USING MACROECONOMIC MODELLING TO INFORM NATIONAL CLIMATE ADAPTATION PLANNING

Lessons Learned from Georgia, Kazakhstan, and Vietnam

addendum to the practitioner's guide
on using climate economic modelling
for sustainable economic development

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On behalf of
German Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)

Germany, 2023

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INTRODUCTION

Between 2021 and 2022, the International Institute for Sustainable Development (IISD) worked with the Global Programme on Climate Resilient Economic Development (CRED) implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and national partners to explore ways of **supporting the use of macroeconomic modelling as a tool to inform national climate adaptation planning**. A generic practitioner's guide on using climate economic modelling for sustainable development was first developed in 2021 (Dekens & Hammill, 2021). The guide identifies **entry points** and **enabling factors** that can support the effective use and uptake of climate economic modelling results in economic development. The guide's ultimate objective is to support climate-resilient development in the three pilot countries that were selected for implementation of the project: **Georgia, Kazakhstan,** and **Vietnam**.

Potential entry points and enabling factors were then explored by the IISD team through a range of advisory services in each country. This included designing and rolling out structured surveys, conducting interviews with modellers and policy-makers, participating in consultations with GIZ and government partners, as well as co-hosting and designing international workshops.

The main findings that emerged from this process in each country were then summarized in dedicated **case studies**, which constitute the main body of this addendum. Each case study offers:

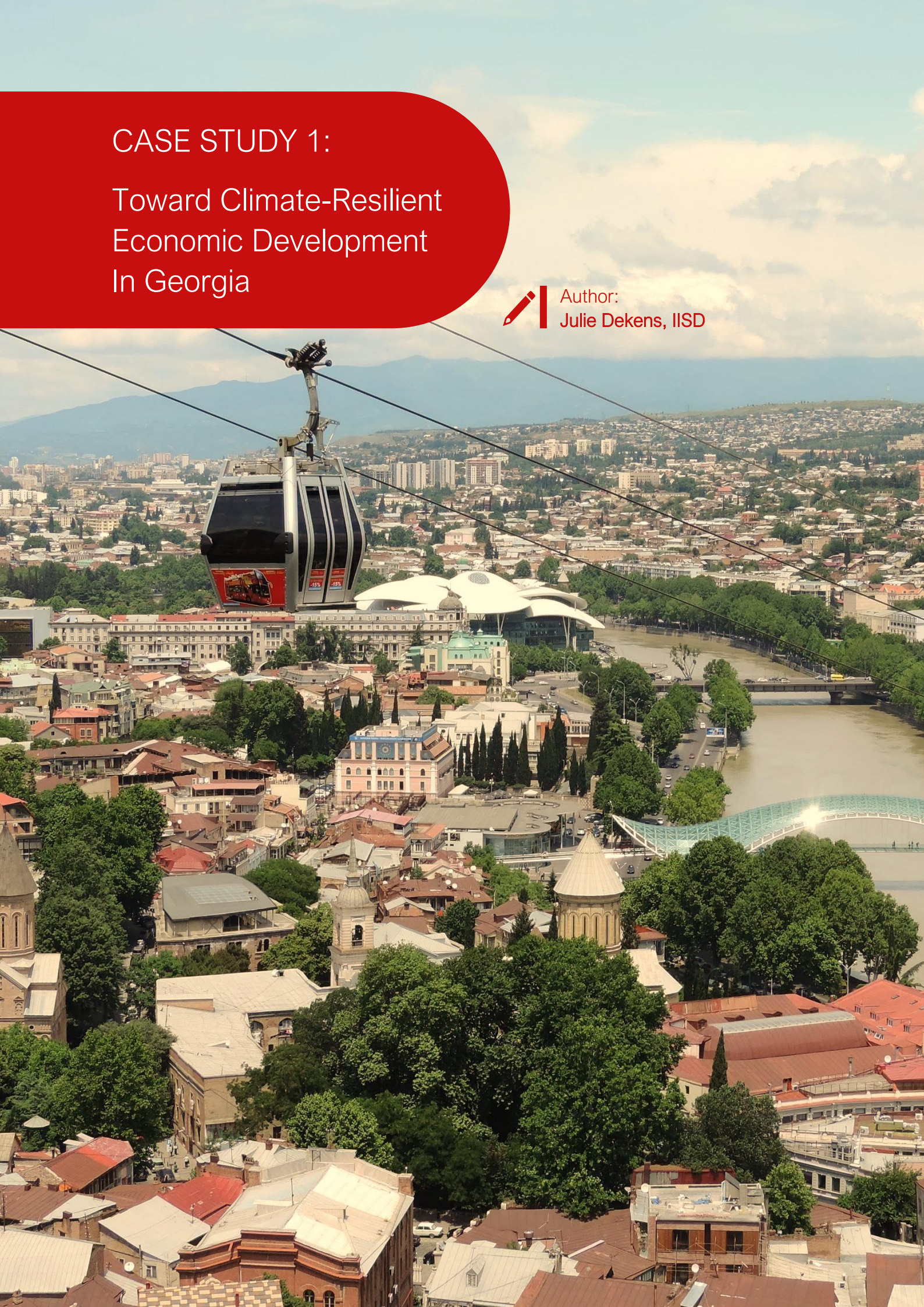
- Context and a brief overview of the macroeconomic model developed and applied in the country (i.e., the **e3.ge model** in Georgia and **e3.kz model** in Kazakhstan, and the **DGE–CRED model** in Vietnam).
- A selection of **key entry points** proposed for integrating macroeconomic modelling into adaptation planning.
- The **enabling factors for mainstreaming adaptation into developing planning** that were either directly explored or proposed for consideration (which depended on different factors, such as how advanced the modelling exercise was in each country).
- A number of **country-specific lessons learned**.

