CLIMATE CHANGE VULNERABILITY AND ADAPTATION ASSESSMENT METHODS AND TOOLS APPLIED IN CAMBODIA

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This brief presents a summary of the literature review for the project *"Climate Change and Water Governance in Cambodia"*. The initial activity of the project, the review examines the existing methods and tools applied for understanding the impacts of climate change and the vulnerability and adaptive capacity of local people regarding water governance and uses in three target areas in the Tonle Sap Basin. The methods and tools identified will be considered for further development and application by mostly Mini Study 2: Modelling and Participatory Vulnerability and Adaptation Assessment (which is part of the overall project).

KEY MESSAGES

In order to assess the effects of climate change, an integrated framework approach is required. Country climate data, downscaled to catchment-level by applying dynamic and statistical approaches, will be used in distributed hydrological models, including the Soil and Water Assessment Tool (SWAT), the Integrated Water Quantity and Quality river basin simulation Model (IQQM), and river modelling Integrated Software for Imagers and Spectrometers (ISIS),[1] to assess water availability and flooding at different times and in different locations of the catchment areas. Participatory tools including Climate Vulnerability and Capacity Analysis (CVCA), Community-Based Adaptation (CBA), Participatory Capacity and Vulnerable Assessment (PCVA) and some other participatory tools for vulnerability and adaptation (V&A) assessment will be used to identify the combined hydrological and economic impacts of climate change and water variability on local livelihoods, especially those of vulnerable groups. Finally, cost-benefit analysis and multi-criteria analysis will be used as other decision support tools for prioritising adaptation interventions and/or project activities.

1. INTRODUCTION

For this review, three key terms need to be defined:

- *Vulnerability* refers to "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC 2001: 995)
- *Adaptive capacity* refers to "the ability of a system to adjust to climate change (including climate variability and extremes)" (IPCC 2001: 982–996)
- *Vulnerability and adaptation assessment* is "a process of defining vulnerability to or risks

[1] Developed by CH2M HILL, ISIS is used throughout the world as an analysis tool for flood risk mapping, flood forecasting and other aspects of flood risk management analysis.

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from changes in climate, other environmental variables and social conditions at several scales and levels" (MOE 2012: 2).

Cambodia is prone to flooding, drought and windstorms, the frequency and intensity of which appear to have increased since 1989 when statistics began to be regularly recorded. These disasters and climate-related hazards have exacted huge socio-economic costs on the country's economy and people's livelihoods. The 2000 and 2011 floods were the worst in recent history, resulting in a high number of internally displaced people, hundreds of deaths, and other losses. Widespread flooding in 2011 especially damaged much of the rural and urban infrastructure that had been developed in the previous ten years in the Tonle Sap and the Mekong floodplains.

The intensification of weather and climate extremes has been compounded by the absence of a proper response mechanism and planning regime within the catchments because of a lack of understanding about the associated issues, and the limited capacity of the people to cope with climate variability and extremes. This project addresses the need to identify vulnerabilities and assess the local knowledge and understanding of stakeholders at community level in specific areas within the Tonle Sap catchment, using appropriate methods and tools.

This brief reviews existing methods and tools, and identifies the most appropriate ones for conducting the V&A assessment at community and catchment levels required by the project. This will support appropriate recommendations for improving vulnerability adaptation measures in the three Tonle Sap Basin catchment areas.

2. METHODS AND TOOLS

2.1. Overview

Methods and tools for V&A assessment employ various guidelines, models, toolkits and frameworks that have been created to support adaptation planning and implementation processes. These range from complex models to assess climate change impacts to guidelines indicating the steps to take from identifying, designing, implementing and evaluating vulnerability, to planning effective adaptation measures (MRC 2010: vii).

The United Nations Framework Convention on Climate Change (UNFCCC 2013) lists 127 different methods and tools categorised according to sector (e.g. agriculture, forestry and so on), theme (e.g. climate scenarios, impact

Table 1: Practical Criteria Used for Selecting Methods and Tools

Methods and Tools	Criteria
Methods and tools for vulnerability assessment	• Is it simple to use or does it require training or other inputs? • Is there evidence of application? • Is it up-to-date?
Methods and tools for adaptation planning	• Is it relevant to the needs and concerns in the study sites (Tonle Sap area)? • Is it holistic in that all sectors are considered, even if the focus is on one sector? • Does it acknowledge an Integrated Water Resource Management (IWRM) approach? • It is simple to use or does it require training or other inputs? • Is it accessible?

Source: modified from MRC (2010: 11)

assessment) and type (e.g. guidance document, modelling tool).

