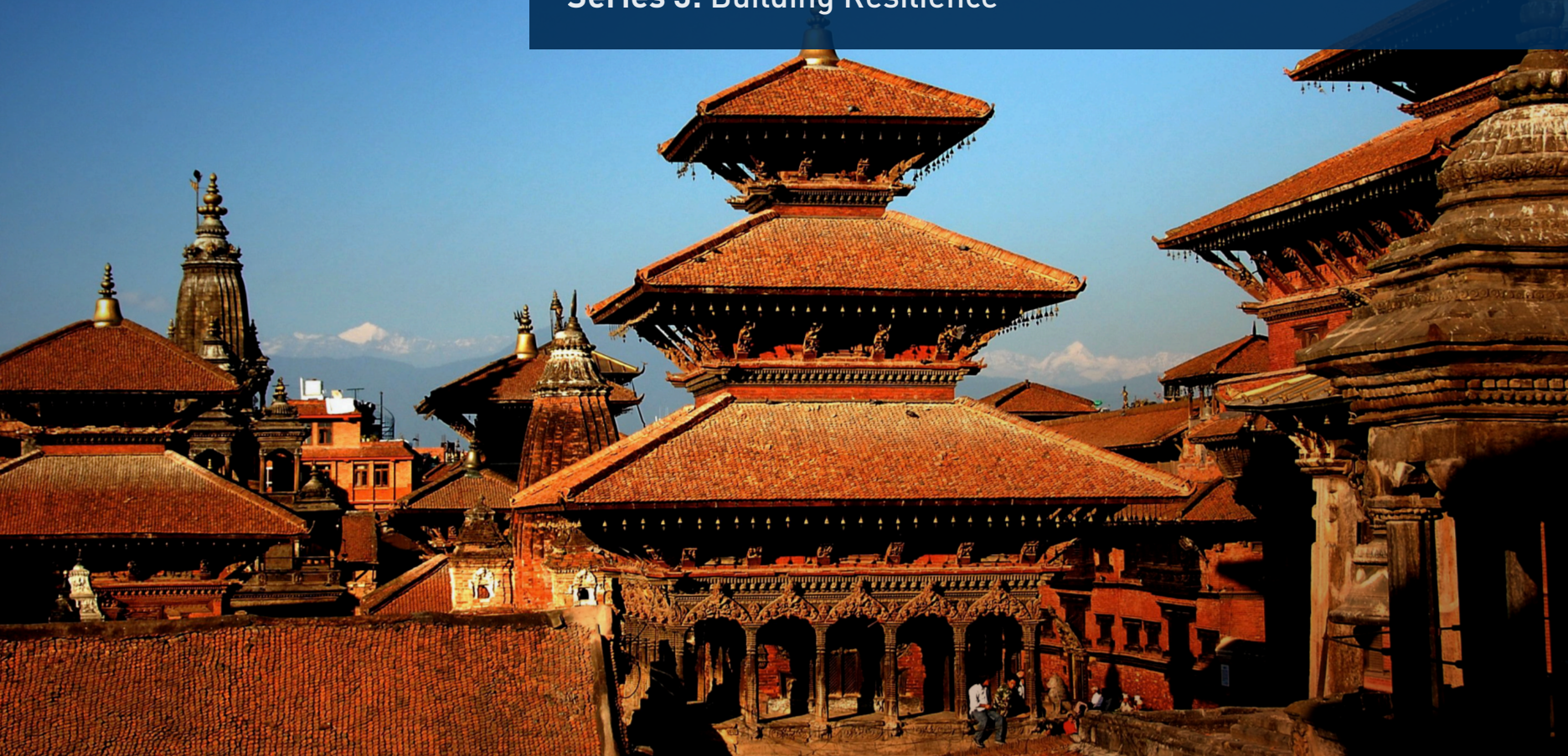
CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

CLIMATE RESILIENCE FRAMEWORK: TRAINING MATERIALS

Series 3: Building Resilience



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The Training Materials Consist of:

- Participant Guides
- Activities
- Supporting Materials: case studies, working papers, tools, and resource links

Series 1: Establishing Resilience Principles introduces the Climate Resilience Framework and shared learning dialogue process, and gets lead partners started in the climate resilience planning process.

Series 2: Understanding Vulnerability systematically walks lead partners through the steps involved in conceptualizing, designing, and implementing initial vulnerability and climate risk study.

Series 3: Building Resilience describes the steps required to identify, prioritize, implement and evaluate actions designed to build climate resilience and provides focused materials on key topics.

ISET-INTERNATIONAL'S MISSION

To catalyze transformative change toward a more resilient and equitable future. Through research, training, and implementation activities we improve understanding and elevate the level of dialog and practice as society responds to natural resource, environmental, and social challenges. We serve as a framework for equal collaboration among individuals and organizations in the North and South.

Cover Images:
Series 1: Mehreen Mallal
Series 2: Kate Hawley, ISET-International
Series 3: Fawad Khan, ISET-Pakistan

This project was supported by the Rockefeller Foundation as part of the Asian Cities Climate Change Resilience Network (ACCCRN), USAID as part of the Mekong-Building Climate Resilient Asian Cities (M-BRACE) program, The Climate and Development Knowledge Network (CDKN), and the American Red Cross.

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CLIMATE RESILIENCE FRAMEWORK
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WHAT IS THE CLIMATE RESILIENCE FRAMEWORK: TRAINING MATERIALS?

The CRF:TM is a set of tools designed to be utilized by a leadership team to help communities and partner organization assess and strengthen their climate resilience.

OUR APPROACH

The materials provide a roadmap for gathering a team, assessing your vulnerability to climate change, and identifying key actions to take to building resilience in your community. We believe that what matters most in a sustainable process is establishing good working relationships with key stakeholders and decision-makers, and employing the appropriate data to inform your communities decisions.

EFFECTIVE USE OF THESE MATERIALS

The CRF:TM is intended to be delivered in a workshop format by a trained facilitator. Additional support for facilitators and trainers is available. If you would like to conduct a training based on these materials and require assistance or support please contact training@i-s-e-t.org

WHERE TO FIND MORE INFORMATION

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Overview

The Climate Resilience Framework is a conceptual framework for simplifying and analyzing complex relationships between people, systems, institutions, and climate change. The framework helps clarify factors that must be included in the diagnosis of climate vulnerability; it structures the systematic analysis of vulnerability in ways that clearly identify entry points for response; and it supports strategic planning to build climate resilience.

The framework has been synthesized from a wide range of related fields, including ecology, engineering, disaster risk reduction, complex systems theory and planning with the goal of prompting new and practical ways of thinking about the challenge of adaptation to climate change.

ISET-International's approach to teaching trainers and communities to use this framework at the community, or city level is delivered in three series in the Climate Resilience Framework: Training Materials (CRF:TM), described below.

The training materials assume stakeholders have no prior experience—that climate change is a new concept—and begins by building the capacity to understand and address climate change from the ground up. The CRF:TM are intentionally iterative, support and rely on collaboration, and require personal and group reflection and the creative engagement of everyone involved.

Series 1: Establishing Resilience Principles

Series 1 is designed to get the lead partners in a local climate resilience planning process started. Participants are first introduced to the conceptual framework behind ISET-International's engagement approach, the Climate Resilience Framework, and to the key tool used for engagement, the Shared Learning Dialogue. Following this introduction, participants are led through identifying resilience planning goals, reviewing existing policies, identifying the stakeholders needed to support and engage in

the climate resilience building process and from this group assembling a "climate working group", and assembling core data. These initial steps are the foundation for Series 2, and Series 3.

Series 2: Understanding Vulnerability and Risk

Series 2 systematically walks the newly formed climate working group through some of the steps involved in conceptualizing, compiling, analyzing and utilizing an initial city-wide vulnerability and climate risk study. This series is designed for a community and/or working group with little previous experience conducting climate vulnerability and risk assessments. However, communities that have conducted vulnerability and risk assessments previously will find that this series contains tips that help re-evaluate previously collected data in a more systematic manner, allowing clear identification of gaps.

Series 3: Building Resilience

The concluding module series, Series 3, reviews the steps required to:

Identify Actions: how to take the information generated in the vulnerability assessment and use it to develop initial actions to address identified vulnerabilities;

Prioritize Actions: introduces a variety of tools that can be used to assess the potential for proposed actions to address identified vulnerabilities under possible future conditions;

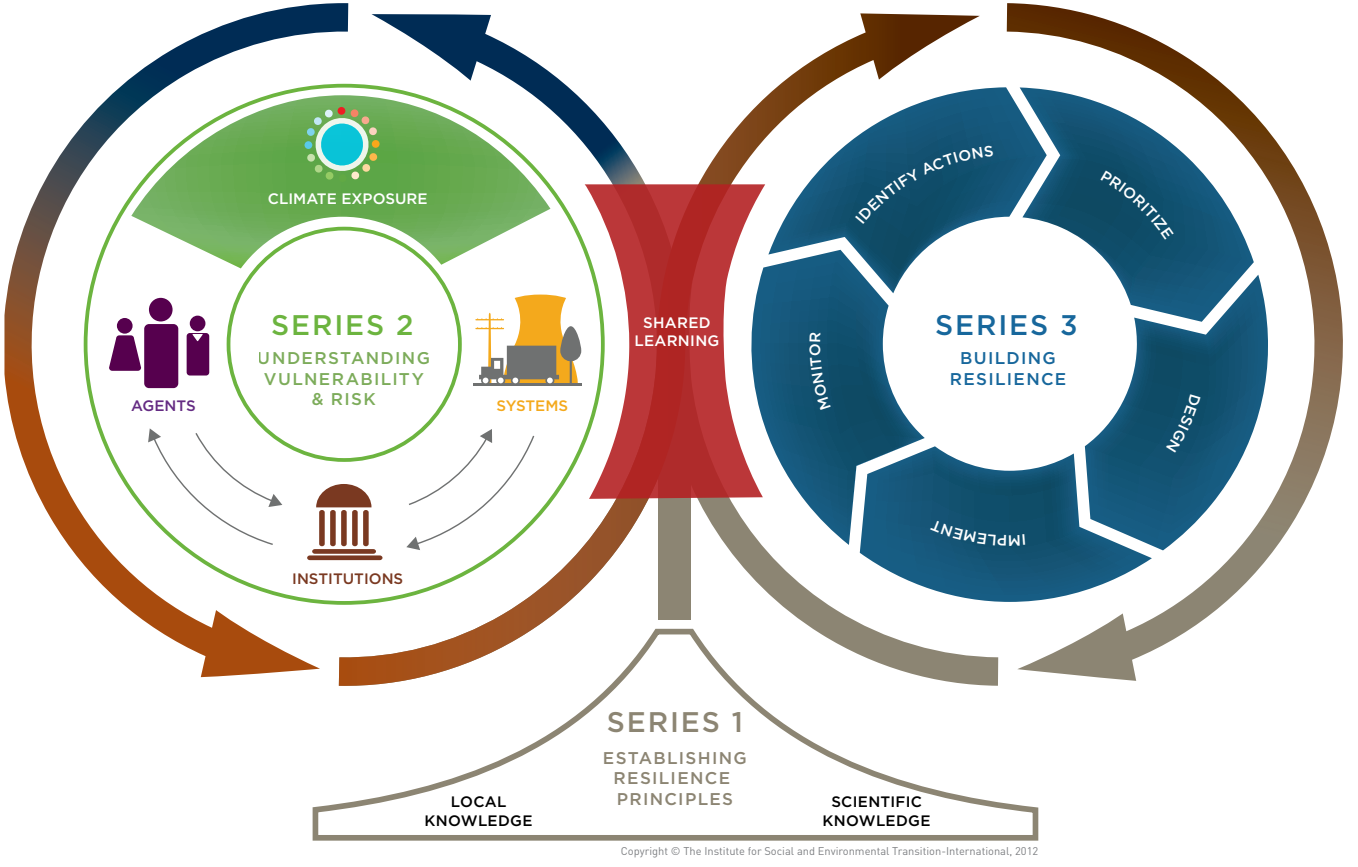
Design Your Resilience Strategy: how to develop a broad, local level guidance document (a Climate Resilience Strategy) that provides the context, evidence and analysis justifying actions to strengthen resilience to climate change, and identifies high priority resilience actions that can be linked and coordinated with other local initiatives;

Implement Actions: begin implementation of priority actions; and

Monitor Results: why you need to develop resilience indicators to monitor whether the activities and actions being taken to "build resilience" are succeeding.

The Series 3 materials do not address all of these steps in detail. For some steps, there are many tools already available —for example, for evaluating, ranking and prioritizing implementation actions. For other steps, such as implementation, tools are highly context dependent. The materials included in Series 3 are those that ISET has developed to supplement materials available elsewhere. They are designed to fill gaps and/or address topics in unique ways. You will need to determine whether they are useful for your city's resilience process.

The Climate Resilience Framework



About the Authors

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Dr. MacClune received a PhD in Earth Sciences from the University of Colorado where she studied glacial hydrology and did field work in Greenland and Antarctica. Prior to her work with ISET-International Karen was a groundwater hydrologist at S.S. Popodopolous & Associates where she worked with multiple and diverse stakeholders in addressing water resource issues in the Southwestern US. With ISET-International Karen has extended her stakeholder outreach, leading the development the Climate Resilience Framework: Training Materials.

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Ms. Kari Hansen Tyler is an instructional designer and researcher. She specializes in the design of educational experiences that engage analysis of complex systems in support of creative problem solving. She received a Masters Degree in Adult Education and Community Development from the Ontario Institute for Studies in Education (OISE) and the University of Toronto. Her research has explored holistic learning in an intercultural context, with a focus on a First Nations culturally integrated curriculum.

Acknowledgements

These materials were made possible through funding provided by the Rockefeller Foundation as part of the Asian Cities Climate Change Resilience Network (ACCCRN), USAID as part of the Mekong-Building Climate Resilient Asian Cities (M-BRACE) program, Climate & Development Knowledge Network (CDKN), and the American Red Cross. The contents of these training materials draw heavily on the efforts of dozens of local partners in fourteen cities across Asia. These city partners are undertaking the challenge of plunging into a difficult set of issues with limited knowledge but strong interest. The number of individuals and organizations involved in all these cities is too great to name, but each has contributed to the activities that are reflected in these learning materials. The authors deeply appreciate their efforts.

Support and training of these city partners has been delivered by ISET-International staff in country and regional offices, and by national partners. Without their committed effort in the field and ongoing discussion about impacts and results, these materials would remain entirely conceptual. We are deeply indebted to them for pushing us to rewrite and revise materials to reflect the needs and reality on the ground.

Finally, while acknowledging these vital contributions to the publication, the authors take responsibility for its contents, including any errors or omissions therein.

CLIMATE
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SERIES 3: Building Resilience

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CLIMATE RESILIENCE FRAMEWORK
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Series 3 Contents

3.0.0

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
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RESILIENCE PLANNING: OVERVIEW

Series 3 addresses the right-hand loop of the Climate Resilience Framework, Building Resilience. The Building Resilience loop includes five steps (illustrated by the blue, inner arrows, shown in Figure 3.0.1):

1. **Identify Actions**
2. **Prioritize** which actions to implement
3. **Design** a strategy for implementation
4. **Implement** actions, and
5. **Monitor** the results of those actions.

The Series 3 materials do not address all of these steps in detail. For some steps, there are many tools already available—for example, for evaluating, ranking and prioritizing implementation actions. For other steps, such as implementation, tools are highly context dependent.

The materials included in Series 3 are those that ISET has developed to supplement materials available elsewhere. They are designed to fill gaps and/or address topics in unique ways. You will need to determine whether they are useful for your city's resilience process.

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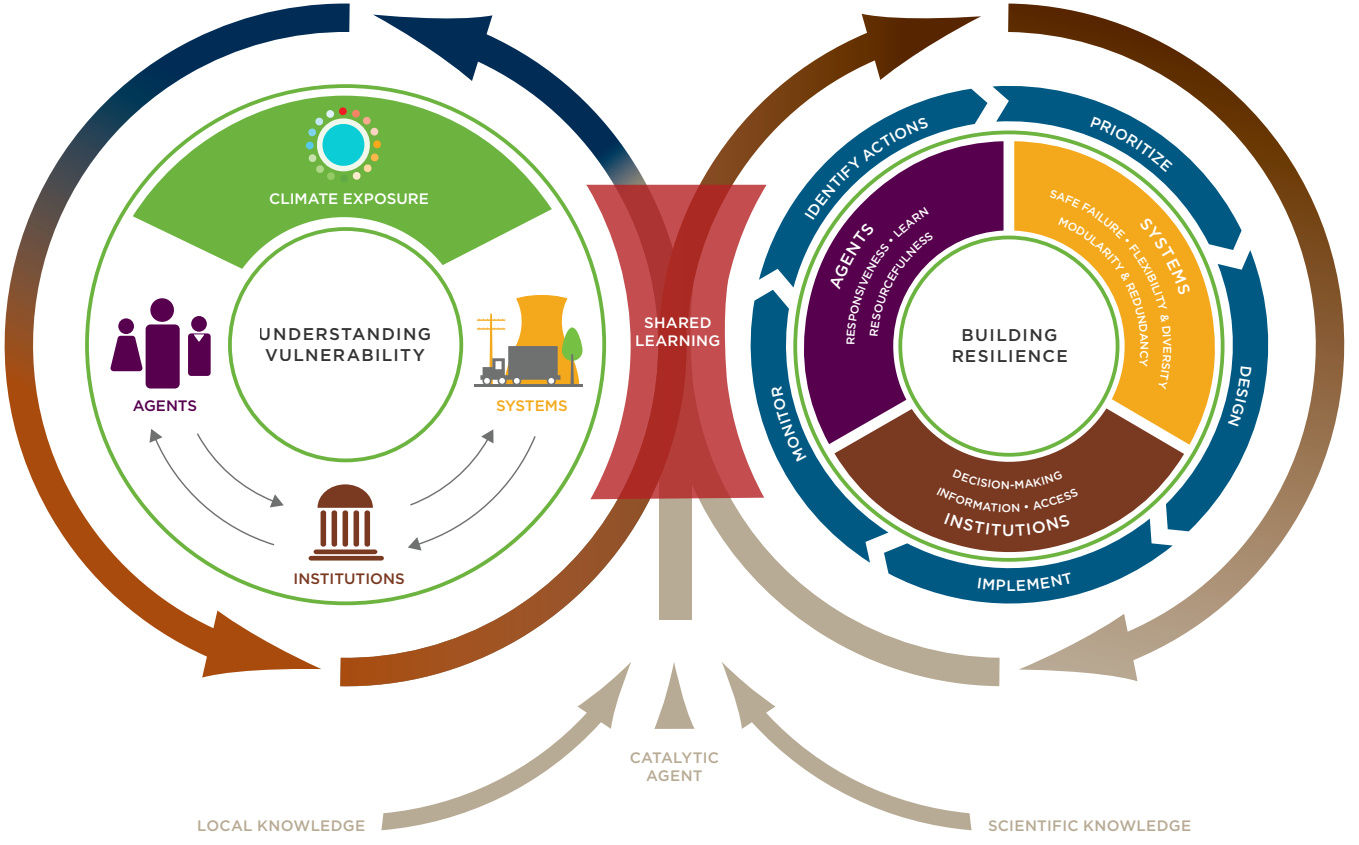
FIGURE 3.0.1
Climate Resilience Framework



Part 1: Identify Actions

The initial three sets in Series 3 address the value of developing a written Resilience Strategy, and explore how to develop initial resilience actions for that strategy given the uncertainty inherent in climate change.

