Early Value-for-Money Adaptation: Delivering VfM Adaptation using Iterative Frameworks and Low-Regret Options

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Contents

List of Boxes

List of Figures

SECTION 1

Introduction to VfM Information and Report

Background

As adaptation moves from theory to practice, there is a need to select, prioritise and implement adaptation interventions. At the same time, as DfID starts to finance large adaptation programmes, there is a need to ensure Value-for-Money (VfM). However, the identification and appraisal of options, and the identification of VfM adaptation, are challenging.

To provide support for these challenges, DFID has produced information notes on early adaptation and value for money, including:

- A Report on Early VfM Adaptation.
- An Early VfM Adaptation Toolkit.

Both the report and toolkit are built around the use of iterative climate risk management frameworks, as recommended in the recent IPCC 5th Assessment Report (IPCC, 2014).

These frameworks can help in sequencing adaptation activities over time and for identifying early actions that are likely to offer good returns on investment, i.e. that deliver VfM.

They include an early focus on low- and no-regret adaptation, priority areas for mainstreaming resilience and early actions that start preparing for long-term challenges.

The Report and the accompanying Toolkit will be useful for any programme that aims to build resilience, i.e. for (i) advisers designing projects as part of a portfolio e.g. in DFID country office (direct adaptation programmes or mainstreaming of adaptation into other non-climate country programmes or sector support) and (ii) for DFID support (finance, technical assistance) of country national/sector plans (e.g. National Adaptation Plans, sector adaptation plans or projects, Climate Funds) or local adaptation.

The early VFM Adaptation Report:

The aim of the Early VfM Adaptation Report is to set out the latest thinking on how to maximise value for money from adaptation programming.

The report:

- Sets out the latest thinking on iterative adaptation and how to use this to maximise value for money.
- Outlines how to use these iterative frameworks for the early identification and framing of adaptation.
- Provides examples of early adaptation interventions that are likely to be priorities.

The Early VfM Adaptation Toolkit:

The aim of the toolkit is to help DFID advisers to design adaptation projects or portfolios of projects that maximise VFM.

The Early VfM Adaptation Toolkit is a word based document, structured around the six steps in the adaptation policy cycle, i.e.

- Step 1. Identify risk, vulnerability and impacts;
- Step 2. The theory of change;
- Step 3. Identify possible adaptation options and sequence these over time;
- Step 4. Early prioritisation of options (listing of promising options);
- Step 5. Theory of change part 2, with programme scenarios;
- Step 6. Appraisal of adaptation options.

For each step it provides relevant context and support, potentially useful sources of information, case study application and examples.

The final step includes more detailed information on cost-benefit ratios and value for money analysis for a large number of promising early adaptation options, i.e. as potential information for economic appraisal and business cases.

Outline of the Report

The Early VfM Adaptation Report is structured as follows:

- Section 2. The adaptation policy cycle, challenges and the rationale for iterative adaptation. This section outlines the policy cycle for adaptation. It explores the key challenges for identifying and prioritising early adaptation and the benefits of using iterative frameworks to address these. It also explains how these iterative frameworks can maximise value for money through the use of no- and low-regret options.
- Section 3. Iterative frameworks and VfM options in practice. This section outlines how the practical use of iterative frameworks can help with the early identification and sequencing of adaptation. It provides a typology of early VfM options, outlining the benefits of each of these, and the cases in which they will deliver value for money (as well as the cases where they do not).
- Section 4. Evidence of how iterative climate risk frameworks are improving VFM. This provides information from a series of case studies that demonstrate how iterative thinking is improving VfM.
- Section 5. The Early Adaptation VFM toolkit. This section summarises the main components of the early VFM toolkit. This uses an iterative adaptation framework to help DFID advisers to design programmes that maximise VFM over time. It includes advice on how to prioritise actions and how to identify early actions, as well as information that will be useful for preparing concept notes and business casese.
- Conclusions. This presents the conclusions and recommendations of the report, and the likely development of these approaches and the toolkit for climate finance effectiveness in the future.

SECTION 2

The Rationale for Iterative Frameworks and Early Adaptation

Key Messages in this Section

- This section begins with an outline of the adaptation policy cycle.
- It examines the issues with the implementation of this cycle and identifies the key challenges with the identification and early prioritisation of early adaptation, i.e. that benefits arise in the future and are subject to high uncertainty.
- In response, it outlines a new framework for considering climate change adaptation, based around iterative climate risk management. This has two key components.
  1. Climate change is viewed in dynamic terms, starting with current climate variability and extreme events, then considering future climate change and associated uncertainty.
  2. In response, adaptation is considered as an iterative process, involving a set of complementary actions (a portfolio) that:
     - Tackles the current adaptation deficit,
     - Mainstreams climate change into development, and
     - Starts preparing for future (and uncertain) long-term challenges.
- The rationale for the use of this framework is outlined, explaining how it can maximise value-for-money for ‘early’ adaptation, i.e. over the next 5 – 10 years.
- Finally, the concepts of early no- and low-regret adaptation, and how these fit within the iterative framework and provide value-for-money are explained.