This addendum then concludes with a set of **overall lessons learned and recommendations from the CRED project,** drawing from the case studies as well as advisory services provided by IISD.

CASE STUDY 1:

Toward Climate-Resilient Economic Development In Georgia

Author:
Julie Dekens, IISD



Introduction

Between 2019 and 2022, the Economic Analysis and Reforms Department of the Georgian Ministry of Economy and Sustainable Development (MoESD) in collaboration with GIZ and the Institute of Economic Structures Research (GWS) developed the macro-econometric Input-Output e3.ge model.[1] The e3.ge model stands for "economy, energy, emissions, Georgia" and makes it possible to develop and compare scenarios of economy-wide impacts of climate change and adaptation measures. During a 2-year period, the development of the model involved multiple trainings targeting government staff from MoESD and other ministries; the collection of secondary and primary data and information, including new analysis on past climate hazards and damages; and the piloting of the model for selected climate adaptation measures in the agriculture and tourism sectors.

This case study gives an overview of the macroeconomic model developed in Georgia, the entry points and enabling factors explored to support the model application, and the lessons learned from this process.

The Macroeconomic Model

As of December 2022, the development of the e3.ge core model has been completed, with possibilities for extensions. It has been set up to assess adaptation measures from a macroeconomic perspective, with a focus on single climate change hazards and single adaptation measures in Georgia. It helps answer the questions: what are the economy-wide impacts of climate change and adaptation measures? How can an adaptation measure selected for one sector impact other sectors of the economy in terms of gross output, employment, and CO_2 emissions? Are the economic benefits of an adaptation measure in sector X likely to be large enough to balance economic losses to sector Z? Results from the model can help determine which measures are likely to have a positive or negative macroeconomic impact in the long term, and the least or the highest macroeconomic impacts (in terms of GDP and employment). Under certain conditions, this information can help build consensus around some adaptation measures across sectors and actors.

For example, MoESD applied the model to explore the macroeconomic impacts of wind erosion on Georgia's crop yields in the context of climate change and the macroeconomic impacts of investing in natural windbreaks as an adaptation measure (Dekens et al., 2022). Results from the model indicate that for the period 2022–2050, GDP could decrease by up to 0.3% due to the impact of extreme winds on crop yields compared with a GDP increase of up to 1.4% with investments in natural windbreaks. Since most of Georgia's windbreaks need to be restored, these results may support access to finance for the implementation of the new 2022 law on windbreaks.

In its current form, the model can primarily be used to justify investments in high-cost adaptation measures, such as large infrastructure projects. Indeed, when the costs or benefits of an adaptation measure are low, its macroeconomic impact may not be visible. In addition, running the model for various climate hazards and adaptation measures to allow the comparison of macroeconomic impacts makes it difficult to identify where the economy-wide effects originally come from. It also requires accessing relevant data and substantial experience in scenario development.

Entry Point: Using The model to inform national climate adaptation planning

The model development was initiated when Georgia was at the early stage of development of its National Adaptation Plan (NAP) process. The government recognizes that the impacts of climate change pose severe threats to the country's sustainable development now and in the future. A review of strategic documents indicates that the government's priority has been on addressing the cause of climate change

[1] For a detailed description of the *e3.ge* model and exemplary modelling results, please see Flaute et al. (2022).

(mitigation). Initiatives on climate adaptation are fragmented, with no comprehensive climate adaptation policy yet. Two strategic documents released in 2021 provide guidance on national climate adaptation: the updated nationally determined contribution (NDC) identifies eight high-level adaptation priorities, and the Fourth National Communication to the United Nations Framework Convention on Climate Change identifies more detailed adaptation measures across 13 sectors (Government of Georgia 2021a, 2021b). It is expected that once the Environment and Climate Change Department's Climate Change Division under the Ministry of Environmental Protection and Agriculture (MEPA) secures finance from the Green Climate Fund (GCF) for the development of its NAP process, more attention will be given to adaptation, and actions will be taken to get adaptation more systematically integrated into development planning and budgeting at national, sectoral, and subnational levels.

During the second half of the model development period, IISD facilitated dialogues between MoESD and MEPA to explore ways of supporting the use of the model in national climate adaptation planning.

Six entry points for applying the e3.ge model to inform the NAP process were first identified based on a review of the key national documents, including the draft proposal to the GCF for the development of the NAP, and exchanges with MoESD and MEPA. These included, using the model for:

- The appraisal and prioritization of adaptation measures in key sectors
- The economic appraisals of adaptation options
- Awareness raising on climate adaptation
- Informing climate risk and impact assessments
- Financing climate adaptation
- Research on climate adaptation modelling.

Two most promising entry points were then further prioritized based on a dialogue between MoESD and MEPA. These include using the model to: (1) support the appraisal of adaptation measures and (2) raise awareness on climate change impacts and adaptation measures. At present, there are several prerequisites that are not yet entirely fulfilled in Georgia that would allow the use of the model for the appraisal of adaptation measures, including assessing climate risks and vulnerabilities in priority sectors and developing a list of priority adaptation measures at the national/sectoral levels. Once this information is available (and if there is a need to build consensus and the business case among key actors for investing in high-cost adaptation measures that have been prioritized), then the e3.ge model application can be considered. To be able to run the model, access to cost–benefit data for each adaptation measure will be needed (the additional costs and benefits of investing in the adaptation measure). As such, the most immediate use of the model in the NAP process was identified as being around raising awareness on climate impacts and adaptation.

Enablers: Leadership, communications, institutional arrangements

During the dialogue process between MoESD and MEPA, three factors were prioritized as essential to promoting the effective use of the model in climate adaptation planning: leadership; institutional arrangements; and information and communications. These were prioritized because they were seen as essential to help increase the model's visibility and credibility, and hence its uptake in the medium and long terms.