3.1 Introduction to Resilience Planning: what it means to plan for and build resilience, and why you might want to plan this way.

3.2 Scenario Development: how to address the uncertainty of both future climate and future development. This set introduces scenario development, including generating a range of possible futures and exploring actions that could be taken to address the vulnerabilities those futures could bring.

3.3 Developing Resilience Actions: how to design actions that build resilience. These actions have the characteristics of resilience that we have been exploring—modularity and redundancy, flexibility and diversity, safe failure, responsiveness, learning, resourcefulness, inclusive, informed, adaptable, with good governance.

Part 2: Evaluating and Prioritizing Options

There are many tools available for evaluating and assessing adaptation and resilience options. These include sensitivity and threshold analysis, technical feasibility assessments, environmental assessments, and social impact assessments. A web-search will turn up multiple different tools to support these assessments developed by numerous organizations. We do not duplicate that material here.

We do include here several tools that ISET has developed for use in our own work. These tools are ones that we find particularly valuable and have not seen in quite this format anywhere else.

3.4 Capacity Assessment: an evaluation of locally available human resources and critical skills that can be leveraged to support local resilience and adaptation efforts.

3.5 Introduction to Cost-Benefit Analysis: an approach to determine the overall economic benefit that would accrue to society if the project or policy were undertaken. This set introduces Participatory Cost-Benefit Analysis and Quantitative Cost-Benefit Analysis and helps the user identify the type of analysis best suited to their evaluation.

3.6 Participatory Cost-Benefit Analysis: introduces a methodology for using participatory research appraisal methods to ensure that financial, social and environmental benefits and costs of an activity are identified. As a result, the participatory cost-benefit analysis both captures information that is often unavailable from traditional data sources or is unincorporated in traditional analyses,and is relatively quick and inexpensive to implement.

3.7 Quantitative Cost-Benefit Analysis: quantitative cost-benefit analysis undertaken for climate change or disaster risk-related projects differs from a conventional cost-benefit analysis by integrating future climate risks and future damages associated with climate events. This set discusses how to adapt a standard cost-benefit analysis to address situations where disaster frequency, magnitude, or intensity is changing due to climate change; and provide the information needed to develop a Terms Of Reference to hire the right the right team to implement the analysis.

3.8 Multi-Criteria Analysis: a simple yet systematic tool for prioritizing one option from among many when there are a number of different criteria influencing your selection. This tool is particularly useful in situations where a decision maker or decision group contemplates a choice of action in an uncertain environment.

Part 3: Designing Your Resilience Strategy

There are now multiple cities around the globe that have developed resilience or climate resilience strategies. A web search will turn up many options, and you can review what cities both similar and vastly different from yours are planning or implementing.

The contents of your City Resilience Strategy will be determined by your city's physical location, structure and challenges, by the cultural and political climate you work in, by financial constraints, and by local expectation, capacity, interest and need. The resilience activities highlighted in your Strategy will be based on the hazards you face, the nature of the city's vulnerable peoples, and how you choose to prioritize action.

Regardless of what your plan looks like, however, it should adhere to several basic principles:

- Any resilience interventions proposed in your Strategy should meet the basic resilience principles you outlined in Set 1.4.
- The interventions should have been evaluated against scenarios and resilience criteria, as discussed in Sets 3.2 and 3.3.

- Proposed interventions should have broad support within the climate working group and steering committee, and ideally also within the agencies or departments that will be called on to implement them. Otherwise, your plan is at risk of being ignored.
- Finally, prior to beginning the writing of the City Resilience Strategy, the city team and facilitators need to decide on who the plan is being written for and how it will be used. For example, is it being written for circulation to city officials and city departments for incorporation into city policy, or is it being written to attract donor funding.

ISET encourages cities to view their City Resilience Strategy as a document for internal use. Once an internal document has been prepared, developing a summary document for use in soliciting funding, accompanied by specific intervention proposals based on that summary document, can be relatively straightforward. City commitment and policies built on the basis of an internal document will help assure funded projects are coordinated and working toward a comprehensive vision rather than addressing needs in a piecemeal fashion.

Part 4: Implementing Your Resilience Strategy

Implementation of your Resilience Strategy will be governed by stakeholder engagement, capacity and budgets. It is important to start where you can, at the scale that is feasible, with the partners that are interested, and build up over time.

Resilience is a process—you will never arrive at "Resilient". Instead, you will continue to incrementally build up resilience—in systems, in actors, in institutions, and by reducing exposure. Throughout this process, you will want to return to the Climate Resilience Framework to reassess vulnerability, to hold additional shared learning dialogues, and to revise your City Resilience Strategy to reflect successes, new opportunities, and new challenges.

Part 5: Monitoring and Evaluation

A core element of any resilience process is learning. It is critical that, as you begin implementing resilience actions, you put in place a system for monitoring and evaluating the impacts and results of those actions. In most cases, this should ideally extend significantly beyond the lifetime of the implementation itself. Consequently, monitoring and evaluation will be most successful if they build on monitoring already in place within city departments and programs.

We encourage you, prior to beginning implementation of activities, to explore in detail what other mechanisms and systems are already in place for tracking and evaluating similar programs, whether they are being implemented by NGOs, government, or private industry. If possible, develop partnerships with these organizations, utilize existing baseline information wherever possible, and develop project indicators that can be monitored with little or no additional data collection.

3.1.0

SERIES 3
Building Resilience

INTRODUCTION TO RESILIENCE PLANNING

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Contents of Set

3.1.0: Guide

Building resilience to climate change in your city and community can take many forms, from enhanced land-use regulations to public education to targeted investments in infrastructure. Coordinating those activities through careful planning helps ensure that actions work together to achieve your goals.

A resilience strategy is a guidance document, prepared by local stakeholders or government, which provides the context, evidence, and analysis to justify individual resilience actions and projects. Having a well-defined, documented strategy for building resilience will help prioritize actions to address specific needs (both now and in the future). It will also serve as an important platform for ongoing activities and stakeholder engagement. Because addressing climate change is a new challenge, a resilience strategy will lay out the scientific case for action and identify linkages to existing city planning efforts and programs.

IN THIS SET YOU WILL:

- ✓ Learn about a City Resilience Strategy and why you might choose to develop one as a starting point for your City Resilience Actions.

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Overview: What is a City Resilience Strategy

A City Resilience Strategy is a broad local level guidance document prepared by local government or an advisory public or private organization. It provides background information, analysis and proposed actions to build city resilience to climate change. City resilience strategies will be different depending on the local conditions, climate vulnerabilities and capacity for response. However, all city resilience strategies should respond to existing development policies, procedures and plans (recognizing that in many cases these are not internally consistent), and should be linked to the budgets and work plans of existing agencies so that they can be easily implemented. The strategy should identify high priority resilience actions that can be linked and coordinated with other local initiatives, and funded through available local resources or external sources. This is not only a matter of identifying "projects" but could also include changes to existing practices, the need for new practices, or discrete new activities to respond to specific issues.

The exercise of assembling a City Resilience Strategy has a wide range of outcomes.

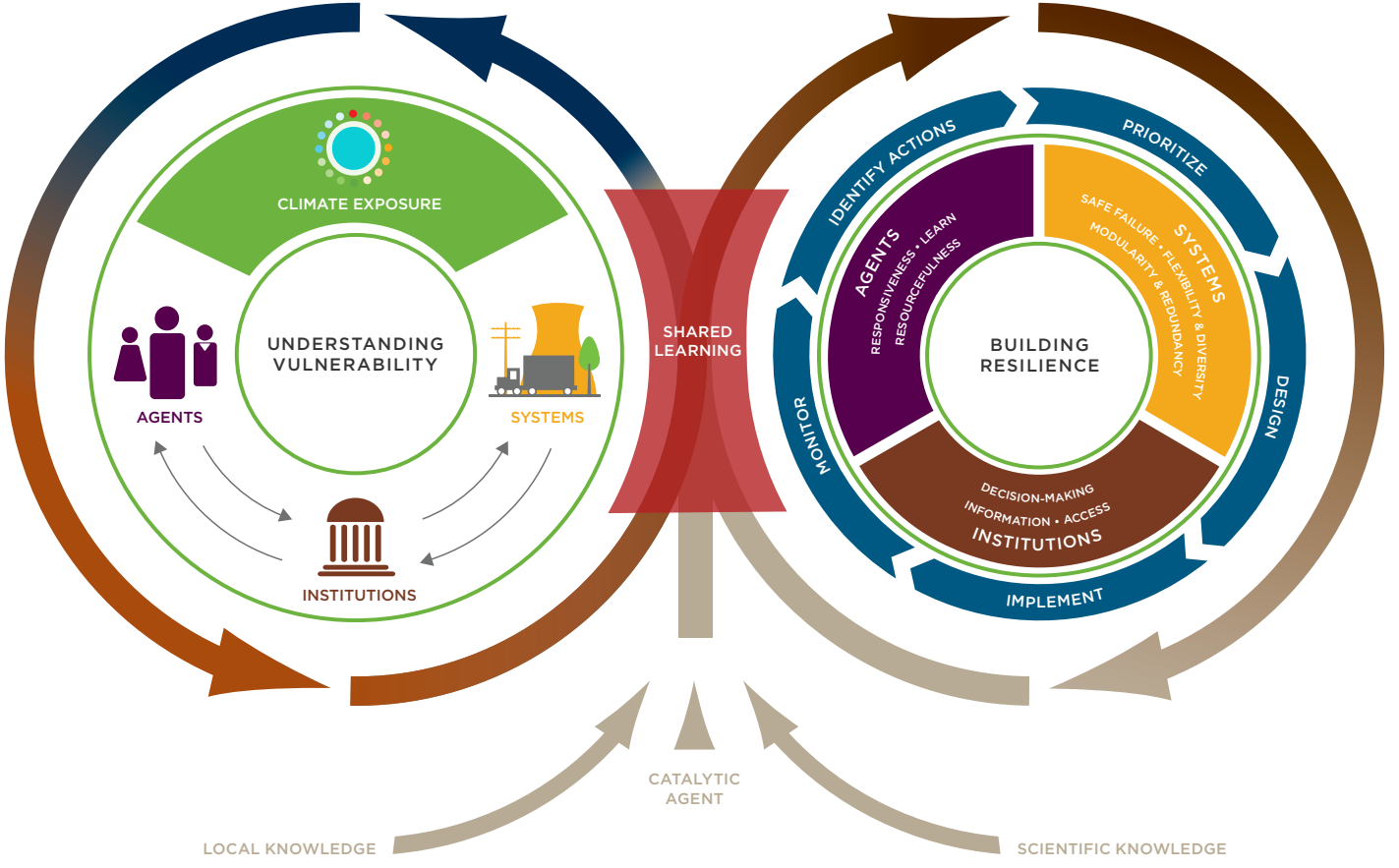
Resilience strategies:

- Consolidate earlier learning about future climate and local vulnerability from SLDs, vulnerability assessments, and in depth studies or pilot projects undertaken to address gaps found during the vulnerability analysis;
- Disseminate these findings to key decision makers;
- Reinforce new knowledge, concepts, and strategic planning approaches among "core" resilience planning stakeholders;
- Strengthen new coordination mechanisms and partnerships; and
- Provide a platform for ongoing engagement and learning.

Consequently, the process of developing a resilience strategy is at least as important to successful outcomes as the documented strategy itself.

The exercises and follow-up work you did for Series 1 and 2, and the discussions and results from your Shared Learning Dialogues (SLDs) all feed into your resilience planning and provide input for your Resilience Strategy. The preliminary Overview work in Series 1 identified goals, existing policies,

FIGURE 3.1.1
The Climate Resilience Framework Planning Process



stakeholders and available data. This was used to support and direct your initial vulnerability assessment (Series 2). SLDs helped ensure the engagement of local knowledge and key implementing partners (local government officials, NGOs, vulnerable groups, private sector representatives, and scientific experts). This engagement is represented by the entry arrow and left-hand loop of the Resilience Strategy diagram (Figure 3.1.1).

Your City Resilience Strategy is the centerpiece of your efforts to build resilience to climate change in your city and community. Depending on your local context, your resilience strategy may be adopted, in whole or part, into the municipal planning process or it may stand outside of more formal processes. However, although it is important to acknowledge and complement government planning efforts, the audience for your document is much larger, including community groups, local businesses, and civil society organizations, among others, who can use the guidance provided to undertake their own adaptation actions. One of the primary objectives of developing a strategy is to coordinate activities across multiple organizations and sectors so that adaptive actions are complementary and working in concert to achieve resilience.

Below is a suggested outline for the contents of your resilience strategy. The strategy you ultimately develop must be responsive to your own local contexts and the content will therefore be individually tailored to your specific situation and needs. This outline will assist you in organizing a coherent and coordinated plan.

Your Resilience Strategy will serve as your guidance document as you work to implement specific actions to address the impacts of climate change. However, a resilience strategy is never truly completed and you will continue to refine it over time as the impacts of climate on your community become clearer, your vulnerabilities change over time, and city priorities shift.

Suggested Contents of Your City Resilience Strategy

Your City Resilience Strategy should consist of four main sections:

1. Introduction to Climate Change and Resilience
2. Climate Impacts and Vulnerability
3. Resilience Actions
4. Prioritizing Activities

Each of these sections is discussed in more detail below.

1. INTRODUCTION TO CLIMATE CHANGE AND RESILIENCE

As you begin writing your strategy, it is important to remember that many of the individuals and organizations that will use the document may not understand some of the concepts and issues associated with climate change and resilience. Briefly introduce climate change and define the technical and/or complex terms you will use later in the document. This will make the strategy more accessible to a wider audience.

You can use the introduction to describe the resilience principles you identified in Series 1 as a general framework for action. Your resilience principles provide the philosophical foundation for developing a strategy.

Finally, many of the concepts associated with systems, agents, and institutions need to be explained early in the document so that users have an understanding of how specific interventions are expected to achieve resilience objectives.

Some of the key questions you should seek to address in an introduction include:

- What is climate change?
- What is resilience?
- What makes a city resilient?

2. CLIMATE IMPACTS AND VULNERABILITY

This section, provides the rational for action. Describe the likely local impacts of climate change and the vulnerabilities you have identified during your assessments and stakeholder engagements. You should specifically identify vulnerable groups, sectors, and infrastructure in a clear manner, describe how you conducted your analysis of those groups, sectors and infrastructure, and explain the nature of their vulnerability. If your vulnerability assessments or climate impact analysis resulted in lengthy technical documents, you can summarize the key findings here and include the full document as an appendix.

Some of the key questions you should seek to address in this section include:

- What is the local climate risk?
- What groups are vulnerable to climate change?
- What infrastructure is vulnerable to climate change?
- What role do institutions play in maintaining, intensifying, or mitigating these vulnerabilities?
- What uncertainties exist in these assessments?

3. RESILIENCE ACTIONS

In this section, you will identify and describe specific actions to reduce vulnerability to climate change impacts. (Sets 3.2 and 3.3 discuss how to identify these actions in more detail). Describe each intervention in detail and explain how each is expected to help achieve resilience, both by itself and when combined with other actions. Interventions should specifically address the vulnerabilities you identified in the systems, agents, and institutions of your city. You will probably identify several different interventions for any given vulnerability, where each intervention addresses a different piece of a large and complex puzzle. For example, if coastal flooding is identified as a significant future hazard, possible interventions could include land-use restrictions, sea-wall construction, mangrove restoration and public education campaigns. Your City Resilience Strategy needs to explain how these different actions all address the vulnerabilities you identified. You also need to clearly demonstrate that these interventions fit together and that one intervention will not inadvertently exacerbate other problems in the process of implementation.

Systematic stakeholder engagement was an essential piece of identifying vulnerabilities (Series 1 and 2) and it is equally important in developing successful interventions. Your climate working group, team, or committee is now likely to have strong representation from a wide range of constituencies. Engaging or re-engaging with these constituencies—local community actors, government agencies, non-governmental organizations, community groups and universities—as you develop interventions will increase the possibility of incorporating new and meaningful changes to your city and broaden the base of support for the plans and actions you ultimately recommend. As with the SLDs and engagements you conducted earlier, multiple, repeated engagement is essential. It will allow you to review intervention ideas with the people who, in some cases, are most likely to be impacted by the activities aimed at building resilience.

As you develop potential interventions, begin identifying how they can be incorporated into city or utility plans and processes. Simply having a good idea is not enough for successful implementation—in most cases there must be a clear opportunity in existing plans to implement the action. Climate change issues are likely to be new to your

community. If you can leverage existing agencies, plans, and processes to assist with implementation, the entire process will be much easier, more likely to be successful, and will have broader support. There may be cases where an activity is so new that it is hard to identify where it fits within the existing planning structure—the creation of a climate planning and education office, for example—so at this stage, you should include activities whether the linkage is clear or not and make an assessment of their viability in the next section.

Some of the key issues you should seek to address in this section include:

- How does each proposed activity help build climate resilience?
- How does each action benefit vulnerable groups?
- What roles will government agencies and other groups play in implementing the activities?
- How does each activity link to other plans or projects?

4. PRIORITIZING INTERVENTIONS

Because resources are limited and not every intervention can be implemented immediately, you will need to prioritize your activities and, in some cases, justify difficult decisions or choices. In this section you will rank the interventions described earlier. Possible tools for use in ranking are described in Set 3.0; capacity assessment, participatory cost-benefit analysis, and quantitative cost-benefit analysis tools developed by ISET are provided in Sets 3.4 through 3.7.

There will probably be several issues on which you will rank your activities. These might include political motivation to implement, available funds, public support, cost, environmental impact, etc. You will want to combine these analyses into a single ranking that will help show which activities are most feasible and will produce the most societal benefits relative to each other. This can be done with multi-criteria analysis (Set 3.8) or a similar tool.

This section of the resilience strategy is the core of your urban resilience strategic planning. It justifies how you prioritize activities and provides a clear roadmap for future activity. It can also help engage stakeholders—it illustrates to agencies, local organizations, funders and donor of the sophistication, depth, and comprehensiveness of your analysis.

As you begin to implement resilience activities other interventions will assume new priority. As a result, your list will change frequently. You may want to think about how to present this information in an easily modifiable format (e.g. a three-ring binder with easily removable pages or as a dynamic document online). Finally, if you find your top ranked activities can't be quickly implemented, be sure to move forward with other activities. This will help build momentum and keep resilience in people's minds.

