Climate Change Benefit Analysis

CCBA Guidelines

Office of Natural Resources and Environmental Policy and Planning

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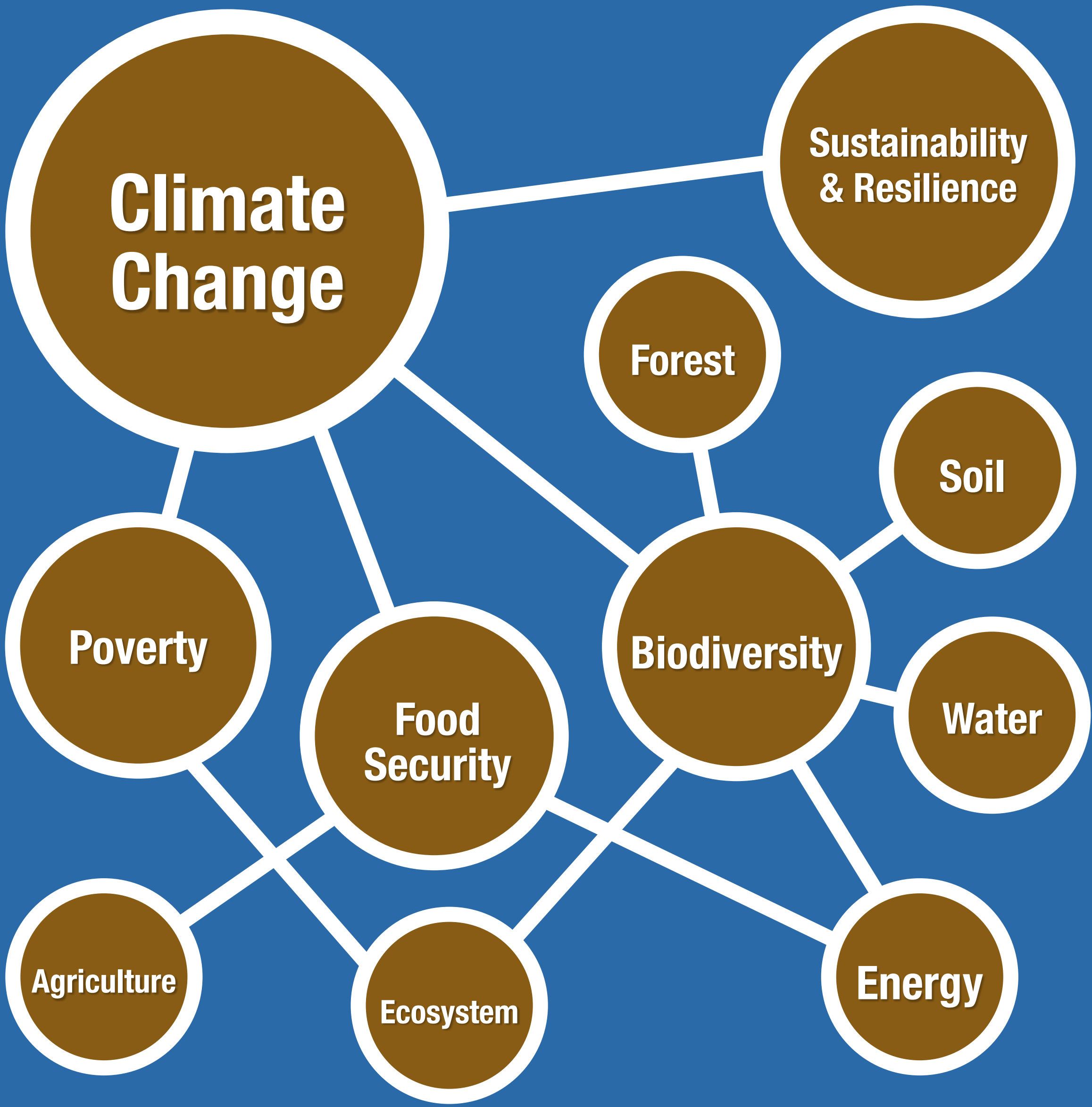

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December 2015


CCBA
Sustainability
Food Security
Water
Soil
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Poverty
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Forest

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Abbreviations

BCR	Benefit Cost Ratio
BoB	Bureau of the Budget
CBA	Cost Benefit Analysis
CC	Climate Change
CCBA	Climate Change Benefit Analysis
CCFF	Climate Change Financing Framework
COP	Conference of the Parties (of UNFCCC)
CPEIR	Climate Public Expenditure and Institutional Review
GHG	Greenhouse Gas
IA	Impact Assessment
IPCC	Intergovernmental Panel on Climate Change
NDP	National Development Plan
M&E	Monitoring and Evaluation
MOAC	Ministry of Agriculture and Cooperatives
MOEN	Ministry of Energy
NESDB	National Economic and Social Development Board
NPV	Net Present Value
OBA	Objectives Based Assessment
ONEP	Office of Natural Resources and Environmental Policy and Planning
RGT	Royal Government of Thailand
SD	Sustainable Development
SNC	Second National Communication (to UNFCCC)
tCO_2e	tons of Carbon Dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change

Glossary

Adaptation: Responding to climate change to reduce the loss and damage

Appraisal: Ex-ante evaluation

Downscaled: Climate change projections that apply to relatively small areas, below the level of detail provided in global or regional climate models

Headline Scenario: The climate change scenario that is used for the main conclusions and may then be subject to sensitivity analysis

Mainstreaming: The process of integrating climate change into the routine processes of planning and budgeting

Maladaptation: A project that becomes less effective when climate change takes place

Mitigation: Reducing greenhouse gas emissions and so reducing climate change

Proofing: Changing a project to protect its performance from climate change

(CC) Relevance: The extent to which project performance is affected by climate change

Scenario: A package of assumptions that produces a particular CCBA result

Sensitivity Analysis: Analysis of how the CCBA results change as an assumption changes

PREFACE

Thailand is one of the countries in Southeast Asia which have explored options for integrating climate change into national planning and budgeting. It was also one of the first group of five countries to produce a Climate Change Public Expenditure and Institutional Review and has played a leading role in piloting analysis of how climate change affects the benefits from public expenditure.

These guidelines are an important step in moving towards changes in the procedures used for planning and budgeting and so embedding climate change within the management routines for public policy and expenditure. Initially, they will be used in a pilot form, with selected ministries. A more formal version, supported by regulations, will then be introduced.

The biggest challenge facing the integration of climate change into planning and budgeting is the need to build awareness and capacity. This starts with the need to understand how climate change will affect the Thai people, especially (but not exclusively) in the key sectors of agriculture, forestry, water, energy, infrastructure and health. Building this understanding of climate change is not easy and will take five to ten years.

At the same time as building understanding about climate change, the government will also build capacity in redesigning services and investments to help protect people from climate change and to reduce greenhouse gas emissions. Building this capacity is a major task, but it is less complicated than it might seem, once the basic understanding of climate change is in place. These guidelines describe methods to integrate climate change into project design which range from demanding cost benefit analysis, suitable only for large investments, to rapid assessment based on expert opinion that can be done in a few hours, if there is already an understanding of climate change.

The line ministries play the leading role in redesigning projects to take climate change into account. The Bureau of the Budget also plays a key role, enforcing any regulations that are introduced to require climate change to be taken into account in plans and budgets. The Office of Natural Resources and Environmental Policy and Planning provides the technical leadership and supports line ministries by promoting understanding about climate change and about how to use these guidelines. We encourage all line ministries to pursue an active programme of capacity building in dealing with climate change and to use these guidelines in preparing budgets, even before any regulations are introduced.


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INTRODUCTION

1. INTRODUCTION

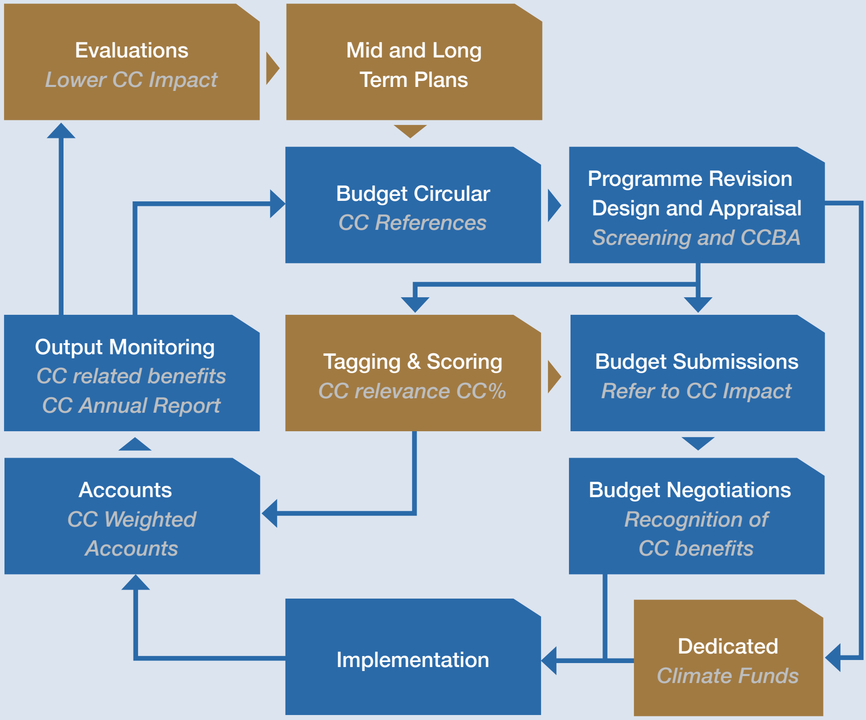
1.1 PURPOSE

The purpose of Climate Change Benefit Analysis (CCBA) is to allow the Royal Government of Thailand (RGT) to identify those investments that will become significantly more important as climate change takes place, because they reduce the loss and damage from climate change and/or reduce greenhouse gas emissions. CCBA then aims to ensure that these investments are properly designed to respond to climate change and receive appropriate additional funding, either from the budget or from national or international climate funds.

1.2 OVERVIEW

CCBA is the key task for integrating climate change into planning and budgeting, as illustrated in the diagram below. CCBA is used primarily to support budget submissions. It also provides the evidence for objective scoring of public expenditure, so that trends in climate expenditure can be monitored, and shows how expenditure reduces loss and damage from climate change. These guidelines describe a range of methods for estimating benefits, including some default values and a rapid approach that can be done easily, once there is a clear understanding of how climate change will affect each project.

Figure 1: The Role of CCBA in Planning and Budgeting



Note: climate change influence on activities in grey

CCBA is a new feature in the existing process for justifying budget requests. It should be used alongside the other techniques required for impact assessment, such as Environmental Impact Analysis (EIA) and Cost Benefit Analysis (CBA). These guidelines describe how CCBA can be undertaken with varying levels of detail, to minimise the burden on government officials. For all but the largest and most sensitive projects, it is sufficient to undertake a form of rapid CCBA that relies heavily on expert opinion, using whatever objective evidence is easily available. The major step required from officials is to understand how climate change affects their projects and the structuring of the benefit analysis does not need to be a major burden.

The CCBA guidelines were developed through a process of consultation with the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Bureau of the Budget (BoB), the National Economic and Social Development Board (NESDB) and key line ministries. It builds on experience with the Climate Public Expenditure and Institutional Review and pilot work in the Ministry of Agriculture and Cooperatives (MOAC) and the Ministry of Energy (MOEN).

