Climate Resilient Economic Development in Vietnam

Exploring the potential for applying the Dynamic General Equilibrium Model (DGE-CRED)

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Key message

Climate change may reduce annual GDP by 4 percent between 2020 and 2050 and 5-11 percent between 2050 and 2100 under different climate change scenarios. The Mekong River Delta and agriculture are the most impacted region and sector.

The DGE-CRED model results confirm the importance of investing in climate-resilient infrastructure (dyke system, housing, drainage, and transport) and promoting diversified climate-smart crop patterns and practices in agriculture and forestry, as highlighted in the National Adaptation Plan (2020-2030) and National Green Growth Action Plan (2022-2030). In combination, these adaptation measures can lessen the adverse impacts of climate change on national consumption by 3-5 percent in 2050 and 4-6 percent in 2100 under different scenarios.

As incremental adaptation alone will not adequately protect the economy from growing risks, it is crucial to promote transformative adaptation that is economic restructuring from primary production and labor-intensive economy to a more business, innovation-based, and capital-intensive economy to adapt better to climate-induced labor productivity reduction. The transformative adaptation pathway requires fundamental changes at a multi-disciplined and regional scale, greater ambition, and a share between both public and private investment.

Adaptation and mitigation measures are intertwined and mutually beneficial and should be designed in parallel to support Vietnam achieve its goal of becoming a high-income country by 2045 and fulfilling its commitment to net zero emissions by 2050.

The mainstreaming of climate adaptation (mitigation) into policies and strategies should be stimulated at the national, regional and sectoral levels. The DGE-CRED model mainly serves as a quantitative and methodological tool to help fulfill these requirements.

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Background

Vietnam is one of the most vulnerable countries to climate change. The country ranks 13th on the Long-term Climate Risk Index for the period 1999-2019 [1]. Vietnam has extremely high exposure to flooding including, riverine, flash, and coastal flooding, high exposure to tropical cyclones and their associated hazards, and slightly lower exposure to drought [2]. During the period 1995-2017, Vietnam lost 14 trillion VND/year (2010 real price) with an increasing rate of 12.7 percent/year due to climate and weather risks [3-5]. In 2020 only, the climate-change-induced loss was $10 billion or 3.2 percent of its GDP and is projected to increase rapidly [6]. Depending on the emissions pathway, climate change is likely to increase the population affected by fluvial flooding, projected to be in the range of 3–9 million people by 2035–2044. In addition, 6–12 million people will potentially be affected by coastal flooding due to sea level rise by 2070–2100 without effective adaptation actions [2]. Impacts are heavily concentrated in the two mega-river deltas of the Red River and Mekong River, and high-density urban areas [2].

The increasing impact of climate change on the long-term economic growth and livelihoods of millions of people reinforces the need for approaches to assess the socio-economic impact of potential adaptation strategies and mainstream climate actions into development strategies and policies, to make the necessary investments for directing Vietnam towards climate resilience, net-zero emissions by 2050 and high-income economy by 2045.

Assessing and planning climate-resilient economic development

DGE-CRED model - standard tool for climate resilient policy assessment

The DGE-CRED model – a dynamic general equilibrium model for climate-resilient economic development – is constructed as a multi-sector and multi-region model currently being tested in Vietnam. It is implemented in the open-source environment Dynare and uses MATLAB software to allow for easy tailoring of the model to the local context. It can be used to analyze the dynamics of economic variables of interest in response to different projections of climate change and associated weather phenomena. At the same time, it can help examine the effectiveness of adaptation measures through cost-benefit analysis, complementing other assessments and considerations policymakers have when prioritizing adaptation measures. Through the inclusion of climate change and potential adaptation measures as variables in macroeconomic models, DGE-CRED can support the monitoring and evaluation of adaptation measures. Lastly, the model uses forward-looking expectations that allow for optimization over time, meaning that today's decisions today are based on expectations realized in the model simulation.

The DGE-CRED model has been developed by the Halle Institute for Economic Research (IWH) in close collaboration with the Central Institute for Economic Management (CIEM). It covers 17 sector groups (rice, other annual crops, fruit tree, dry rubber, coffee, other perennial crops, livestock, and agricultural services, aquaculture, forestry, water, energy, manufacturing, construction, water transport, road transport, health, and services) and 6 regions (Red River Delta, Northern Midlands and Mountainous Area, North Central and Central Coastal area, Central Highlands, South East, and Mekong River Delta) The model is simulated for three Shared Socioeconomic Pathways (SSP) scenarios (SSP119, SSP245, and SSP585)[1] (including heat stress and sea level rise impacts) with and without planned and autonomous adaptation interventions.