Under "leadership," activities were undertaken to strengthen the relationship and the dialogue between MoESD, the owner of the model, and MEPA, responsible for coordinating the NAP process and to increase MEPA's understanding and buy-in around the model. A series of meetings were organized between MoESD and MEPA to discuss the status of the NAP process, the relevance of the model, and its potential use. A total of four meetings were organized between representatives from MoESD and MEPA in

November 2021 and January 2022 and between MoESD, MEPA, and other actors in March and October 2022.

Under "information and communications," efforts were made to improve key stakeholders' understanding of the model through the organization of trainings, meetings, and the development of knowledge products. On the latter (and based on a review of key documents related to the model development), a joint knowledge product was developed between the model developers and climate adaptation practitioners and presented to key stakeholders (Dekens et al., 2022). The process for developing this joint knowledge product served as a means of translating the information to a different target audience—development and adaptation practitioners. The document offered an example of application of the model to clarify the key steps required for applying the model, the data and information requirements, the assumptions, and some possible results. The briefing note helped MoESD to communicate about the model to a broader audience. For example, in March 2022, MoESD presented the model to the Climate Finance and Economic Working Group under the National Climate Platform, a mechanism established in 2021 and coordinated by MEPA to support stakeholder participation in the development and implementation of climate change policy processes.

Under "institutional arrangements," IISD advised MoESD on a process to facilitate the use of the model so that ministries and other public institutions (as well as the National Bank of Georgia) who are interested in using the model have clear guidance on the key steps to follow and the roles and responsibilities of the key actors involved. The proposed process involves seven steps: (1) requesting modelling support to MoESD, (2) reviewing and prioritizing requests, (3) agreeing on a workplan, (4) collecting data and information, (5) updating the reference scenario, (6) running the model, and (7) analyzing and communicating the results. The proposed role and responsibilities of key actors at the national level in using the model were also clarified and presented to key stakeholders at a national inter-ministerial workshop.

Lessons Learned in Georgia

The following lessons from the process and outcome of developing the e3.ge model can be highlighted and might be useful for governments and development partners interested in investing in climate economic modelling:

1. **Ensure that at least one practical entry point for applying the model is identified among key stakeholders before starting the model development to ensure its sustainability**. Identifying the most appropriate time for developing a model is important but can be tricky. If the model is developed too early, actors may not be able to see its immediate relevance, and there is a risk of losing momentum if no concrete applications are identified and implemented soon after its early development. If it is developed too late, there is a risk that the model may not be sufficiently developed for its use and/or not sufficiently integrated in advance in budgets and project proposals. In the case of Georgia, national adaptation priorities have not yet been identified aside from the need to conduct climate risks assessments in various sectors as per the adaptation component of the country's NDCs.

2. **Invest in the process of developing the model to strengthen the participation of the ministries of economy and finance in climate adaptation planning**. The process of developing the model allowed the participation of new actors—the MoESD, the Ministry of Finance, and the National Bank of Georgia in particular—in national climate adaptation planning. It supported increased dialogue between and among these actors and MEPA on climate change impacts and climate adaptation, which is essential to strengthen a more coordinated approach to national climate adaptation planning going forward.

3. **Integrate key actors interested in using model results in activities related to the development of the model from the start**. Model developers and model users should work very closely together from the very

initial stage of the model development. This can help ensure that the model responds to stakeholders' priority needs and create buy-in and ownership among multiple actors beyond the institution responsible for developing the model.

4. **Invest in disseminating communication materials about the model tailored to different audiences**. Modellers and policy and decision-makers speak different languages. Sufficient resources and time are needed to translate information about the model and its results into an easily accessible language and on an ongoing basis. In the context of the e3.ge model development, various trainings and meetings were organized to disseminate information about the model, but a lot more is still needed to improve key stakeholders' understanding of the model.

5. **Manage expectations on what a model can and cannot do**. The development of a model can generate a lot of expectations among stakeholders. These expectations may be further heightened in a context like Georgia, where there is limited experience and capacities within the government both on adaptation and economic modelling and on the linkages between climate (adaptation) and economic development. It took time for different stakeholders to understand what the e3.ge model can realistically do (in its current form) and what it could do in the future with further enhancements. Additional efforts are also still required to continue to improve key stakeholders' understanding. For example, limited data availability on the costs and benefits of adaptation measures reduces the model's application in Georgia. Given its current focus on mitigation, the Government of Georgia is interested in applying the model to assess the macroeconomic impacts of transitioning to renewable energies.

CASE STUDY 2:

Toward Climate-Resilient Economic Development In Kazakhstan

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Introduction

Between 2019 and 2022, Kazakhstan's Ministry of National Economy (MNE), in collaboration with GIZ, GWS, and the Economic Research Institute, developed the macro-econometric Input-Output e3.kz model.[2] The e3.kz stands for "economy, energy, emissions, Kazakhstan" and allows to develop and compare scenarios of economy-wide impacts of climate change and adaptation measures.

During the 3-year period, the development of the model involved multiple trainings targeting government staff from MNE, the Ministry of Ecology and Natural Resources (MENR), as well as from subordinate research institutes like the Economic Research Institute. The work revealed the need for strategic adaptation planning to strengthen the uptake and application of the model.

The following case study identifies strategic entry points as well as enabling factors to advance adaptation planning informed by macroeconomic modelling within Kazakhstan's current institutional arrangement and national planning processes.

Context

Kazakhstan has positioned itself as a regional leader in terms of implementing climate change mitigation measures. The country set ambitious goals to transform into a green economy by 2050, and to help meet these targets, Kazakhstan adopted national energy-efficiency requirements in 2012 and launched a greenhouse gas emissions trading system in 2013. In 2016, Kazakhstan ratified the Paris Agreement and pledged to reduce greenhouse gas emissions by 15% to 25% by 2030 compared to 1990 levels. In 2023, this commitment has been followed by the adoption of the Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan until 2060.