1.3 WHO SHOULD USE THESE GUIDELINES

It is the responsibility of line ministries in the RGT to use these guidelines to determine whether CCBA is required and to conduct CCBA in a structured and rigorous manner, with a level of detail that is appropriate for the scale and nature of the proposed expenditure. Section 4 provides further details of institutional responsibilities for managing CCBA.

1.4 WHEN TO USE THE GUIDELINES

Chapter 3 describes a screening process to determine which projects need to undertake CCBA and what level of detail is required. The guidelines are to be used mainly for projects whose benefits are positively affected by climate change. They should be used for public investments including those undertaken by State Owned Enterprises (SOEs), and also for public policies that affect private investments, such as regulations and incentives. CCBA is not obligatory for private investments, but companies may find it useful as it helps them protect their profitability from climate change threats.

CCBA is required for all projects costing more than THB 50m that are affected by climate change (see section 3.2). If the project costs more than THB 1,000m, then a full analysis is required. For projects between THB 50m and 1,000m, these Guide lines describe a range of practical options for CCBA that can be completed easily and rapidly, once the basic impact of climate change on the project is clear. Some smaller projects of less than THB 50m may also opt to undertake CCBA in order to strengthen the justification for funding.

The benefits may come from adaptation (i.e. reducing the loss and damage arising from climate change) or from mitigation (i.e. reducing greenhouse gas (GHG) emissions to contribute to the global efforts to stop climate change itself).

The guidelines apply to projects that are justified primarily by climate change benefits (i.e. adaptation and mitigation) as well as to projects that are justified primarily by sustainable development (SD) benefits (i.e. economic growth, social development and environment), but which has secondary climate change benefits. There are a variety of different interpretations of the relationship between climate change, sustainable development and green development, as discussed in Box 1.

Box 1: Climate Change, Sustainable Development, and Green Development

The term sustainable development came to prominence after the Earth Summit in Rio in 1992 and was then defined as having three pillars: economic growth, social development and environmental development. Since 1992, climate change has become steadily more important and, in order to provide added emphasis on the importance of climate change, the term ‘green development’, or ‘green growth’ has become popular. There are various definitions of green development, but they generally refer to five dimensions, including the three dimensions conventionally associated with sustainable development and the two new dimensions of climate change. Some analyses now use the term sustainable development interchangeably with green development. The CCBA guidelines use the old definition of sustainable development (i.e. covering economic growth, social development and environment) and assume that green development covers all these dimensions plus the two additional benefits of climate change (i.e. adaptation and mitigation).

Examples of different combinations of climate change and sustainable development benefits are shown in the table below. CCBA provides options for estimating the various benefits.

Table 1: Example Adaptation and Mitigation Projects and Level of Climate Change Benefits

Type	Adaptation Projects	Mitigation Projects
High CC benefits	• Vulnerability analysis • Community resilience planning • Protection for floods & sea level rise • Drought resilient crop varieties • Flood proofing roads, irrigation etc.	• Research on cost effectiveness of reducing GHG emissions • Studies on loss and damage from not mitigating GHG emissions • Public awareness of GHG emissions
Mixed CC and SD benefits	• Biodiversity corridors • Irrigation schemes • Community forestry • Untargeted water/sanitation • Forward plans to tackle CC diseases • Urban plans to reduce vulnerability	• Renewable energy • Reforestation • Energy efficiency • Public transport
Negative CC benefits[1]	• Unsustainable groundwater use • Promoting water intensive crops	• Roads that increase deforestation • Fossil fuel subsidies

[1] Negative CC benefits occur if CC reduces the performance of projects, either because of higher loss and damage or because of high GHG emissions. Such projects should normally be generating high SD benefits, since they would otherwise not be considered for funding.
Source: Experience from CPEIR and CCFF work in Southeast and South Asia

CCBA can also be used for projects whose benefits are negatively affected by climate change. Line ministries (or independent bodies) might be interested to understand the scale of the climate change risks, compared with sustainable development benefits. And, if the risks related to climate change are widely debated, they might wish to use CCBA to provide more objectivity on the scale of the risks in debate, whether in government policy circles or in public.

1.5 INTERACTION WITH OTHER GUIDELINES

CCBA supplements existing guidance on how to appraise public investment, as summarised in Table 2.

The BoB 'Practical Guide to the Budget'. The annual BoB budget guide requires budget submissions to describe, among others:

a) the links to national and ministerial strategies and targets;
b) the goals and expected results of the expenditure and the impact on beneficiaries;
c) the readiness and efficiency of the agencies delivering the expenditure;
d) the challenges faced and conditions for addressing these challenges; and
e) the resources required

The NESDB Project Appraisal Guidelines 2012. The Guidelines set criteria for appraising an investment project, including:

a) the project's consistency with the national development plan;
b) the needs for a project;
c) the project's appropriateness in terms of physical, financial, economic dimensions;
d) the project's impacts on environment; and
e) the appropriateness of project management and risk management

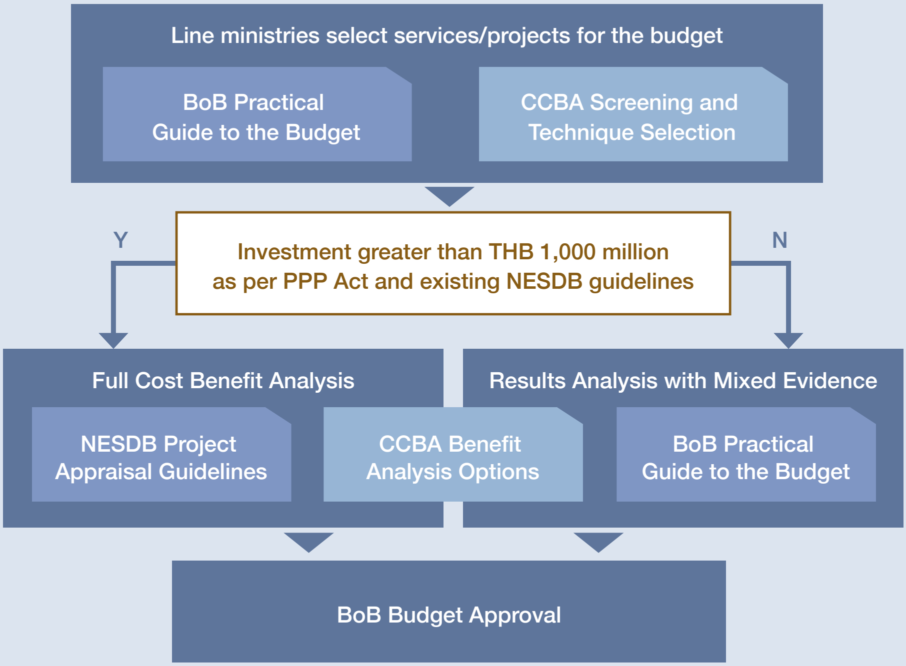
Table 2: Complementarity of CCBA Guidelines and BoB and NESDB Guidelines

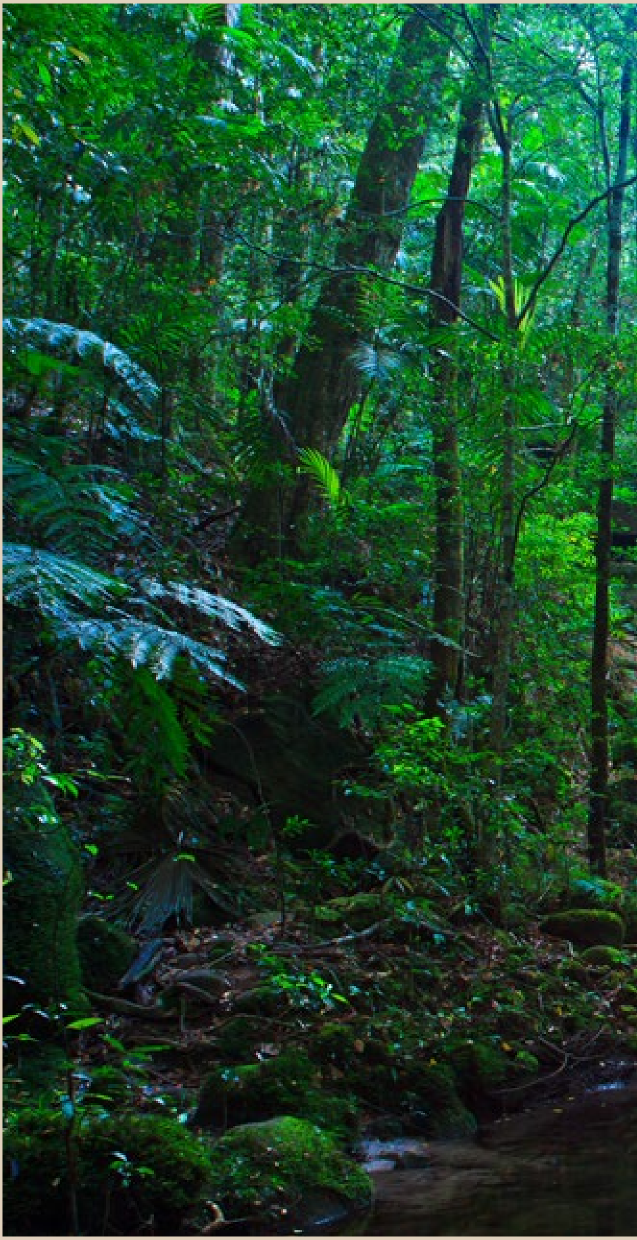
BoB GUIDELINES	CCBA COMPLEMENTARITY
Links to national and ministerial strategies (a)	Consistency with CC Master Plan and the contribution to protecting growth and equity in the NDP
Implementation and results (b & d)	CCBA identifies possible risks to implementation
Strategic goal (b)	CCBA requires clear definition of CC related benefits
Contribution to ministry targets (b)	CCBA requires CC benefits to be estimated
Results and impact on beneficiaries (b)	CC benefits relate to impact on beneficiaries and encourage project design to improve benefits
Readiness and efficiency of agencies (c)	CCBA incorporates cost effectiveness, either on its own or as part of cost benefit analysis
Challenges, measures to respond (d)	CCBA highlights challenges associated with CC
Resources required (e)	CCBA requires specification of costs
NESDB GUIDELINES	**CCBA COMPLEMENTARITY**
Consistency with NDP (a)	Consistency with CC Master Plan and the contribution to protecting growth and equity in the NDP
Needs of the project (b)	CCBA requires estimates of any additional needs arising because of CC
Appropriateness (i.e. physical, financial, economic dimensions) (c)	CCBA requires evidence-based assessment of the implications of CC for these dimensions, including on economic performance
Environmental impacts (d)	CCBA requires evidence-based assessment of how CC alters the impact on environment
Appropriateness of project management & risk management (e)	CCBA requires project management to take explicit measures to deal with CC risks