Introduction: the Adaptation Policy Cycle

Earlier studies of climate change focused on assessing vulnerability or future impacts, using vulnerability or impact assessment. In turn these studies were used to identify broad lists of possible adaptation options.

In recent years, however, there has been a shift towards **adaptation assessment**. While these studies still use information from vulnerability or impact assessments, adaptation plays a much more central role in the objectives and analysis. Indeed, these studies are focused around the identification and implementation of real adaptation, within the context of policy and development, and have a much immediate time focus.

The broad set of steps in an adaptation assessment have been identified, and summarised in guidance such as the PROVIA and Mediation projects (see box). These outline a broad policy cycle for adaptation, summarised around five steps.

i) identifying vulnerability and impacts;
ii) identifying adaptation measures;
iii) appraising adaptation options;
iv) planning and implementing adaptation; and
v) monitoring and evaluation.

Box 1 Initiatives on Adaptation

Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) is a global initiative which aims to provide direction and coherence at the international level for research on vulnerability, impacts and adaptation (VIA).

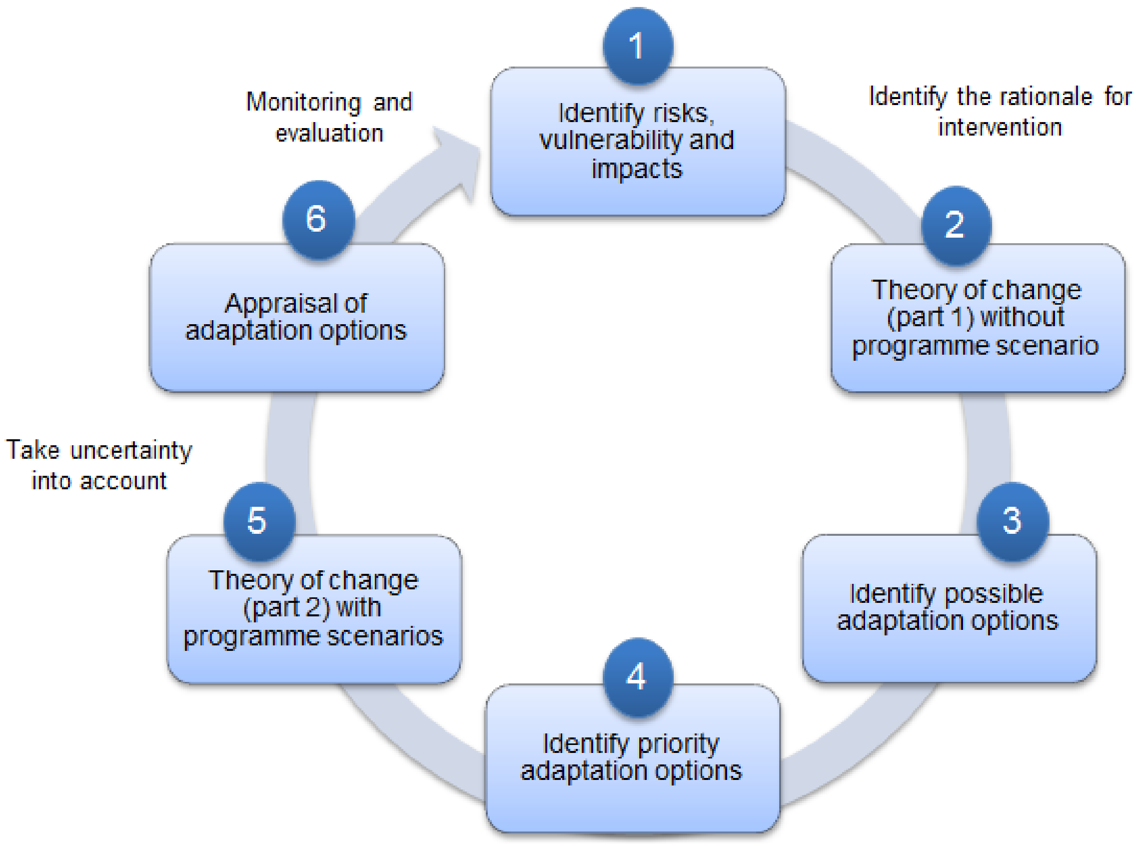
http://www.unep.org/provia/

Provia was supported by the Mediation Project (Methodology for Effective Decision-making on Impacts and AdaptaTION). This project provided scientific and technical information about climate change impacts, vulnerability and adaptation options, including the adaptation learning cycle, methods, decision support and information.

http://mediation-project.eu/

This cycle has been adapted to align to the DFID context. This proceeds through a cycle of six stages of Business Case Development, set out in the diagram below. Stages 1 to 5 are aimed at advisers who are developing a Strategic Case. Stage 6 is aimed primarily at DFID economists for use during the economic appraisal of programme options.

Figure 1 DFID Cycle for designing programme options and carrying out options appraisal



This Report focuses on the third and fourth steps of the cycle, the identification and prioritisation of early adaptation.