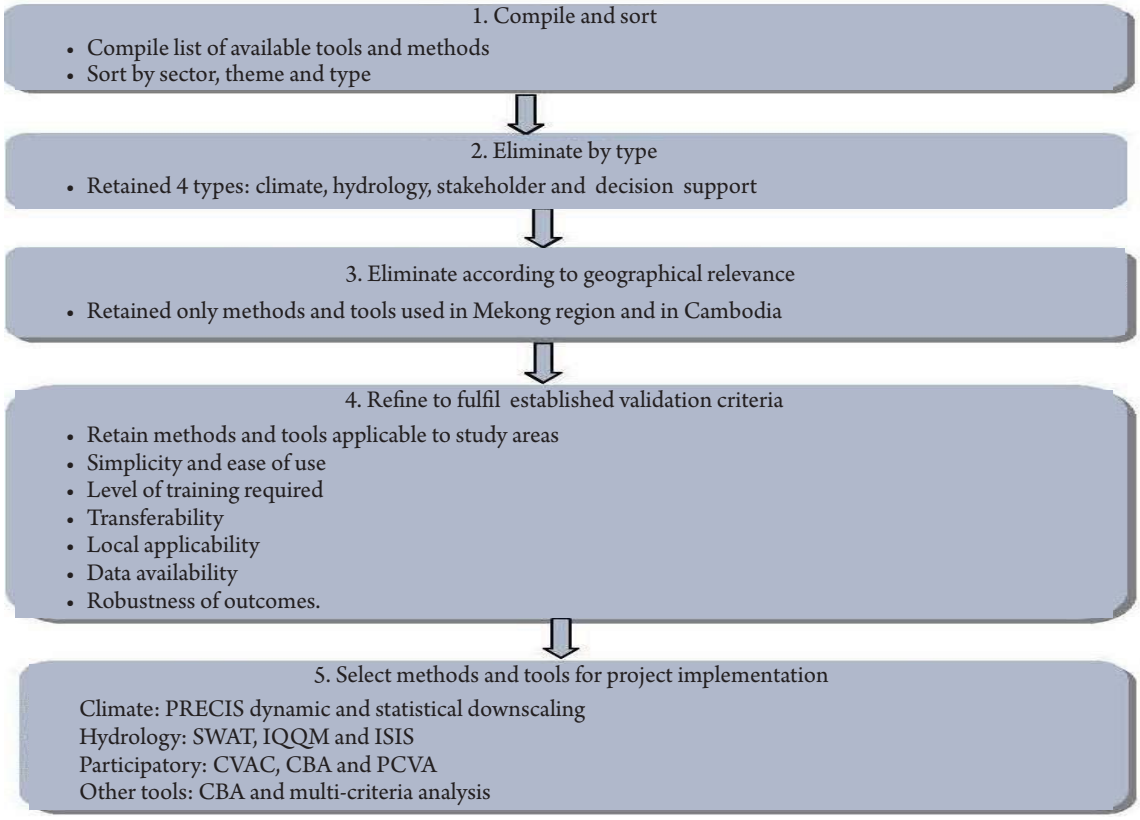
2.2. Criteria and Selection Process

The methodological aspects have been analysed by comparing the sets of best practice criteria listed in Table 1. In selecting the methods and tools for assessing vulnerability and adaptive capacity, the following criteria should be considered: simplicity and ease of use, applicability at the project site, and how up-to-date the method or tool is. However, the selection of methods and tools for adaptation planning is slightly different in that a wider set of factors must be taken into account; the associated criteria include those described in Table 1.

A stepwise approach is used for screening and/or filtering out the methods and tools for assessing climate change vulnerability and adaptation in Cambodia, particularly in the Tonle Sap region (Figure 1). It starts with the collection of all available methods and tools applied in the world, most of which are listed in the UNFCCC Compendium (2013). The whole process is as follows:

1. Collect information about the methods and tools available to assess vulnerability, impacts and adaptation to climate change from both the UNFCCC Compendium (2013) and the Mekong River Commission Review (MRC 2010).
2. Categorise these methods and tools by sector, theme and type.
3. Eliminate the methods and tools that are not relevant to V&A assessment in the project sites. Consider the methods and tools that might be appropriate for assessing climate change and water governance related vulnerability and adaptation in their totality.

Figure 1: Process for Selecting Methods and Tools



4. Retain the methods and tools that are applicable to activities in the Tonle Sap catchment.

5. Select each method or tool as appropriate for implementation in the project areas. The process identified four methods and tools: climate downscaling, hydrological modelling, interactive stakeholder participatory analysis, and other decision support tools.

2.3. Selected Methods and Tools

2.3.1. Modelling Methods and Tools

The climate model PRECIS (Providing Regional Climates for Impacts Studies)[2] has been applied in the Mekong region, including in Cambodia. Some key members of the project team have a good understanding of this model as well as experience in using it. Given that the PRECIS model has already been run at national and regional levels, there is no benefit in repeating this wide-scale exercise. Instead, it is necessary to downscale the existing results generated by PRECIS to understand current climate variability in the project areas in Kampong Chhnang, Pursat and Kampong Thom provinces; therefore, climate data (temperature and precipitation) was downscaled using a resolution of 0.2 x 0.2 degrees (equivalent to 22 x 22 km of land area).