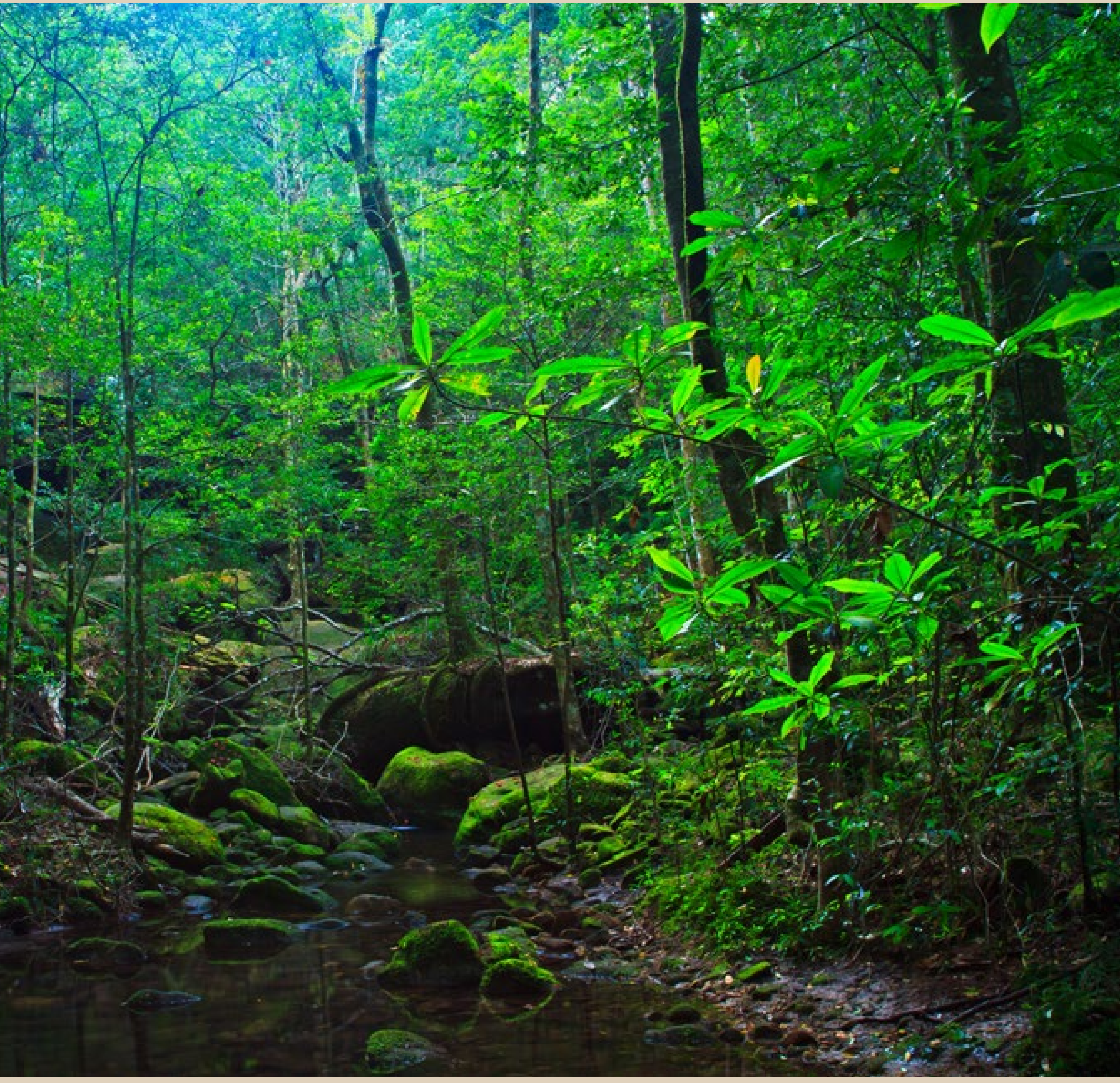
Rules regarding the appraisal of large public-private-partnership (PPP) projects of more than THB 1,000 million are defined by the B.C.2556 PPP Act which specifies that, for public-private-partnership (PPP) projects, NESDB provides recommendations on appraisal, but project appraisal is done by the State Enterprise Policy Office, who is also responsible for submitting the project to Cabinet. For a project of more than THB 1,000 million that is not a PPP project, Cabinet approval is also required. The Secretariat of the Cabinet decides whether the project should be sent to NESDB for full appraisal and recommendations or whether to submit directly to Cabinet.

Figure 2 shows the budget submission and approval process and how the CCBA supplements other guidelines.

Figure 2: Interaction between CCBA and other Guidelines







GENERAL PRINCIPLES

2. GENERAL PRINCIPLES

The general principle behind all CCBA is to assess the relative importance of adaptation and mitigation benefits, compared with other sustainable development (SD) benefits (i.e. economic growth, social development and environment). This comparison gives an indication of the extent to which climate change should increase the prioritization given to the project.

CCBA draws on the basic concepts of Cost Benefit Analysis (CBA) and Impact Assessment (IA). It requires an assessment of how benefits change over the period to 2050, which is a typical date used for climate change projections. CCBA can be done using classic CBA/IA methods, using as much hard evidence as possible, or they can be applied in a less detailed way, with varying sources of more qualitative assessment. There are many guides on conducting CBA and IA and these CCBA guidelines do not aim to duplicate these (Chutubtim 2001; World Bank 2009; World Bank IEG 2010; HMG 2011; UNFCCC 2011; ADB 2013). The following guidance shows how the specific requirements of CCBA influence the way in which CBA/IA is done.

The main steps in CCBA are as follows:

1. Select the CC scenarios to be used (e.g. IPCC, downscaled, trend-based scenarios);
2. Define how the parameters, both physical (e.g. yields) and behavioural (e.g. enterprises), and how the inputs (i.e. project expenditure) lead to the outputs (e.g. changes in yields, water flows, electricity, disease cases, etc.);
3. Define how the project changes these parameters, both with CC and without CC;
4. Estimate prices for all costs and benefits;
5. Estimate the total value of costs and benefits, with and without CC;
6. Estimate the CC relevance (CC%), defined as CC benefits as a proportion of total benefits; and
7. Conduct sensitivity analysis

For a single ex-anti appraisal, these steps will normally be taken sequentially. It is often good practice to proceed rapidly through the steps to obtain an initial result and then return to refine the analysis. The structure of the CCBA should provide the basis for monitoring and evaluation.

Step 1: Climate Change Scenarios

CCBA requires CBA/IA to be done with and without climate change, to show how the performance of the project is affected by climate change. CCBA should not be required to undertake climate change modelling, but should use existing evidence and contract specialist studies, for larger investments where detailed results are critical. The scenarios of climate change should be based on as many sources as possible, including the followings:

- The IPCC climate change analysis is the starting point. Ideally, projections should be based on the Fifth Assessment Report (AR5) and should use the RCP2.6 scenario (IPCC 2014) to avoid overstating the case. When referring to AR4 (IPCC 2007), or to the Special Report on Extreme Events (IPCC 2012), the B1 scenario should be used. The IPCC scenarios may be sufficient for more rapid CCBA;
- Downscaled projections of climate change are now available in Thailand and should be used for projects that are based in one geographical area. These will be necessary for more detailed CCBA (e.g. as required for large investments). Particular care must be taken in analysing extreme events, which may require some integration of hydrological modelling with climate change modelling, for large investments; and
- Where historical records are available for three decades or more, these should be analysed to assess whether past trends are consistent with future projections. This can usually be done quickly and so can be used in rapid CCBA, as well as full CCBA.

Given the uncertainty about climate change, it is normal to undertake the analysis, using one main scenario (or 'headline' scenario) for climate change and then repeat the analysis with at least one other climate change scenario. The headline scenario should normally be an optimistic scenario (i.e. RCP2.6 or B1, as suggested above), with little climate change and low benefits from adaptation and mitigation. The sensitivity analysis may refer to another scenario to show how adaptation and mitigation may give higher value with more severe scenarios.

Step 2: Physical and Behavioural Parameters

Any CBA/IA requires a clear presentation on all assumptions relating to key physical parameters (e.g. yields obtained, fuel consumed, water supplied, hectares of forest, or GHG emissions) and behavioural parameters (e.g. farmers' choices or institutional sustainability). It also requires a 'model' of the relationship between inputs and outputs. CCBA is no different from any CBA/IA in this respect. It is important to analyse these parameters, and the relationships between them, regardless of the technique used. Chapter 3 describes a range of techniques and sources of evidence (e.g. including quantitative analysis and/or expert opinion) and how to select the most appropriate for the nature and scale of the project. Some of the technical parameters can require extra care because the analysis can involve scientific details which often use similar but different units (e.g. emissions can sometimes be reported in tons of carbon and sometimes in tons of carbon dioxide equivalent).

The model may be quantitative, especially for larger and more complex CCBA, but, in many cases, it will be a simple qualitative description of the key parameters and the relationships between them. If the model is quantitative, then line ministries may require specialist help to draw on the latest options for modelling. For simpler options, the 'model' is simply a way of clearly presenting the consensus on how climate change affects the parameters that determine project performance.

Confusion can also arise because CCBA often has to analyse unpredictable events. It may be possible to estimate an average of different outcomes, taking into account the different probabilities of each outcome. In most cases, uncertainty is best dealt with using scenarios. However, scenarios need to be used carefully as policy makers can usually only consider a high and low scenario, each of which may include a package of different assumptions (e.g. on climate change, on yield response, and on prices).

Step 3: Implications of Project and CC on Parameters

All CBA/IA, including CCBA, requires a clear definition of the situation without and with the investment. For CCBA, the analysis also needs to compare the situation with and without climate change. Adaptation projects address circumstances when climate change will be bad for project beneficiaries because of loss and damage, either directly or through longer term impact on livelihoods. The adaptation projects then reduce the loss and damage from climate change and so an adaptation project becomes more valuable, with climate change. Table 3 illustrates this with four types of project:

- Type A activities are activities which become more valuable to beneficiaries. Examples might include flood protection and soil moisture management, which are already useful and become more useful. These activities may not need to be changed and the project may simply expand the funding;
- Type B activities are activities which become badly affected by climate change, but the project improves the performance of the activity and provides some protection from climate change through proofing of the activity. Examples might include irrigation and strengthening roads;
- Type C activities are mainly mitigation activities, which usually involve some additional expenditure (e.g. direct investment, grants or subsidies). If there is no climate change, then the reduction in GHG emissions has no value and the expenditure on mitigation is wasted. With climate change, the mitigation benefits should be higher than the costs, if the investment is to be worthwhile. Box 3 discusses how to value GHG emissions; and
- Type D activities are activities which increase the loss and damage that climate change imposes on beneficiaries and these are termed ‘maladaptation’ projects (e.g. construction in flood plains, without proofing, and roads that accelerate deforestation).

Table 3: Example of With and Without Grid for Climate Change and Project

	Type A Activity (Adaptation no proofing)			Type B Activity (Adaptation with proofing)			Type C Activity (Mitigation project)			Type D Activity (Maladaptation)		
	No CC	With CC	Diff.	No CC	With CC	Diff.	No CC	With CC	Diff.	No CC	With CC	Diff.
No proofing	1.9	2.1	11%	1.9	1.7	-11%	1.7	2.1	24%	2.0	1.7	-15%
With proofing				1.8	2.2	4%						

The figures in the cells of the table above are illustrative and could come from a full CBA and reflect the Benefit Cost Ratios (BCRs) or Net Present Values (NPVs). They could also come from a structured rapid assessment and present the results of a carefully structured multi-criteria analysis (MCA). If the cells refer to BCRs, then for type A projects the BCR increases from 1.9 to 2.1 and project spending expands the size, but doesn't affect the BCR. For type B projects, climate change reduces the BCR from 1.9 to 1.7, if nothing is done. The project expenditure succeeds in protecting against losses from climate change and increases the BCR to 2.2, but if there is no climate change then the extra expense of the project produces little benefit and the BCR drops to 1.8. For type C activities the project increases the BCR to 2.1, if the mitigation value is taken into account, but the extra expense has no value if climate change is not taken into account as so the BCR falls to 1.7.