However, while this cycle- and the identification and prioritisation steps – seem fairly intuitive, in practice there are a number of challenges. These are set out below. .

The Challenges with Early Adaptation

Climate change has a large number of potential impacts, and this leads to a large number of potential areas to consider for adaptation. Early critical questions therefore include where to focus resources and how to select and prioritise early options?

While an initial focus on major risks is useful, even when these have been identified, there are usually a very large number of possible adaptation options available, even within an individual sector.

These can involve different types of adaptation interventions, at multiple geographical scales (farm-level, local, regional or national) and temporal scales (immediate or long-term), and range in nature from technical project level interventions through to policy interventions or institutional change. When all of these factors are combined, the list of possible adaptation options can become very large indeed.

As an example, most National Climate Change Strategies identify several hundred adaptation options, and work in Ethiopia developing an adaptation strategy for the Government in the agricultural sector (Watkiss et al, 2013) identified almost 1000 possible options. Such a large number is unhelpful.

It is therefore important to identify and prioritise adaptation interventions, i.e. to direct available resources most effectively, efficiently and equitably, and thus to deliver Value for Money. However, this is made difficult by the issues associated with future climate change and uncertainty.

Future Climate Change and Uncertainty

The climate is already changing. The recent 5th Assessment Report of the IPCC states that warming of the climate system is unequivocal (IPCC, 2013). In turn, these observed changes are leading to early impacts, particularly in developing countries (IPCC, 2014).

While these changes are important, the main concern over climate change has historically been on the future, as the rate of temperature change increases and major climate shifts emerge. Indeed, most climate change modelling has focused on the middle of the century (2050s) and beyond, because this is the time period when a clear climate change signal emerges, relative to the noise of underlying variability.

However, these future changes are very uncertain, as explained in the box. This uncertainty presents a number of critical challenges for adaptation.

First, as impacts arise in the future, e.g. towards 2050 or beyond, the benefits of adaptation also arise (predominantly) in this time period. <u>This means that the costs of early adaptation action (today) are high when compared to future discounted benefits</u>.

Second, as there is high uncertainty over future impacts, this also affects the future benefits of adaptation. An early adaptation response has the potential to waste resources by over-investing against risks that do not emerge, or implementing measures that are insufficient to cope with more extreme outcomes.

Critically, this uncertainty acts as a barrier to adaptation, i.e. as a reason for inaction. However, this need not be the case, though it does require a re-framing of climate change. This involves a shift away from a classical optimisation framework (i.e. a predict-and-optimise approach where future climate is predicted, then an optimised adaptation response is advanced) towards a more dynamic view of climate change, and an iterative approach for adaptation.

Note that further information on uncertainty is provided in the **DFID TOPIC GUIDE: Adaptation: Decision Making under Uncertainty**.

Box 2 Uncertainty

While adaptation involves several difficult aspects, the most challenging is uncertainty[1] (UNFCCC, 2009: Hallegatte, 2009), particularly in relation to future climate change. This arises for two reasons:

First, future greenhouse gas emissions – and thus the level of climate change that will occur over time - are uncertain. It is currently not clear whether the world will implement the emission reductions (mitigation) needed to limit global warming to 2 degrees relative to pre-industrial levels (the 2°C goal) and many commentators consider higher emission scenarios towards a 3 or 4°C warmer world are more likely. The future emission path makes a large difference to future warming and changes in other climate parameters, such as precipitation.