3.2.0

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
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SCENARIO DEVELOPMENT

Contents of Set

Planning for an uncertain future is complex. It requires resilience planners to make assumptions about what is driving urban change, what changes will occur, and then, ultimately, what activities can be undertaken to control that change in beneficial, resilient ways. Powerful forces are rapidly altering the form and function of cities around the world. Three of the most important drivers of urban change are climate change, demographic shifts (both in terms of birthrates and rural to urban migration), and economic transformations. Understanding how these forces might interact in the future will help you identify possible points of intervention to reduce vulnerabilities and increase resilience.

Traditional long-range economic and urban planning efforts create future scenarios based on historical trend analysis. The uncertainty associated with the local scale, timing, and magnitude of climate change can require a different approach. Focusing on possible future outcomes, rather than the specific trends, can lead to more climate adaptive responses.

IN THIS SET YOU WILL:

- ✓ Learn how to use scenario planning as a tool for exploring future conditions and developing, evaluating and ranking resilience interventions.
- ✓ Understand why scenario planning is a more effective means of future planning than trend analysis.

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OVERVIEW

To build resilience you must first explore what you need to be resilient to. This requires a vision of what your city or community might look like in the future. Scenario development allows you to explore a range of possible future conditions, to examine how vulnerability might change in each future, and to evaluate what actions would build resilience under most or all of those possible futures. There are a number of different ways to develop future scenarios. One of the simplest is projecting past historical trends into the future. This is often how future population and population growth is determined.

Cities are highly dynamic; the form and function of the urban environment is constantly shifting. Two of the most important forces at work in cities are economic development and demographic change. In many developing countries, urbanization has dramatically increased over the last 3 or 4 decades. One of the primary drivers of this change has been rural to urban migration. Migration can occur for a number of reasons, but is often closely associated with the growing economic opportunities in urban areas relative to traditional rural livelihoods. Migration is not a new phenomenon and has played an important role in growing and transforming cities throughout history. However, rapid migration can strain resources and infrastructure and pose challenges to urban planners.

Migration becomes a "problem" when a city is unable to accommodate new residents; for example when adequate housing and economic opportunities are lacking. As a result, the rate and scale of migration are often used as indicators of social and infrastructural weakness and vulnerability. Although similar, rate and scale can mean two different things for future planning. The rate of migration is the speed by which new residents are moving to the city, which may accelerate or fluctuate over a given time. The scale of migration is the overall volume of new residents, particularly relative to existing urban population. Both can strain city resources.

Not all urban change is driven by migration. Cities are the center of concentrated economic activity and prosperity. This makes them attractive for migration. It also means there will be ongoing investment in public sector improvements and private development. Some urban areas, such as the Central Business District, may see rapid turnover in buildings as older, outdated structures are replaced by modern high-rises and transportation networks. Outlying areas may be converted from farm or pasture to factories and business parks. These trends have implications for the exposure of infrastructure and for the flexibility and redundancy of critical systems. For example, a high concentration of business development and activity in the urban center may result in the development of stronger systems of transportation,

energy, and water distribution. However, it may simultaneously expose the entire city to a catastrophic failure if an extreme event overwhelms this one area. However the alternative, such as factories and business parks that are dispersed around the city, can require lengthy "single line" extension of services that are vulnerable to failure at lower levels of exposure.

When envisioning possible futures for your city or community you will want to develop high, medium, and low anticipated growth trends scenarios based on historical trends of economic growth and migration for the future. Ideally, you will understand what has driven these trends in the past (e.g. recovery from war, change in political structure, recurring severe drought and crop failure, etc.) and weigh how events in the next several decades might maintain or change these trends.

With climate change, climate becomes a third important driver for urban development and change. However, trend analysis is not the best way to construct future scenarios related to climate. This is the essence of the challenge that climate change presents—future climate is likely to look quite different from past climate. Certain broad level changes will occur. Global average temperature will increase, and this warming will be felt as specific impacts such as increased frequency and severity of tropical cyclones, rising sea levels, changes in the timing and intensity of rainfall events, alterations of monsoonal cycles, and the reduced productivity of many agricultural crops, among many others. However, climate scientists can't say exactly what the temperature changes and associated impacts will be in any given location or year. Consequently, resilience planners need to explore how possible climate changes in the future may disrupt urban systems, agents, and institutions under different development scenarios. It is useful for planning purposes to choose a time horizon, such as 2025 or even 2050 which is within the reasonable lifespan of most urban infrastructure and where the effects of climate change will be more fully evident so that interventions are adaptive to the full extent of the threat[1].

1 Many climate change reports include potential changes as far out as 2100. However, this is not a time horizon that is practical for local resilience planning.

How to Construct Scenarios

In Activity 3.2.1 we suggest a two-step process for developing and using scenarios. First, imagine a series of possible futures for your city. Then second, use these possible futures to build a best-case/worst-case analysis of specific issues facing your community or city. You will work through the details of this in the activity.

This type of scenario analysis can be conducted very qualitatively or very quantitatively, depending on needs and desires of the planning team.

- When used to generate initial resilience options, you may want to conduct a series of qualitative scenario building exercises that look at a broad range of physical and social conditions. By fairly quickly exploring a broad range of futures, you may quickly come to find that the range of future challenges are captured in two or three scenarios. You can then focus in on those.
- As you develop resilience options, you will want to evaluate them against your selected future scenarios to make sure they will work in all futures, or at least do no harm in all futures.
- As you prioritize resilience interventions, you may want to do more detailed scenario analysis that addresses the relative effectiveness of one intervention over another across your full range of scenarios.
- Finally, as you begin to implement resilience interventions, you may want to conduct quantitative scenario analyses to inform intervention design, scale, environmental, social or technical considerations, etc.

3.2.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

CONSTRUCTING SCENARIOS

Activity 3.2.1

One of the biggest challenges in planning for climate change is uncertainty—past trends are no longer useful indicators of future conditions. In this activity, you will explore how to develop future scenarios that focus on future outcomes, rather than past trends. You can use these scenarios to guide the development, evaluation and ranking of resilience interventions. Systematic use of scenarios in evaluating potential future conditions and needs can help you achieve a more resilient future.

IN THIS ACTIVITY YOU WILL:

- ✓ Select a future planning question to focus on.
- ✓ Identify the two most important factors for that future planning question.
- ✓ Identify the best- and worst-case scenarios for each of those factors.
- ✓ Set up a matrix analysis to explore the four possible futures that would result from combining the best and worst cases for both factors.

TRAINING.I-S-E-T.ORG

ACTIVITY 3.2.1: CONSTRUCTING SCENARIOS

INSTRUCTIONS

We suggest a two-step process for developing and using scenarios. First, imagine a series of possible futures for your city. Then second, use these possible futures to build a best-case/worst-case analysis of specific issues facing your community or city.

In the first step, imagining different futures for your city, you can use demographic and economic trends to create several storylines for a period in the future (such as 2030 or 2050):

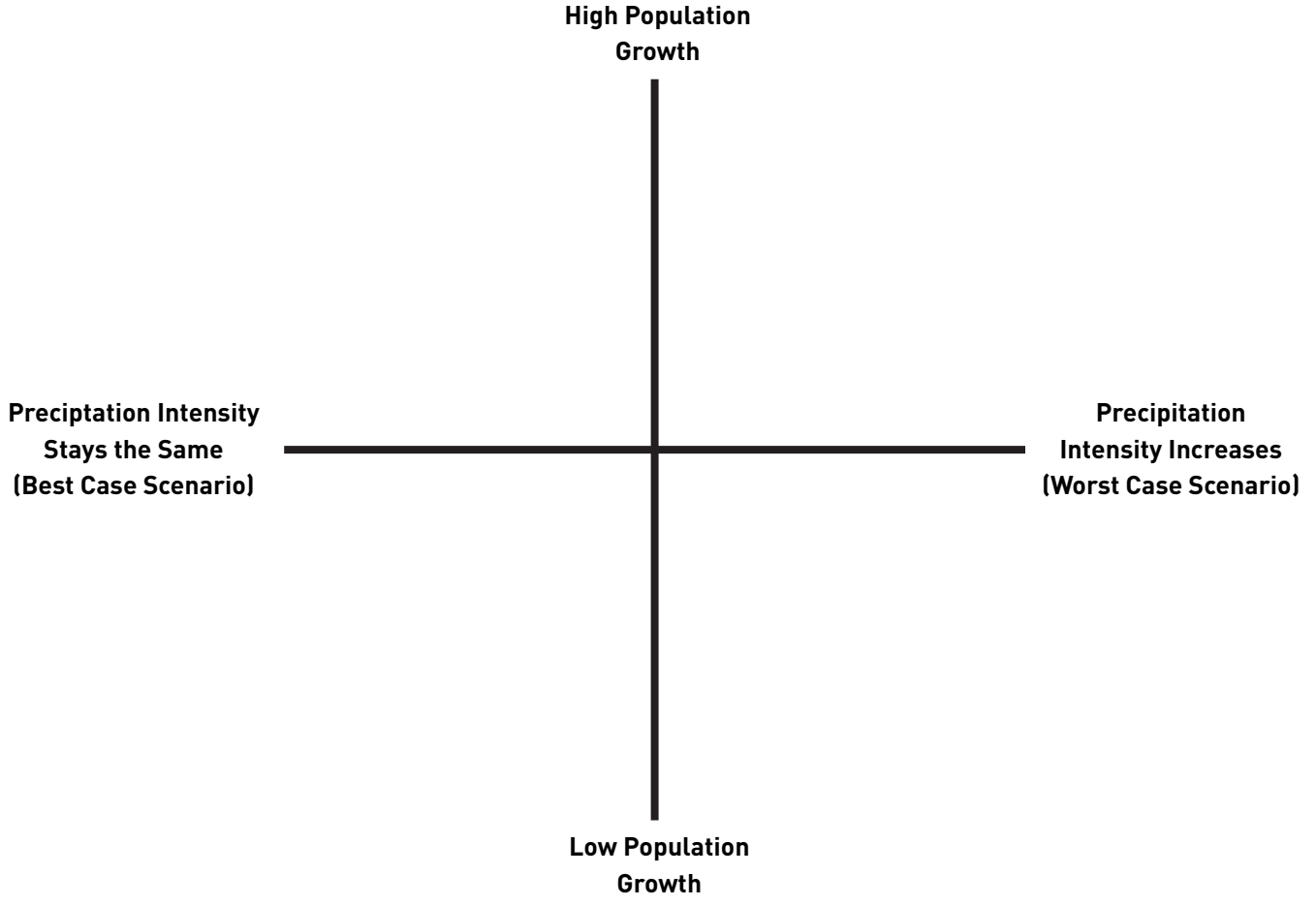
- high rates of migration with low economic growth
- low rates of migration and low economic growth
- rapid migration and fast growth
- slow migration and rapid growth.

If you find it helpful, these can be tied to specific events that are being discussed for the future, such as development of a bridge, road or airport connecting your city to new markets, changes in national agricultural policy which might impact migration rates, etc.

These storylines will help you define high and low rates of growth and characterize what your city might look like under each of those conditions. At a very basic level, you are just telling a story about what the city looks like and how it functions. Some cities in your region may have attributes that you hope your city will achieve in the future—an active business district with clean, safe public transit or abundant, high quality, affordable housing for the poor, for example. This can provide a starting point for exploring the conditions needed to achieve those goals. The goal of creating these broad story lines is to think about how changes in economic conditions or populations may promote or inhibit resilience aside from the role that climate change might play. A rapid rate of urban population growth, for example, that exceeds the city's ability to provide sufficient support for new residents will increase vulnerability to climate impacts.

The second step in Scenario Development is to identify two factors that are most important for your future planning. If you are concerned about city vulnerability to flooding caused by rainstorms, the two most important factors might be population growth rate and precipitation intensity. If you are concerned about how climate change will affect food security, your two factors might be temperature and drought. There also may be more than two factors that are important,

FIGURE 3.2.1
Setting up your future scenarios.



in which case you will want to pick two to start. Once you have completed your analysis of the first two factors, you can then build additional scenarios to address additional factors. Dealing with two factors at a time, even if there are many others, allows for an easier, more structured analysis. Because scenario planning is less about predicting a specific future and more about thinking about the range of potential futures and the main characteristics of each future, it is not necessary to attempt to construct a more complex set of scenarios at this point.

For each of the two factors you identified, you will create a best-case scenario and a worst-case scenario. In selecting your two most important factors, avoid factors that are highly predictable or highly unpredictable. If your factor is highly predictable, then there will be no difference between the best-case and worst-case scenarios. If it is highly unpredictable, it may be impossible to guess what the best-case and worst-case scenarios are. Work with factors that you can come up with reasonable bounds for. One way you might want to select factors is to choose one physical factor, and one social factor, e.g. drinking water vs. education/ awareness around drinking water.

On a blank sheet of paper draw vertical and horizontal axes as shown in Figure 3.2.1.

Use the best-case and worst-case scenarios to label the ends of horizontal and vertical lines. It does not matter which factor goes on which line, nor does it matter on which end of the line the best-case and worse-case conditions are put. Once you have set up your axes, look at each quadrant. What are the positive and negative aspects of each quadrant for your future planning? List these in that quadrant. We show a very simple example on the following page in Figure 3.2.2.

Once you have listed positives and negatives for each scenario, think about current systems and whether they are set up to either address the negatives or take advantage of the positives.

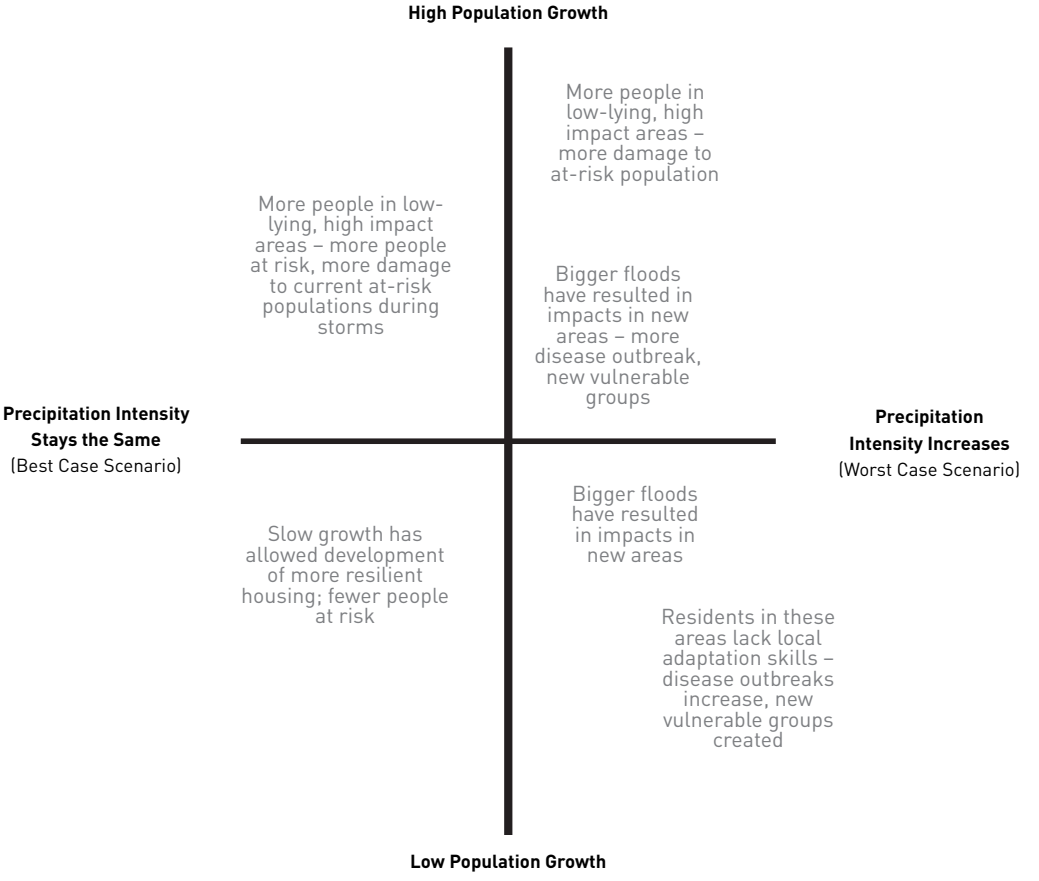
- What challenges are posed in each scenario? Which can your city handle? Which can't you handle and why? What would happen? For example, high heat might not affect a particular sector until energy production or distribution is affected. Then energy constraints, coupled with high heat, might result in high vulnerabilities.

- Are the current systems redundant or modular? Are there backups in place in case of failure? If not, how could backups or safe failure points be included?
- Is there a scenario in which current systems will completely fail? What could you do if those conditions occurred?

Write down the information you generate about teach of your future scenarios either next to the grid or on another sheet of paper.

Finally, explore whether, if you had to plan for just one of these scenarios, which you would choose, why you would choose that scenario, and what the risks of selecting that scenario over the other could be.

FIGURE 3.2.2
Populated Scenario Chart



3.3.0

SERIES 3
Building Resilience

DEVELOPING RESILIENCE OPTIONS

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

In this set, you will begin to explore what steps and activities you can take to address potential climate impacts.

Though climate resilience planning may be a new concept for your city, there are probably many actions already underway within your city that you can leverage. Ongoing disaster risk reduction, urban or utility planning, and poverty alleviation work all have the potential to contribute to building resilience. By leveraging existing tools, institutional mechanisms, and engagement in those efforts, and by enlisting the stakeholders responsible for their implementation, you may have a strong start to your resilience work. In most cases, there will be no need to invent new technology or tools to address the future threats of climate change. However, building resilience will often require new ways of thinking and solving problems. The Climate Resilience Framework can help structure this new way of thinking and problem solving.

IN THIS SET YOU WILL:

- ✓ Learn how to use the Climate Resilience Framework and resilience characteristics to evaluate potential resilience actions; and
- ✓ Explore how existing city initiatives can be leveraged, within the Framework, to efficiently and effectively start your resilience building work.

Contents of Set

TRAINING.I-S-E-T.ORG

Overview

Building urban resilience is a complicated and lengthy endeavor. It requires ongoing engagement with a wide group of stakeholders, and eventually may require addressing new threats or developing new approaches and methodologies. However, many of the most effective interventions start with existing activities and address existing vulnerabilities that are likely to get worse as a result of climate change. They are easy to implement, because they are already familiar to residents and planners, and they are easy to engage stakeholders around because they address current needs while also addressing likely future challenges. For example, many disaster risk reduction efforts involve extensive public awareness and education campaigns. A climate change component can be developed for these campaigns addressing growing flood risk, risk of increased incidence of extreme weather, increasing risk of storm surge, etc. By augmenting existing programs, resilience planners access a well-established and credible public engagement process with relatively little investment. Leveraging existing projects, programs, and municipal efforts like this will allow you to broaden the effect of your interventions and increase the likelihood that they will be sustained by a large and willing group of stakeholders.