[1] The SSPs describe alternative socio-economic futures in the absence of climate policy intervention, comprising sustainable development (SSP1), regional rivalry (SSP3), inequality (SSP4), fossil–fuelled development (SSP5) and middle-of-the-road development (SSP2). The combination of SSP-based socio-economic scenarios and Representative Concentration Pathway (RCP)-based climate projections provides an integrative frame for climate impact and policy analysis. Accordingly SSP119 is SSP1 combined with RCP 1.9; SSP245 is SSP2 combined with RCP 4.5; and SSP585 is SSP5 combined with RCP 8.5 [7].

Projected impacts of climate change on the economy by 2100

The model results show that climate change is projected to reduce annual GDP by 4 percent between 2020 and 2050 and 5 to 11 percent between 2050 to 2100 under different scenarios. Over the period 2020-2100, the impact is relatively stable under SSP119 while increasing constantly under SSP245 and SSP585. Contraction in consumption is responsible for 3 to 4 percentage point until 2050 and 4 to 8 percentage point between 2050 and 2100 of GDP reduction followed by investment and government expenditure . In relation to direct damage, the loss in GDP is largely attributed to a reduction in labor productivity, then total factor productivity and capital.

The Mekong River Delta is the most impacted region whose GDP reduces by 8-8.76 percent in SSP585 scenario for the period 2055-2079. The region contributes 1.2 percentage point and 1.5-2.5 percentage point to the decline in GDP in Vietnam until 2050 and at the end of the century respectively under different scenarios. Next are the Red River Delta, the Northern Central and Central Coastal Area with similar contribution to national GDP reduction of around 0.5-2 percentage point. The least suffering region is the Central Highlands with 0.2-0.7 percentage point by 2050 and–2100 (Figure 2). This poses the risk of increasing socioeconomic disparities among regions if adaptation measures are not implemented adequately.