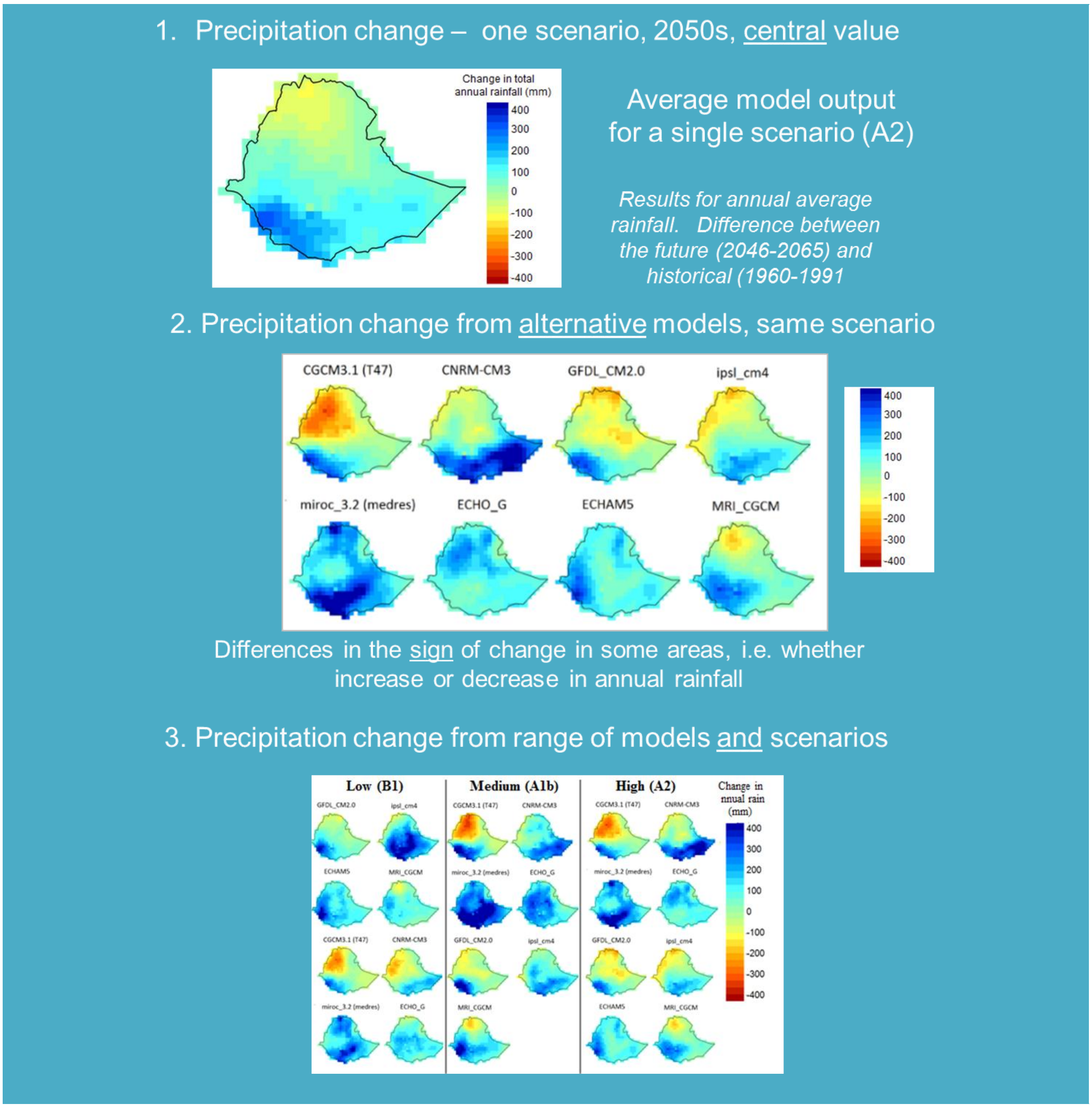
Second, even when a future emission scenario is defined, there are still large variations projected from different climate models. This arises because of structure and sensitivity of the models, the regional and seasonal changes associated with global temperature, and the difficulty in projecting complex effects such as rainfall. As a result, different climate models often give very different results even for the same scenario and same location.

This can lead to a very high range of uncertainty. An example is shown below for the change in annual rainfall with climate change in Ethiopia in the 2050s, with a comparison of downscaled regional climate information. This shows how uncertainty increases in moving from:
1) a single model or ensemble mean to:
2) comparisons of alternative climate model outputs for a single scenario to:
3) comparisons of alternative climate models and scenarios.

The figures show increasing uncertainty from top to bottom, noting there is even disagreement on the sign of the change, i.e. whether rainfall will increase in the North (blue) or decrease (orange). These uncertainties also exist for individual months of the year, and for other parameters such as extreme rainfall or drought periods. Even for more robust changes, such as average temperature increases, future differences are large. It is stressed that it is not possible to use probabilities to get around these problems, because of the uncertainty across both future scenarios and models.

This uncertainty grows when different socio-economic scenarios (e.g. population projections) and alternative impact models are considered, which adds to the uncertainty above.

[1] There are many different definitions of uncertainty. We adopt a definition from UK Government economic appraisal (HMT, 2007), where uncertainty involves a large number of possible outcomes and it is impossible to attach probabilities to each of these, as differentiated from risk, which is defined as the likelihood, measured by the probability, that a particular event will occur.



Using Iterative Adaptation Frameworks

Earlier adaptation studies used a predict-then-optimise approach, where a climate model produced a future projection, which was used in an impact assessment to quantify future impacts, and finally to consider potential adaptation responses. While this is a logical approach, in terms of costs and benefits, this has a number of problems related to the discussion above, i.e. the challenge of future discounted benefits and the fact that uncertainty is ignored (as these approaches assume perfect foresight).

These problems are compounded when moving towards real adaptation, i.e. to the ‘here and now’, because of the need to make decisions and investments over the next five to ten years (‘early’ adaptation), and because of the need to consider broader policy and development, e.g. beyond science-only. Furthermore, in this context, it is important to balance resource allocations for adaptation against broader development.

To address these problems, the focus of adaptation has changed over recent years.

There is now a greater focus on starting with current climate variability and extreme events (such as rainfall variability, droughts, floods and tropical storms). These already cause large economic impacts in developing countries, as well as affecting millions of livelihoods.

As an example, the IPCC SREX (2012) reviewed losses from current natural disasters and reports these amount to about 0.3% of GDP (on average) for low-income countries. However, in small exposed countries, losses were much higher, exceeding 1% in many cases and 8% in the most extreme cases, especially when indirect and macro-economic costs are included.

