Appropriate Costing Options of Climate Change Adaptation in Infrastructure Development: Experimental Studies for Road and related Infrastructure Projects in Cambodia (CAMI)

(PRELIMINARY RESULTS/FINDINGS)

Project Implementor: Master of Science in Climate Change Program, Graduate School of Science, Royal University of Phnom Penh (MCC/RUPP)

Project Partners: Asian Institute of Technology, Thailand; University of Freiburg, Germany (Foreign); Ministry of Public Work and Transport (MPWT), Ministry of Rural Development (MRD) (Local)

Project Locations: Kampong Thom and Pursat (Tonle Sap Lake), Kratie and Prey Veng (Mekong River), and Kampot (coastal zone)

Introduction

IPCC's sixth assessment report (2021) clearly stated that humans have been the main cause of climate change, causing many climatic extremes in all part of the globe. Extreme climatic conditions caused by the results of human actions include heatwaves, heavy precipitation, droughts, glaciers melting, and storms. Future global surface temperature will still be on the rise, exceeding the temperature rise of 1.5°C to 2°C during the 21st century until unless extreme actions have been taken to reduce the carbon and GHG gas emissions. The transport infrastructure and operations are seriously threatened and challenged by the existing variability in climate. **Cambodia as one of the most vulnerable countries to climate change as there will be more extreme weather events at higher intensity and frequency.** Climate change is a potential threat to Cambodia's development as current and future infrastructure will be vulnerable to climate change impacts. The planning, design, construction, operation, and maintenance of roads and related infrastructures by the government ministries have mostly followed the conventional methods, and each type of roads and related infrastructures has proposed different levels of costing and construction approaches.

Materials and Methods

The methodology of this assessment is mainly done through literature review. Excessive literature review is done on cost effective climate change adaptation infrastructures. This is done through published journals, thesis, articles, and reports. The study seeks to reveal what lessons can be drawn from the selected South-East Asian countries in the region experiences in climate change adaptation and the cost analysis, and how those lessons can be transferred to other local authorities to encourage them to engage in and advance climate change adaptation. Based on the gathered information regrading adaptation strategies, economic analysis and loss and damage assessments, a conceptual framework for economic analysis on climate change adaption on road infrastructures are developed.

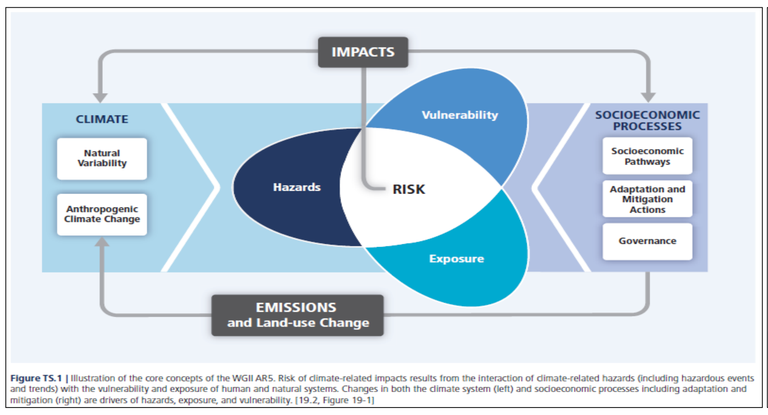
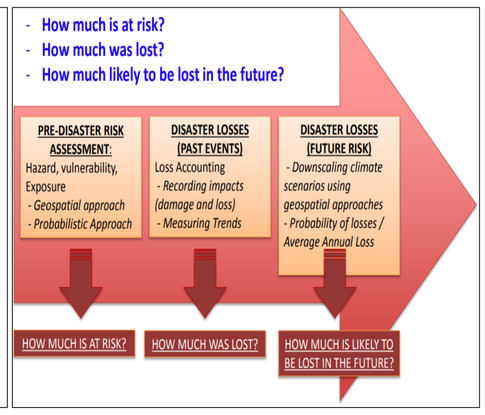


Figure TS.1 | Illustration of the core concepts of the WGII AR5. Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability. [19.2, Figure 19-1]