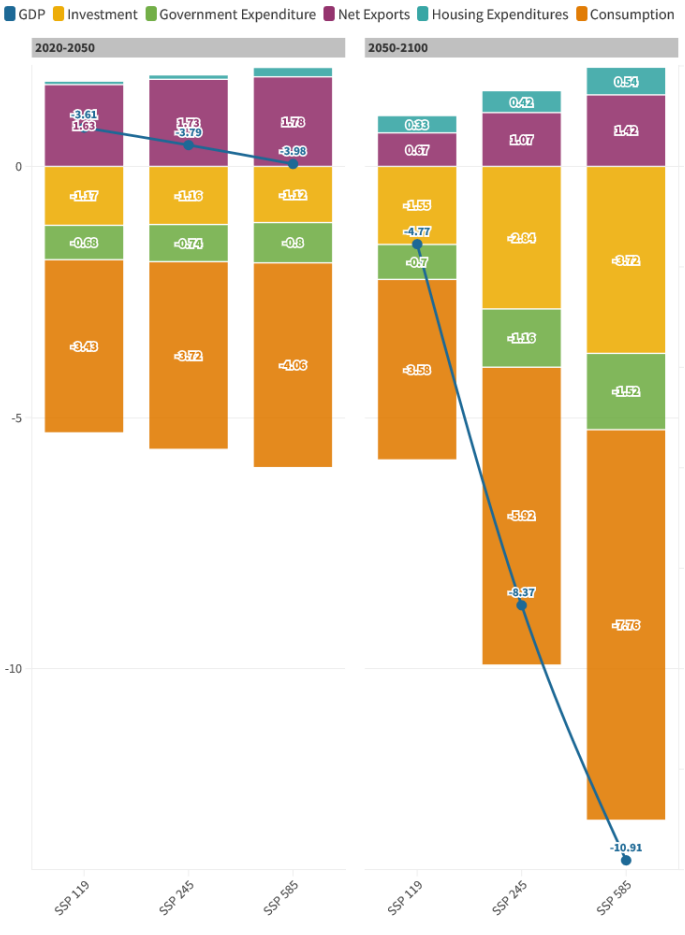


Figure 1: *GDP components - Deviation from baseline in percent*

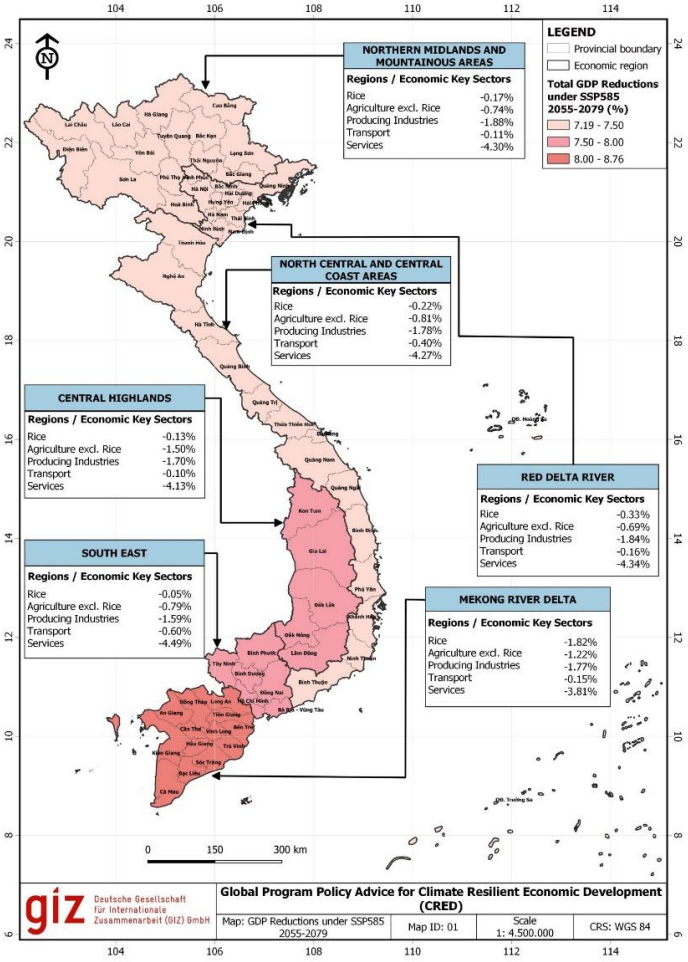


Figure 2: *Regional contribution of GDP to deviation from baseline scenario in percent*

Projected impacts of climate change on the economy by 2100

Climate change appears to have the biggest impact on agriculture and services contributing to the decline in value-added_similarly by around approximately 1.0-1.7 percentage point by 2050 and 1.0-6.0 percentage point by 2100 under different scenarios. Fewer impacts are seen for manufacturing and transport and the least suffering sector is housing (Figure 3).

Within the agriculture sector, crop production suffers the most, typically rice and annual crops (around 0.80-0.90 and 0.60-0.90 percentage point), followed by livestock (0.05-0.10 percentage point), and aquaculture (0.03-0.07 and 0.04-0.10 percentage point) (Figure 4).

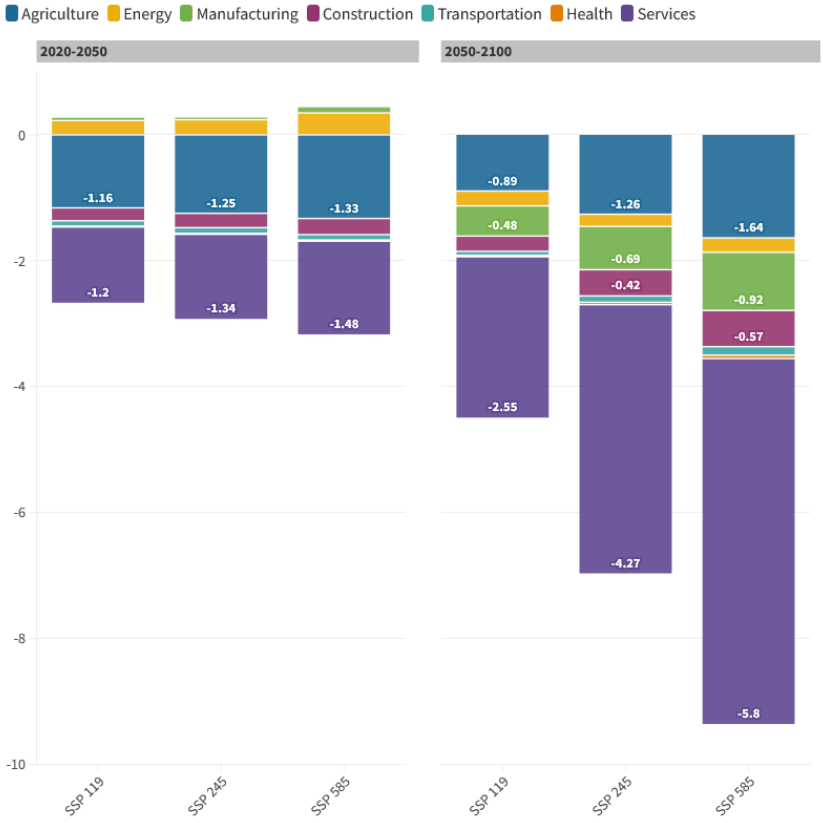


Figure 3: *Sectoral contribution to GDP deviation from baseline scenario in percent*