The BoB may wish to insist on CCBA for certain maladaptation projects, to understand the level of risks. Line departments may also wish to undertake CCBA, if they want to understand maladaptation risks, in order to reduce them, or if they suspect that they have been overstated.

Step 4: Prices and Valuation of Costs and Benefits

CBA/IA can be undertaken from the perspective of an enterprise, in which case it is a financial CBA/IA, or for a country as a whole, as assessed by a national planner, when it is an economic CBA/IA. This also applies for CCBA, which may be done primarily from the perspective of private investment or from the perspective of broader public good. Just as with CBA, the government adopts procedures to define the requirement for CCBA (as defined in these Guidelines), but private enterprise is free to use CCBA if they feel it is useful. For financial CBA/IA, the value of inputs and outputs is determined by market prices. For economic CBA/IA, the market prices may need to be adjusted to reflect additional concerns and some parameters may have no market prices and require other methods of valuation. In addition, economic analysis excludes transfers within the country (e.g. taxes, duties, fees and subsidies). Particular problems with valuation in CCBA are as follows:

- For adaptation, the benefits from reduced vulnerability are often closely related to benefits from poverty reduction and may be concentrated amongst disadvantaged groups in society, such as women, children and ethnic groups that live in marginal lands. The concentration of benefits amongst already disadvantaged groups should further enhance the priority given to adaptation projects;

Box 2: Accommodating Poverty and Gender in CCBA

There are various ways of recognising the additional value that may arise from a project if its benefits are concentrated amongst relatively poor and/or disadvantaged groups. In routine Impact Analysis, the most common option is to provide separate estimates for general economic benefits (e.g. increasing incomes or GDP) and for reductions that are specific to certain groups (e.g. number of poor people, women, children, etc. that are made resilient to climate change). This option is the best way of exploring the full range of implications, both qualitative and quantitative and leaves the policy maker to make judgements about the relative importance of the economic benefits and the social benefits.

It may also be useful to define a 'poverty premium' which reflects the extra value that society places on incomes for disadvantages groups. This premium can be applied to any disadvantaged group (e.g. women, children, etc.) as well as to poor people generally. For example, if the premium is 2, then any benefits received by poor or disadvantaged people are considered to be twice as valuable to society as other benefits. This approach has the advantage of simplifying the message to policy makers who may otherwise get lost in the range of social evidence. It is particularly useful when comparing relatively similar projects that present alternative ways of achieving similar goals.

- There are often strong links between environment and mitigation, especially with pollution (and health) and forestry (and biodiversity). Health benefits should normally be possible to estimate, although techniques such as Disability Adjusted Life Years (or DALYs) do receive some criticism. Valuation techniques for environmental benefits like biodiversity that have little or no market value are controversial and can be difficult to 'sell' to policy makers. Project promoters often exaggerate mitigation benefits to compensate for undervalued environmental benefits. But most valuation methods suggest that environmental benefits (especially relating to health) are higher than mitigation benefits and these issues need to be addressed transparently in the analysis. For mitigation, the relative importance of reductions in GHG emissions depends on the value associated with those emissions. The markets for carbon have been volatile and are well below the social cost of carbon (SCC), so it can be useful to undertake sensitivity analysis around the price of carbon. In more qualitative assessments it is typical for expert judgement to imply a very high value on GHG emissions close to (or exceeding) the social cost of carbon (see Box 3).

Box 3: The Carbon Market and the Social Cost of Carbon

It is common practice to use carbon markets as an indication of the value of carbon, because these reflect the potential financial gains from GHG reduction. Until recently, carbon markets were dominated by the European Trading System (ETS), which initially traded at over 30 $/tCO_2e$. However, the ETS has suffered from over-supply and verification problems and prices have dropped to about 7 $/tCO_2e$. The ETS now accounts for only about a third of global carbon trading and there are numerous regional and national schemes, with a very wide variety of prices, covering about 13% of total global GHG emissions (ECOFYS and World Bank 2014). The commitments announced in COP21 in Paris, in 2015, should help strengthen markets. Taking this more optimistic view of the mid-term prospects for the carbon market would suggest that a market price of about 25 $/tCOe would be reasonable.

The Social Cost of Carbon (SCC) is determined by dividing the total expected loss and damage from climate change by the total projected GHG emissions. There have been various studies to estimate the SCC. The Stern Report suggested that a value of about 50 $/tCO_2e$ is a conservative estimate. Other studies have suggested a value of over 100 $/tCO_2e$. Estimates of the SCC are normally made at a global level in order to avoid the political issues of which countries should take most responsibility for reducing GHG emissions. Countries that are vulnerable to climate change may argue that a higher SCC should be used in making decisions on mitigation projects.

Step 5: The Cost and Benefit Stream

All CBA/IA uses the physical parameters (see Step 2) and prices (see Step 4) to determine the costs and benefits over a period and so to obtain an estimate of net benefits. In routine CBA/IA, it is often straightforward to identify the various costs and benefits, although decisions may be required about which non-market benefits to include (e.g. relating to the environment or social benefits). For CCBA, simply identifying each cost and benefit is an important step, because it then requires an analysis on how climate change will affect each cost and each benefit. Breaking down the impact of climate change on each cost and benefit is often one of the most informative steps in CCBA.

Most projects involve a few years of investment, followed by annual costs and benefits. In quantitative forms of CCBA, future benefits and costs are discounted to reflect the fact that they are worth less in the future than the present. In more qualitative analysis, the assessment of time is often important, but rarely explicit. Many advocates of sustainability give high value to projects that deliver long term benefits because they believe that conventional development undervalues to longer term implications of development. When dealing with climate change, it can be valuable to make the issues of time more explicit, since the best response to climate change requires careful phasing of projects and normally requires a focus on projects that have long term impact (e.g. such as infrastructure, research, and institution-building).

Box 4: Time Period and Discount Rates

CCBA should use a discount rate of 5%, which is consistent with the practice in many countries to use lower discount rates to promote longer term decision-making {HM Treasury, 2011 #537}. It also reflects the more stable macroeconomic conditions of recent decades. The 5% discount rate is lower than that used by many development banks, who argue that 10% reflects the opportunity cost of capital because they have strong demand from projects showing good returns using 10% or more. However, in theory, the discount rate should equate to the real interest rate, which is a better indicator of the opportunity cost of capital. Over most of the last 10 years, the Thailand central bank policy interest rate has been less than 5%, and the government bond rate has also been less than 5%, at a time when inflation has been 1% to 4%. This suggests that 5% is, in fact, significantly higher than the opportunity cost of capital.

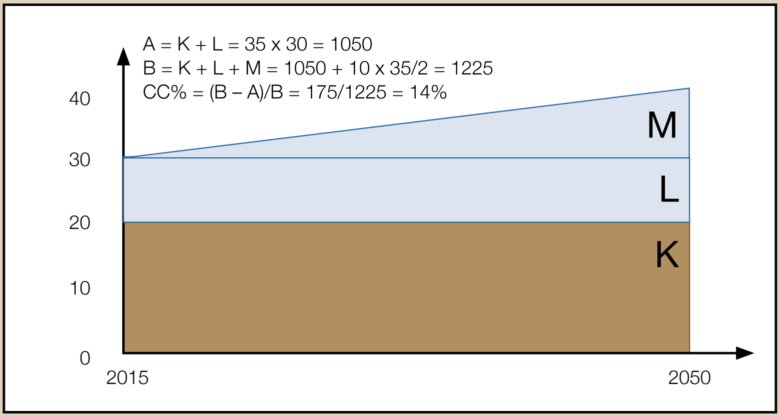
Because climate change happens slowly, CCBA should be done over a time period of at least 35 years, taking the analysis to 2050, which is also the date often used for the first time step in climate change projections. When lower discount rates are used, the time period needs to be extended because future costs and benefits have more value: using a 10% discount rate, and assuming a constant stream of values, 88% of the discounted value happens in the first 20 years; using a 5% discount rate, 84% of the discounted value happens in the first 35 years.

Step 6: The Climate Change Relevance Score (CC%)

The climate change relevance score (CC%) provides an indication of the relative importance of climate change to the justification of a project. It normally varies between 0% and about 30%, although it can be up to 100% for a few dedicated projects and is negative for maladaptation. The CC% is not an indicator that can be used on its own to justify expenditure. It shows only the marginal changes that climate change will cause in the performance of expenditure. A project that has doubtful performance with current climate conditions is unlikely to be justified, even if the CC% is high, at 20% to 30%. But projects with well-established justification that have high CC%s should expect to receive some added priority in budget negotiations and in applications to climate funds.

The CC% is defined as the proportion of total benefits arising from the projects that are associated with adaptation and mitigation. If the project benefits without climate change are termed A and the project benefits with climate change (i.e. including adaptation and mitigation) are B, then CC% = (B –A) / B. Figure 3 presents an example of an adaptation project without proofing as defined in Table 3 (type A project). The project generates a stream of two types of net benefit: the first is unaffected by climate change and generates a constant net benefit stream; and the second is affected by climate change. For example, a community forestry project delivers income benefits that are estimated to be worth 20 units per year. These are not affected significantly by climate change (i.e. area K in the figure). The project also delivers watershed benefits (e.g. longer water retention and reduced soil erosion) which are worth 10 units a year in the current climate. If there is no climate change, the watershed benefits stay at 10 units a year (i.e. area L in the figure). Climate change is expected to double these benefits gradually by 2050 and the additional benefits are areas M in the figure. The total benefits without climate change are 1,050 units (i.e. K+L) and the total benefits when climate change is taken into account are 1,225 units (i.e. K+L+M). The CC% is therefore 14%. For projects that are not affected by climate change, B = A and CC% = 0%. For projects that are dedicated only to climate change, A = 0 and CC% = 100%.

Figure 3: Example Net Benefit Streams and CC% Estimate



Notes: This example describes an existing service that does not require any investment. The estimation of CC% excludes any discounting.

As described in Table 3, CCBA has to consider the situation with and without the project, but also the situation with and without climate change. The difference between with and without project provides the estimate of the net benefits of the project and this estimate is calculated both with and without climate change to see how the net benefits are affected by climate change.

Chapter 3 shows that the assessment of benefits can be done very rapidly (e.g. by a group of experts in a few hours) or in great detail (e.g. through a cost benefit analysis drawing on statistical evidence). But all the options require an assessment of the relative importance of climate related benefits, compared with other benefits. There is some international experience with this work which suggests that the results are likely to fall within the ranges presented in Table 4. This work is mostly through ongoing Climate Public Expenditure and Institutional Reviews and Climate Change Financing Frameworks in South and Southeast Asia, the most recent of which are available through an internet search.

The table shows that there are some similarities in how climate change affects different sectors. For example, in type W sectors, the majority of benefits are related to floods, drought or rainfall variability and so gradually increase until they are double the current levels, in 2050. Type X are similar, but also include some benefits that are not affected by climate change and so have lower CC%. Type Y give a wide range of benefits and the balance between these depends on local biophysical and socio-economic circumstances. Type Z are all related to energy and CC%s are strongly affected by the relative costs and emission factors for different energy sources.