Often, however, developing resilience to climate change does require a new way of thinking about urban vulnerability and new ways of focusing financial resources and human capacity. It is not enough to identify current, successful projects in your city and assume they will be effective for future challenges. The effects of climate change will be broad, impacting your city in complex and sometimes hard-to-predict ways. The Climate Resilience Framework (CRF) provides a basic structure for thinking about how to address these complex, inter-linked social and physical vulnerabilities and assists in identifying specific, sustainable, effective actions.

The basic structure of the CRF—systems, agents, institutions and exposure—is a good starting point for exploring options to build climate resilience. Your vulnerability assessment (Series 2):

- Identified systems and agents in your city that are currently vulnerable;
- Considered the role institutions play in creating or maintaining those vulnerabilities; and
- Explored how climate changes over the next few decades might increase exposure, exacerbating vulnerabilities.

You will want to identify potential actions that address deficiencies in each of these elements, although it is not necessary to treat them equally in terms of number or scale of activity. Not all urban systems and agents will be affected equally, and not all interventions will have the same impact. Ultimately you will want to select the MOST viable, cost-efficient, and timely actions possible. Use the priority list of vulnerable systems and agents you identified earlier to initially limit the scope of your efforts. However, in these early stages you want to focus first on engaging a broad range of stakeholders to leverage the experience and creativity of your entire community to identify as many potential solutions and activities as possible. Broad engagement with stakeholders will also serve to build a network of people with shared resilience goals. This will make the transition from the prioritized actions that are easiest to take now (based on existing mandates, resources and expertise) to broader resilience actions easier.

A climate resilient city or community will seek to reduce the vulnerability of systems and agents while simultaneously improving the ability of social/cultural institutions to enhance, rather than inhibit, social equity and opportunity. Below are the characteristics that make a system, agent, or institution resilient. These characteristics can be used in two ways: the first is to identify existing weaknesses and, at an initial level, target a more specific area where an intervention may help solve the problem. Later, once you've begun to develop resilience actions themselves, you can use this list as a basic assessment of the inherent resilience of the concept. For example, "does modifying the height of a dike increase the flexibility and diversity of the flood management system?" Within each category, it is important that each action meet several of these characteristics.

SYSTEMS

CHARACTERISTIC	FLEXIBILITY AND DIVERSITY	REDUNDANCY AND MODULARITY	SAFE FAILURE
Description	The ability to perform essential tasks under a wide range of conditions, and to convert assets or modify structures to introduce new ways of performing essential tasks.	Spare capacity for contingency situations or to accommodate increasing or extreme surge pressures or demand; multiple pathways and a variety of options for service delivery; and/or interacting components composed of similar parts that can replace each other if one, or even many, fail.	Designed to fail in predictable and/or planned ways that will minimize damage; ability to absorb or respond to sudden shocks or the cumulative effects of slow-onset stress in ways that avoid catastrophic failure.
Examples	• Food is imported into the city from numerous, diverse national and international locations, so if crops fail in one region food is still available. • Community flood shelters can be flexibly used during non-flood periods, doubling as clinics or meeting halls.	• There are multiple roads leading out of the city so that if one roadway is blocked, alternate routes are available. • Water tanker trucks provide modularity: if one truck fails the system is not seriously affected.	• Dikes and floodways that channel extreme floods into wetlands or retention zones where they cause minimal damage. • Fuses and breakers in home electrical systems that break or fail rather than letting a power surge melt wires or destroy electronics.

AGENTS

CHARACTERISTIC	RESPONSIVENESS & RE-ORGANIZATION	RESOURCEFULNESS	CAPACITY TO LEARN
Description	Able to organize and re-organize in an opportune fashion; ability to establish function, structure and basic order in a timely manner in response to a disruptive event or organizational failure.	Capacity to identify and anticipate problems; establish priorities, and mobilize resources for action. This includes the capacity to visualize and plan, which may require collaboration. It also includes the ability to access financial and other resources, including those of other agents and systems in order to take action.	Ability to learn new information, skills, techniques and behaviors, to internalize past experiences, to avoid repeated failures and innovate to improve performance.
Examples	• Releasing water from a water supply or power generation reservoir in advance of a forecasted typhoon to allow for floodwater storage and avoid catastrophic release. • Disaster Risk Reduction planning, training and re-structuring for community organizations. • Moving your furniture up to the second flood before a large storm or flood forecast.	• Ability to access credit or insurance to protect against and recover from shocks and to leverage opportunities. • Strong social networks that provide physical and emotional support and resources.	• Monitoring, through formal and informal reviews of performance of key systems, identification of opportunities for improvement. • The ability to understand and implement innovative changes, such as adopting a new housing design to address recurrent flooding.

INSTITUTIONS

CHARACTERISTIC	RIGHTS AND ENTITLEMENTS	DECISION MAKING	INFORMATION
Description	Rights and entitlements to use key resources or access urban systems are equitably distributed.	Decision-making processes, particularly in relation to urban development and urban systems management, follow widely accepted principles of good governance, chiefly: transparency, accountability and responsiveness (United Nations Development Program, 1997 #202).	Private households, businesses and other decision-making agents have ready access to accurate and meaningful information to enable judgments about risk and vulnerability and for assessing adaptation options.
Examples	• All city residents have access to water and water is priced to provide minimum basic needs at a rate that the poorest city inhabitants can afford.	• Diverse stakeholders have ways to provide meaningful input to decisions.	• Useful, clearly presented information regarding hazards and possible response options are available to the public through accessible media, such as in newspapers, on the radio or television, and on websites.

Using Resilience Characteristics

For each of the system or agent weaknesses you identify, you should attempt to look beyond the apparent obvious cause to more subtle, underlying issues. For example, in a seaside town, storms may be causing beach erosion. However, further exploration may reveal that erosion was not as great a problem before the offshore reef was damaged and a nearby mangrove forest was removed to allow for construction directly on the beach. By uncovering the root cause of the erosion, this town might decide that rather than build a heavily engineered and very expensive beachfront retaining wall, they would invest in a short-term retaining wall, in restoring the coral reef, and in mangrove planting. The latter two efforts could employ local residents in their implementation and maintenance, providing local jobs, and be accompanied by a community education program around climate change, sea level rise, and the protection provided by reefs and mangrove forests. Long-term planning for this community might begin exploring zoning and land use planning mechanisms that would support or drive a gradual retreat from the coast as sea-level rise results in higher storm surge.

Identifying and developing actions to influence or intervene with institutions may be particularly difficult. In some respects, the pervasive, socially constructed nature of institutions provides few opportunities for small, targeted actions to effect meaningful change. However, public education campaigns aimed at changing underlying social behavior could be considered "institutional change". In other instances, changing specific regulations (e.g. around school access) could bring meaningful social or planning change. However, it should be noted that advocating for changes in formal government laws can be fraught with political risk and create divisions rather than coalitions among stakeholders and therefore should be undertaken cautiously. The perspective that we advocate with this process is that the consideration of institutional restraints is important, even if they are not being acted upon. It can give insight into current limitations and opportunities for future partnerships, facilitated learning or other exchange with other organizations.

Resources, both human and financial, are limited for resilience activities so inevitably the range of options is somewhat limited. Experience with resilience planning in other cities around the world suggests that some interventions are repeatedly identified as likely to build resilience within the same general resource constraints. Although each city and community has a unique social, cultural, economic, and environmental context that will

lead to some specific, place-based solutions, the nature of climate change, its likely impacts on cities, and the persistent problems that plague almost all developing countries and cities mean that you can start identifying options by examining a list of strategies that have been successful elsewhere. Table 3.3.1 lists some of the activities that have been implemented in the ACCCRN cities and the problem they seek to address.

In the next activity, you will work in small groups to identify possible resilience options for your city. These options should take into account the findings of your Vulnerability Assessment, and the basic scenarios you outlined in Set 3.2. Your vulnerability assessment will help you identify fragile systems and weak agents, and the institutions that constrain current response to those fragilities and weakness. The scenario work you completed in Set 3.2 will help you envision how different combinations of conditions will highlight the importance of some risks and vulnerabilities relative to others, allowing you to narrow the possible range of activities to those that will have the greatest impact in areas most important to your community.

TABLE 3.3.1: ACCCRN INTERVENTIONS MAPPED AGAINST CRITICAL UCCR ACTION AREAS

Current ACCCRN City Interventions	Land use & urban planning	Drainage, flood & solid waste management	Water demand & conservation systems	Emergency management & early warning systems	Responsive health systems	Resilient housing & transport systems	Ecosystems service strengthening	Diversification & protection of climate affected livelihoods	Education & capacity building of citizens	Institutional coordination mechanisms & capacity support
INDONESIA										
Semarang: Pre-feasibility study for expanding rainwater harvesting systems			X							
Bandar Lampung: Integrated solid waste management master plan		X								
Semarang: Flood forecasting and warning system		X		X						X
Bandar Lampung: Ground Water Conservation (Biopores)	X	X	X							
Bandar Lampung: Building Teachers and Students Climate Change Resilience Capacity				X					X	
INDIA										
Surat: End-to-end early warning system		X		X						X
Indore: Testing and promoting decentralised systems for differential water sources and uses			X			X				
Indore: Strengthening vector-borne disease surveillance and response systems				X	X				X	

TABLE 3.3.1 (CONTINUED): ACCCRN INTERVENTIONS MAPPED AGAINST CRITICAL UCCR ACTION AREAS

Current ACCCRN City Interventions	Land use & urban planning	Drainage, flood & solid waste management	Water demand & conservation systems	Emergency management & early warning systems	Responsive health systems	Resilient housing & transport systems	Ecosystems service strengthening	Diversification & protection of climate affected livelihoods	Education & capacity building of citizens	Institutional coordination mechanisms & capacity support
INDIA										
Surat: End-to-end early warning system		X		X						X
Indore: Testing and promoting decentralised systems for differential water sources and uses			X			X				
Indore: Strengthening vector-borne disease surveillance and response systems				X	X				X	
Gorakhpur: Implementing and promoting ward-level micro resilience planning	X	X							X	X
Gorakhpur: Implementing and promoting adaptive peri urban agriculture	X	X					X	X		
Indore / Surat: Cool roof and passive ventilation promotion for low income housing						X				
Indore urban lake restoration for emergency water provision	X		X				X			

TABLE 3.3.1 (CONTINUED): ACCCRN INTERVENTIONS MAPPED AGAINST CRITICAL UCCR ACTION AREAS										
Current ACCCRN City Interventions	Land use & urban planning	Drainage, flood & solid waste management	Water demand & conservation systems	Emergency management & early warning systems	Responsive health systems	Resilient housing & transport systems	Ecosystems service strengthening	Diversification & protection of climate affected livelihoods	Education & capacity building of citizens	Institutional coordination mechanisms & capacity support
VIETNAM										
Can Tho, Da Nang, Quy Nhon: Climate Change Resilience Coordination Offices (CCCOs)	X									X
Quy Nhon: Hydrology and urban development modelling for flood-related land-use planning	X	X								
Da Nang: Hydrology, hydraulic and urban development simulation model	X	X								
Da Nang: Storm and flood resistent credit and housing scheme						X				
Da Nang: Developing, testing and promoting new education modules to increase youth awareness on UCCR									X	
Quy Nhon: Urban mangrove restoration for storm surge protection and resilient land-use practice	X	X		X			X	X		
Can Tho: Strengthening dengue fever surveillance and response system				X	X				X	
Can Tho: Developing and implementing real-time salinity monitoring, disemmination and response mechanisms					X			X	X	
Can Tho, Da Nang, Quy Nhon: Vietnam youth urban resilience competition									X	

TABLE 3.3.1 (CONTINUED): ACCCRN INTERVENTIONS MAPPED AGAINST CRITICAL UCCR ACTION AREAS

Current ACCCRN City Interventions	Land use & urban planning	Drainage, flood & solid waste management	Water demand & conservation systems	Emergency management & early warning systems	Responsive health systems	Resilient housing & transport systems	Ecosystems service strengthening	Diversification & protection of climate affected livelihoods	Education & capacity building of citizens	Institutional coordination mechanisms & capacity support
THAILAND										
Chiang Rai: Restoration of Kok River for urban flood management		X					X			
Hat Yai community based flood preparedness and institutional coordination systems		X		X					X	X

*Note: The critical UCCR action areas are derived from the base of specific interventions proposed by ACCCRN city and national partners in India, Indonesia, Thailand, and Vietnam as well as the ten city resilience strategies prepared by the multi-stakeholder Climate Working Groups of each ACCCRN city. These documents are available at www.acccrn.org.

Table excerpted from: Brown, A., A. Dayal and C.Rumbaitis Del Rio, 2012. From practice to theory: emerging lessons from Asia for building urban climate change resilience. Environment and Urbanization, October 2012, vol. 24, no. 2, 531-556.

3.3.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Developing Resilience Options

Activity 3.3.1

In this activity, you will work in small groups to identify possible resilience options for your city. These options should take into account the findings of your Vulnerability Assessment, and the basic scenarios you outlined in Set 3.2. Your vulnerability assessment will help you identify fragile systems, weak agents, and the institutions that constrain current response to those fragilities and weakness. The scenario work you completed in Set 3.2 will help you envision how different combinations of conditions will highlight the importance of some risks and vulnerabilities relative to others, allowing you to narrow the possible range of activities to those that will have the greatest impact in areas most important to your community.

IN THIS ACTIVITY, YOU WILL:

- ✓ Use simple matrices to organize your thinking around possible resilience actions that could address identified vulnerabilities.

TRAINING.I-S-E-T.ORG

ACTIVITY 3.3.1: DEVELOPING RESILIENCE OPTIONS

INSTRUCTIONS

Select one of the city vulnerabilities that you have previously identified. This could be a vulnerability that you explored in Set 3.2, but doesn't have to be.

For this vulnerability, identify key systems, agents and institutions involved. For example, you might identify flooding of informal settlements during intense rainstorms as the area of vulnerability. Agents involved might be local residents of the settlement, international donors and NGOs working in the settlement, and city line department staff and managers tasked with providing services to the settlement. Systems could include drainage, solid waste disposal, sewage, piped water, electricity, health care and housing. Institutions might include land title, city zoning and enforcement, and social and cultural biases and expectations around migrant workers and women.

Once you have identified the agents, systems, and institutions associated with the vulnerability, list them along the top of the matrices below. As you will see, the resilience characteristics of systems, agents and institutions are already listed down the left-hand side of the matrices.

Next, talk through examples of each of the resilience characteristics as they relate to the vulnerability you identified. Consider whether the words we use to describe these characteristics are the most useful in your context. If there are other words that better convey the same ideas for you and your stakeholders, write those in the matrix instead.

Now, go through the matrices first with a red pen, and then with a black or blue pen. First, with the red pen, briefly note how the system, agent or institution identified at the top of that column fails to meet the resilience characteristic listed at the left-hand side of that row. Second, go through with a blue or black pen and write a descriptive statement of where and how resilience characteristics are met.

SYSTEMS

SYSTEMS ASSOCIATED WITH VULNERABILITY				
List Your Examples:				
Flexibility & Diversity				
Redundancy & Modularity				
Safe Failure				

AGENTS

AGENTS ASSOCIATED WITH VULNERABILITY				
List Your Examples:				
Responsiveness				
Resourcefulness				
Capacity to learn				

INSTITUTIONS

INSTITUTIONS ASSOCIATED WITH VULNERABILITY				
List Your Examples:				
Access				
Decision-making				
Information				

To Think About

The matrices provide a visual method for identifying which characteristics are not currently being met. Once completed, you can use these matrices to brainstorm actions that address the identified deficiencies. As a group, review your filled in matrices and brainstorm what actions could be taken to address areas that are red. Note these either within the relevant matrix cell or list them on a separate page of paper.

This exercise will identify far more potential resilience actions than you can feasibly undertake, and will address only one area of vulnerability. Ultimately, you will want to complete similar analyses of other city vulnerabilities, and then prioritize initial resilience actions taking into account the full range of possible actions for possible vulnerabilities.

Sets 3.4 through 3.8 present tools that can help you prioritize actions. Other tools to aid in selection and prioritization are mentioned in Set 3.0 and can be found on the internet or from other sources. Ultimately, however, the process of selecting resilience actions, particularly which actions you will begin with, should highlight what is most feasible given existing resources, networks and strengths of your team. Over time, as you gain increasing familiarity and comfort with resilience planning and greater recognition of your work, you can use the full range of potential actions to help identify places where building city resilience will benefit from or require partnerships and alliances with other groups to bring in other skills. As you move forward with your resilience efforts, you will want to also draw in the expertise of these other groups so that a increasingly broader range of resilience actions becomes possible.

3.4.0

SERIES 3
Building Resilience

CAPACITY ASSESSMENT

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Most cities do not have all the climate information and planning resources they would like to have. Consequently, they must determine what knowledge, skills, and abilities they and their citizens do have and how those can contribute in a meaningful way to resilience goals. A capacity assessment is an evaluation of the human resources that are available locally, and which critical skills may need to be filled by outside experts or consultants. Outside experts can be costly. By effectively using local citizens and institutions whenever possible you can save significant funding while simultaneously generating ongoing public education and engagement in the city resilience process and increased institutional buy-in into the project goals and efforts. Additionally, relying on local resources may help you discover local conditions and/or social priorities that outside experts would not be aware of.

IN THIS SET YOU WILL:

- ✓ Be introduced to capacity assessments and the role they play in prioritizing resilience interventions and planning project implementation;
- ✓ Identify core capacities your city will need to deliver climate intervention projects;
- ✓ Discuss whether these skills might be available locally, and if so where that capacity is located;
- ✓ Develop a rating system to indicate the depth of that capacity; and
- ✓ Develop an initial capacity assessment matrix for one of your proposed resilience projects.

Contents of Set

TRAINING.I-S-E-T.ORG

Overview

Capacity assessments can help you determine what skills, knowledge, and experience local individuals and organizations can contribute to specific resilience efforts and projects in your city. Ideally, a capacity assessment will be implemented for each adaptation or resilience action you plan to implement. In some cases, the capacity and information needed for the project will be clear and the capacity assessment will be very brief, possibly as simple as a discussion among the climate working group members. In other cases, it may require a more formal effort, in which project goals are systematically reviewed, the capacities and information needed to achieve those goals compiled, and stakeholder meetings held to identify local sources of capacity and information. During this assessment process, skills and knowledge that are not available locally will also be identified.

Capacity assessments are most useful and effective when they are conducted with specific project goals in mind and particular skills and knowledge can be identified. However, a capacity assessment for a specific project will be useful for other projects as well. For example, an assessment of capacity for a mangrove restoration project may result in a matrix of local skills and abilities that can be saved and shared with other project teams. This way, another teams working to restore or enhance city parks, for instance, will already know whether there are local ecologists familiar with both the local environment and city resilience efforts. Ultimately, your climate working group should have a large and detailed (and constantly growing!) understanding of all the local capacities you have used for planning or implementing individual projects as part of your broader resilience plan.