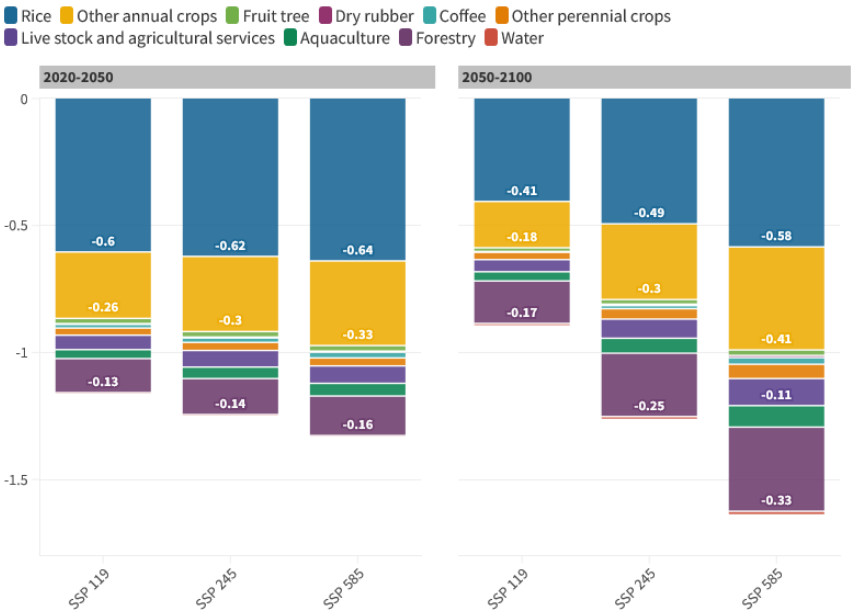


Figure 4: *Contribution of agricultural commodities GDP deviation from baseline scenario in percent*

Adaptation measures supported by the government can help lessen the adverse impacts of climate change but should be combined with private investment in a transformative adaptation pathway.

There are various potential adaptation measures across sectors that can be categorized into 2 main groups (i) climate resilient infrastructure including dyke systems, housing, drainage, and transport, and (ii) climate-smart crop patterns and practices in agriculture and forestry. These adaptation measures include both the planned interventions by the government and the endogenous reaction of optimizing private actors (farmers, businesses).

The DGE-CRED model results show that the adaptation measures either individually or combined do not always help to recoup GDP loss due to climate change. Instead, they would expand exports and lessen the impacts of climate change on consumption, an important component of GDP reflecting welfare; thus, enhancing the country's resilience and narrowing the socio-economic gaps among regions. The combination of all measures can reduce the consumption gap by 3-5 percent by 2050 and 4-6 percent by 2100 under different scenarios. For example, in SSP 585 scenario, when all adaptation measures are implemented, the consumption reduces by 7.33 percent whereas without adaptation, the reduction is 7.76 percent (Figure 5).

The results prove that incremental adaptation alone will not adequately protect the economy from growing risks. Additionally, it is vital to promote transformative adaptation that changes the fundamental attributes of the economic structure at a scale and ambition greater than incremental activities [8]. Both public and private investment should be mobilized to promote this transformative adaptation pathway, considering that many adaptation measures are endogenous responses of private actors.