While consistent efforts have been made to enhance national policies and plans for mitigation, measures for climate adaptation have only begun to be emphasized in policy and legislation, with gaps existing in adaptative capacity and the lack of an enabling environment to develop appropriate adaptation measures.

Critical gaps continue to exist within Kazakhstan's institutional arrangements and planning processes for mainstream adaptation. Mainstreaming efforts are constrained by limited support for climate science and data as well as low awareness among government actors about climate change impacts. Currently, the regulation of the adaptation process is limited to only four priority sectors: agriculture, forestry, water management and civil protection/ disaster risk reduction.

While rules and frameworks have been adopted and legislative actions have been identified on climate change adaptation, institutionalization and formalization of the process remain inadequate. This is further exacerbated by limited transparency in how decisions are made and a lack of direction on roles and responsibilities for relevant actors and line ministries to create an enabling environment to mainstream adaptation into the different sectors.

Entry Points to Integrate Adaptation and Macroeconomic Modelling Into Kazakhstan's Institutional Arrangement and Planning Processes

Enabling climate-resilient development and the design of suitable adaptation measures, informed by macroeconomic modelling, requires adaptation to be integrated into Kazakhstan's existing institutional arrangements and planning processes. It involves a systematic approach emphasizing the interdependencies between different authorities, clear mandates, communication, and an understanding of roles and responsibilities to address the negative impacts of climate change on the economy and plan adaptation projects.

[2] For a detailed description of the e3.ge model and exemplary modelling results, please see GIZ (2022c).

Practical entry points have been identified to strengthen adaptation planning supported by macroeconomic modelling within Kazakhstan's existing development planning efforts. These entry points focus specifically on creating an enabling environment for adaptation by:

- Raising awareness of current and future climate change impacts on strategic economic sectors
- Overcoming existing silos among government ministries and actors in different sectors, including economic planning, budgeting, and environmental policy-making
- Utilizing platforms for cross-sectoral coordination on adaptation
- Producing and sharing relevant climate data and information
- Strengthening financing to plan, design, and implement adaptation measures.

Entry Point 1: Establish a high-level political mandate from Kazakhstan's government

A high-level political mandate plays an important role in integrating climate adaptation at the national level and across sectors. It usually entails a political mandate for adaptation to be established within a particular ministry. In the case of Kazakhstan, the main players at this entry point include the president's office, the cabinet (government), and the key responsible ministries, specifically the MENR and MNE. While Kazakhstan's national-level Environmental Code provides a directive for climate change adaptation to be carried out, including general requirements and the need for assessing risks and vulnerabilities, it lacks a long-term vision, an enabling environment for mainstreaming adaptation into development planning, and an agency with sufficient powers to ensure the integration of climate change. To drive an adaptation mainstreaming agenda, the cabinet, supported by the president's office, must create a national mandate for adaptation and establish a clear responsibility for MENR to integrate climate change adaptation within development planning processes, sectoral decision-making, and regular budgeting processes, rather than as stand-alone measures. The mandate will help to establish a clear vision for a national adaptation process, including expectations and outputs. It will also help to direct the mainstreaming agenda, foster leadership, and ensure stakeholder participation. Many of the subsequent entry points depend on the country's vision and mandate for adaptation.

Entry Point 2: Operationalize adaptation integration into sectoral development planning in Kazakhstan

To start adaptation planning across key economic line ministries (e.g., agriculture, water, infrastructure), the MENR, as the assigned lead ministry on climate change, should take the lead on initiating the integration of adaptation within sector strategies and action plans. For this to happen, the MENR may set up a strategic climate change committee made up of focal points representing each ministry. Further, the MENR may develop a strategy or framework document, guided by the full engagement of all ministries, that would establish a joint consensus and elaborate on joint and specific goals for all sectors. The strategy would define a road map for sectoral adaptation integration to be followed by the ministries, including a set of specific, sequential steps and activities and respective responsibilities. Part of this road map is to identify available information on climate change impacts, vulnerability, and adaptation to understand gaps and needs for enabling sectoral adaptation planning and how to engage key stakeholders. The document would help sectoral decision-makers understand how to conduct risk and vulnerability assessments (the basis for identifying solutions) and incorporate climate change into policy and operational decisions across key economic sectors. Macroeconomic modelling can play a key role in this entry point to identify the most beneficial adaptation options supporting climate-resilient economic development. Hence, climate-sensitive macroeconomic models should be promoted as an element of a standardized sectoral vulnerability and risk assessment.

Entry Point 3: Initiate strategic engagement with the Ministry of National Economy on climate change

The MNE provides strategic planning and sets out priorities for tax and budget policy and public investments. The MNE is also responsible for

Kazakhstan's Low-Emission Development Strategy. Further, the MNE, through its subordinate JSC Economic Research Institute, provides modelling services to assess the climate change impacts on key economic sectors and the economic impacts of adaptation options. Strategic and ongoing engagement between the MNE and the MENR on climate change will build support and ensure the exchange of information, clarify modelling requests, and provide evidence to integrate climate change aspects into Kazakhstan's development planning priorities. The MENR may establish a dedicated committee or working group to exchange ideas with MNE staff on sector-specific economic consequences of climate change: both the risks posed by its mounting impacts on the economy (e.g., reduced GDP growth) and, increasingly, the opportunities presented by climate action (e.g., a green economy), which could unlock investments and create jobs. It is an opportunity for reinforcing the climate change–economy nexus and for determining which options, priorities, and approaches to consider or pursue and who should be involved in advancing climate-resilient economic development in the country.