Capacity assessments are often conducted in conjunction with technical feasibility studies. A technical feasibility study aims to answer the question "can this be done?" A capacity assessment seeks to determine who can do it, either locally or from other institutions outside the city. However, capacity assessment should not be limited to just the technical project skills and needs identified through a feasibility study, but instead should be conducted more broadly to assess the full range of skills that a community can bring to solving complex climate issues.

It is important that the team of people conducting the capacity assessment be both knowledgeable about the city resilience efforts and have broad community representation. Having diverse team members with various community backgrounds and expertise will help you identify a broader range of local capacity, and will help ensure that your team addresses the considerations and perspectives of vulnerable

populations. For example, an assessment team that does not include women, in a community where women are the primary household managers, may fail to identify that these women have a detailed understanding of local well water levels. For studies that will need groundwater level information, such as water supply studies, salinization studies, or flood control studies, this information could be critical, and not available elsewhere. It is also essential that the assessment team include members who are knowledgeable about the city resilience efforts so that the appropriate skills and knowledge are identified.

Capacity assessment can be undertaken at a number of points in a project:

- As resilience actions are developed and prioritized, capacity assessments can help evaluate whether you can meet the project's goals using local resources. The ability to use local capacity, and thereby keep costs down, may play a role in how you prioritize your resilience options.
- Once you have selected resilience actions for implementation, surveying local capacity in the planning process will save time and energy by maximizing the use of local talent and minimizing outside consultation.
- Once a project has been developed and is ready for implementation, a capacity assessment that was conducted during the prioritization or planning phases should be re-evaluated in light of modified goals or project requirements. Alternatively, if a capacity assessment was not conducted during earlier phases, one should be undertaken before implementation is begun.

Your team may be interested in identifying a whole range of capacities, including local skills in project planning, monitoring, and integration, as well as specific scientific and community knowledge. Because few cities have staff experienced with implementing projects specifically for climate resiliency, it will be necessary to seek these skills in departments and organizations that have achieved success in other areas. For example, transportation departments often have experience in projects that require large logistical planning and coordination across a city and in a variety of communities. Transportation agencies, therefore, may be a source of strong project planning skills. Likewise, a local community health NGO may have experience building awareness on public health issues, and would therefore be a good source for community education or awareness campaign skills.

There are a number of ways you can record and evaluate the capacities within your community. One simple method is to create a Project Capacity Matrix on paper or in a computer

spreadsheet. In the left-hand column you list the skills and knowledge areas necessary to plan and implement the project. Across the top, you list local organizations and departments. The capacity of each department, organization, or individual will be scored using a regular rating system, such as the one below:

0 **Unknown capacity:** The team is unaware of the department/organization's current skills or knowledge in this area, and therefore needs more information.

1 **No evidence of relevant capacity:** The team has determined that this department/organization does not have relevant skills or knowledge in this particular area.

2 **Anecdotal evidence of capacity:** The team has reason to believe that this department/organization has relevant skills or knowledge, and therefore needs more information to determine the extent.

3 **Partially developed capacity:** The team identifies some relevant experience that has recently been developed or is in the process of being developed. The team may therefore approach this department/organization, however keeping in mind that additional expertise is likely to be necessary.

4 **Widespread, but not comprehensive, evidence of capacity:** The team sees this department/organization as a strong, if not expert, source of skills or knowledge. The team agrees it can rely upon this organization/department for a great deal of the project's capacity needs, with the chance that external consultation may still be required.

5 **Fully developed capacity:** The team has identified full or expert capacity in this department/organization and may rely upon it for all relevant skills and knowledge. No outside consultation will be required.

To ensure consistency, the same rating system must be used for all aspects of the assessment. Your assessment team must define the basis for each rating level so that there is reliable evaluation of capacities. For example, a rating of four (4) from the example above might be defined as a general agreement and understanding among your assessment team that the water department is capable of long term budgeting because they have recently completed a city works project that required that skill, but the team believes that skill to be relatively new to the department, one that has not been used regularly with well known success. Each city should develop its own system—other examples include: 1-10 ratings, High-Medium-Low scales, or more simplified Yes

or No categorization. Because the ratings themselves may be subjective, based solely on the available knowledge of the assessment team, it is important to have a diverse team and be willing to make adjustments to the ratings as more information becomes available.

When creating your project matrix, it is useful to develop a list of skills that all or most projects will need. Those could include multi-year budgeting experience, logistical planning, and project monitoring and evaluation, among others. The skills that every project needs should form the basis of your assessment matrix and will appear in each assessment. Other skills and knowledge may be needed based on specific project requirements, and will therefore change from assessment to assessment. Many of the specific knowledge and technical skills a particular project may need will be identified through a technical feasibility study and should be incorporated into your assessment matrix.

In addition, the matrix should list as many departments and organizations as possible. While assessment team members might come to the table with specific departments or organizations already in mind, it is critical to consider a large range of possible sources, since skills often exist in unexpected places.

To Think About

Capacity assessments can be challenging because of the tendency for departments, organizations, and institutions to work independently and therefore unintentionally restrict outside knowledge of their internal capabilities. Valuable skills and knowledge can remain inaccessible because the assessment team is simply unaware of potential resources. As individuals and organizations are identified as partners, they should be consulted for their knowledge about other potential contributors, thereby extending the reach of the assessment process and increasing the buy-in of new partners. It is important to acknowledge that it will be nearly impossible to assess the full range of skills available within a community for resilience efforts, so the assessment should be seen as an ongoing process that can be added to as the project develops.

There is also a risk that the assessment process itself will become the goal rather than a means of achieving a larger goal. The identification of individuals with necessary skills is only a step in the planning and implementation process and should be conducted within a limited timeframe to complement other ongoing activities.

Finally, and perhaps most challengingly, assessing the local availability of a certain set of skills obviously does not guarantee that those organizations or people will participate in your planning and implementation efforts. This can leave inconvenient gaps that will still need to be filled by other means. If you have identified capacities that you hope to use in your projects, begin discussions early with the relevant departments or organizations.

While many aspects of resilience planning will capitalize on skills already present in your community, climate change also raises an entirely new set of challenges due to the highly uncertain nature of impacts. Existing departments or organizations may be more comfortable planning traditional projects, such as construction of flood infrastructure, that assume a predictable, stable climate. Projects managers should take this into consideration when approaching departments for their skills or knowledge.

A Note on Technical Feasibility Assessments

Technical feasibility assessments generally go hand-in-hand with Capacity Assessments. Technical Feasibility Assessments are designed to answer "can it be done?" and if so, "what skills will we need to do it?"

Technical feasibility assessments are not just for highly technical or 'hard' projects (e.g. infrastructure solutions), but are valuable for any project, including those based on softer approaches such as capacity building, community action, and policy development. A technical feasibility assessment should also addresses the practicality of the proposed project by addressing potential constraints such as available timeframe, risks to implementation, and governance (such as regulations). The type of assessment you will need will be highly dependent on the type of project you are proposing. We do not provide a framework for technical feasibility assessments as part of Series 3, but encourage groups to look for local or regional feasibility assessment resources and to include this as part of your evaluation and ranking of resilience options.

It should also be noted that technical feasibility analyses do not evaluate 'should it be done'. This is an important question, and is better answered through other approaches such as cost-benefit, vulnerability analysis, stakeholder consultations, environmental and social assessments, and multi-criteria analysis. Several of these other approaches are addressed in Series 2 and Series 3 Sets. The Participatory Cost Benefit Assessment approach, provided in Set 3.6, may be particularly helpful in answering 'should it be done'.

3.4.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Capacity Assessement

Activity 3.4.1

Assessments can be used to determine what knowledge, skills, and abilities a city and its citizens have, how those can contribute in a meaningful way to resilience goals, and where local capacity gaps will need to be filled from outside the community. In this activity, you will develop the foundation for a capacity assessment.

IN THIS ACTIVITY, YOU WILL:

- ✓ Identify core capacities your city needs to deliver climate intervention projects;
- ✓ Discuss whether these skills might be available locally, and if so where that capacity is located;
- ✓ Develop a rating system to indicate the depth of that capacity; and
- ✓ Develop an initial capacity assessment matrix for one of your proposed resilience projects.

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ACTIVITY 3.4.1: DEVELOPING RESILIENCE OPTIONS

INSTRUCTIONS

Step 1: Begin by creating a list of the most important skills needed to complete medium to large projects in your city. For this example, focus on listing the core skills and knowledge needed to complete projects, regardless of whether they are for city resilience efforts. List as many specific skills or areas of knowledge as necessary.

In order to successfully complete a city resilience project, we must have an organization or individual who can:

Example: Monitor project progress, and report budget and timeline variances to the project coordinator in a timely and efficient manner.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Step 2: Develop a draft capacity rating system for your city. Choose a rating system that will convey a range of capabilities from higher to lower and then provide a simple, regular definition for each level to ensure consistent application.

Capacity Rating System	
Rating	Definition

Step 3: Finally, select one of your proposed resilience intervention projects. Using your list of core capacities created in Step 1 and your draft rating system created in Step 2, create an initial matrix for this project. In this example exercise, use an existing list, or create a list from memory, of city departments and local non-governmental organizations and assess their capacity to contribute to this project's objectives. Just list about five organizations or departments that you feel could be particularly useful and proceed with the assessment. However, if you choose to use this exercise as the basis of a more complete capacity assessment, you will want to expand on this initial analysis by listing as many organizations or departments as possible and considering each one's capacities as they related to the skills you have identified as necessary.

An example table format has been provided below, and a blank matrix has been provided on the next page on which you can complete the exercise. You may choose to redesign the matrix to fit your own needs.

Project Goal:						
Departments and Local Organizations	Core Skills					
		Skill 1	Skill 2	Skill 3	Skill 4	Etc.
	Dept. A					
	Dept. B					
	Dept. C					
	Org. A					
	Org. B					
	Etc.					

Project:						
	Core Skills					

3.5.0

SERIES 3
Building Resilience

INTRODUCTION TO COST-BENEFIT ANALYSIS

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Contents of Set

3.5.0: Guide

This guide describes what Cost-Benefit Analysis (CBA) is and explores two approaches to CBA: adaptation of a traditional quantitative CBA to climate risk related interventions (Set 3.7); and participatory CBA (Set 3.6). It also discusses the limitations of CBA and how supplementary methodologies can overcome these shortcomings. In these materials, we do not go into detail on how to conduct your CBA—that is covered in the following sets. Instead, this guide provides information on how to determine if CBA is useful to your process and if so, which type of CBA is most appropriate and what the scope of that analysis should be.

IN THIS SET YOU WILL:

- ✓ Be introduced to cost-benefit analysis;
- ✓ Decide whether to do a participatory analysis only, or whether you need both a qualitative participatory analysis and a quantitative analysis; and
- ✓ Learn about both participatory cost-benefit analysis and quantitative cost-benefit analysis and the differences between the two.

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Overview

Cost-benefit analysis is a process in which you compare the benefits (increases in human well-being) and the costs (reductions in human well-being) of implementing a specific project or policy. The use of cost-benefit analysis is to determine the overall economic benefit that would accrue to society if the project or policy were undertaken.

WHY COMPLETE A COST-BENEFIT ANALYSIS?

Cost-Benefit Analysis (CBA) is generally necessary to secure funding for, or justify the implementation of or decision not to implement, a project. Most people use cost-benefit analysis to:

1. Help identify which project, among a collection of proposed projects, will have the most positive impact on society.
2. Determine long-term costs and benefits of a project.
3. Identify key areas of risk.
4. Provide justification to funding entities (private or non-private) that the project you are undertaking has a realizable return either financially or for society.

There are many opportunities to use cost-benefit analysis and many variations that are used in different situations. If you have a number of options and cannot adequately identify a solution, cost-benefit analysis provides a logical way to evaluate the project or projects from multiple angles. In addition, funding agencies often ask funding recipients to justify the payback of their investment. Cost benefit analysis is a systematic, widely accepted approach to generate payback information. However, cost-benefit analysis is most useful in situations where there is a comparison being made. For example, building a raised transportation system for the city could be compared to what it would cost not to raise the transportation system. The value in cost-benefit analysis is to find the best solution and requires analysis of all agreed upon ideas.

It is important to note, though, that CBA should not be used as the only analysis informing your decision-making. Often, impacts to society or the environment, either positive or negative, are not included in the CBA analysis. This is particularly true of quantitative cost-benefit analysis where there is no standard way to identify the financial value of things like a life, a livelihood, or a healthy forest. The value of these things is highly dependent on who you are and how you live. Clearly, this information should be considered when a project is evaluated for implementation.

WHAT TYPE OF CBA?

Most cost-benefit analyses use a quantitative approach. However, this requires a significant amount of data, time, and technical expertise to complete, and is consequently expensive and time consuming to implement. To address the need for a simple way to evaluate cost-benefit in situations where data, time, money or technical expertise is limited and where community input is critical for evaluating social and environmental impacts, ISET has created a participatory cost-benefit analysis. The basic characteristics of each of these approaches are given below:

PARTICIPATORY COST-BENEFIT ANALYSIS

Participatory cost-benefit analysis is a qualitative analysis that captures information that is often unavailable from traditional data sources. It ensures that financial, social and environmental benefits and costs of an activity are identified. It can be implemented quickly and easily, requiring little or no data and instead relying on the knowledge and opinions of the stakeholders that will be impacted by the decision. In working together to complete a participatory CBA, the stakeholders involved not only identify the benefits and costs of proposed options, but also learn about and negotiate the implications of the different options and how those implications should be valued. Participatory cost-benefit analysis can be used to initiate discussions with diverse groups of stakeholders and can be facilitated during shared learning processes. Finally, unlike traditional cost-benefit analyses, a participatory cost-benefit analysis identifies the benefits and costs to most parties impacted by that policy, project, etc. (for more information concerning this see page 4, viewpoints). This is generally not possible in a desk study.

TRADITIONAL, QUANTITATIVE COST-BENEFIT ANALYSIS FOR CLIMATE RISK REDUCTION

Traditional cost-benefit analysis is a quantitative analysis in which costs related to a certain investment are quantified and compared to total benefit derived from that investment. This is a time consuming and data intensive process. Climate risk reduction cost-benefit analysis adds additional complexity to this process. Although costs are calculated in the same manner as any other investment, benefits are measured in terms of damages avoided if that intervention is implemented. To do this, one needs to: know the historic and projected future frequency of climate hazard events; know the damages associated with various intensities of past events; know the potential intensity of future events; and estimate potential future damages associated with those event intensities. This requires additional expertise, data and analysis time.

Overall, participatory CBA is highly recommended for everyone. It's quick, it's inexpensive, and it usually generates new

Limitations of Cost-Benefit Analysis

Cost-Benefit Analysis is a tool that can support decision-making, but it has many limitations.

It is important that you be aware of these limitations before you use cost-benefit analysis results in your decision process.

Assumptions. Most cost-benefit analyses are based on a series of assumptions. It is important that those assumptions are clearly stated and understood by anyone using the analysis. For example, one assumption might be the timeline of the project. A dam might have a 25-year project life, or a 50-year project life. Both numbers are critical to projected yearly costs and benefits. At fifty years, the payback of the investment might never make it viable. Another example might be how data limitations are handled. For example, data about household losses during a flooding event that are available for only one city might be used to characterize losses for the entire province, which could easily over- or under-estimate losses if applied by someone unfamiliar with actual conditions in the province. These assumptions need to be clearly stated.

Viewpoints. Cost benefit analysis evaluates benefits to society, but "benefit" can be considered from many viewpoints and the cost-benefit analysis is likely to only use one viewpoint. Consequently, it is important to understand from whose view the analysis was completed or whose view the analysis left out.

Data limitations. Cost benefit analysis is data dependent. When data is unavailable, it is sometime left out or not considered. It is important to understand the data requirements of cost-benefit analysis, what data has been used in the analysis, and what details may have been left out.

Valuing non-monetary items. Valuation techniques have been created to identify many non-market items and place them into monetary terms. For example, the value of a state park might be considered as the value one-person is willing to pay to visit that state park. Be aware of how the analyst conducts valuation, whether they have included non-monetary values, and if so, how they have valued them.

Discount rate. This discount rate is a critical item in cost-benefit analysis. It allows the projected year values to be placed into real time information. This discount rate, however, varies and can differ from project to project. The higher the discount rate, usually the lower return. Therefore, understanding the discount rate effect is critical.

information about the project, the project impacts, who will or will not benefit, etc. However, it does not necessarily substitute for a quantitative CBA, though it can add to them. Set 3.6 will lead you through the process involved in implementing a participatory cost-benefit analysis.

Definitions Used in Cost-Benefit Analysis

Net Present Value (NPV) The NPV takes the net benefit (benefit minus cost) each year and discounts these to their present day value. If the result is greater than zero, this indicates that the benefits outweigh the costs. The higher the value, the greater the financial argument for initiating the project. A Project will just have one Net Present Value number. This project can be ranked against the alternatives that also have positive or negative NPVs.

Benefit-Cost Ratio (BCR) The BCR indicates how much benefit will accrue for every $1 of cost. A ratio greater than 1 indicates that the project is worth investing in from a financial perspective; anything less than one indicates a negative return. Projects can also be ranked by BCR.

Internal Rate of Return (IRR) The IRR is the rate of growth participating parties require to make the investment. It is often used when determining economic efficiency, is expressed as a percentage.

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3.6.0

SERIES 3
Building Resilience

PARTICIPATORY COST-BENEFIT ANALYSIS

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Contents of Set

Participatory cost-benefit analysis differs from a traditional cost-benefit analysis by not requiring as much technical knowledge and allowing input from many different community groups. Participatory cost-benefit analysis (CBA) uses participatory research appraisal (PRA) methods to ensure that financial, social and environmental benefits and costs of an activity are identified. As a result, the participatory cost-benefit analysis both captures information that is often unavailable from traditional data sources or is unincorporated in traditional analyses, and is relatively quick and inexpensive to implement. Participatory cost-benefit analyses are particularly effective with diverse groups of stakeholders and can be facilitated via shared learning dialogues at virtually any level (community, city, state, national). Because they capture different information, a participatory CBA should be completed even when a quantitative cost-benefit analysis is also completed.

IN THIS SET YOU WILL:

- ✓ Learn how to use participatory cost-benefit analysis to identifying whether your proposed climate resilience projects are feasible.

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Overview

As discussed in Set 3.5: Introduction to Cost-Benefit Analysis, participatory cost-benefit analysis is always useful for delivering an initial evaluation of a project.

- It can be implemented relatively quickly and inexpensively with the information and people on hand;
- There is little or no need to assemble outside technical expertise; and
- The results will incorporate a broad spectrum of non-monetary input (social and environmental concerns, community input, information on the distribution of benefits and harm from the project, etc.) that a more formal analysis will likely miss.

Implementing a participatory CBA can be broken down into seven steps. If you have been systematically working through the CRF:TM steps one through three will have already been completed. If not, we suggest you complete steps one through three with guidance from Series 2 and Series 3 (3.2 and 3.3).