Table 4: Likely Ranges for Climate Change Benefits Compared with Other Benefits

	Green Development						Type
	Sustainable Development			Climate Change CC%			
	EC%	SO%	EV%	MI%	AD%	Total	
Highest CC Relevance							
CC Planning, Management, Capacity, Studies	0	0	0	100		**100**	
Hydrometeorology, Early Warning	40-50	10-20	0	0	33	**33**	W
Livelihoods for CC Vulnerable Households	40-50	10-20	0	0	33	**33**	W
Coastal Protection from Sea Level Rise	0	0	0	0	100	**100**	
Protection from Saline Intrusion	20-50	10-30	5-10	0	25-75	**25-75**	
Irrigation and Drainage	50-70	5-20	0-5	0	10-33	**10-33**	X
Flood Protection/Proofing	40-50	10-20	0	0	33	**33**	W
Disaster Risk Reduction and Management	25-50	25-50	0-10	0	33	**33**	W
Middle CC Relevance							
Agriculture, Rural Development, Food Security	40-50	10-20	0-10	0-5	5-20	**5-25**	Y
Forestry Protection	5-10	5-10	60-95	5-15	0-10	**5-25**	Y
Forest Management	20-50	5-20	30-50	5-20	5-20	**10-40**	Y
Renewable Energy	70-90	0-10	0-10	5-20	0-5	**5-25**	Z
Energy Efficiency	70-90	0-10	0-10	5-20	0-5	**5-25**	Z
Lower CC Relevance							
Livelihoods for General Households	50-70	20-30	0	0	5-10	**5-10**	X
General Infrastructure (roads, urban…)	90-99	0-10	0	0-1	1-5	**1-5**	
Sanitation and Waste	20-30	20-30	50-75	0-5	5-15	**5-20**	
Water Quality	50-70	20-30	0	0	5-10	**5-10**	X
Public Health for Climate Sensitive Diseases	30-50	30-50	0	0	5-10	**5-10**	
Public Transport	60-80	10-20	5-10	1-5	0	**1-5**	Z

	Green Development						Type
	Sustainable Development			Climate Change CC%			
	EC%	SO%	EV%	MI%	AD%	Total	
Uncertain							
Fisheries, Aquaculture	40-50	10-20	0-10	More research needed			
Biodiversity, Wildlife, Eco-tourism	0-25	0-10	75-100	Variable/site specific			

Notes: EC% = economic growth; SO% = social development; EV% = environment; MI% = mitigation; and AD% = adaptation.

See below for explanation of Types W, X, Y and Z

Source: Based on experience from CPEIR and CCFF work in Southeast and South Asia over the last 4 years.

The table presents the various types of benefits as five dimensions of green development, although there are a variety of different interpretations of green development and a project may contribute to green development without generating all five types of benefit (see Box 1).

The various types of benefits should add up to 100% and this discipline helps avoid exaggeration of any individual benefit. Adaptation benefits are generated by avoiding loss in economic, social and environmental benefits. For example, consider a project that, without taking climate change into account, generates 120 units of benefit split equally between economic, social and environmental benefits (i.e. EC=40, SO=40, EV=40). Suppose that climate change halves the social benefits if the adaptation benefits are not considered (i.e. EC=40, SO=20, EV=40). But suppose the project has adaptation benefits that offset half the loss in social benefits then the restored social benefits are treated as adaptation benefits, not social benefits (i.e. EC=40, SO=20, EV=40, AD=10).

Step 7: Sensitivity Analysis and Scenarios

Most CBA/IA will be subject to degree of uncertainty in at least some of the assumptions and should explore the sensitivity of the results to different assumptions. For CCBA, some of the more common parameters that often need sensitivity analysis include:

- Climate change scenarios, including the extent, probability and timing of change;
- Biophysical sensitivity to climate change (e.g. yields, flood damage, health impact, etc.);
- Carbon density of energy sources displaced by energy efficiency or renewables;
- Values associated with carbon, environment, poverty, etc.; and
- Extent of ‘auto-adaptation’ by beneficiaries adjusting their behaviour.

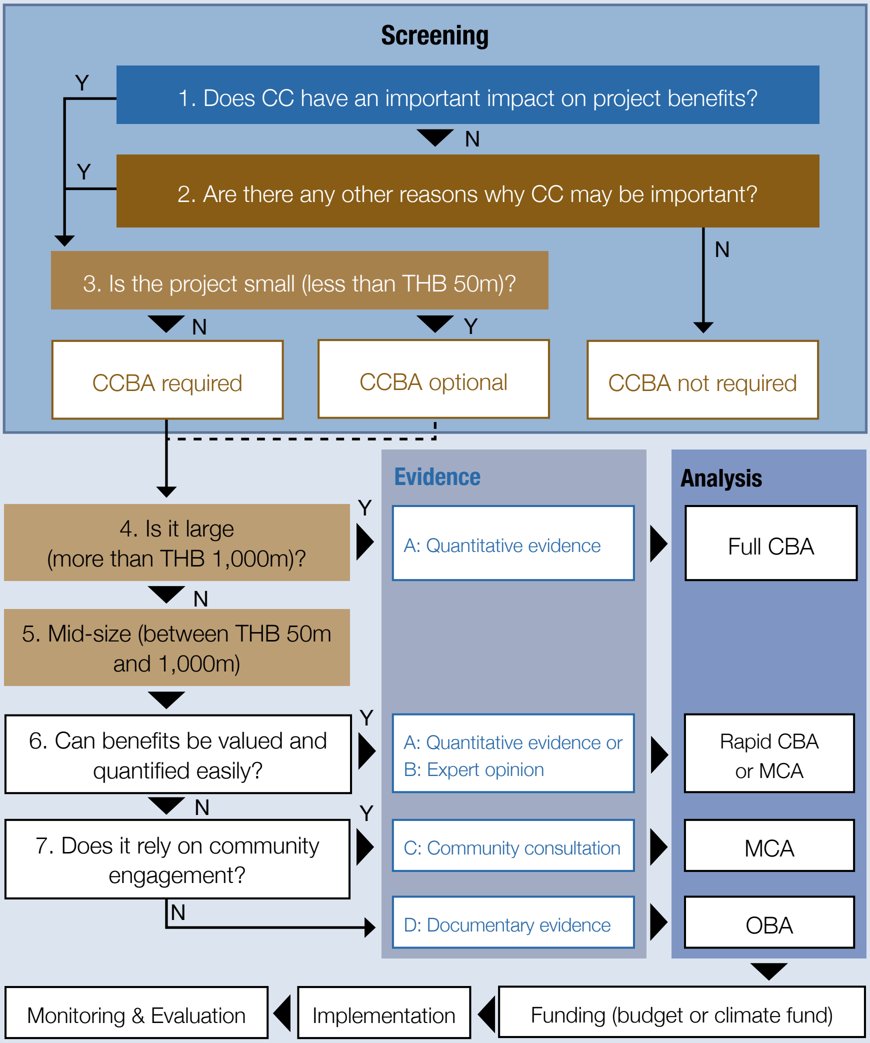
TECHNICAL OPTIONS

3. TECHNICAL OPTIONS

3.1 OVERVIEW OF THE STEPS

The flowchart below describes the process for conducting Climate Change Benefit Analysis (CCBA), starting with screening and followed by selecting the appropriate type of evidence and methods of analysis.

Figure 4: Screening and Selecting the Appropriate Evidence and Analysis



The flow chart describes 7 steps, starting with two steps that consider the nature of a project and whether it is affected by climate change. For those projects that are affected by climate change, there are then 3 size classes (large, mid and small) and these dictate the type of evidence and analysis required. For small projects, CCBA is optional. For large projects, a full cost benefit analysis is required. For mid-size projects (and for any small projects that opt to conduct CCBA), there is an option of undertaking rapid CBA, based on expert opinion, or using other sources of evidence to assess benefits.

CCBA should provide evidence that will help in funding applications, either in the budget or to climate funds. Monitoring ensures that the climate related benefits that were projected to take place in the CCBA are still expected to occur. If there are doubts about this, then the investment may require minor refinement by management or a major overhaul.

3.2 SCREENING

Screening Step 1. Table 5 contains a list of sectors and of activities that are likely to be affected by climate change. The final row also lists sectors that are unlikely to require CCBA.

Table 5: Screening Reference Table

Sector	Activities Likely to Require CCBA
Information services Capacity building Research	• Information services relate to weather
	• Capacity building specifically related to public response to CC
	• Research on the impact of CC on the sector or of the effectiveness of public policy
Coastal protection Saline intrusion	• Protection against sea-level rise
	• Protection against saline intrusion affected by CC
Agriculture Rural development Food Security	• Protection against flood or drought
	• Protection against unpredictable/unseasonal rainfall
	• Significant reduction in GHG emissions from agriculture
	• Supporting livelihoods for households vulnerable specifically to CC

Sector	Activities Likely to Require CCBA
Irrigation Drainage Watersheds	• Irrigation that protects against more variable rainfall
	• Response to watershed challenges affected by CC
	• Flood protection
Water supply Water quality	• Reducing the threat of CC to water quality (e.g. from floods)
	• Reducing the threat of CC to water security
Forestry	• Preventing deforestation and improving forest productivity
	• Promoting forestry incomes for CC vulnerable households
Fisheries	• Responding to known risks of how CC will affect fisheries
Biodiversity	• Responding specifically to CC risks for biodiversity
	• Not general biodiversity, unless responding to CC risks
Health Education	• Forward capacity building for CC sensitive diseases, including research, infrastructure and institution-building
	• Climate resilient infrastructure for schools, clinics, hospitals etc.
	• Education that is specifically related to CC
Urban planning	• Reducing flood loss/damage (e.g. flood protection, land use)
	• Reducing GHG emissions from waste
	• Reducing health costs from waste, when these are affected by CC
	• Reducing GHG emissions significantly
Infrastructure Housing	• Proofing against increased costs of rehabilitation or maintenance
	• Energy efficiency of buildings
Disaster management	• Disasters related to CC (e.g. flood, storms, heat …)
Energy Industry and Transport	• Renewable energy
	• Energy efficiency

Sector	Activities Unlikely to Require CCBA
Sectors unlikely to require CCBA	• General governance (e.g. parliament, cabinet, justice, interior, defence, foreign affairs …)
	• Commerce, trade and finance (except CC insurance)
	• Education and health (unless explicitly related to CC as above)
	• Labour & social welfare (unless for climate vulnerable households)
	• Culture, religion and sports

Screening Step 2. Table 5 provides a good indication of which sectors are likely to require CCBA, but it is not exhaustive and step 2 asks whether there are other reasons to think that climate change might have an important effect on the benefits of the expenditure. This more general question is often answered by reference to a vulnerability analysis and by an assessment of how the proposed public expenditure will affect that vulnerability.

Screening Step 3. CCBA, in some form, is only required for investments of more than THB 50m. This threshold is intended to ensure that a manageable number of the major investments are covered by CCBA. However, it should be clear that the large majority of projects above THB 50 million will be below THB 1,000 million and so will only require relatively rapid CCBA that should not impose a major burden on project designers. The THB 50 million threshold applies either to the level of public investment or to the level of private investment that will be generated by public policies, such as regulations or incentives. Smaller investments may choose to do a CCBA voluntarily if the investment managers believe it will help with the design and/or justification of the investment in budget negotiations.

3.3 CHOOSING THE TECHNIQUE

CCBA can be conducted quickly, based on general knowledge about an investment, or it can take several months and involve substantial time and skills obtaining new primary evidence and conducting detailed analysis. There are five main types of CCBA although the distinctions between types are not clear-cut and it is often useful to mix several techniques. The choice of evidence and analysis depends on the scale and nature of the investment, as presented in figure 4

Figure 4 shows that the choice of evidence and techniques uses the following steps:

1. If the investment costs more than THB 1,000m, then the CCBA should use Cost Benefit Analysis (CBA) based on robust quantitative evidence. This is in line with the NESDB requirement to conduct CBA on any investments of more than THB 1,000m. The CBA techniques used for CCBA should be the same as those required in the NESDB guidelines, with the CBA being run both with and without climate change, to estimate the extent to which benefits increase as a result of climate change.