These impacts of current climate variability are often known as the 'adaptation deficit'. Addressing this current adaptation deficit provides immediate economic and livelihood benefits and also enhances resilience to future climate change. It is also recognised that adaptation (to future climate change) will be less effective if current adaptation deficits have not been addressed (Burton, 2004).

However, while reducing the deficit is generally beneficial, there is an economic component to consider. Some level of adaptation deficit exists in all countries, even in highly developed economies. This reflects the trade-off between the costs of reducing the deficit versus the costs of bearing 'residual risks'. This means it is optimal to reduce but not eliminate the deficit, e.g. to reduce climate risks to the point where benefits are equal to costs. As an example, the costs of flood defences rise with higher levels of protection, and for rare events, the use of risk financing (insurance or reserve funds) may be more economically efficient.

At the same time, the future benefits and high uncertainty associated with future climate change is now recognised, and in response, the use of more flexible frameworks is being advanced, that allow learning and iteration.

These aspects have been brought together in a new overall framework for climate change adaptation, illustrated in the Figure below. The framework starts with climate change (top), which is split into a number of linked risks, each related to different policy problems and time-scales. This starts with current climate variability and extremes (top left), i.e. the adaptation deficit. Over time, climate change will affect these existing impacts, and lead to major new risks (top right), though often with high uncertainty.

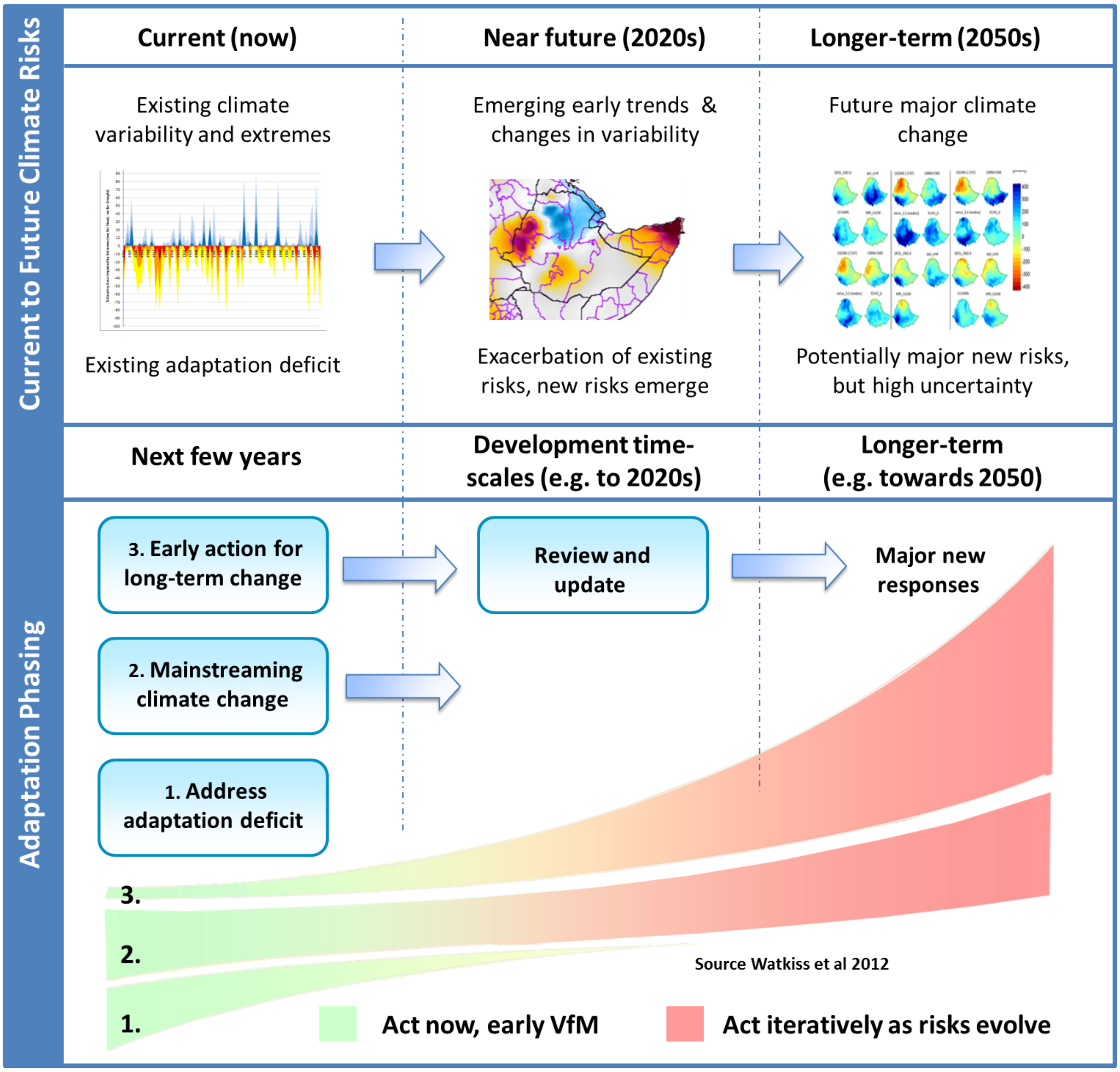
In response, an adaptive management framework is recommended for adaptation (bottom), also known as iterative climate risk management (IPCC, 2014). This involves complementary responses that cover different challenges across the time-periods and climate challenges. Three broad sets of complementary adaptation activities are identified: 1) addressing current risks, 2) mainstreaming climate into development and infrastructure (e.g. to address future exposure) and 3) building iterative responses to address future long-term risks. These **iterative frameworks can help maximise value for money adaptation.**