Models for hydrological, hydrodynamic, and water quality assessment are important. They can be used to provide quantitative inputs for V&A assessments, and for resilience planning to mitigate the risks to critical infrastructure and services (property, water storage, flood protection, roads and embankments, electrical/power grid, railways and bridges). However, there are greater learning requirements that need more versatile and powerful tools.

Many hydrological models have been applied in different river catchments in the country, and in the case of the Tonle Sap catchment the study team has decided to use a combination of SWAT, IQQM, ISIS, and the physical tank model.[3] Also, two new hydrological models, namely, Integrated Water Resource Management (IWRM) and eWater Source[4], which have not yet been implemented in Cambodia, are proposed for the purpose of capacity building only (i.e., the team will use them not to gather data but to learn the application processes).

2.3.2. Participatory Methods and Tools

Participatory vulnerability assessment is commonly used by different organisations to empower community members to systematically analyse their problems, suggest their own context specific solutions and identify the means to achieve those solutions (UK-AID 2011; McNamara and Limalevu 2011). PVA is also considered as a bottom-up approach for identifying appropriate solutions to reduce the risks caused by natural hazards that are linked to climate change. PVA is used as an entry point to strengthen community-based action. It places community knowledge, experiences and attitude towards climate change at the centre of vulnerability and adaptive capacity assessments and in designing area-specific local adaptation measures.

The Cooperative for Assistance and Relief Everywhere (CARE 2009) developed and implemented Climate Vulnerability and Adaptive Capacity Assessment (CVAC) and Community-Based Adaptation (CBA) toolkits based on the Sustainable Livelihoods Approach. A variety of participatory appraisal tools are suggested for data collection and analysis, including hazard trend analysis, hazard

[2] PRECIS is a regional climate model developed by the Hadley Centre at the UK Met Office.

[3] Proposed by Sugawara (1995), the tank model is a simple model composed of four land-based tanks laid vertically in a series. The tank model is used to estimate the movement of rainwater over the soil surface (surface runoff) and into the soil (sub-base runoff and base flow), flowing into small streams and then to bigger rivers.

[4] http://www.ewater.com.au/products/ewater-source/

ranking, hazard mapping, seasonal calendars of livelihood activities, historical timelines, vulnerability matrices, and Venn diagrams. These will be used for the project for assessing the impacts of both climate change and human activities on hydrology and water use in the project sites of the three provinces.

2.3.3. Other Decision Support Tools

In addition to the above complex mathematical models and other assessment tools for local participatory assessment of V&A, various other decision support tools including multi-criteria analysis, cost-benefit analysis and cost-effectiveness analysis will be used. Further details about the applicability, use, technical requirements and suitability of each of these tools are explained in the full report.

3. CONCLUSION

In selecting methods and tools for vulnerability assessment the following main criteria should be considered: the simplicity and ease of use, the applicability at the project site, the transferability, and how up-to-date each method or tool is. The trade-off between these criteria is essential, taking into account the availability of data and financial and human resources, as well as the robustness of the outcomes.

To test the project hypothesis relating to climate change vulnerability and adaptive capacity, it is necessary to apply an integrated approach combining comprehensive V&A assessment frameworks. These consist of four different types of methods and tools that should be applied simultaneously at the early stage of the project.

For climate modelling, climate data can be downscaled from the regional (Mekong) or national scale (Cambodia) to the catchment scale (Tonle Sap) by applying PRECIS dynamic and statistical climate downscaling. For hydrological parameters, SWAT and IQQM are suggested for predicting future hydrological changes. In following these, ISIS should be applied for predicting flood levels in the catchment areas. At the same time, two new hydrological models, namely the Integrated Water Resource Management (IWRM) model and the eSource model, are proposed for the time being solely for training and capacity building of the Cambodian researchers and partners involved with modelling.

Participatory V&A assessment is commonly used by different organisations to empower community members to systematically analyse problems, suggest their own context specific solutions and identify the measures needed to achieve those solutions. Specifically, Climate Vulnerability and Capacity Analysis (CVCA) and Community-Based Adaptation (CBA) toolkits, Participatory Capacity and Vulnerability Assessment (PCVA) and some other participatory V&A tools that are based on the Sustainable Livelihoods Approach are considered to be close to the Climate Resilience and Water Security Assessment Framework (CWSAFE) mentioned in the full report. They are thus relevant.

Cost-benefit analysis and multi-criteria analysis are popularly used as other decision support tools for selecting and prioritising intervention activities and/or for use in projects related to climate change adaptation. These will also support the project aims.

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