2. Even if the investment costs less than THB 1,000m, a CBA may still help in the design and justification of the investment, if it is easy to quantify and value benefits and there is sufficient time and resources to conduct a CBA. Smaller CBAs may use expert opinion and may use qualitative techniques if quantitative evidence is not available.

3. If CBA is not appropriate and the investment requires strong community participation, the CCBA should rely on participatory consultation for evidence, using a form of Multi-criteria Analysis (MCA), with the criteria related to the main parameters that determine the benefits.

4. If community participation is not required, then the CCBA can resort to expert opinion, if experts are available that are familiar with the investment. Ideally, the expert opinion should also be structured using MCA.

5. If experts are not available, with the time and resources available, the CCBA may rely on documentary evidence and Objectives Based Assessment (OBA). This is typically used in broad reviews that cover large numbers of investments.

Box 5: Cost Effectiveness and Cost Benefit Analysis

Cost effectiveness is a version of CBA that is used to compare different ways of achieving the same benefits, when it is difficult to estimate a value for the benefit. It is often used, for example, to compare options for reducing GHG emissions (where the cost effectiveness is measured in $/t$CO_2$e) or for protecting forest area (where it would be measured in $/ha).

Consider a renewable energy project that costs THB 100 million, reduces annual GHG emission by 100 tCO_2e and has annual net financial benefits of THB 6 million, without taking into account the value of reduced GHG emissions. The Net Present Value (NPV) of the financial benefits is THB 92 million, assuming a 5% discount rate over 30 years. The financial Benefit Cost Ratio (BCR) is therefore 0.92. There are two options for including the GHG emissions in the analysis.

- *Full CBA* assumes a value for the reduced emissions. If a value of 300 THB/tCO_2e is assumed, then the economic benefits from reduced GHG emissions are worth THB 0.9 million per year (i.e. 100t x THB 300 x 30 years), with an NPV of THB 13.8 million, which increases the BCR to from 0.92 to 1.06. A sensitivity analysis can then be done to estimate the BCR for different carbon prices.
- *Cost effectiveness* calculates the cost of reducing GHG emissions so that this can be compared with other options for reducing emissions. In the example above, the net financial cost of reducing GHG emission has an NPV of THB 8 million and the total GHG savings are 3,000 tCO_2e, so the cost effectiveness is 2,667 THB/tCO_2e.

The cost effectiveness option is particularly useful when comparing a number of different options for reducing GHG emissions. For example, another renewable energy project might cost 3,000 THB/tCO_2e and an energy efficiency project might cost 1,400 THB/tCO_2e. In this example, the energy efficiency project is clearly the most cost effective way of reducing emissions. However, if reducing emissions is only one objective and it is also important to examine the impact on development, it may be necessary to use CBA in addition to cost effectiveness.

3.4 CONDUCTING THE CCBA

Defining How the Project Works. All CCBA requires a clear statement of the costs and benefits associated with a project and how these are affected by the project and by CC, as described in chapter 2. The way in which inputs lead to outputs may be considered a 'model', though it may not be described in mathematical terms. CCBA aims to place numbers on the inputs/costs and outputs/benefits which may be obtained by using various techniques, as described in this chapter.

Examples of Models of How Projects Work:

- The response of crops to temperature or moisture can be based on crop models that assess the relationship between biophysical parameters, including climate, and the productivity of crops. The way projects change crops and farming practices then alters the crop models.
- For renewable energy, the project model involves the relationship between the energy source (e.g. water, solar, biomass, wind …) and the amount of energy produced.
- For flood protection, the model often requires some hydrological modelling of storage and flow rates associated with different infrastructure and management options, which can be used to predict flood levels.
- For health, the model is typically a simple relationship between a climate variable (typically temperature) and the probability of a health challenge.

Technique A: Quantitative Evidence. For projects of more than THB 1,000m, with significant climate change implications, the key parameters determining the performance of the investment should be determined using quantitative analysis. Full CCBA follows similar principles to full CBA and would normally be undertaken as an integral part of the CBA required under NESDB Guidelines. In many cases, governments will need to contract in specialist assistance to conduct this analysis. There are many guides and manuals for conducting CBA and all project appraisal experts will be familiar with the principles. These Guidelines do not aim to provide a comprehensive manual on CBA.

The project 'model' can be simple (e.g. farm models based on crop budgets) or complex. Among the complex models are Integrated Assessment Models (IAMs) that combine biophysical modelling (e.g. hydrological models) with economic behaviour (e.g. computable general equilibrium models), but these would only be appropriate for the largest projects, or for sector or national level overview analysis. The quantitative analysis 'calibrates' the model and defines the relationships. The data analysis can also be simple, using basic descriptive measures (e.g. averages and probabilities) or more sophisticated (e.g. correlation and regression).

This analysis should normally consider at least two climate change scenarios, based on climate models and/or recent trends in climate, as described in Step 1. Where possible, a variety of different models and/or data sources should be used to improve understanding about the reliability of results, as described in Step 2.

For CCBA, it is often difficult to find useful time series data, since past trends are not necessarily useful indicators of future trends and are confused by other factors. This is particularly true for agriculture and other natural resource sectors. Instead, it is popular to use Ricardian analysis, which compares variations in space and assumes that these give evidence of how changes in time will happen. But this type of analysis needs to be very carefully designed, to ensure that there are no other variables that are influencing the variation in space.

Examples of Quantitative Analysis:

- Crop response models need data on local conditions which may come from research data or field data.
- The relationship between flood levels and damage can be derived from actual data over recent decades, based either on surveys or on data from insurance or government compensation schemes.
- Risks associated with increased frequency and severity of soil loss and landslide can be based on data from trends in soil loss in recent decades, correlated with weather conditions in the area.
- The impact of climate on disease threat can be based on observations of the frequency of disease in different locations, after controlling for any other factors that might vary between the locations.

Technique B: Expert Opinion. For projects that cost less than THB 1,000m, the sources of evidence may be more varied. In practice, much applied CBA relies on expert opinion that synthesises a mix of sources. The analysis follows all the same principles as CCBA with more quantitative evidence, but accepts the more subjective assessment of evidence. Where the evidence is less clear, it may be sensible to conduct more sensitivity analysis to clarify which assumptions have the biggest impact on the results.

Ideally, expert opinion should be used to determine the key relationships between inputs and outputs and so make it possible to estimate costs and benefits. If the project model is more subjective, the parameters may be considered as ‘criteria’ in a multi-criteria assessment (MCA), as illustrated by an example below.

Example of Estimating CC% using Expert Opinion:

A community forestry programme delivers four types of benefits: incomes, biodiversity, watershed and mitigation. It costs THB 190 million, but there is insufficient funding or time to conduct a full Cost Benefit Analysis. A group of experts is asked to assess the relative importance of each type of benefit and how they are affected by climate change. They do this by assigning a score, between 1 and 10, of the relative importance of each of the benefits. To help with this, they have evidence from various sources. An estimate of the sustainable timber yield, multiplied by the area of forest suggests potential net annual incomes of THB 20 to 30m. For biodiversity, there is no valuation work but their own views and a study from another country suggests that the willingness to pay for biodiversity is worth about half the potential income from the forest. For watershed benefits, the experts have evidence of flood damage downstream of about THB 1,000m, once every 10 years. The forest accounts for 20% of the watershed and the experts believe that maintaining mature forest will eliminate the contribution of the forest area to the floods. For mitigation, the experts assume that the sustainable harvested timber eliminates decomposition from the forest, enabling it to turn from a carbon neutral mature forest into one giving net sequestration of 5,000tCO_2e, which they value at THB 5m. They assign scores as follows: incomes 10, biodiversity 5, watershed benefits 8 and mitigation 2. The experts further decide that climate change will have little impact on incomes and biodiversity, but that watershed benefits will double gradually over 35 years. Using the terminology in Step 6, B is 29 (i.e. 10+5+8x (1+1/2)+2), A is 23 (i.e. 10+5+8) and CC% = 20.7%.

In theory, the experts could use the evidence on values to estimate Benefit Cost Ratios. However, they feel uncomfortable doing this, given the rough nature of the evidence. They are, however, comfortable to estimate the CC%, because this depends only the relative importance of each benefit, and the way climate change affects the benefit.

Another option with MCA relying on expert opinion is to ask experts to assess the importance of CC benefits, compared with other benefits, without requiring a specification of the project model. There is a risk of optimism bias, but this risk can be reduced by asking for scores that must add up to 100%. Table 4 presents a reference table showing ranges of relative scores for the five dimensions of sustainable development for selected sectors.

One challenge in relying on expert opinion is to find experts who have experience of projects in different climate conditions. There are also challenges associated with some experts becoming enthusiastic about particular technologies or projects without necessarily being aware of all the real world constraints that can affect the success of the project.

Examples of Analysis based on Expert Opinion:

- If official crop data is not available, or if it comes from sources that are considered weak, then it is normally possible to find agronomists with experience from a range of conditions, who will be able to provide guestimates for key parameters.
- If there is no quantitative evidence on flood protection, it should be possible to obtain expert opinion from people who are familiar with how businesses and households have been affected.
- Evidence for energy projects can often rely on the opinion of experts who are familiar with installing and using the technologies in different circumstances.

For health programmes, it will usually be possible to find doctors who have sufficient experience to estimate the increased threat of climate sensitive diseases.

Technique C: Participatory Appraisal. As with quantitative CBA, there is a long history of participatory appraisal and there are many guides, manuals and sourcebooks for participatory appraisal (ODI 2001; World Bank 2003; Care 2009; IUCN, IISD et al. 2012). These describe a very wide range of techniques that are available for eliciting views in an informative and objective manner. Some have been specifically adapted to address climate change, including community maps; timelines; causal flow diagrams; climate analogues, which take people to other climates (Chaudhury, Kristjanson et al. 2012); and the 'community-based risk screening tool – adaptation and livelihoods' (IUCN, IISD et al. 2012). Some general principles for use of participatory MCA in CCBA are presented in Box 6.

Box 6: Good Practice in Participatory CCBA

a) Ensure participants understand the scientific evidence on CC and bio-physical sensitivity.
b) Clarify the difference between CC and current climate variability.
c) Ask participants to comment on changes in climate over the last few decades and on whether these changes are consistent with future projections.
d) Ask participants to explain how past changes in climate have affected their livelihoods.
e) For each proposed project, ask participants to define the various benefits from the project.
f) Ask participants to score the relative importance of each benefit.
g) For each benefit, ask participants to score how much they expect this to change with CC.
h) Estimate the CC% as discuss with participants whether this is consistent with their more intuitive and subjective views about priorities.
i) Discuss the implications for any CC policies (e.g. Community Based Projects or Local Adaptation Plan of Action (LAPAs).
j) Review the key features of vulnerability and whether the conclusions of the participatory CCBA are addressing these issues and, if not, whether the analysis should be revised or new activities should be considered.
k) Discuss whether there should be any changes in systems to manage climate projects.

Most techniques use a version of Multi-criteria Analysis (MCA) to compile and structure the evidence from participatory appraisal. Participatory CCBA also uses a sort of MCA, but the criteria are the benefits generated by the project and the MCA is done by subjective assessment of the relative value of the benefits and how this changes with climate change. Some communities in Thailand have already received capacity building in climate resilient local planning. In some cases (e.g. for flooding), trends in climate over the last three decades are very similar to those projected for the next three decades, which makes it easier for stakeholders to appreciate climate change. But most CCBA will have to provide this capacity building before consultation can be useful.