FIGURE 3.6.1: PARTICIPATORY CBA STEPS
Steps 1–3 will have been completed in Series 2, Set 3.2 and 3.3.

STEP 1

GATHER NECESSARY BACKGROUND INFORMATION

If possible, background information should be collected concerning potential resilience strategies or actions and the costs and benefits associated with them. Background information could include climate information, hazard impact information, socio-economic data, or other data directly related to assessing the costs or benefits of the proposed action. Assembling data in advance generally allows for a somewhat more quantitative assessment. However, assembling data in advance is not critical. Background information can be filled in later as needed, though a second meeting of the group may be needed if the background information contradicts assumptions made in the first meeting.

STEP 2

CONDUCT COMMUNITY BASED VULNERABILITY ASSESSMENT

Series 2 of these training materials describes options for conducting a climate change vulnerability assessment. You will use this assessment now to identify who might be impacted, positively or negatively, by your proposed activities, and who will be left out of possible benefits. You will want to include representatives of all these groups in your discussion group conducting the cost-benefit analysis.

STEP 3

IDENTIFYING ADAPTATION/RESILIENCE ACTIONS

In Sets 3.2 and 3.3 you explored ways to identify potential adaptation and resilience actions. Ideally, you will focus in on 2 or 3 of these actions for your participatory cost-benefit analysis. If you have more than two or three actions to evaluate, it is probably better to conduct a series of cost-benefit analyses. If more than three or four options are evaluated at one time, the time and complexity of the review rapidly increases.

STEP 4

IDENTIFYING THE COSTS AND BENEFITS

Your stakeholder group will meet, through either an SLD or group discussions, and identify the economic, social, and environmental costs and benefits of each strategy. The costs and benefit should be described qualitatively at this point, not

quantitatively. It is important to initially explore the costs and benefits without assigning value to them to avoid steering the discussion in one direction or another, and to ensure that you include all the costs and benefits. These costs and benefits will be quantified, relative to one another, in the next step.

The economic costs of most projects are the upfront implementation costs. There may also be social and environmental costs, such as relocation of people or inability to use land for certain other productive purposes. The benefits of adaptation interventions are both economical—the cost that are prevented by the adoption of the proposed intervention (i.e. value of the damages or losses that might occur in absence of the intervention)—and social and environmental. Some of the social and environmental benefits may be associated with building resilience, such as improving forest health and developing forest products that locals can sell to diversify household income. However, many of the social and environmental benefits may not be associated with resilience building. These benefits are referred to as "co-benefits", such as a storm shelter that can also be used to house a school or dispensary when there is no storm.

In Da Nang, Vietnam, the SLD included members from:

- Da Nang's People's Committee
- Da Nang's Women's Union
- Ward Households

STEP 5

VALUATION AND BENEFIT COST RATIO

In the valuation stage the group scores each cost and benefit from one to five according to perceived cost and benefits. The lowest costs are scored as 1, the highest costs as 5. The lowest benefits are scored as 1, and the highest benefits as 5. For example, promotion of minimum tillage might have no environmental cost because it's improving the environment therefore ranking a 4. Economic costs associated with training and/or potential future output of the land might be significant and therefore rank a 2. If an issue is particularly contentious, or the group is for any reason having trouble scoring a cost or benefit, the team can use participatory rural appraisal ranking methods. After ranking each option from one to five, it is necessary to compare the costs and benefits and determine the benefit cost ratio by dividing the cost into

the benefit. This is done by simply summing the economic, social and environmental costs as well as the economic, social and environmental benefits. Once these are summed, total benefits are divided by the total costs to obtain the cost-benefit ratio.

STEP 6

DISTRIBUTIONAL CONCERNS

When you aggregate results to obtain the cost-benefit ratio, distributional concerns —information about who benefits, who is negatively impacted, and who is left out—may be lost. For example, large losses in a few wealthy households may have higher monetary value than smaller losses amongst a larger number of poor families. Yet, it may be preferable to choose strategies that are focused on the poorer families and larger number of households. One way to recapture this information is to review your vulnerability analysis and identify which households may be targeted or excluded by the proposed actions. If distribution issues do appear, multi-criteria analysis can be used to weight these factors in a final ranking of proposed actions. This is addressed in Set 3.8: Multi-criteria Analysis.

STEP 7

FINDINGS

In presenting the cost-benefit analysis results, results for each of the steps above should be presented, and how and why different options are ranked the way they are should be reviewed. If actions were removed from consideration as a result of the analysis, why they have been removed from consideration should be clearly explained. Similarly, if the analysis clearly identified either the most appropriate resilience action for a given situation or information gaps that must be addressed before a decision can be made, this information should be presented and discussed (Khan et al., 2012).

To Think About

A participatory cost-benefit analysis can be conducted with several smaller groups rather than one large group if it is necessary to ensure that participants can participate freely and equally. However, advance thought and planning will be needed if you then want to combine the costs and benefits rankings from each sub-group. In some cases, it may not be appropriate to combine the priorities of one group with another. Social and environmental costs and benefits

vary from one location or context to another, and in some situations, aggregated figures may be meaningless. A careful review of disaggregated results should be made before results are aggregated, and final rankings should be verified against individual concerns, vulnerabilities, and distributional issues presented in earlier discussions.

Resilience Principles: In Set 1.4 you identified the key principles that inform your resilience planning process. These principles should be reviewed along with your vulnerability assessment, and used to inform your cost-benefit analysis. For example, if equity is a core principle, actions that increase equity should rank higher than those that increase inequity.

Distributional affects of an action can strongly impact how it is ranked. If an action will cost a large number of people even a small amount, but will deliver benefits only to a select few, it is unlikely that those that do not benefit will be interested in supporting it. This also means that if people can not see how they will benefit from an action, they may reject its implementation, even if, in fact, they would benefit. If benefits of a proposed action are not clear to the communities they will affect, it will be necessary to educate those impacted before including them in your participatory cost-benefit analysis meetings.

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3.6.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Implementing a Simplified Participatory Cost-Benefit Analysis

Activity 3.6.1

In this activity, you will select 3 to 4 of your proposed resilience actions and conduct a simplified participatory cost-benefit analysis for these actions.

IN THIS ACTIVITY YOU WILL:

- ✓ Select 3 or 4 of your proposed resilience actions;
- ✓ Identify the costs and benefits of each action;
- ✓ Score each cost and benefit and use these to calculate the cost-benefit ratio of each action;
- ✓ Consider distributional concerns (who benefits, who doesn't benefit, and who, if anyone, is harmed) for each of the resilience action, and based on distributional concerns, reassess your assigned cost-benefit ratios; and,
- ✓ Discuss the process of completing a Participatory Cost-Benefit Analysis. Did it change your assessment of any of the proposed resilience actions you assessed?

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ACTIVITY 3.6.1: IMPLEMENTING A SIMPLIFIED PARTICIPATORY COST-BENEFIT ANALYSIS

INSTRUCTIONS

In this activity you will conduct a simplified participatory cost-benefit analysis of several of your proposed resilience actions. Assuming that Steps 1–3 have been completed, the activities will take you through Step 4: identifying the costs and benefits, Step 5: valuing those costs and benefits, Step 6: integrating distributional concerns, and finally Step 7: determining how to present the findings.

In Step 4, *Identifying the Costs and Benefits* you will identify the economic, social, and environmental costs and benefits of several of your proposed resilience actions. As you do this, keep in mind that at this initial stage, the costs and benefits should simply be described; they do not have a quantitative value placed on them yet. Benefits might include assets saved or damages avoided. When describing costs and benefits consider both the infrastructure elements and impact on livelihoods. For example, participants may have lost sewing machines during annual flooding. To ensure that losses are accurately represented, you would include both the cost of replacing the sewing machine and the income lost during the time that a working sewing machine was unavailable.

In Step 5, *Valuation and Benefit Cost Ratio* you will score each cost and benefit for each resilience action. Costs and benefits should be scored using a simple scale, such as one to five. The lower the number, the lower the cost is to the group or the lower the benefit is to the group. For example, the group scores the strategy 'the promotion of tillage' a 1. This means that the group overall thinks the cost of implementing tillage is low. Be aware that the economic, social and environmental costs and benefits should stay proportioned to one another; try not to exaggerate one type of benefit over another. After valuing each cost and benefit, the costs and benefits are summed for each action, and a benefit-cost ratio for the action is derived. When you aggregated your costs and benefits into a cost-benefit ratio, information about who benefits or is harmed by the action is often lost.

In Step 6, *Distributional Concerns* we will consider these "distributional concerns" directly. For example, large losses in few wealthier households may have higher monetary costs than smaller losses amongst more numerous poor families. However, considering the number of livelihoods impacted, it may be preferable to choose strategies that are focused on the larger number of families.
This activity is conducted as an introduction to Participatory Cost-Benefit Analysis. It introduces the steps involved in performing a full Participatory Cost-Benefit Analysis, but, because it is designed as a training, is probably missing many of the stakeholders that should be included in a full analysis.

In Step 7, *Findings* you will consider how PCBA can be used to support your resilience planning process, who should be included, and how the results should be presented.

Step 4: Identifying Costs and Benefits

BRAINSTORM CAROUSEL

1. Select 3 or 4 of your identified resilience actions. These can be related to one another, e.g. actions that all address capacity building, or water, or they can be very different. For each action, write the action name and a brief description at the top of a piece of flip chart paper. Place the flip chart papers on the walls around the room.
2. Identify costs and benefits for each action; these can be written on separate slips of paper and stuck to the flip-chart pages, or written directly on the flip charts. However, use one color for costs and a different color (pen or paper slips) for benefits.
3. Once everyone has contributed, review the flip charts as a large group to determine if there are any obvious costs or benefits that have been overlooked.

TRIPLE BOTTOM LINE COSTS & BENEFITS TABLE

4. Organize the feedback on each of the flip charts into economic, social and environmental costs and benefits. Have one person record all the responses in a pair of large tables drawn on a blank sheet of flip-chart paper. Table 1, below, is an example of a costs table; a similar table should be made for benefits.
5. For each Resilience strategy ensure that there are costs and/or benefits identified in each category, or that you have considered that category and there is nothing to record there.

EXAMPLE COSTS

Resilience Action	Economic	Social	Environmental
1. Promotion of minimum tillage operations	Trainings Demonstration Plots	Disruption of grazing	none
2. Plantation in the degraded and eroded land	Cost of raising saplings Labor Protection of land for 3 to five years	Disruption of grazing and walking routes	none
3. Construction of check dams	Labor Construction Material	Fetch water from a different stream	Disruption in spring water

(Source: Khan 2011)

Step 5: Valuation of Benefit Cost Ratio

Decide, as a group, how you will score costs and benefits. From 0 to 5? From 1 to 10? The lower the number, the lower the cost is or the lower the benefit is. You will use this scale for each cost and each benefit of every resilience action you assess. Once you have selected a scoring system, complete the following steps:

1. Select a resilience action. Discuss each benefit listed for that resilience action:
    - What benefit has the largest monetary value?
    - Which benefit does the group value most for non-monetary reasons?
    - How can you compare the highest monetary value with the highest non-monetary value? Which benefit would you rank the highest overall?
2. Score each benefit in relation to the highest benefit. These scores can be written next to your costs and benefits in the tables you prepared in Part 1. For example, the group decides that promotion of tillage has the highest benefit. Not only does it have significant monetary benefit, but it has ecological benefits as well. All other benefits are then compared to promotion of tillage and ranked somewhere below tillage in their benefit. Note, this step is highly subjective; how you rank benefits will be dependent on the values of the group. If you get stuck on a particular benefit (or cost), for the purposes of this activity you may want to omit it, but make a note that this is something that requires further discussion.
3. Now, discuss each cost listed for your resilience action:
    - What cost has the largest monetary value?
    - What cost does the group rank as largest for non-monetary reasons?
    - How can you compare the highest monetary cost with the highest non-monetary cost? Which cost do you rank as highest overall?
4. Score each cost in relation to the highest cost. Again, write your scores next to your costs and benefits in the tables you prepared in Part 1.
5. Repeat this for each of your 3 or 4 resilience actions.
6. Now, construct a scoring table for your resilience actions. See Table 2, below, for an example.
7. Sum the total costs and sum the total benefits for each resilience action.
8. Divide total benefits by total costs for each action. The result is your final benefit cost ratio (shown in the column labeled "B/C" below) for that action.

TABLE 2: EXAMPLE SCORING TABLE

Source: Unpublished data collected by Li-Bird through the CADP project under ISET's direction. Method design by ISET.

	COST (0-5)				BENEFIT (0-5)				
ACTIVITIES	**ENV**	**ECON**	**SOC**	**TOTAL**	**ENV**	**ECON**	**SOC**	**TOTAL**	B/C
Promotion of minimum tillage operation	0	2	1	= 3	5	4	4	= 13	4.33
Plantation in the degraded and eroded land	0	3	1	= 4	5	5	5	= 15	3.75
Construction of check-dams	1	5	3	= 8	5	4	4	= 13	1.62
Protection of water sources	0	4	3	= 7	5	5	5	= 15	2.14

Step 6: Distributional Concerns

"Distributional concerns" are information about who benefits or is harmed by an action. To ensure that distributional concerns are identified and addressed directly, discuss the following questions for each resilience action:

- Are there people or groups that do not benefit from this action? Are they intentionally left out? Is there some way the project could be modified to benefit them?
- Are there people or groups that may be negatively affected by this action? How will they be impacted? Has this already been considered in the costs of the action?
- Are there people or groups that will benefit more from this action than from actions? If so, who will benefit more? Are these the people you think most need the extra benefit? Who will benefit less? Are those who will benefit less often the people who benefit less? Is it okay that they are going to benefit less?
- Consider the cost-benefit score you assigned to this action. Based on your answers to the questions above, is the cost-benefit score you have assigned to this resilience action appropriate? Does this action positively address distributional concerns in ways that you didn't address in the original scoring? If so, do you want to raise the score? Or, does this action have negative distributional concerns not previously addressed? If so, do you need to lower the cost-benefit score?

TO THINK ABOUT

This may be a challenging discussion. Often, distributional concerns are strongly influenced by politics, social expectations and cultural dynamics. Your vulnerability assessment may provide supporting evidence for issues that are raised here, and may therefore provide a way to open the discussion.

Step 7: Findings

In this activity you have completed an initial participatory cost-benefit analysis. The steps you have worked through are exactly those that you want to walk your full stakeholder group through; the only reason this assessment is initial rather than final is that, presumably, there are other

stakeholders who should be included in the discussions about the actions you assessed.

Discuss the process of completing this assessment:

- Did it change your assessment of any of the proposed resilience actions you assessed?
- Did any of the results surprise you? Were there costs or benefits identified that you hadn't considered?
- Were there any new issues raised in the discussion of distributional concerns?
- Would this activity be different, or achieve different results with a different group of participants?
- Who should be invited to review the activities you assessed today?

When you conduct a full participatory cost-benefit analysis, including representatives of all those impacted by the proposed actions, you will need to present your results to the larger stakeholder group, including the decision-makers who will ultimately determine which actions are implemented. At this presentation, you should review your findings by showing results of the each of the steps above (Parts 1–3) and how and why different options were scored the way they were. This should include:

- What were the qualitative costs and benefits?
- How were the costs and benefits scored?
- What were the reasons for assigning those scores?
- What cost-benefit ratios did this result in?
- Were the cost-benefit ratios further modified based on distributional concerns? If so, what were those concerns, and how were they used to modify the final scores?
- What does the final scoring indicate? What actions should be pursued?

Be sure to include the discussion on final options. In addition, report on whether this exercise gave you clear answers to what the most appropriate resilience plan would be, what questions remain, and what further analysis may be needed to come up with the answers.

References

Khan et al. (2011). [Local Adaptation Plans for Action LAPA Manual.] Unpublished Raw Manual.

3.7.0

SERIES 3
Building Resilience

QUANTITATIVE COST-BENEFIT ANALYSIS

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

This training set is designed for teams that need to implement a quantitative cost-benefit analysis to evaluate the cost-benefit of a proposed or implemented disaster risk reduction, climate adaptation, or climate resilience project. These materials discuss how to adapt a standard cost-benefit analysis to address situations where disaster frequency, magnitude, or intensity is changing due to climate change; and provide you the information you will need to develop a Terms Of Reference to hire the right the right team.

IN THIS SET YOU WILL:

- ✓ Learn the steps associated with implementing a quantitative cost-benefit analysis in a resilience and adaptation planning context; and
- ✓ Leave this training with materials that you can use to develop a Terms Of Reference for hiring the right team for the job.

Contents of Set

TRAINING.I-S-E-T.ORG

Overview

A quantitative cost-benefit analysis undertaken for climate change or disaster risk-related projects differs from a conventional cost-benefit analysis by integrating future climate risks and future damages associated with climate events. In the case of adaptation and resilience planning, a quantitative cost-benefit analysis may include, but is not limited to:

- Using downscaled climate model results for a specific location to assess potential future changes in climate risk;
- Estimating damage costs that could occur as a result of potential disasters, such as damage to houses that could occur in future flood events;
- Assessing direct and indirect costs related to proposed or implemented adaptation or resilience solution; and
- Conducting a sensitivity analysis of the cost-benefit analysis results.

TYPICAL TEAM MAKEUP

The first step in implementing a quantitative CBA is to assemble a team to conduct the work. To address disaster risk reduction (DRR) and/or climate adaptation, your team will need to include an economist, a climate scientist, and potentially, a hazard specialist. These team members will provide key expertise and ensure the analysis is rigorous.

Economist: A quantitative CBA requires an economist with experience in completing the following:

- Has conducted and understands the steps involved in implementing a quantitative cost-benefit analysis;
- Understands how to read and develop depth damage curves;
- Can use valuation techniques to determine market and potential non-market values; and
- Familiarity with sourcing and identifying many types of data.

Climate Scientist: ISET has developed a cost-benefit approach that integrates climate change projections into the future cost-benefit assessment. However, this approach requires that both the city planning team and the CBA economist work with a climate scientist to identify the point at which climate events become an issue for the proposed or implemented resilience project.

- For city flooding, this could be a specific rainfall intensity, such as rains of more than 30 mm/hour for more than 3 hours.

- For energy production, this could be peak temperatures of over 40C, because generation efficiency drops at high temperatures.
- For typhoon-related damages and disasters this could be related to storm surge or wind speed.

However, your climate scientist will need specific information and input from you in order to contribute effectively. You will need to communicate what climate events are a problem and work with the climate scientist to describe those in ways that can be addressed with the information available from global climate models (e.g. in terms of temperature, precipitation intensity, or wind speed thresholds). Once you and your climate scientist have identified these climate thresholds, your climate scientist can gather the data needed to assess how the intensity and frequency of these events may change at specific times in the future.

Hazard Specialist: A hazard specialist will probably be required for your CBA analysis, to work with the economist, climate change scientist, and city planning team. The hazard specialist can:

- Help identify climate thresholds that are a problem;
- Help translate those into climate parameters the climate change scientist can work with; and
- Help the economist determine how to value current and potential future impacts.