1. The first area targets the current adaptation deficit, to reduce the impacts of climate variability, and also build resilience for the future. This often includes interventions termed no- or low-regret measures, which are good to do anyway (even without climate change).
2. The second area targets short-term decisions with long life-times, i.e. which will be exposed to climate change in the future (e.g. infrastructure, development planning decisions). This can be addressed using risk screening and mainstreaming, with early priorities around low-cost robustness and flexibility.

3. The final area addresses the long-term (and uncertain) risks of future climate change, building iterative response pathways using a framework of decision making under uncertainty and identifying early action to allow learning for future decisions. This allows responses to evolve over time (with a learning and review cycle) so that appropriate decisions can be taken at the right time, allowing for action to be brought forward or delayed as the evidence and observations (of climate change) emerge. Note that in some cases, where there are limits to adaptation, there may be a need for transformational change, achieved through a long-term vision and a set of incremental actions.

Variations on these themes exist in the literature, e.g. there may be further sub-divisions, or alternative terms, but the key thing is around the timing of responses, with (1) immediate action to address the deficit, (2) short-term actions that will be exposed in the future, and (3) early action to address future risks, to keep options open and avoid the risks of lock-in.

Figure 2 An Iterative Framework for Climate Change and Adaptation.



These frameworks have been recommended widely in the literature, including in the recent IPCC SREX report (2012) and more recently in IPCC 5th Assessment Report (2014).

Importantly, they also provide the means to select the early focus for adaptation.

Using Iterative Frameworks to Select Early VfM Adaptation

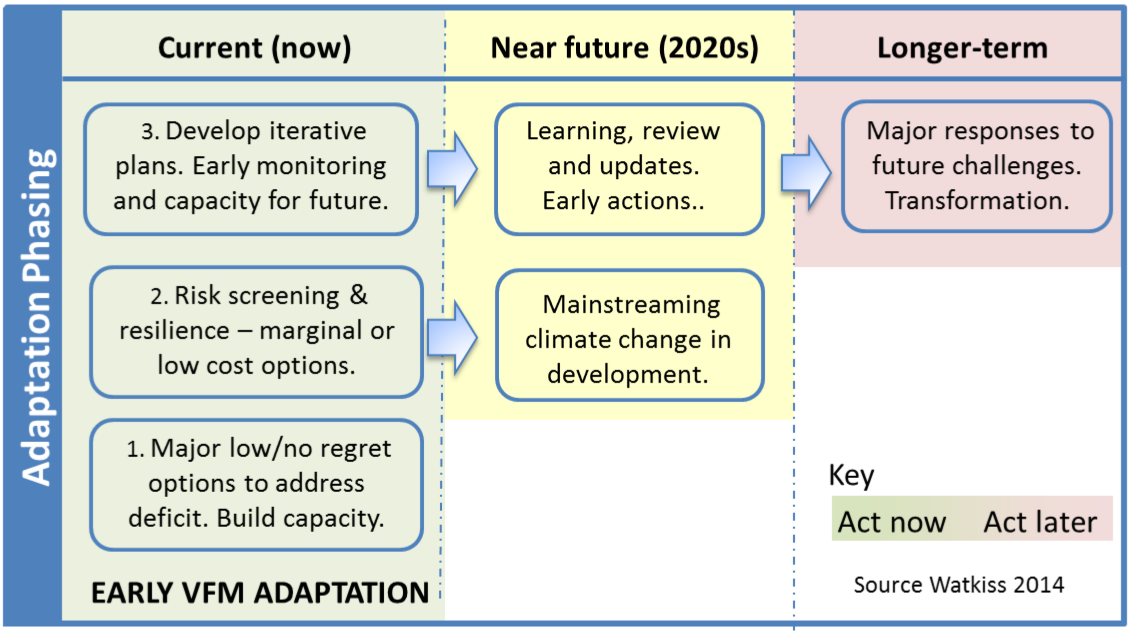
The framework above allows the identification of adaptation interventions that start with the current adaption deficit and build resilience for the future, taking account of uncertainty. These frameworks can be used to identify areas of early adaptation focus.

It is stressed that while much of the recent focus has been on addressing the current adaptation deficit, focusing on this area alone (at the expense of longer-term changes) will lead to mal-adaptation. For example, failure to account for long-term risks when designing short-term responses could increase future impacts by increasing future exposure. Furthermore, the historic climate is not a good predictor of the future (with climate change), and thus optimising responses against historic experience is unlikely to be sufficient.