Technique D: Project Documents and Objectives Based Assessment (OBA). If there is no data and expert opinion or participatory appraisal is not possible, then it may be possible to obtain a first rough estimate of the degree of climate relevance by consulting project documents and assessing whether climate change features explicitly or implicitly in the design and objectives of the investment. This approach is typically used for broad reviews, such as with project databases or Climate Public Expenditure and Institutional Reviews (CPEIRs), where there are insufficient resources to do a CCBA on every project, even if the simplest techniques were used (Fozzard and Steele 2014; Limskul, Sirisamathakarn et al. June 2012). Table 6 gives a typical example of guidance for scoring climate relevance based on explicit or implicit objectives.

Table 6: Typical Guidance for Objectives Based Assessment of Climate Relevance

Level	CC% CPEIR	CC% CCBA	Guidance
High	>75%	>33%	CC is the explicit primary objective
Mid	25%-75%	15%-33%	Include a mix of activities, only some of which are CC relevant
Low	10%-25%	5%-15%	CC is a secondary objective, or one objective amongst several
Marginal	<10%	<5%	CC is a very minor objective, often only implicit
No	0%	0%	Unaffected by CC

The CC% scores indicated in Table 6 are substantially higher than those in Table 4. This reflects the fact that subjective assessments typically overstate the importance of climate change, either through lack of evidence and experience or through deliberate exaggeration of climate relevance in order to improve changes of access to climate finance. Therefore, wherever possible, OBA should be validated at least roughly, with other evidence, such as the default values in The Table 4. As a rule of thumb, the indicative scores used in the CPEIRs can be halved to make them comparable with scores based on CCBA.

3.5 MONITORING AND EVALUATION

Figure 1 presents the role of monitoring and evaluation in CCBA. The primary role of monitoring is to provide evidence that allows the managers of expenditure to refine their management. However, monitoring also allows central government to aggregate the progress of each investment into a national level monitoring, which then helps assess whether strategic objectives are being met and whether the prioritization given to climate related investments should be accelerated or relaxed.

Adaptation. The common impact indicator for all adaptation benefits is the reduction in loss and damage arising from climate change, measured in THB. These adaptation benefits are then added to those associated with routine sustainable development, as described in Step 6. But climate change happens slowly and irregularly. Even in the most vulnerable countries, loss and damage is only expected to grow at around 0.1% of GDP a year. And the loss and damage varies greatly from year to year. It is not, therefore, possible to monitor adaptation benefits directly, in the short or medium term. Instead, it is necessary to monitor the outputs and outcomes from investments and then describe and estimate how these are likely to impact on reduced loss and damage. These outcomes may be reflected in measures of the resilient capacity of institutions, which can then be used to infer likely future loss and damage arising because of greater resilience. However, the relationship between indicators of resilience and reduced loss and damage are still being developed and this is an emerging field that could provide useful elaboration for future monitoring and evaluation practices.

In most cases, the indicators of outputs and outcomes that are useful for estimating adaptation impact are the normal indicators of the outputs of the investment. The indicators should reflect the key variables that determine the results of the CCBA. Typical examples are presented in Table 7, but there may be more detailed output indicators that are more easily monitored and are specific to each investment.

Mitigation. For mitigation, monitoring is usually more straightforward. The reduction in GHG emissions is the single indicator of impact and it should normally be easy to estimate this directly from output indicators such as energy savings, renewable generation and changes in land use.

Table 7: Typical Indicators for Monitoring Outputs Leading to Impact

Sector	National Level Indicator
Forestry, Peatland, Marine Resources, Coastal	Change in deforestation rate (ha/year)
	Degraded peatland rehabilitated (ha/year)
	Coral area protected (km^2)
	Vulnerable coastal areas protected from storm surge (ha)
Agriculture	Drought resistant crop varieties planted (ha)
	Area with water harvesting protection (ha)
	Farm area benefiting from weather insurance (ha)
	Irrigation area (ha)
	Biofuel production (t)
Energy and Industry	Energy saving (kWh)
	Renewable energy generated (kWh)
	Carbon intensity of electricity generation (tCO_2e/kWh)
	Expenditure on fossil fuel subsidies ($)
Transport and Urban Planning	Households with water supplies vulnerable to flood
	Number of rail/metro/bus passengers
	Waste going to landfill (t)
	Use of climate proofing standards (value of investments)
	Urban area vulnerable to 10 year flood (ha)
Education and Health Programmes	Education spending on CC programs as % of all education
	Health spending on CC related programs as % of all health
Disaster Reduction and Management	Communities with disaster management plans
	Lead times before warning for flood/tidal surge

Aggregating to National Impact. Many of the indicators used for monitoring the effectiveness of expenditure can be aggregated at a national level to give indications of national progress towards adaptation and mitigation objectives. When the output and outcome indicators are aggregated, it should then be possible to make an assessment of how they will affect adaptation impact (i.e. reduced loss/damage) and mitigation impact (i.e. reduced GHG emissions) and this can then be compared with total expected loss and damage to give an indication of the Adaptation Gap (or the extent to which this loss and damage is not addressed by current or planned climate change expenditure). This approach has been pioneered in the use of Climate Change Financing Frameworks (CCFFs), which have now been done in a number of countries in Southeast and South Asia. The conclusions from this work suggest that the Adaptation Gap is typically between 80% and 90%.

Process and Institutional Readiness. In addition to the actions that directly affect adaptation and mitigation, some projects will provide 'soft support' to build the institutional capability to respond to climate change. These may be considered 'overheads' that are essential for the effectiveness of direct projects but do not generate benefits without the direct projects. It is difficult to estimate the benefits from these overhead projects on their own, but their role in facilitating direct benefits can be taken into account when considering the full range of projects, including overhead and direct projects. For example, a country may decide to devote 40% of resources to overhead projects and 60% to direct projects in the first few years of a climate change strategy, but, once the institutions are in place, the overhead projects may require only 20%. There are a number of international initiatives that provide guidance on monitoring institutional readiness to climate change (Brooks and Fisher 2014). In essence, these involve a checklist of institutional capacity that needs to be in place covering the following issues:

- Awareness and knowledge;
- Planning and financing systems;
- Information services and knowledge systems; and
- Processes for consultation, participation and coordination.

INSTITUTIONS AND OPERATION

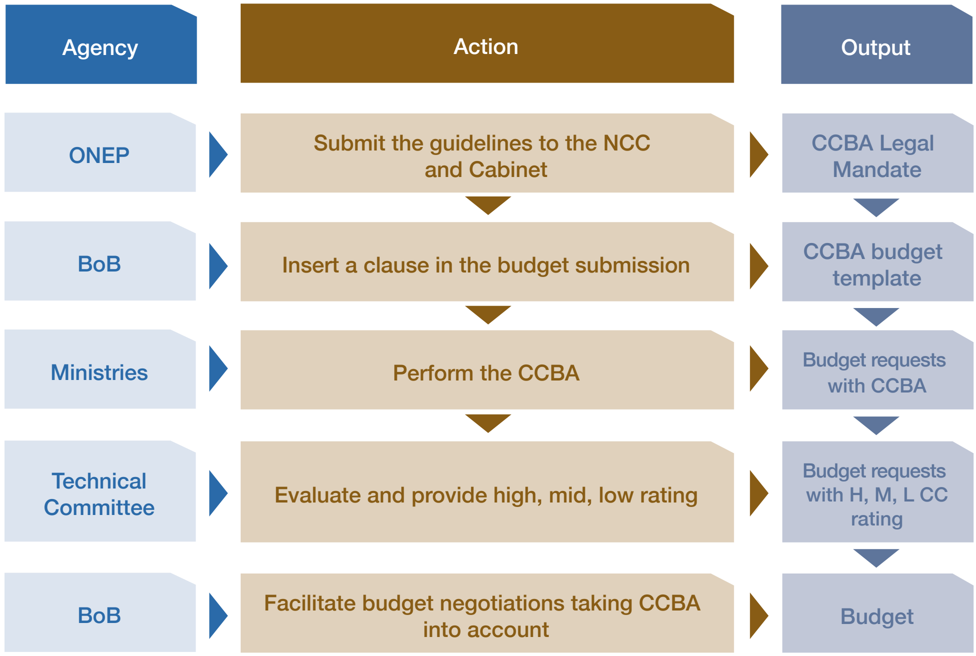
4. INSTITUTIONS AND OPERATION

4.1 INSTITUTIONS

The key institutional arrangements and responsibilities for operationalizing the guidelines are summarized in Figure 5 and include the following key roles.

- **ONEP** takes the lead in operationalizing the guidelines by submitting them to the National Committee on Climate Change Policy (NCCC) and the Cabinet for concrete policy and legal mandates. ONEP also plays a key role on the CCBA Technical Committee, providing the climate change expertise.
- **BoB,** complying with the mandates, inserts a clause in the budget submission template to require an additional appraisal for Climate Change related projects (CCBA Template). BoB also ensures that this template is filled in correctly.
- **Line ministries** perform, as required by the mandates, the CCBA, and submit their budget requests with CCBA to BoB and to be evaluated by the CCBA Technical Committee established under the NCCC.
- **The CCBA Technical Committee,** composed of key relevant agencies and experts, evaluates the quality of the CCBA undertaken by line ministries, requests improvements that may be required and, when satisfied with the quality, confirm the CC%. The committee also summarises the conclusions of the CCBA by providing a rating of high, mid, or low CC relevance that is derived from the CC%.
- **BoB** considers the submitted budget requests (with the evaluation undertaken by the technical committee) along with other existing budget approval criteria and decides when the CCBA should influence the budget negotiations.

Figure 5: Institutional Arrangement and Responsibilities



Box 7: Template for CCBA Reporting in Budget Submissions

Nature of and Severity of CC Risks: ………………………………………………………….
[e.g. flood (high); sea-level rise (low); drought (low) …etc.]

How CC Risks Impact the Population/Environment: ……………………………….....
[e.g. livelihood threatened; increased health burden; species extinction …etc.]

How the Proposed Expenditure Reduces CC Impact: ………………………………….
[e.g. livelihood threatened; increased health burden; species extinction …etc.]

Techniques/Evidence Used to Assess CC%: …………………………………………….
[e.g. livelihood threatened; increased health burden; species extinction …etc.]

Relative Importance of CC Benefits, Compared to SD Benefits: ……..................……
[i.e. CC%]

Sensitivity of CC% to Key Assumptions: ……………………………………………….
[e.g. change in flood return frequency (high sensitivity); dependence of households on dry season rain fed cultivation (mid) ; value of GHG emissions (high)…etc.]

4.2 OPERATION

Table 8 summarises how the CCBA is operationalized under existing project planning and budgeting and is used for monitoring and tracking CC related investments for the Climate Change Master Plan and other CC related Plans (e.g. National Development Plan).

Planning. The project screening helps identify which investments require CCBA and the steps provided for conducting CCBA help assess the relative importance of climate change benefits compared with other sustainable development benefits.

Budgeting. The CCBA clause in the budget submission template requires line ministries to prepare budget requests with CCBA to be submitted to BoB and subsequently reviewed by the CCBA Technical Committee. The technical evaluation (with confirmed CC% and associated high, mid, low rating) provides confidence in the assessment of CC relevant projects for budget negotiation and M&E purposes.