Entry Point 4: Analyze, assess, and develop adaptation options at Kazakhstan's sectoral level

An important step in enabling Kazakhstan's line ministries to identify and integrate adaptation options into their sectoral planning processes is to understand current development efforts most at risk from climate change. In Kazakhstan, each national sectoral ministry is connected to a specific scientific body that supports the ministry analytically. They will play a key role in conducting sectoral climate risk analyses and vulnerability and risk assessments. These assessments provide the evidence and knowledge decision-makers need to trigger policy responses and drive the mainstreaming of adaptation. Sectoral assessments will also benefit from incorporating specific sections summarizing the economic impacts of climate change and the opportunities offered by climate adaptation for economic growth. Specifically, macroeconomic modelling can provide insights into the broader economic opportunities associated with adaptation compared to a situation with climate change and no adaptation. This is followed by identifying and appraising adaptation options at the sector level to address priority vulnerabilities. In 2021–2022, the CRED program conducted a series of sectoral consultations, trainings, and workshops to introduce and discuss economic modelling assumptions and key results for selected sectors with national stakeholders.

Entry Point 5: Integrate adaptation into Kazakhstan's budgeting process

Financing is needed throughout the adaptation planning process, from its initiation to the implementation of prioritized adaptation options. It is important that the Government of Kazakhstan's (the cabinet's) high-level mandate and vision related to climate change clearly set out objectives to inform fiscal planning for adaptation (e.g., defining climate adaptation as a priority for resource allocation). For example, dedicated financing from the central budget may be designated for use by the MENR and other line ministries, science authorities, or state agencies to conduct sectoral climate risk assessments. Climate-proofing budgeting processes will support well-informed decision-making and align investments and actions around climate-resilient development. The most suitable approach for allocating financing to adaptation planning could be sector-specific medium-term budgets or an annual budgeting process. Involving key actors from the Ministry of Finance responsible for budget allocation in any climate-related coordination mechanisms is crucial to capitalize and carry out targeted efforts to integrate and finance adaptation measures.

Enabling Factors for Mainstreaming Adaptation in Kazakhstan

All five entry points inform and mutually support each other but are also dependent on the conditions within which the entry points operate. To drive adaptation planning within the Government of Kazakhstan, the identified entry points need to be supported by enabling factors:

- **Awareness and motivation:** All key actors and stakeholders within the Government of

Kazakhstan must be made aware of the need to adapt and be adequately incentivized to integrate climate adaptation into development planning processes with their ministries.

Related activities: The sectoral consultations, trainings, and workshops conducted under the CRED program raised awareness of the benefits of using macroeconomic assessments for adaptation planning. The results not only show that climate change impacts will cause overall harm to the economic development of Kazakhstan but also help identify which adaptation measures have significant economy-wide benefits in the mid to long term.

- **Information sharing and communication:** Kazakhstan's adaptation planning and macroeconomic modelling efforts need to be grounded in the best available information about current and projected climate risks. Adequate climate services, including climate data and information along with impact and vulnerability assessments, must be made available to decision-makers to provide clear understanding of climate impacts and adaptation options for different sectors and territories.

  Related activities: Under the CRED program, multiple knowledge products, such as technical reports, policy briefs, and infographics, were produced to share information about the e3.kz model, explain underlying assumptions, and assess modelling results to inform policy-making.

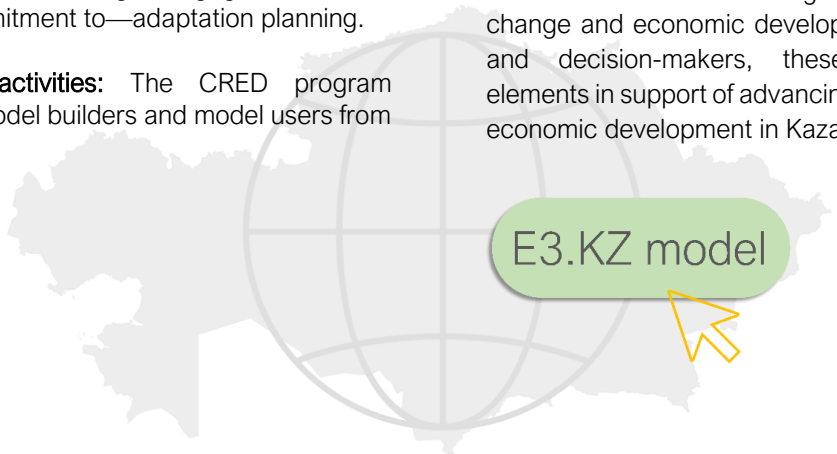
- **Capacity development:** Ongoing capacity development in defining climate adaptation and understanding its link with economic development is essential for all key actors to enable their meaningful engagement with—and commitment to—adaptation planning.

  Related activities: The CRED program trained model builders and model users from ministries, governmental institutions, research institutes, and universities. Model builders were involved in implementing the national models while model users learned how to interpret results.

Lessons Learned in Kazakhstan

To meet the challenges arising from climate change impacts on Kazakhstan's economy, a process for adaptation to climate change needs to be formalized and institutionalized. There is a need for standard procedures for integration of climate risks into medium and long-term policies, investment plans, and business strategies. This must be underpinned by a mandate that clearly outlines how decisions are made and gives direction on roles and responsibilities for relevant actors and line ministries to create an enabling environment to mainstream adaptation into sectors.

A significant element in advancing climate-resilient economic development is the consideration of macroeconomic modelling in adaptation planning. However, this needs to be facilitated by a robust national adaptation planning process that enables the integration of macroeconomic modelling and formalizes the demand for this information. Climate-sensitive macroeconomic models enable policy- and decision-makers to assess the economy-wide and sectoral impacts of climate change, build the business case for adaptation, and provide an economy-wide perspective on specific adaptation measures. These macroeconomic results can be particularly helpful in framing the problem, engaging (new) stakeholders and raising their awareness, and improving communication on the linkages between climate change and economic development. For policy- and decision-makers, these are essential elements in support of advancing climate-resilient economic development in Kazakhstan.