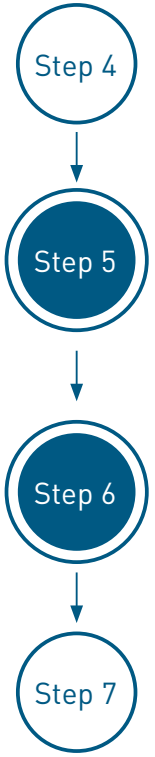
If you can hire a hazard specialist with detailed local community knowledge, they can help guide the economist in understanding community values, and based on those values, assign monetary values to non-monetary costs and benefits associated with the resilience strategies.

QUANTITATIVE PROCESS REVIEW

Once you have assembled your CBA team, the team will identify the key steps they plan to include in the quantitative cost-benefit analysis. You should be aware of key elements of a CBA related to adaptation/resilience planning and address any missing areas in the proposed scope of work. Figure 3.7.1 illustrates the steps involved in determining the costs and benefits associated with different disaster risk reduction strategies. This framework can be applied within the context of resilience and adaptation planning.

FIGURE 3.7.1: QUANTITATIVE PROCESS REVIEW

This process is similar to a typical cost-benefit analysis with the addition of a few key elements, primarily in Steps 5 and 6.



Step 4 Data Collection, the CBA team gathers the data needed to support the CBA analysis. It is helpful to categorize this data by hazard, exposure, fragility and impacts (explained in more detail below).

Step 5 Hazard and Vulnerability, the CBA team builds future hazard and vulnerability scenarios and uses the collected data to assess the damages or impacts that could occur under those scenarios. This entire step is unique to DRR/climate change resilience CBA, and entails making a number of assumptions about future systems, institutional constraints, and economic and governance conditions. The planning team should either be involved in this process, or at least require that these assumptions are clearly documented.

Step 6 Risk Analysis takes the future scenarios and builds loss-frequency curves for each scenario. Loss-frequency curves illustrate the recurrence interval of an event (on the x-axis) vs. the damage costs of that event (on the y-axis). So, for example, a loss-frequency curve will show the expected cost of annual flood events, 1-in-5 year flood events, 1-in-10 year events, etc. Separate loss-frequency curves are usually developed for the business-as-usual scenario (i.e. with no interventions or risk reduction strategies) and for each risk reduction strategy. By comparing damage costs between two curves, the reduction in damages achieved by the risk reduction strategies are readily apparent. This step differs from a traditional CBA, where benefits are calculated as the overall financial or social benefits of implementing the project. In this DRR/climate resilience approach, benefits are the reduction in damages — the losses that would have occurred, but because of implementation of a resilience strategy are avoided.

Step 7 Determining the Net Benefits the costs of implementing each of the strategies are compared against the avoided losses (benefits) associated with that strategy. The result is the economic efficiency of each strategy.

THESE FOUR STEPS AND THE ANALYSIS ARE DISCUSSED IN FURTHER DETAIL BELOW.

Step 4: Data Collection

Conducting a quantitative cost-benefit analysis is a data intensive process. It is suggested that the team organize the needed data into specific data categories (see below) that correspond with the analysis. An example data checklist is included in this training set to help with identifying and categorizing data. Data categories include:

Hazard Data: Hazard data are data used by the climate scientist and hazard specialist. These data include information on previous floods, flood depths, wind speeds, historical rainfall data, etc., and are used to develop future climate scenarios. These data can be found through:

- Scientific publications and official statistics
- Geological, metrological, and water authorities
- Disaster management authorities
- Statistical agencies
- Private firms
- For Climate Change Data: national or regional climate data centers, international climate data organizations such as the Hadley Center, UK, the National Center for Atmospheric Research (NCAR), USA, the National Oceanic and Atmospheric Administration (NOAA), USA, the Tindall Center, UK, and the World Meteorological Organization (WMO).

Exposure Data: Determining exposure levels is critical to understanding future vulnerability to events. Exposure data can be thought of as an inventory of current assets that exist in the city, village, district, etc. For example, this is the number of houses in the district, number of commercial buildings, etc. Exposure data is most often found in:

- Scientific publications and official statistics
- Census information

Depending on the availability and coverage of existing assets data, household or district level surveying may be required to establish the baseline data needed for this element of the analysis.

Fragility Data: Fragility data is information related to the percentage of current assets exposed to future events. For example, flood and storm risk maps allow the team to identify potential areas of future risk and determine

future exposure potential. This can be used to determine the fragility of certain geographic areas of types of assets. Fragility information is generated using:

- Flood and storm risk maps
- Topographical maps that show locational vulnerabilities
- GIS analysis

Damages/Impacts Data: This is data about damages that occurred due to past events. For example, the lives lost, livestock losses, assets lost and infrastructure damages caused by a past flooding event. Past damage event data is used in Step 5 to project into the future and determine future event damages. Past event damage/impact information may be found in:

- Post-disaster publications
- Disaster management authorities
- Statistical agencies
- Private firms, such as insurance agencies

Once all available, relevant data is collected, the team moves into the next phase, the hazard and vulnerability analyses.

STEP 5: HAZARD AND VULNERABILITY ANALYSES

Series 2 of these training materials introduced vulnerability assessments. The vulnerability and hazard analyses used in a quantitative CBA can build off this previous work, but in general are more focused and quantitative in nature.

First, the CBA team will use the data gathered in Step 4 to develop informed assumptions about both future climate event frequency and future damages due to those events. They then conduct two separate analyses: first, a hazard analysis and second, a vulnerability analysis. For the vulnerability analysis, the team has the option to choose either an exposure and fragility approach or an historical impacts approach. The selected vulnerability approach will likely depend on the CBA team, their existing capacities and toolsets, and the available data.

Hazard Analysis: Future climate hazard data is obtained from climate change models. The models identify the probability of occurrence of various climate events. If you know at what point a climate event becomes a hazard, climate scientists can tell you how the frequency and intensity of that event may change in the future. However, to do this the climate scientist will need both a fairly long record of historical

weather data (e.g. 20 or more years of daily temperature and rainfall data) and past hazard events data (ideally hourly data; could include temperature, precipitation, river flow, wind speed and/or sea level data depending on the hazard being analyzed) to develop scenarios for the future. If this data is not available, you may not be able to do this type of analysis; a participatory cost-benefit analysis may be far more successful if the required data is lacking (see Set 3.6).

Vulnerability Analysis: Within the cost-benefit analysis framework, vulnerability is associated with damages and losses that occur during future events. Determining future vulnerability is not an easy task and depends on the data available. ISET International utilizes two types of approaches to identify vulnerability of future assets. Your CBA team should select one of these for your analysis.

1. Exposure & Fragility Analysis Approach. Exposure and fragility can be used to determine future damages by identifying current stocks of assets, determining the fragility of those assets, and making assumptions that relate to future exposure and future fragility of those assets.
    - Exposure. Exposure is whether or not a system experiences impacts from a particular climate event. For a CBA, assessing exposure involves taking an inventory of current assets, etc. that would or could be impacted by climate events if they occurred.
    - Fragility. Fragility relates to the damages incurred in areas that are exposed. For a CBA, fragility is expressed as a percentage of exposed assets. For example, the percentage of assets that would incur damages during a flood where floodwaters reach a depth of 1 meter.
2. Impacts Based Approach. An impact-based approach differs from the exposure and fragility approach by collecting information on past events and identifying the damages that occurred during those historical events. This information is used to define a set of points along a curve related to the intensity of historical events. The curve is then used to determine future event damages associated with future event intensities. It is important to note that this process needs to take into consideration future changes in exposure and vulnerability.

The impact-based approach takes a more historical look at events, while the exposure and fragility approach looks at current assets and current fragility. Both approaches use a set of assumptions to project into the future, but the assumptions are a bit different for each one. And, the data needed for the two approaches can differ substantially.

For example, in an area lacking good data on the damages incurred during past hazards, the exposure and fragility approach is likely to be far more successful. When hiring your team, discuss with them how they might approach the hazard and vulnerability analyses portion of the quantitative CBA and make sure there is data to support their analysis and that you are comfortable with and understand their planned approach.

STEP 6: RISK ANALYSIS

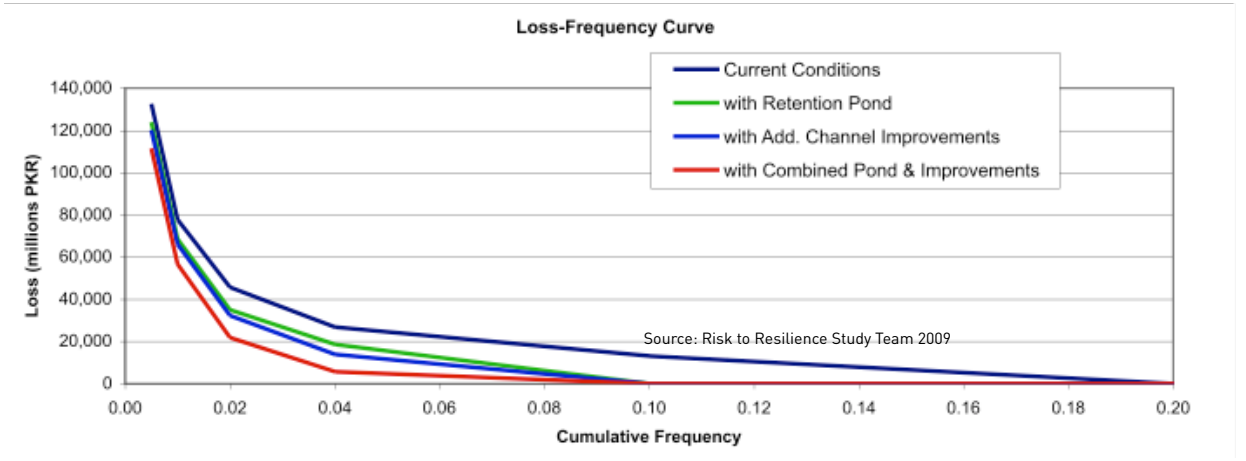
Identification of potential resilience/adaptation strategies was reviewed in Sets 3.2 and 3.3. As part of evaluating and prioritizing those potential strategies, you will want to assess their benefits. As stated earlier, the benefits in a climate change or DRR CBA are the avoided losses. Avoided losses are those losses (direct and indirect) that would be incurred under a business-as-usual scenario but would not be incurred if the risk reduction strategy were to be implemented. To determine those avoided losses (benefits) it is beneficial to develop loss frequency curves (Figure 3.7.2 below).

A loss frequency curve is created by plotting the recurrence frequency of an event (e.g. a 1-in-10 year flood event) with the damages sustained during that event. By plotting multiple events at multiple frequencies, you create a curve that can be used to determine the projected losses for events that haven't occurred. The loss frequency curves use the hazard and vulnerability analyses from Step 5 to determine potential events and potential losses.

Figure 3.7.2 illustrates a set of loss-frequency curves for a flood project evaluated by JICA. The y-axis shows estimated losses (in millions of Pakistani Rupees) and the x-axis shows the cumulative frequency of flooding. Cumulative frequency is the percentage chance that an event will happen in a given year; for example, 20% translates to a 1-in-5-year event.

In Figure 3.7.2, baseline conditions are shown in dark blue, and loss-frequency if various resilience strategies are implemented are shown in green, light blue and red. As can be seen, losses are lower when resilience strategies are implemented. When both retention pond and channel improvements are made (red line), there are no losses at the higher frequency events. Losses are only incurred at frequencies of 0.1 and lower (1-in-10-year events or rarer). Under current conditions, there are losses at frequencies of 0.2 (1-in-5-year events), and higher cost losses at all frequencies.

FIGURE 3.7.2: JICA OPTIONS FOR THE LAI RIVER



Loss frequency curves allow us to evaluate the relative benefits of alternatives against each other and against the business-as-usual scenario. We analyze the overall costs and benefits of the risk reduction strategy in Step 4. This is where we will look at the lifetime of the project and assess the benefits and costs that are expected to accrue each year.

STEP 7: DETERMINE NET BENEFITS

To determine net benefits, you subtract the total benefits (avoided losses) identified in Step 6 from the total costs of implementation. The costs are usually the cost of implementing the project (capital costs) as well as ongoing operations and maintenance. Projects (such as the retention pond in Figure 3.7.2) may not be completed within the first year of implementation, so benefits may not start accruing immediately.

Table 3.7.1 shows the expected benefits and costs of the retention pond strategy included in Figure 3.7.2. You can see that in the first year significant costs are incurred (construction of the pond) but no benefits are realized. Benefits start to accrue in year two, and costs from year two

TABLE 3.7.1: COSTS AND BENEFITS TABLE

Year	Calendar Year	Costs	Benefits	Net Benefits: Benefits-Costs	Discounted Costs	Discounted Benefits	Discounted Net Benefits
1	2005	84	0	-84	84	0	-84
2	2006	1	72	71	1	64	63
3	2007	1	73	72	1	58	57
4...	2008	1	74	73	1	53	52
27	2031	1	104	103	0	5	5
28	2032	1	106	105	0	5	5
29	2033	1	108	107	0	5	4
30	2034	1	109	108	0	4	4
31	2035	1	111	110	0	4	4
	SUM	**114**	**2703**	**2589**	**92**	**650**	**558**

Source: Mechler 2005

on are much smaller, reflecting on-going maintenance only. The table also employs the use of discounting (see side box for further explanation) to bring all future costs and benefits to today's values. These adjusted costs and benefits are listed in the "Discounted costs/benefits" columns. This type of cost-benefit table should be completed for each alternative to allow ranking among projects.

To rank projects relative to one another, the costs and benefits table needs to be condensed into terms that will allow the team to compare alternatives. This is done by calculating net present value (NPV), benefit cost ratios (BCR) and internal rates of return (IRR).

Net Present Value (NPV): takes the net benefit (benefit minus costs) each year and discounts these to their present day value. If the result is greater than zero, this indicates that the benefits outweigh the costs. The higher the value, the greater the financial argument for initiating the project. A project will just have one Net Present Value number. In general, if a project has a negative Net Present Value it should not be adopted.

Benefit-Cost Ratio (BCR): indicates how much benefit will accrue for every $1 of cost. A ratio greater than 1 indicates that the project is worth investing in from a financial perspective, anything less than one indicates a negative return. Projects can also be ranked by BCR.

Internal Rate of Return (IRR): the rate of growth participating parties require to make the investment. It is often used when determining economic efficiency, and is expressed as a percentage.

If we take the Lai River Case from Figure 3.7.2, we saw that three strategies were investigated: the use of a retention pond, the construction of additional channel improvements, and the combination of both the alternatives. The loss-frequency curve indicates that both alternatives reduce damages, and the combination of alternatives reduces damages more than either alone. However, Figure 3.7.2 does not indicate the implementation costs. To ranks the alternatives, we need additional information. We need to look at the NPVs and BCRs to determine which strategy to adopt. Figure 3.7.3 provides the associated net present value and benefit cost ratio each of the alternatives alone and the two combined, along with additional options not shown in Figure 3.7.2.

DISCOUNT RATE

To interpret CBA results you must pay attention to the discount rates that are used to put all income (benefit) and cost streams in the project life as a single number in the present. The discount rate allows us to compare benefits (or costs) in the future with benefits (or costs) in the present. The discount rate is basically the return one might expect if the same money was invested in an alternative project or put in a bank. For example, if we put money in a bank with an interest rate of say 10% per annum, a $100 investment will become $110 in the next year. So if we have choice of getting a benefit of $100 this year it is better than receiving $100 in the next year because we have the ability to generate 10% income from it in the meantime. Therefore, we can say that if we were to get a benefit of $110 in the next year it would be worth $100 in the present, if we applied a discount rate of 10% per annum to it.

However, there are many ways to calculate discount rates and many donors and/or countries use different discount rates to accept results of Cost-Benefit Analysis. In our previous example, we use a bank interest rate as the discount rate. However, it may be more appropriate to use a social discount rate because disaster risk reduction is not necessarily a commercial investment and it creates public benefits. Social discount rates represent the returns (in percentage per annum) to other similar interventions in say public health or education, and represent the current value of income streams vs. foregoing public good related investment.

The discount rate can strongly influence the outcome of a CBA. A large or very small discount rate can tilt the balance between costs and benefits by putting different values on future costs and benefits. One way to overcome this is to preform sensitivity analysis on discount rate. In a sensitivity analysis, your CBA analyst will calculate results using a range of different discount rates. You can then clearly see how the discount rate affects results.

TABLE 3.7.3
Lai River Case Final Results

Strategy/Intervention	Net Present Value of Investment (PKR mill.)	Benefit-Cost Ratio
Expressway/channel	24,800	1.88
JICA options (both)	3,593	9.25
Retention Pond	2,234	8.55
River Improvement (additional channel improvements)	1,359	25
Early Warning	412	0.96
Relocation	15,321	1.34

Source: Adapted From Risk to Resilience Study Team 2009

Figure 3.7.3 indicates that the expressway and relocation strategies for flood control (not included in Figure 3.7.2) have very high net present values. The rule of thumb for net present values is to consider any project that has a positive net present value, and to rank projects from largest to smallest NPV.

If we were to use NPV alone to select projects, the expressway/channel would be the top priority project. However, most communities are resource (money) constrained and want to ensure that they are getting as much benefit as possible out of their money. The benefit-cost ratio indicates the projects that yield the greatest benefit for their cost. Projects with benefit-cost ratios greater than one are generally retained for further consideration, and the higher the benefit-cost ratio, the greater the benefit accrued for the money spent. Figure 3.7.3 indicates that both the expressway/channel and relocation alternatives have benefit-cost ratios greater than one, but their benefit-cost ratios are relatively low in comparison to the other strategies. In the case of the Lai River, the river improvement strategy yields the highest benefits per dollar spent (BCR=25). However, because in this case river improvements can be done relatively cheaply and only in specific areas, the net present value of the river improvement strategy is actually quite low (i.e., the overall cost is low, the relative reduction in damages for the cost is high, but the total reduction in damages is only moderate). In this type of situation, decision-makers need to weigh overall goals of strategy implementation along with the NPV or BCR of individual strategies in prioritizing and ranking strategies for implementation.

In summary, it is critical to assemble the right team when conducting a climate change cost-benefit analysis. If well implemented, the quantitative process can significantly contribute to understanding the overall benefits of certain adaptation or risk resilience strategies. In general though, quantitative cost-benefit analysis, both traditional and for DRR/climate change, is expensive, time consuming, and data intensive. A participatory CBA should be conducted prior to a quantitative CBA, and quantitative CBA should only be used if there is clear demand for the specific output it will produce. If it is clear a quantitative CBA is required, the CBA team should be carefully selected, should have prior expertise with traditional CBA approaches, and should be excited about the opportunity to incorporate future risk into their analysis.

TO THINK ABOUT

Cost-benefit analysis is most useful while comparing options. It will be more effective to comparatively assess two or more risk reduction options than to analyze just one preferred option.