Monitoring and Tracking. The budget requests tagged with CC relevance facilitate the M&E of CC relevant projects and the tracking of CC relevant investments for the CC Master Plan.

Table 8: Operation of the CCBA Guidelines under Existing Planning and Budgeting

	Process					
	Planning	Budgeting			Monitoring	Tracking
		Submission		Approval		
Responsible Agency	Line Ministries		Technical Committe	BoB	BoB + Line Ministries	ONEP NESDB
Action	Screen projects for CCBA Conduct CCBA	Integrate CCBA into budget request	Evaluation with rating	Consider the evaluation with other approval criteria	Monitor and evaluate CC relevant projects	Track CC activities & budget for CC Master Plan and NDP
Output	CC relevance identified	Budget request with CCBA submitted	Budget request rated with high, mid, low CC relevance	Budget with CC relevance approved and tagged	CC relevant projects monitored and evaluated	CC relevant projects tracked for related plan

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ANNEX

Annex 1: Example CCBA using Quantitative CBA – Flood Proofing

Photo Credits: Royal Irrigation Department, Government of Thailand

The 2011 floods in Thailand not only caused more than 800 deaths and loss and damage of about THB 1,430 billion, affecting especially the manufacturing sector, but also urban infrastructure and agriculture. In response, the Royal Thai Government (RTG) prepared a range of projects to reduce flooding in future in the Chao Phraya River Basin, including diversion canals, improvements in information and controlled flooding of some agricultural land.

An initial economic analysis was undertaken in 2011 which did not take climate change into account. This considered three different options. The largest cost THB 508 billion, including all construction, land and resettlement costs. This option protects against all floods up to the level experienced in 2011. On the basis of past records, the 2011 flood has a return period of 43 years (i.e. a probability of occurring in any one year of 2.3%).

The 2011 economic analysis estimated the reduction in loss and damage to property would have a Net Present Value (NPV) of THB 529 billion, using a discount rate of 12% over 38 years. The details of the analysis were not provided, but this suggests an average annual benefit of THB 41.5 billion in 2012 (i.e. the THB 1.43 trillion 2011 costs times the 2.3% probability of recurrence, plus an additional 25% of average annual costs for smaller floods), growing at 5% a year, in line with real economic growth (and thus giving an increase in asset value at risk to flooding without the project). The Benefit Cost Ratio (BCR) was 1.1, which means that benefits were slightly higher than costs, but well below the level (e.g. 1.5) usually required for approval.

The 2011 analysis has been revisited to consider the implications of climate change and to take into account a wider range benefits. Key additional features are described below.

- According to the latest downscaled climate models, the return period of a 2011 flood will change dramatically in the future and will reduce to 7 years by 2050 (i.e. a probability of 14.3%). This has a dramatic impact on the benefits, since they are related to the probability of a flood occurring. However, the increased risk takes place gradually, in equal annual increments up to 2050. The net effect is to increase the NPV of benefits from THB 529 billion to THB 1,557 billion, taking the BCR to over 3 and transforming the conclusions of the appraisal.

- Analysis was also undertaken to assess the relative importance of wider benefits not taken into account in the initial analysis. These included the value of a wide range of social issues associated with the flooding and was based on surveys using contingent valuation method. The issues covered included: health issues, lost days of work, stress ….etc. These surveys suggested that the value placed on the disruption and loss caused by the flood averaged THB 100,000 per person, for those most seriously affected and it might be reasonable to assume a value of THB 10,000 for those on the margins. The number of people has not yet been assessed, but an estimate of 2 million people most seriously affected and 20 million people on the margins seems likely. The extra costs would therefore be THB 400 billion, increasing the potential costs of the flood by about 28%. As the benefits from the project are directly related to the avoidance of flood costs, the BCR will therefore be increased by 28%, increasing it from slightly over 3.0 to nearly 4.

- The benefits of avoiding loss of life can also be considered, using international conventions for the value of Disability Adjusted Life Years (DALY). WHO recommends that a DALY is valued at 3.5 times the annual GDP per capita, which is about THB 125,000. Assuming that the average age of those who lost their lives in 2011 was 30 years and that the life expectancy in Thailand is 74 years, the economic value of the loss of life was THB 15 billion (i.e. 800 x (74-30) x 125,000 x 3.5), or about 1% of the loss of property.

- The new analysis also has the benefit of observing the recent response of the private sector to the 2011 floods, which has included substantial investment in localised flood protection around high value manufacturing locations. This provides an alternative options to reduce the costs of flooding. No formal survey work was undertaken. However, the opinions of local officials in the areas worst affected suggested that at least 10 industrial estates have built protection and that these sites contain between 5% and 10% of the total manufacturing asset value. This therefore reduces the benefits from the flood protection by 5% to 10%.

- A sensitivity analysis is done to consider the implications of reducing the discount rate from 12% to 5%. This is in line with best international practice and is above the rate of interest that government pays when borrowing money. It is, however, below the real interest rate of commercial borrowing. Changing the discount rate also has a dramatic impact on the NPV of benefits, increasing them to over THB 6,000 billion and raising the BCR to over 9, which is well beyond the levels normally available for public investment.

The above analysis shows that taking climate change into account makes a dramatic difference to the economic case for the project to invest in flood protection.

Annex 2: Example CCBA using CBA with Expert Opinion – Biogas Scheme

Photo Credits: Energy Policy and Planning Office, Government of Thailand

The government is proposing to subsidise a pilot scheme to encourage rubber plantations to invest in biogas generation. The analysis relies strongly on the experience of the experts involved in biogas generation and the manager of the rubber plantation. The climate change benefits are those associated with the reduction in greenhouse gas (GHG) emissions.

The physical and financial parameters involve some detailed estimates of: the volumes of wastewater and pollutants; the efficiency of the process in extracting carbon from the wastewater and converting it into biogas and methane; the heat content of the biogas generated and the savings in firewood that can therefore be made; and the value of replacing harmfully polluting wastewater with beneficially fertilising wastewater.

The equipment costs THB 8.65m and has annual operating costs of THB 0.41m. The opportunity cost of the land (i.e. the income from using it for other purposes) is estimated to be THB 0.16m per year. The NPV of these costs over 35 years using a 5% discount rate is THB 15.4m.

The benefits come from four sources: savings in firewood, the fertilising value of the wastewater, the reduction in water pollution and the reduced GHG emissions. The savings in firewood are estimated to be THB 1.09m per year. The fertilising benefits are based on the nutrient content of the wastewater, valued at the price of nutrients in conventional chemical fertiliser, which suggests the fertiliser value is very small at less than THB 0.01m per year. The value of avoiding pollution is determined from studies in other locations of the impact of water pollution on health and livelihoods, including fishing. This suggests that the benefits of avoiding pollution are relatively small at THB 0.02m per year. Excluding the value of GHG emission reductions, the NPV of benefits is thus THB 13.91m, giving a Benefit Cost Ratio of 0.90, which is insufficient to justify the investment and would argue against a public subsidy.

The rubber processing plant produces about 15,000t of rubber per year and 184,000 m^3 of wastewater. Without biogas generation, about 50% of the carbon in the wastewater decomposes into methane and about 73,000 m^3 of methane is emitted into the atmosphere, equivalent to about 1,160 tCO_2e. With biogas generation, all methane generated is burnt and released as carbon dioxide, which contributes only about 65 tCO_2e. The saving in GHG emissions from wastewater arising from biogas generation is therefore 1,095 tCO_2e, which has a value of THB 1m, assuming a carbon price of about 5 $/$tCO_2e$, which increases the BCR from 0.90 to 1.23, which is an improvement but still not strongly attractive.

In addition, there are potential savings from GHG emissions associated with not having to burn firewood. If the firewood comes from sustainable sources (i.e. it comes from forests where only mature timber is extracted to avoid decomposition and the stock of timber is maintained) and there is a plentiful supply of this firewood, then the firewood is carbon neutral and there are no gains in emissions from not using firewood. However, if the firewood is not from sustainable sources, or if there is a limited supply of sustainable timber and others are forced to use fossil fuels (e.g. kerosene) or electricity generated from fossil fuel, then there is reduction in GHG emission from the savings in firewood. In the latter case, there are savings of about 2,600 tCO_2e per year. If carbon is valued at 30 $/$tCO_2e$, this has an NPV of about THB 11m. This lifts the BCR to 1.94 which is strongly attractive.

The analysis therefore suggests that, in areas where sustainable firewood is in short supply, there is a strong justification for subsidising the installation of biogas treatment, when GHG emission is valued at carbon market values slightly above existing market values. If the carbon emissions are valued at the higher levels seen in earlier carbon markets, then the BCR increases from 1.94 to over 4, and becomes very strongly attractive. If carbon is valued at the social cost of carbon (e.g.50 to 100 $/$tCO_2e$), then the argument for investing in biogas is irresistible.

Annex 3: Example CCBA using Participatory Approaches – Conservation Agriculture

The following example is a hypothetical project described to illustrate the techniques. Traditional farming practices in a region rely on ploughing land and growing a rotation of staple crops, combined with legumes and pasture. These techniques provide a living that is close to subsistence for most small farmers during normal years. However, in dry years, yields drop significantly and households are unable to survive from their farms and have to resort to various coping strategies to diversify incomes.

There have been a number of small NGO projects that demonstrate that a low tillage approach to farming can result in rapid improvements in soil moisture capacity which gives farmers marked improvements in yields during dry years. Farmers practice a wide range of mixed activities, including crops, livestock and agro-forestry. Low tillage approaches must therefore be well adapted to the local circumstances. The government is subsidising a network of farmers' field schools that will allow the pilot projects to disseminate their experience and then build a system that allows farmers to share their experience.

The government does not have strong evidence about the benefits. The project designers call a meeting of leading farmers and of those people who have been closely involved in the NGO projects. This meeting discusses the range of potential benefits from low tillage farming, which include: a) higher soil moisture and more resilient yields in dry years; b) reduced soil erosion, especially in wet years; c) lower requirements for herbicides, after 3 years; d) lower probability of the most serious pest attacks. It also identifies a number of costs, including, notably, some high labour costs during the first few years, while the new system is becoming established.

The group scores the relative importance of the various benefits, assuming current climate conditions. It then considers the available evidence on climate change, including recent trends and the evidence from climate modelling, all of which point to an increased probability of a moderate drought from 25% to 35% by 2050. The meeting then discusses the relative change in the various benefits as a result of this expected climate change.

The farmers then discuss the potential interest in the new techniques and think that about 1,000 farmers could be using some form of fairly comprehensive low tillage cultivation by 2025. The proposed government budget for the project is THB 200m. In order to estimate the additional benefits associated with climate change, the group estimates the income of a typical small farm, using current practices and current climate conditions. It then uses the existing consultation to assess the change in that income and this allows a BCR to be estimated for the new techniques, with current climate conditions. The consultation also provides the qualitative participatory evidence to show the likely impact of climate change on these benefits.

Annex 4: Example CCBA using Expert Opinion and OBA

The Ministry of Agriculture and Cooperatives has been pursuing a programme to promote climate change across all its activities and wishes to evaluate the results of this programme. Part of this programme has involved requesting all departments to comment on the relevance of climate change to their proposed projects, in their budget submission forms. The forms therefore include a box which asks whether climate change is a primary objective, a secondary objective, a minor consideration or irrelevant. The Ministry then has to convert the evidence in this box into an estimated CC% that is roughly consistent with other more rigorous evidence on CC%, based on the relative importance of climate change benefits, compared to total benefits.

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