(1). Climate Risk Assessment Framework



(2). Climate Risk Assessment on Damage and Loss of Road and Related Infrastructures

Results and Discussion

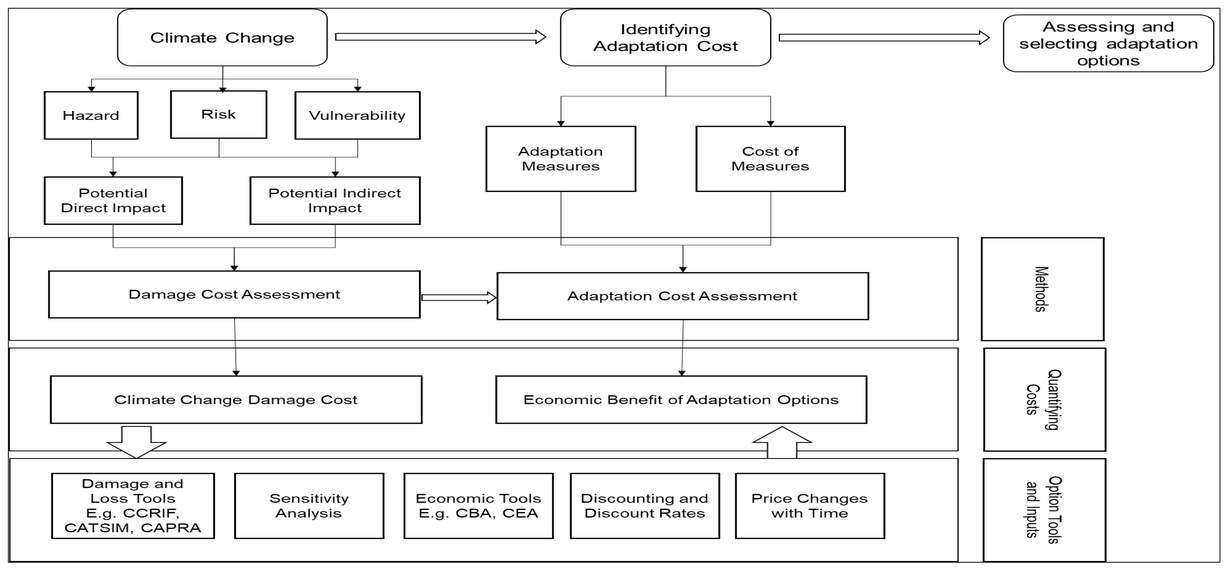
Develop tools and methods to assess damages and losses from climate change for infrastructure projects in Cambodia based on survey and consultations with relevant stakeholders. We have reviewed the available tools and approaches on loss and damage assessment, and adaptation costing for climate change projects in the region and around the world.