CASE STUDY 3:

Toward Climate-Resilient Economic Development In Vietnam

Author:
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Introduction

Since 2019, the Central Institute for Economic Management (CIEM), in collaboration with GIZ, has been exploring how climate-sensitive macroeconomic modelling can be used to inform adaptation and development planning in Vietnam. Novel in its scope, the Halle Institute for Economic Research conceptualized and developed, in collaboration with CIEM, the **dynamic general equilibrium model for climate-resilient economic development** (DGE–CRED) (Drygalla et al., 2023). The model development involved multiple trainings and policy dialogues targeting government staff from CIEM and other key ministries, including the Ministry of Natural Resources and Environment (MONRE), Ministry of Agriculture and Rural Development (MARD), and the Ministry of Investment and Planning (MPI).

The data collection process for the model developers proved particularly challenging in Vietnam, given that the model's data requirements were very specific and the needed data not available. The process required collecting and reorganizing existing data, as well as collecting new primary and secondary data at the national, regional, and provincial levels. The resulting delays meant that the inclusion of model results as part of policy processes only really kicked off at the end of the project.

This case study gives an overview of the DGE–CRED model, the main entry points and enabling factors that could be explored in Vietnam to support the model application, and the lessons learned from this process.

The Macroeconomic Model

In Vietnam, the DGE–CRED model was operationalized between 2020 and 2022. It now covers 17 sector groups[3] in Vietnam's six statistical regions: the Red River Delta, Northern Midlands and Mountain Areas, North Central and Central Coastal area, Central Highlands, South-East, and Mekong River Delta. The model enables its users to carry out simulations for the Vietnamese economy at the regional and sectoral levels, with the distinct feature of factoring in climate change impacts. After the appropriate economic and climate data has been collected and entered into the model, the user is able to look into the dynamics of economic variables of interest (i.e., gross value added, investment, and consumption) and how damage caused by climate change would affect different sectors and regions according to different scenarios.

In terms of scenarios, the model considers three different shared socio-economic pathways (SSPs). SSPs provide narratives to examine how global society, demographics, and economics might change over the next century and are increasingly being used as important inputs for the latest climate models, including the latest Intergovernmental Panel on Climate Change sixth assessment report (Hausfather, 2018). The DGE–CRED model uses SSP119, SSP245, and SSP585, three scenarios that span a range of plausible futures with increasingly pessimistic outlooks in terms of global average temperature increase. Biophysical damages, such as crop yield and land losses due to sea level rise, as well as productivity losses for key economic sectors, are also considered by the model.

Users with the appropriate training are also able to analyze the counteracting effects of adaptation measures and facilitate cost–benefit analysis for policy-makers. Under certain conditions, and in combination with additional considerations, this information can help build consensus around some adaptation measures across sectors and actors.

Entry Points: Using the DGE–CRED model across the policy cycle to inform national climate adaptation and development planning

The DGE–CRED model's success depends to an extent on how effectively its results can be used to inform decision-making processes. To help identify potential entry points for using DGE–CRED model results, IISD carried out a literature review, surveys, and interviews together with a national consultant between 2021 and 2022.

[3] These are rice, other annual crops, fruit trees, dry rubber, coffee, other perennial crops, livestock and agricultural services, aquaculture, forestry, water, energy, manufacturing, construction, transport over water, transport over land, health, and services.

Entry Point: Using DGE–CRED modelling results to support a transition from input-based to output-based adaptation budgets and resource optimization

Vietnam's latest Climate Public Expenditure and Investment Review (MPI/United Nations Development Programme, 2022) highlights that adaptation is already the dominant expenditure of key ministries' climate change budgets. The study shows that for the climate change expenditures and budgets between 2016-2020 for six ministries,[4] 28 provinces and one nationally managed city (Can Tho), adaptation represents over 70% of the ministries' climate change budget and over 90% of the provinces'. However, the report also highlights that the current level of investments is not enough to address the current expected climate impacts.
In light of this imbalance, a **shift to more output-based adaptation budgets that focus more on the expected results (or outputs) of adaptation investments** than on existing funding levels (i.e., inputs) would benefit Vietnam's adaptation planning efforts. For instance, this shift in focus could lead to budgets being informed by actual adaptation needs, as opposed to setting budget targets based solely on inputs (i.e., available taxes or official development assistance).

The DGE–CRED model's capacity to make predictions and assess the economic impact of selected adaptation measures at the provincial level**, could provide an additional tool to prioritize adaptation investments based on the expected impacts of climate change on key sectors and cost–benefit analysis, supporting these key ministries to transition to more output-based climate change budgets.** This output-oriented focus would also benefit from considering the adaptation priorities that have been identified in Vietnam's NAP document developed by MONRE (2020).

Other potential entry points within existing strategies and guidelines in Vietnam

Based on our research, **Table 1** outlines the key policy documents and strategies that lend themselves as entry points for using the modelling tool and methodology, as well as offering timing considerations to make this happen. This list covers entry points across the policy cycle, which includes planning, budgeting and financing, implementation, and monitoring, evaluation, and learning.