All three response areas in Figure 2 are an essential part of early adaptation, i.e. for decision and investments over the next 5 – 10 years. They represent a **key focus for delivering value for money adaptation**. However, a <u>good adaptation programme will comprise of a portfolio of interventions</u> that cover all of these different aspects.

It is highlighted that the <u>nature of actions</u> will vary across each of the three areas. Early interventions to tackle the adaptation deficit will focus on concrete action, while early actions for the medium and longer-term (2 and 3) will involve marginal aspect, early planning or information and evidence gathering, rather than large-scale action or major investment. This is highlighted in the figure below, with the early actions highlighted in green.

Figure 3 Priority Areas for Early VfM Adaptation.



These early actions (in the green shaded area) are the early priority for adaptation. They include options that are often termed '<u>**no-regret'**</u> or '<u>**low-regret'**</u>.

These low-regret options are now seen as an early priority for adaptation finance, for example, the IPCC SREX report highlights that *low-regret; actions are a starting point for* *adaptation, as they have the potential to offer benefits now and lay the foundation for addressing projected changes*. However, there are differences in the literature on exactly what constitutes no – and low-regret adaptation, as outlined in the box.

While the definition of a no-regret option is generally agreed, there are large differences in what constitutes low-regret adaptation – notably on the type of options, the benefits, and their timing. However, it is clear is that there are a set of no- and low-regret adaptation options which are extremely promising for early implementation, i.e. **that are likely to deliver early value-for-money adaptation**. This Report focuses on these options, setting out a way to assess them and then looking in detail at promising options and providing information on them for appraisal.

Box 3 What are No- and Low-regret Options?

What are no-regret options?

The concept of no-regret options has been advanced for mitigation, where it relates to measures which can reduce GHG emissions and save costs (i.e. that generate a positive net present value) such as energy efficiency. A similar concept has emerged for adaptation. In this case, **no-regret adaptation** is defined (by the IPCC) as adaptation policies, plans or options that*:*

'generate net social and/or economic benefits irrespective of whether or not anthropogenic climate change occurs'.

This often focuses on options that address the current adaptation deficit (e.g. disaster risk management), efficient options that are similar to the mitigation domain (e.g. improving irrigation efficiency) or options that address existing problems (e.g. reducing post-harvest losses), though many of these are actually development options. These no regret options provide immediate economic benefits, and they are therefore an obvious area of early Value for Money adaptation. They also have the potential to build the foundation for adaptation to future climate change, i.e. building resilience. A variation of no-regret options are **win-win** options. While there is no formal definition, these are options with wider social, environmental or ancillary benefits, and thus benefits may involve non-market values, GHG mitigation cross-sectoral synergies, etc. that are difficult to include in a standard project appraisal.

What are low-regret options?

There is no agreed definition of low-regret options. A number of definitions have been proposed:

- Options or interventions that are no-regret in nature, but have opportunity, policy or transaction costs. As an example, some climate smart options for agriculture are no-regret in theory, but involve opportunity costs, meaning in practice they are low-regret.
- Options that are probably worth doing in the <u>current</u> climate, and also have benefits in addressing climate change in the future. This often includes low cost options that have benefits that are difficult to monetise (e.g. capacity building, better climate information, etc.). It can also include options that are low cost and provide future information to enable better decisions in the future, or the opportunity for learning.
- Options or interventions where the costs are low and the <u>future</u> benefits are high, i.e. low cost measures that can provide high benefits if future climate change emerges (noting the benefits are in the future, rather than immediate). This can also include interventions that perform well over most, but not all, possible future climate change scenarios.
- Options that are robust or flexible, and thus address uncertainty. This can include options that are robust, i.e. that perform well across <u>many different climate futures</u> (addressing uncertainty), rather than a measure that performs optimally to one defined central future (and poorly to others). It also includes options that are flexible, i.e. that allow changes in plans or project design over time, to take account of new knowledge.

A number of additional points are also highlighted.

- A number of options that are considered low-regret in some studies are considered high-regret in others. This often applies to technical/structural (hard) options. This difference can be explained by the different framing of studies, i.e. whether the potential impacts of future climate change and uncertainty are considered or not.
- Many no- and low-regret options are non-technical (soft) in nature. This can make their appraisal more challenging. It is also noted that these soft measures may not always be a substitute for hard adaptation.
- A number of studies highlight the potential for community-based adaptation as a no-regret option, as practical adaptation at the community level seeks win-win outcomes – that benefit both local communities and the ecosystems on which they depend. This involves a different orientation to a standard technical based and national perspective.

Why aren't these options already implemented?