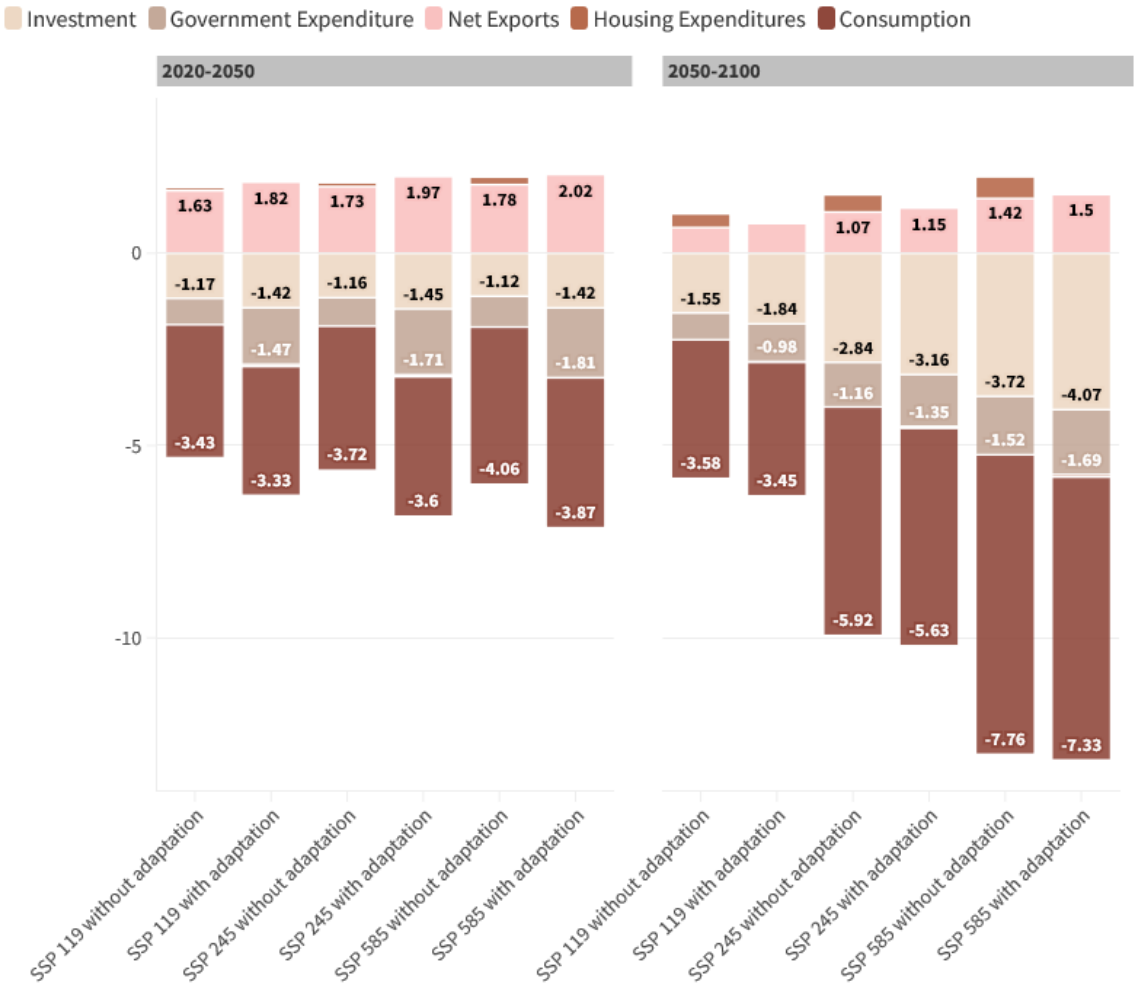
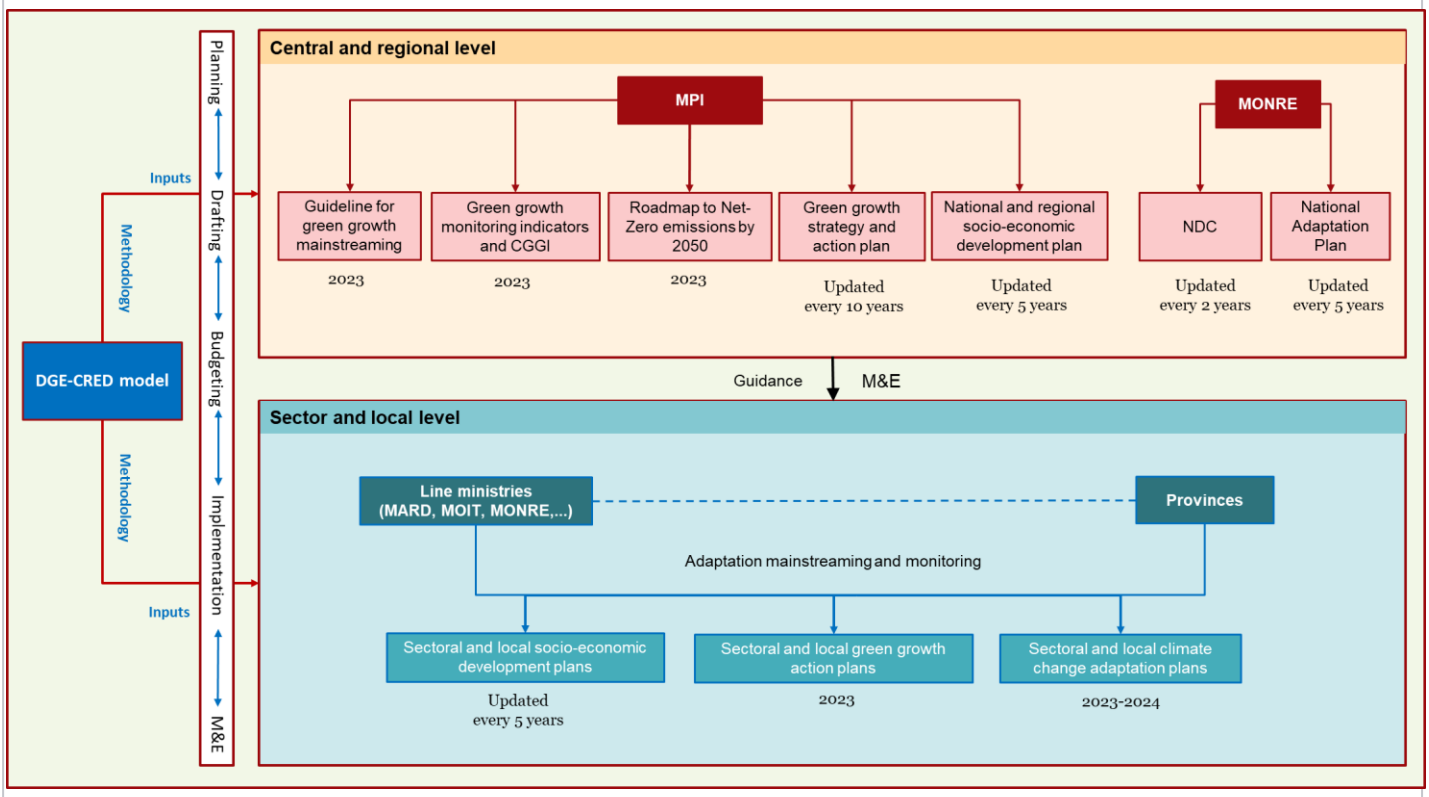