Table 1. Entry points within key strategic documents for using DGE–CRED model results

Lead ministry	National-level strategic documents	Integrating DGE–CRED model results	Timing for integration
MPI	Roadmap to Net Zero Emissions by 2050	While the Roadmap mainly focuses on mitigation, climate change adaptation considerations could also be factored in as part of the strategy to avoid maladaptation and increase policy coherence. The DGE–CRED model could be used here **to help estimate the costs and benefits of specific adaptation measures**, providing a **basis for budgeting** as well as **baseline data for monitoring and evaluation efforts.**	2022–2023
MPI, MONRE	Guidelines for Mainstreaming Green Growth (MPI) and Guidelines for Mainstreaming Climate Adaptation (MONRE)	The model results could be integrated during the drafting phase of both guidelines as a methodology/tool **for situation diagnosis, impact assessment of climate change and adaptation measures, intervention prioritization and budgeting, and monitoring and evaluation.**	2022–2023
MPI	Green Growth Monitoring and Evaluation Statistical	The model could be used to **help suggest possible climate adaptation indicators at national and regional level** and provide **inputs to help measure and monitor**	2022–2023

[4] The ministries are: MARD, MONRE, Ministry of Transport, Ministry of Industry and Trade, Ministry of Construction, and Ministry of Science and Technology.

	Indicators and Composite Green Growth Index	**these indicators** along the implementation process of the green growth strategy.	
MONRE	National Adaptation Plan	DGE–CRED model results could be considered to inform **planning, drafting, budgeting, financing, implementation, and monitoring and evaluation efforts.**	Updated every 5 years (last update 2020)
MONRE	Nationally Determined Contribution		More long-term
MPI	National Green Growth Strategy and Action Plan (VGGAP)		Updated every 10 years (last update 2022)
MARD, MONRE	Provincial and sectoral green growth action plans	Based on the VGGAP and following MPI's guidelines, provinces and priority sectors have to develop their green growth action plans and/or mainstream green growth in their development strategies and planning in 2022–2024. DGE–CRED model results could play a role in **informing planning, drafting, budgeting, financing, implementation, monitoring, and evaluation by providing inputs, methodology, and mathematical tools to help with scenarios development analysis, impact assessment, objective** setting, and optimal portfolio designing and budgeting with clear priorities.	2022–2024

Enablers: Leadership, communications, institutional arrangements

Most entry points within the policy cycle will rely heavily on a combination of enabling factors to support the effective use and uptake of climate economic modelling results in economic development. This is particularly important in a context where a new tool is being deployed and offered as a means to inform existing processes.

Key Enablers: Capacity building, information and communication, institutional arrangements, and financial resources

Based on the information gathered and feedback from model users and policy-makers, the following specific actions could be implemented by Vietnam (see policy brief) that would act as enablers, in particular to support capacity, information and communication, institutional arrangements, and financial resources to support the project's objectives.

1. Access to data has posed a real challenge for the project and ultimately the uptake of modelling results. To enable the mainstreaming of climate change adaptation and the model, a critical enabler is the integration of **comprehensive climate and socio-economic datasets into the official statistics system** at both national and local levels for regular updates and open access (to be led by General Statistics Office (GSO)/MPI). This would make it possible to cater to the different needs of key stakeholders. At least four different types of data users have been identified, namely those with an interest in socio-economic data (GSO and MPI); climate data sets (MONRE and Vietnam Institute of Meteorology, Hydrology and Climate); climate damage data (Viet Nam Disaster Management Authority); and adaptation measures data (sectoral adaptation leads).
2. Translate **climate information and CRED results into user-driven concrete and understandable climate risks and list of adaptation actions** in various user-friendly forms and promote timely accessibility (to be led by MPI). For instance, having clear and readily available information will be key to

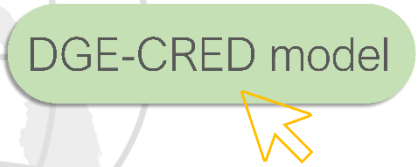
facilitating **mainstreaming of results as well as ensuring stronger ownership among potential users** from different ministries.

3. **Set up a technical group in CIEM** supported with external capacity building for at least the medium term (5 years) to continue customizing the model and take ownership, building on their existing modelling capacities. However, funding will be needed to support this.
4. **Build capacity for policy and strategy research institutes and policy-makers across sectors** on risks and vulnerabilities to climate change, adaptation measures, cost and benefits, and methodological knowledge (to be led by CIEM and MPI). This taps into a need for stronger cross-sector collaboration to explore the potential of the model to inform sector-specific adaptation action. For this to happen, economic modelling and sectoral planning experts need to be involved to identify adequate policy questions and relevant model use to help address these questions.
5. **Mobilize technical and financial support** to set up the foundation, generate demand for the tool, and train users (to be led by GIZ and other potential donors).

Lessons Learned in Vietnam

- The CRED project has contributed to developing, maintaining, and strengthening the enabling conditions for integrating macroeconomic modelling results into adaptation planning processes. For instance, it has initiated conversations between sectors that were not necessarily taking place seriously. For the first time, consultants working with key ministries (i.e., Agriculture, Water, Housing) collaborated with the CIEM to create macroeconomic cost–benefit analyses.
- The project has also contributed to raising awareness about the importance of adaptation across sectors, building the capacity of policy-makers and model users to appreciate how climate-sensitive macroeconomic models can be used to inform policies.
- The model and respective results contribute to awareness raising about the importance of adaptation for development, the need for access to regional-level (six) and provincial-level (63 provinces) data to be able to estimate the impacts of climate change based on different SSP scenarios.
- Closer collaboration between the GIZ and ministries with a strong adaptation mandate (e.g., MONRE and MARD) would further increase the likelihood of the model results being used to inform adaptation policy.
- More time, resources, and dedicated work are needed to make a stronger user case in Vietnam and integrate modelling results into adaptation planning processes.

The DGE–CRED model's flexibility as a tool could be used to cater to the different interests and needs of decision-makers in Vietnam, but it also requires the development of systems and protocols. The model can continue to be tailored and improved to serve as a quantitative and methodological tool to help inform adaptation planning efforts.