Before starting a quantitative CBA assessment, clarify the objectives with the project stakeholders—why are you doing this CBA, what information do you need to get from the analysis, and how will you use that information? **At a very early stage of the analysis, it is critical to achieve consensus among the interested and involved parties on the scope of the CBA to be undertaken** (Mechler 2005).

Once objectives have been clarified, identify the information and data needed to address those objectives. If the required data isn't available, consider using a participatory cost-benefit analysis approach instead.

Distributional benefits—who will benefit, how they will benefit, who will not benefit, who will be harmed, and how they will be harmed—are not addressed by cost-benefit analysis. **If you are going to use a cost-benefit analysis in evaluating a project, it is important to also evaluate the social and environmental impacts of the project.**

When controversial projects (such a hydroelectric dam) appear, **CBA cannot be used to effectively resolve value-based arguments.**

CBA should be used with other decision-making tools to ensure that a broad range of opinions is represented.

EXAMPLE DATA FRAMEWORK CHECKLIST

1: HAZARD/METEOROLOGICAL DATA				
Type of data	Do we need this data? Yes/No	Who has the data?	What type of format is the data in?	Additional Notes (i.e. data must be purchased, doesn't exist.)
Flood Depths and Duration				
River Flow or Stage				
Wind Speed				
Rainfall				
Temperature				
Drought Durations				

1: This is data that will be collected and used by the climate scientist. Any data relating to past events would be very beneficial.

2: FRAGILITY				
Flood & Storm Risk Maps				
Topographical Maps				

2: Information related to the fragility of the city to future events, such as areas in flood plains that are planned for development.

3: DAMAGES/IMPACTS				
Overview of events and year of occurrence				
Total deaths and injuries associated with each event				
Total residential damages (assets lost, working days lost, school days lost)				
Total Business & industry damages (total business disruption costs, total business assets lost)				
Total Public damages (roads, water system, public buildings)				

3: Damage data related to past events.

4: EXPOSURE: VALUATION OF POTENTIALLY EXPOSED ASSETS				
Type of data	Do we need this data? Yes/No	Who has the data?	What type of format is the data in?	Additional Notes (i.e. data must be purchased, doesn't exist.)
Exposure: Valuation of Potentially Exposed Assets				
Residential (current value of typical household assets. This might mean livestock, tv, radio, others).				
Commercial property (current value of assets related to current businesses and industries –formal and informal.)				
Public Assets (current inventory of public assets. This is usually expressed in a monetary term for value of the assets. For example, the cost to build, maintenance, staffing, upgrade, etc.):				
Roads				
Water and sewage				
School Buildings				
Health units, outlets, centers etc.				
Electrical Utilities and Distribution Network				
Livestock and poultry				
Vegetation, farmland and crops				
Transport (rickshaw, pickup, trucks, donkey carts, etc.)				

4: Exposure of assets and indoor moveables in district, city, state, etc.

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Mr. Fawad Khan, senior economist based in Islamabad, has been collaborating with ISET-International on a number of projects since 2006. Mr. Fawad Khan has extensive experience working on the economics of major policy and implementation projects from his period as a staff member with the World Bank. Along with partners at IIASA he has also played a lead role in the methodology design and implementation of ISET-International's prior research on the costs and benefits of climate related disaster risk reduction interventions for the Risk to Resilience project. Formalities to establish ISET-Pakistan as an independent, sister organization to ISET, are ongoing. ISET's office in Islamabad can be found on the very preliminary website, still under construction: www.isetpk.org

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3.7.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Developing A Terms of Reference

Activity 3.7.1

This activity is based loosely on the format used by the European Commission to solicit pre-feasibility studies. This format can easily be adjusted to the needs of your team, but touches on the main areas required in most terms of reference and provides some standard text and main bullets.

IN THIS ACTIVITY YOU WILL:

- ✓ Develop a terms of reference to ensure that the right team is hired for the CBA process

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ACTIVITY 3.7.1: DEVELOPING A TERMS OF REFERENCE

INSTRUCTIONS

Step 1: Read through the climate framed cost-benefit analysis terms of reference below.

Step 2: Review the reminders in the left hand column; these describe what should be contained in each section.

Step 3: Work with your team to build draft terms of reference.

A. STUDY BACKGROUND

_____

_____

_____

_____

_____

_____

A: Information concerning the background of the Hiring Authority and the agreement that will be made between the Consultant and the Hiring Authority.

B. STUDY OBJECTIVES

"This study will provide the {*hiring authority*} in the {*organization, governmental department, etc.*} with the ability to make informed decisions concerning the adoption, rejection or modification of {*project interventions under review*} to ensure more informed decisions are made, with climate information integrated in the project appraisal."

B: Information concerning the overall objective of the cost-benefit study and how it will support your team.

C. STUDY RESULTS

This Cost-Benefit Analysis of the *{proposed project interventions}* will include the following:

- A comprehensive listing of all data needed or desired to conduct the cost-benefit analysis as planned. This will be recorded in a data framework checklist similar to the one attached.
- Assessment of whether all needed data is available, and if so, collection and compilation of all needed data and useful supplemental data.
- A hazard analysis associated with future climate scenarios for {*specify future time period that is to be assessed*}
- An analysis of current vulnerabilities. This analysis may include exposure, fragility or damage information of current asset stocks, etc.
- An analysis of the proposed risk reduction strategies in terms of losses by frequency or recurrence period of future climate events compared to a business-as-usual scenario (current conditions without interventions).
- A discounted cash flow analysis that looks at each alternative risk reduction strategy and identifies at least the net present value and benefit cost ratio (but is not limited to looking at only these aspects).
- Recommendations on how to prioritize risk reduction activities, including detailed information concerning timeline of implementation, cost to implement, and overall feasibility.
- A set of recommendations stemming for the analysis.
- {*Others to be included*}

C: Information concerning the expected outputs that your team requires of the consultants. This is not limited to just the cost-benefit analysis, but can include a more comprehensive review.

D. Issues to be studied

The consultants will study:

_____

_____

_____

_____

D: Information about the larger issues concerning the study: the background behind why risk reduction actions are being proposed and why this CBA is being undertaken, gaps in current information the CBA study is designed to fill, etc. This may include information that the cost-benefit study will generate or areas that the cost-benefit study should focus on.

E. WORK PLAN

The consultants should provide a detailed plan for how they will structure and implement the proposed cost-benefit analysis. This could include:

- How the data collection phase will be conducted, which agencies will be contacted, whether data is free or will need to be purchased, etc.
- How they will determine whether critical data needed for the analysis is available (i.e. verification that the CBA can be conducted as planned), and by what date this will be accomplished.
- How they plan to integrate local participation, perhaps using the Shared Learning Dialogue Approach.
- How the current proposed interventions will be analyzed.
- What methodology will be used for the vulnerability assessment.
- What will be included in the final report?

E: Desired work plan activities, deliverables, and due dates.

F. EXPERTISE REQUIRED

The consultant will be sure to assemble a team that includes the following experts:

Economist: A quantitative CBA requires an economist with the following experience:

- Has conducted and understands the steps to conduct cost-benefit analysis.
- Understands how to read and develop depth damage curves.
- Can use valuation techniques to determine market and potential non-market values.
- Familiarity with sourcing and identifying many types of data.

Climate Scientist: The climate scientist will need to work with both the city planning team and the CBA economist to identify the point at which climate events become an issue for the proposed or implemented resilience project.

F: Key qualifications required for the study. For the purposes of the cost-benefit analysis, the suggested key team has been described.

- Has experiencing analyzing weather and hazard trends.
- Has experience conducting frequency analysis and developing climate scenarios that can be used by the economics team.

Hazard Specialist: The hazard specialist will work with the economist, climate change scientist and city planning team.

- Has experience working with communities to identify future or current hazards.
- Can provide qualitative information concerning the benefits and negative benefits of current risk reduction strategies.

G. REPORTING

G: Details required by the contracting group.

H. TIME SCHEDULE

H: A Gantt Chart detailing out the timeframe for each element in the work plan.

3.8.0

SERIES 3
Building Resilience

MULTI-CRITERIA ANALYSIS

CLIMATE RESILIENCE FRAMEWORK
ISET-INTERNATIONAL

Contents of Set

Multi-Criteria Analysis (MCA) is a simple yet systematic tool for prioritizing one option from among many when there are a number of different criteria influencing your selection. It provides a framework for assigning numerical values to both quantitative and qualitative actions with respect to how they address a list of specified criteria. Numerical scores assigned to actions via MCA can be useful when justifying selection of a particular action to a reviewer outside the selection process.

IN THIS SET YOU WILL:

- ✓ Be introduced to Multi-Criteria Analysis as a tool for prioritizing resilience actions;
- ✓ Design and use a simple multi-criteria analysis matrix to rank potential resilience project; and
- ✓ Articulate the limitations of the ranking and why selection of an option based on the ranking alone might not be a good idea.

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Overview

Multi-Criteria Analysis is a tool for selecting or ranking alternatives when there are multiple criteria influencing your selection. It is particularly useful in situations where a decision maker or decision group contemplates a choice of action in an uncertain environment. The decision making process often relies on information about multiple alternatives, and the information itself can range from scientifically-derived hard data to subjective interpretation, from certainty about decision outcomes to uncertain outcomes represented by probabilities. Comparing across alternative and evaluating one set of information relative to another becomes highly problematic when there is no clear basis for comparison—it becomes much like comparing apples to elephants.

Multi-Criteria Analysis avoids direct comparison by first establishing a "goal"; for the purposes of this training series, the goal is increasing citywide resilience. Within this, you might select a sub-goal, such as increasing the resilience of women headed households within a certain community. Then, for that goal, identify a set of criteria that can be used to assess whether different options achieve or contribute to that goal. The criteria must be measurable—even if the measurement is performed only at the nominal scale (yes/no; present/absent)—and a value for each criterion must be provided for every alternative. The values assigned to each criterion are called the "Criterion outcomes". For each alternative, the criterion outcomes are combined to provide the basis for comparison of alternatives and therefore determine the selection of one alternative over others.

In application, criterion outcomes for each alternative are collected in a table (See Table 3.8.1 on next page). The table columns represent the alternatives (e.g. one column for each proposed resilience actions or adaptation project); table rows represent criteria (e.g. resilience principles, statutory requirements, requirements posed by funders, cost, environmental impact, etc.). Values found at the intersection of each row and column in the table represents a criterion outcome—a measured, predicted or estimated assessment of how that alternative will perform with respect to that criterion. Structured in this way, the decision matrix compiles and presents the data for comparison of alternatives.

Table 3.8.1: Example multi-criteria analysis matrix from Surat, India.				
	Flood awareness raising, building safe-houses	Raising height of dikes by 0.3 meters	Relocating vulnerable community	City develops and enforces new limits on floodplain development
Inclusion of Vulnerable Groups in Process	4	2	1	2
Technical Feasibility	5	5	5	5
Cost known (1=high cost; 5= low cost)	4	1	3	5
City management and capacity	4	5	2	4
Generates New Knowledge (5=yes; 0=no)	5	0	5	5
Total Score	22	13	16	21

Index: 1-5, 1 = least desirable, 5 = most desirable

Table 3.8.1 provides an example matrix from Surat, India developed in 2010 as part of the ACCCRN initiative. The city's goal is to increase resilience by reducing the impacts of flooding. In this example, the city was evaluating which of the identified possible actions are best across a range of criteria. Criteria include whether the city has the management structures and capacity to implement proposed actions, whether the actions address the needs of vulnerable groups, and cost. Actions are scored from 1-5 for each criterion, with high numbers being more desirable than lower numbers. An overall low score, therefore, indicates a less desirable action. The low total score assigned to "Raising dike heights" might suggest it should be removed from the list of projects under active consideration, while the similar, higher scores assigned to the other three activities might be used to justify including all three in an 'Adaptation Activities to Address Flooding' proposal package.

DISCUSSION

Though the basic approach to decision matrices is straightforward, depending on the alternatives being evaluated and/or the criteria used for evaluation, there can be challenges in a systematic application. For example, if different criteria are contradictory or not easily comparable, it may be difficult to assign them numerical values. In this case, a yes/no scoring or a present/absent scoring may be needed.

Alternate scoring may also be desirable when one criterion is deemed more important than the others. In the example, criteria were scored from 1 to 5, with 1 being the least desirable and 5 being the most desirable. However, in broader application, it could be that technical feasibility will simply make a project viable or not, and should therefore be given more weight such that the difference between technically feasible and technically unfeasible projects is reflected more strongly in the scoring. There are a number of ways this could be done, such as by specifying a minimum value for the criterion e.g. 3 to 5, or by double-weighting the criterion ((1 to 5)*2), Both of these approaches have the advantage of preserving the 1 to 5 scoring scale, making it simpler to see what is being compared.

Determining when a criterion should be given extra weight and how that extra weight should be applied is, unfortunately, something that will depend on the issues surrounding the criterion. In general, the criterion weight should reflect how important it is to meeting the stated goal, how it impacts failure, political and/or social values, etc. However, as noted above, if a project is technically infeasible, ultimately it does not matter how strongly it is scored in other areas; it simply cannot be implemented.

Overall, the strength of Multi-Criteria Analysis for resilience planning work is that it supports the inclusion of subjective criteria in the evaluation and scoring of alternatives. Inclusion of criteria such as gender equality, for example, are of particular interest when designing projects that are to be truly sustainable and resilient. However, ranking these based on an associated quantitative measure, e.g. number of individuals impacted or average increase in annual wage for impacted individuals, can be difficult or impossible. By including a subjective score, which could be obtained for example by surveying the populations that would be impacted, we can assign a quantitative value to a non-quantitative activity.

Summary

Strengths of the Multi-Criteria Analysis approach to decision-making include:

- Provides a single number for each alternative by which alternatives can be compared.
- Makes alternative selection relatively transparent by providing a numerical "score" which can be pointed to in justifying selection.
- Provides a non-monetary basis for judging relative value of different activities.

Weaknesses of this methodology include:

- There may be compelling reasons why the highest scoring proposal should not be selected (e.g. politically unfeasible).
- Criteria weights and scores can be subjective. Different experts may have different opinions, and actual results may be different from the perceived outcomes.

For additional information on Multi-Criteria Analysis:

- The Center for International Forestry Research's Guidelines for Applying Multi-Criteria Analysis to the Assessment of Criteria and Indicators
- The Queensland Department of Natural Resources and Water Technical Document 10: Multi-criteria Analysis

3.8.1

SERIES 3
Building Resilience

CLIMATE RESILIENCE FRAMEWORK
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Multi-Criteria Analysis

Activity 3.8.1

Prioritization of resilience options is about far more than just cost or technical feasibility. Yet subjective features of an activity, such as social benefit or inclusiveness, are often omitted when projects are prioritized because they are difficult to incorporate into a numeric ranking. In this activity you will develop scoring and weighting systems that can be used within multi-criteria analysis matrices to numerically rank your potential resilience actions. The strengths and weaknesses of this scoring will be discussed and the limitations of the methodology identified.

IN THIS ACTIVITY YOU WILL:

- ✓ Design a simple multi-criteria analysis matrix based on your city's resilience criteria;
- ✓ Use the matrix to prioritize proposed resilience actions; and
- ✓ Articulate the limitations of the ranking and why selection of an option based on the ranking alone might not be a good idea.

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ACTIVITY 3.8.1: MULTI-CRITERIA ANALYSIS

For this activity, you will need the following information, much of which will come from previous modules:

- Your resilience criteria (Set 1.4)
- City capacity assessment (Set 3.4)
- A list of proposed resilience projects (Set 3.3)
- Projected project or activity cost (Set 3.5, 3.6 or 3.7)
- Technical feasibility information
- Vulnerability information (Series 2)

You will use this information to fill in a matrix and numerically score how each proposed resilience activity meets the resilience criteria you have identified. An example from Surat, India is provided in the associated Guide, 3.8.0.

INSTRUCTIONS

1. Discuss and write down the goal you are trying to achieve via your interventions. This could be "increase citywide resilience to climate impacts", or something significantly more focused, such as "increase resilience to flooding in the downtown business district".
2. Fill in the column headings across the top of the matrix using resilience options you have identified for your city. (A blank matrix is provided on the next page.)
3. Fill in the row headings with the criteria that you will use to evaluate and rank options. Criteria should include at least some of the resilience criteria you identified in Set 1.4 if you have that information available.
4. Think about how you want to score each criterion. Come up with a scoring method that takes into account the following questions:
    - Will you score all criteria equally from 1 to 5?
    - Do higher numbers indicate more or less desirable outcomes? (This needs to remain constant for all criteria or you can't meaningfully calculate and compare total scores!)
    - Do some criteria require special weighting?
    - Do you have quantitative data to associate with a particular scoring, or will scoring for that criterion be subjective?
5. Fill in the boxes in each column indicating how the resilience option in that column satisfies the criteria in each row.
6. When you have all the boxes in the matrix scored, add up the scores in each column and record the value in the Total row. These values indicate the numerical ranking of each proposed activity with respect to the resilience criteria you have identified.

Criteria	Potential Resilience Actions or Interventions			
	e.g. City develops and enforces new limits on floodplain development			
e.g. City management and capacity				
Total Score				

Once you have completed the scoring and ranking of your potential interventions, reconvene in a large group and discuss:

- Are there factors that are not included in the rankings?
- Which criterion scores are based on qualitative data and which on quantitative data and how does this impact the total score for each proposed activity?
- How would different weighting of the criterion scores (e.g. weighting actions that involve and are supported by vulnerable groups twice as much as other criteria) impact the total score?
- What criteria have you not included in this assessment, but are important in your city and/or country and should be incorporated into the analysis (e.g. support of key political figures or agencies required to make the project a reality)?

To Think About

The scoring and ranking you have done in this exercise is clearly just an exercise. To use Multi-Criteria Analysis to formally rank and prioritize resilience alternatives, you will probably want to collaboratively develop criteria and the basis on which those criteria will be scored. Some criteria scores will be easy to quantify. They will be based on simple judgments, nominal ratings by "experts", or on cost. Others may require serious study to come up with meaningful scoring. Still others may require discussion by multiple stakeholders. Formulation of these numbers, as for the criterion weighting, will depend on local, regional, and national issues. In cases requiring more thorough study and/or multiple stakeholders, it may take some time to develop the criterion scores. Consequently, how to score project proposals for various criteria should be carefully considered prior to project proposal evaluation.

The Climate Resilience Framework is an analytical, systems-based approach to building resilience to climate change. The goal of this structured framework is to build networked resilience that is capable of addressing emerging, indirect and slow-onset climate impacts and hazards.

ISET-International is using this framework with cities across Asia to build local capacity for climate change resilience with funding provided by the Rockefeller Foundation as part of the Asian Cities Climate Change Resilience Network (ACCCRN), USAID as part of the Mekong-Building Climate Resilient Asian Cities (M-BRACE) program, the Climate & Development Knowledge Network and the American Red Cross.

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