Figure 5: *Consumption gap under different scenarios in percent*

Recommendations

- Promote economic restructuring from primary production and labor-intensive economy to a more business, innovation-based, and capital-intensive economy to adapt better to climate-induced labor productivity reduction.
- Facilitate the endogenous reaction of optimizing agents (farmers, businesses) to climate change in the agriculture sector by government's preferential policies such as information and knowledge sharing, technical diffusion, credit access, and agricultural insurance in order to attract private investment and stimulate changes in attitudes, behaviors, and actions.
- Prioritize public investment and encourage public-private partnership in developing climate-resilient infrastructure including dyke systems, housing, drainage, and transport based on no-regret and nature-based approach to avoid "lock-in" risks.
- Promote research and education on the social and economic effects of climate change in Vietnam to better understand and address distributional and growth impeding effects through adequate economic and adaptation policies.

Mainstreaming the assessment and planning of climate adaptation



Enabling factors

In order to enable the mainstreaming of climate change adaptation and DGE-CRED modeling results, the critically important factors are officially accessible climate data system, information sharing, and capacity development for reciprocal understanding, consensus, and commitment as well as future collaboration among stakeholders. It is recommended the following:

- Promote the set-up of comprehensive climate and socio-economic datasets integrated into the official statistics system at both national and local levels for regular updates and open access (led by General Statistics Office (GSO)/MPI);
- Translate climate information and CRED modelling results into user-driven concrete and understandable climate risks and list of adaptation actions in various user-friendly forms, and promote timely accessibility (led by MPI);
- 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;
- Build capacity for policy and strategy research institutes and policymakers across sectors on risks and vulnerabilities to climate change, adaptation measures, cost and benefits, and methodological knowledge (led by CIEM and MPI);
- Mobilize technical and financial support to set up the foundation, create needs, and train users (led by GIZ and other potential donors).

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Data and basic assumptions are mostly up to date and were discussed with national sector experts in 2020-2022. Further contextualization and expansion of the results of the scenario analysis as well as economic evaluation of different adaptation measures should be respectively coordinated with the Central Institute for Economic Management, Ministry of Planning and Investment in Vietnam.

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