BROADER CONCLUSIONS AND LESSONS LEARNED

Using novel macroeconomic models to inform adaptation planning is no small feat, regardless of the timeline, ambition, or national context. **The absence of significant examples where macroeconomic models have been used to assess adaptation options in both developed and developing countries is telling (Dekens & Hammill, 2021)**. This chapter highlights some lessons that have emerged from the implementation of the CRED project in Georgia, Kazakhstan, and Vietnam to shed some light on the opportunities and barriers that emerged from this ambitious initiative.

The Status of National Adaptation Planning Matters

It is worth highlighting that the three governments in which the CRED program has been active were at very different stages of their NAP process, which is a strategic process that enables countries to identify and address their medium- and long-term priorities for adapting to climate change. Why is this relevant to the project's efforts?

The NAP process seeks to mainstream adaptation across sectors and can be used to promote and/or prioritize new practices—such as the use of macroeconomic modelling for adaptation planning—within the government. **Yet, in all three countries, national adaptation planning efforts are in the very early stages, impeding the full uptake of macroeconomic modelling to inform sectoral adaptation options and policy-making**, in particular given the relatively short time frame of the project.

For instance, in Georgia, the NAP process is only in its initial stage, and adaptation is not yet considered a national priority. Kazakhstan, on the other hand, has not yet initiated its NAP process, although it has requested funding to support the development of a NAP document from the GCF. Vietnam's process is most advanced, having published its NAP document in 2020 outlining the government's adaptation priorities.

Important Opportunities Emerged That Macroeconomic Modelling Presents for Climate-Resilient Economic Development Planning

In the short term, the overall project and **modelling results have added value to raising the profile of adaptation within the three governments**, specifically in relation to the following:

1. **The impacts of climate change on economic development**. Economic modelling has illustrated that climate change will have significant impacts on priority sectors of the economy and should be treated as an economic and social development issue. Model results have also helped government representatives see the evidence and general direction of climate impacts within specific sectors of the economy.

2. **The importance and urgency of climate change adaptation**. Being able to assign numbers to climate change impacts helped provide the impetus toward adaptation planning and has helped to translate the impacts of changes in climate on various economic activities.
3. **The added value of stakeholder engagement and policy dialogue around adaptation.** The process of developing the models and associated trainings has provided an opportunity to engage different stakeholders that do not necessarily deal with climate adaptation and build awareness and understanding around the topic.

The approach has been conducive to **initiating new (and hopefully lasting) conversations between ministries and sectors** that were not necessarily talking before, raising awareness about adaptation and the need for adequate data. In Vietnam, for example, the project itself has initiated conversations between sectors that were not necessarily taking place seriously. For the first time in key sectors such as agriculture, forestry, water, and housing, consultants

collaborated with the CIEM to create macroeconomic cost–benefit analyses. This was the countries' first systematic assessment of climate damages and adaptation options from a macroeconomic perspective.

While this wasn't always feasible in this project, **giving policy-makers early access to modelling results and examples of analysis** can be an important step to build the capacity of model users and foster uptake of the tool. It's an opportunity for policy-makers to understand and embrace the idea of using macroeconomic modelling results as one avenue to inform adaptation planning.

To help further institutionalize this type of model in the short term, applying it to specific activities and requests that are of interest and manageable in their scope and ambition, instead of focusing right away on how the model could be used more broadly in the medium and long terms. This could involve **focusing on one strategic entry point or enabling factor and targeting a specific audience**. This can also help increase the model's visibility, credibility, and ownership, and hence uptake in the medium and long terms. **A learning-by-doing approach** is therefore recommended.

Barriers Remain to Adopting Macroeconomic Modelling to Inform Climate-Resilient Economic Development

The implementation of the CRED project revealed different **barriers** to adopting macroeconomic modelling as a tool to inform climate-resilient economic development. Combined, these barriers can have significant implications and delay (or even prevent) model uptake.

Data availability for macroeconomic modelling: The data collection process for macroeconomic modelling is particularly time consuming and challenging. This needs to be factored in when designing and implementing this type of initiative. For the CRED program, the **required data for the chosen models was often not in the right format or available in the selected countries**. Beyond the extensive data requirements, applying the model also required specialized capacity, knowledge, and resources to continue to build and keep the model up to date. Building this capacity is also a significant investment. Combined, these requirements significantly delayed the production of macroeconomic model results and analysis.

Considering modelling results as one of many assessment criteria for climate-resilient development: For this initiative, modelling results were produced with the intention to help prioritize selected adaptation options for different regions and sectors in all countries. However, for policy-makers to be able to make informed decisions and prioritize adaptation options effectively, a combination of elements or criteria is required. It is thus important to point at the modelling results **together with other criteria (e.g., political feasibility, implementation cost, cultural appropriateness)**, acknowledging that decisions by policy-makers won't be made solely based on the economic opportunities or impacts that the models highlight. This might further strengthen the case for integrating the modelling results in policy-making but requires additional resources and analysis.

Having relevant or significant modelling results is not sufficient to ensure uptake within government: Having results that are sound and relevant is not sufficient to change how economic development is planned, even when providing specific entry points that lend themselves to integrating findings from the different models. The modus operandi for decision making is often tied to processes, systems, and individuals that have either been operating in a specific way for a number of years or are being reassigned due to a change in government. In both cases, rapid change in decision making is difficult to achieve.

For this type of initiative, assessing and being very clear about political feasibility, the main user's needs, data availability, and potential uses of the model are crucial to ensuring there is sufficient interest and capacity for the uptake of the results. For future projects of this kind, significant time and effort should be invested early to understand the needs of the government partners and ensuring that the data requirements for the model do not slow down climate-resilient development efforts. This will also help set realistic expectations regarding the timeline for when the results will begin influencing development policy.

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