Analysis	Description	Inputs	Methods	Tools	Advantages	Disadvantages	Reference
Risk Assessment	Risk assessment is a process to identify potential hazards and analyze what could happen if a hazard occurs	Hazard, Vulnerability, Exposure	Exposure–Impact–Adaptive-capacity framework incorporates elements of the risk analysis framework adopted by the IPCC and the framework for vulnerability assessment used by the USAID	World Bank Climate and Disaster Risk Screening Tools assist in the development of planning processes that identify the severity of the potential risks to projects of various scales; ranging from national plans to individual project investments; and helps stimulate thinking towards developing enhanced resilience opportunities as well as potential risks to climate change.	Freely available	Data Intensive	World Bank and NDC partnership https://ndcpartnership.org/toolbox/climate-disaster-risk-screening-tools
Cost Assessment	Total Cost Assessment is the consideration of all environmental and health costs associated with a decision, including direct costs, risks and liabilities, and costs borne by others.	Adaptation measures, cost of measures, timing and discount rates	Quantitative Analysis	Total Social Costs Total economic costs of the baseline scenario, either in a given future year, or as a total net present value over. By dividing by the total emissions of carbon, it is possible to assess the average cost of Greenhouse Gas (GHG) emissions.	Provides a systematic outlining of monetized costs and benefits, ultimately offering a simple economic value. Protect high value investments, infrastructure, or properties.	Does not explicitly deal with uncertainty Choice of time horizon and scales can dramatically change results Choice of discount rate is a matter of on-going contention and debate	RAMESES PROJECT, Reconciling Adaptation, Mitigation and Sustainable Development for Cities. 2013
				Marginal Social Costs Estimated as the net present value of all climate change impacts over the next 100 years (or longer) of one additional tonne of carbon or other GHG emitted to the atmosphere today. The marginal social costs are usually estimated by assessing the economic costs of climate change under the given baseline, and then rerunning the analysis with an additional pulse of carbon emission. The difference between the two scenarios (over all future years) provides the marginal social cost.			
				Marginal Abatement Costs Reflects the marginal technology and represents the cost of abating an additional tonne of carbon.			
				Cost-benefit Analysis Quantifies costs and benefits in monetary terms, including values not captured by markets			
			Multi-criteria Analysis Systematic approach for ranking adaptation options against a range of decision criteria	ECONADAPT Assess and score adaptation options against a set of decision criteria	Relatively simple and transparent and can be done at relatively low cost and within a limited time. Provides a structured framework for combining expert judgement and stakeholder preferences.	Subjectivity can be high. Giving consistent scores can be difficult. Analysis of uncertainty often highly qualitative	ECONADAPT https://econadapt-toolbox.eu/multi-criteria-analysis
			Cost Analysis	Urban Assessment Support Tool (UAST)	More participatory and stakeholder oriented	Less quantitative	RAMESES PROJECT, Reconciling Adaptation, Mitigation and Sustainable Development for Cities. 2013
Damage Cost Assessment	The quantified, monetized impacts of climate events. They include direct and indirect costs, market and non-market costs, and may be estimated as total or expected costs.	Direct and indirect cost Market and non-market costs Total and expected costs	Integrated Assessment Models (IAMS)	Dynamic Integrated Climate Change Model (DICE)	Useful tool for assessing trends and relationships related to climate change	Calibration is based on large sets of assumptions,	Kopp, R.E., Hsiang, S.M. and M. Oppenheimer (2013). Empirically calibrating damage functions and considering stochasticity when integrated assessment models are used as decision tools. In: Impacts World 2013 Conference Proceedings. Potsdam: Potsdam Institute for Climate Impact Research, pp. 834–843.

Proposed Analysis Methods and Tools for Loss and Damage from Climate Change for Road and Related Infrastructures

Conclusion and Recommendation

In conclusion, suitable methods for analyzing cost and benefit of adaptations for road and related infrastructure are produced. Analysis on current climate variability (the adaptation deficit), existing decision support tools can be used, including Cost-Benefit Analysis (CBA) and Cost- Effectiveness Analysis (CEA). The areas that are difficult for valuation, and usually lack of quantitative information, Multi-Criteria Analysis (MCA) is often used. Lastly, conceptual framework is established based on the literature review, which covers the climate change adaptation and economic analysis for road and related infrastructures in the context for developing countries, including Cambodia.



Conceptual Framework for Economics Analysis on Climate Change Adaptation for Road and Related Infrastructures

Lessons learned and Next Steps

Lessons Learned: The project team has learnt a lot about the variety of tools and methods used for loss and damage assessment, and adaptation costing of climate change projects in the region.

1. Official data on loss and damage and estimate including projection for different components and future years are limited.
2. In country study on loss and damage with related monetary and non-monetary values are limited.
3. Adaptation types and options including its limits with possible costing in the development phases and future years are shortages.

Next Steps

1. Finalize the potential methods and tools for costing climate change adaptation on infrastructure.
2. Conducting field visits (AIT experts, Thailand) to hold consultations with target Cambodian infrastructure development ministries, departments and provinces in order to gain insights of infrastructure development problems and challenges, as well as testing out the selected tools and methods
3. Refinement of tools and methods through consultations and meetings with relevant stakeholders following testing at the field and with historical data on climate change induced damages and losses.

Acknowledgement

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