	1,376.68	1,313.04	1,770.67	2,134.64	1,470.04	1,273.28
Paddy	51%	5%	24%	6%	10%	1%	7%	4%	1%	22%	5%
Upland rice	12%	14%	6%	1%	2%	29%	4%	17%	9%	1%	9%
Casava	6%	33%	1%	0%	0%	1%	1%	2%	7%	6%	18%
Perennial cash crop	3%	15%	11%	1%	0%	0%	7%	0%	11%	3%	3%
Short-day cash crop	3%	4%	0%	5%	1%	5%	10%	7%	1%	1%	2%
Livestock	2%	3%	12%	1%	15%	20%	42%	30%	30%	35%	45%
Fishery	10%	0%	16%	49%	14%	6%	2%	6%	0%	0%	0%
Nonfarm	3%	11%	15%	30%	17%	11%	23%	11%	41%	32%	17%
NTFP	11%	15%	14%	4%	40%	28%	3%	22%	0%	1%	0%
Livestock asset											
Pigs	1.1	0.7	0.9	0.6	0.9	1.6	1.1	2.2	0.8	1.1	1.9
Buffalos	0.5	0.4	0.6	0.0	1.9	1.0	1.3	1.2	0.2	0.3	0.5
Cows	1.7	0.9	0.8	0.1	2.8	0.8	0.7	1.4	0.7	0.6	0.4
Goats	0.0	0.1	0.0	0.0	0.0	0.6	0.3	0.4	0.0	0.2	0.3
Poultry	8.9	6.0	15.2	5.7	11.5	2.7	4.7	9.1	5.5	8.7	3.7
Access to finance											
Borrowing from banks/MFIs (%)	37%	9%	10%	20%	10%	0%	0%	0%	82%	77%	65%
Loan size ($)	128	869	663	1,128	325	NA	NA	NA	1,173	1,058	1,218
Monthly interest rate (%)	3.0%	2.2%	2.7%	2.5%	0.9%	NA	NA	NA	0.7%	0.7%	0.7%
Borrowing from informal institutions (%)	48%	37%	31%	57%	11%	9%	0%	0%	14%	0%	18%
Loan size ($)	496	773	353	566	198	210	NA	NA	568	NA	231
Monthly interest rate (%)	2.5%	2.4%	2.5%	2.0%	1.5%	1.5%	NA	NA	0.7%	NA	1.0%
Saving (%)	55%	45%	31%	59%	8%	5%	0%	0%	7%	5%	15%
Deposit size (avg $)	1,229	1,190	1,003	756	598	123	NA	NA	197	429	547
Monthly interest rate (%)	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	NA	NA	0.1%	0.1%	0.1%
Climate Self-reported frequency in past 10 years											
Droughts	20%	40%	10%	30%	10%	20%	30%	20%	30%	20%	20%
Floods	30%	30%	30%	20%	30%	10%	0%	10%	40%	30%	30%
Storms	10%	20%	30%	40%	10%	10%	10%	10%	40%	30%	20%
Seawater intrusion	0%	0%	0%	40%	0%	0%	0%	0%	0%	0%	0%
Normalized Difference Vegetation Index (NDVI)											
Average	0.68	0.75	0.73	0.74	0.73	0.80	0.77	0.77	0.78	0.76	0.78
Standard deviation	0.14	0.09	0.20	0.07	0.09	0.05	0.09	0.08	0.08	0.08	0.08
Corr. Of communities and zone's anomalies	0.29	0.40	0.54	0.45	0.44	0.61	0.64	0.61	0.79	0.76	0.79
Number of communities (aggregated NDVI units)	4	8	7	3	40	4	15	10	13	10	12
Station weather											
Average annual rainfall (mm)	1,677	2,431	1,424	2,805	2,235	2,450	1,889	1,889	2,656	2,987	2,174
Average drought index (max cum. no-rain days)	52	36	30	33	46	37	33	33	39	10	16
Standard deviation	34	25	22	26	26	24	23	23	21	5	8
Average flood index (max 5-day cum rain)	172	236	115	169	237	287	141	141	248	530	360
Standard deviation	114	103	57	118	134	158	67	67	272	322	256
Stations	1	2	1	1	2	2	0	1	1	2	2
Periods	2000-2004	1958-1967	1982-2008	1972 2004	1980-2008	1980-2008	NA	1980-2008	1980-2006	1980-2006	1980-2006
Stations	Bor Keo	Sen Monorom	Kampong	Koh Kong	Patumphon	Attapue		Sekong	Dak to	Aloui	Khe Sanh
		Oriang	Speu		Nonghine	Mahaxai				Hue	Dong Ha

ha = hectare, MFI = microfinance institution, mm = millimeter.
Source: Authors

Risk Financing for Rural Climate Resilience in the Greater Mekong Subregion

Rural communities in the Greater Mekong Subregion (GMS) are vulnerable to climate-related disasters. In 2008, tropical cyclone Nargis killed 84,500 people and impacted the livelihood of 2.4 million people. In 2011, large-scale floods in Thailand affected 14 million people and caused $45.7 billion in damages. This report presents findings of a climate risk financing study conducted by the GMS Core Environment Program in 28 rural communities in Cambodia, the Lao People's Democratic Republic, and Viet Nam. Learn more about how communities cope with climate-related disasters, how this study contributes to the knowledge base on rural climate risk financing in the GMS, and how it can become the basis for more comprehensive feasibility studies.

About the Core Environment Program

The Core Environment Program (CEP) supports the Greater Mekong Subregion (GMS) in delivering environmentally friendly economic growth. Anchored on the ADB-supported GMS Economic Cooperation Program, CEP promotes regional cooperation to improve development planning, safeguards, biodiversity conservation, and resilience to climate change–all of which are underpinned by building capacity. CEP is overseen by the environment ministries of the six GMS countries and implemented by the ADB-administered Environment Operations Center. Cofinancing is provided by ADB, the Global Environment Facility, the Government of Sweden, and the Nordic Development Fund.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to a large share of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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