A final question is given the nature of these options, especially no-regret options, why haven't these been already implemented. Several studies have investigated this question and these identify a number of issues:

- Sometimes the no- or low-regret characteristics of these options are associated with non-market sectors or ancillary benefits, thus while they have a positive social present value, they provide lower returns than other options.
- In many cases, there are high opportunity costs. For example, climate-smart agriculture often involves some loss of land, or up-front labour costs.
- There can be underlying barriers, e.g. access to finance, lack of information and awareness, risk aversion to new techniques.
- There are often transaction costs, as well as institutional/socio-institutional barriers to overcome. This may therefore require some planned interventions or support, and a focus on capacity building and awareness-raising.

These barriers are extremely important. The successful analysis of early low-regret adaptation will need to consider these, otherwise the uptake/implementation of promising options will be low. This necessitates a focus on these issues, alongside technical or economic appraisal.

Sources: Watkiss et al, 2013; IPCC AR4, 2007; IPCC SREX, 2012; UKCIP, 2006; UKCIP, 2008; HMT, 2009; Wilby and Dessai, 2010; Conway and Schipper, 2011; Ranger and Garbett-Shiels, 2012

Key points

The section above highlights a number of important conclusions:

- Adaptation is unlikely to involve an individual intervention. It is likely to require a response that recognises different risks, noting these are likely to vary over time, and with the application and context.
- Early value for money adaptation will include a mix of interventions (a portfolio), which includes some direct no-regret activities, but also low-regret options tackling short and medium-term issues, and some early planning for long-term challenges. Importantly these different activities are complementary and are linked.
- These frameworks require greater focus on current climate variability (the adaptation deficit) and future uncertainty.

SECTION 3

Iterative Frameworks and Early VfM Adaptation

Key Messages from this Section

- This section provides information to help identify and sequence early VfM adaptation.
- It outlines the types of interventions that can be included within an iterative framework and why each of these is likely to deliver value-for-money.
- It provides a description of each of these option types, and outlines their potential benefits, their justification, and the cases when they are likely to deliver value for money adaptation.

Introduction

The previous section provided a general framework to identify broad areas for early possible adaptation using an iterative framework. This chapter focuses down on the identification (selection) of possible early VfM adaptation using this framework.

- It provides a typology of early VfM actions that fit within an iterative climate risk management framework, i.e. a classification for types of early VfM adaptation.
- It describes some of the key aspects of each option, outlining the benefits, transferability, etc.
- It outlines which contexts and applications are likely to deliver value for money (as well as those which may not).

Issues with Identifying Early (VfM) Adaptation

In looking at the early identification and prioritisation of adaptation, it is useful to compare the similar early steps for mitigation, to highlight key differences.

There are widely accepted methods for identifying and prioritising promising options for reducing greenhouse gas (GHG). As mitigation is concerned with reducing a global burden, it is possible to compare options directly across and between sectors using cost-effectiveness analysis and the metric £/tCO_2. This provides a simple and efficient way to prioritise options and to assess potential benefits/outputs. However, it is much more challenging to identify and prioritise early adaptation for a number of reasons:

- There are no simple common metrics to compare and prioritise adaptation interventions. While mitigation targets a common <u>burden</u> of GHG, which can be measured in terms of £/tCO_2 abated, adaptation targets a large number of sector-specific <u>impacts</u>. The analysis of impacts and subsequent adaptation benefits therefore involves additional steps (e.g. who is exposed? how are they affected by climate? and what impacts arise as a result?) and is site and context specific.

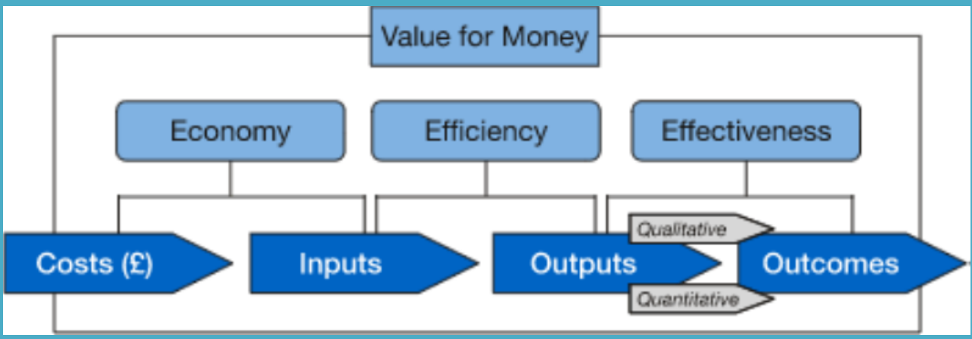
- Adaptation has to account for the dynamic and changing nature of climate change over time, i.e. the baseline impacts and the levels of adaptation benefits vary. This requires an additional time element as well as the consideration of inter-dependencies.
- There are a set of different challenges (or problems) for adaptation to address, related to current climate variability, near-term mainstreaming, and future climate change. This requires portfolios of options, rather than a single, linear optimised solution (as with mitigation).
- There is high uncertainty associated with future climate change, impacts and thus with future adaptation benefits. This uncertainty cannot be ignored with the use of central projections and estimates (as with mitigation). Uncertainty needs to be included in the selection of adaptation options and the decision framework for prioritisation.
- Many promising early adaptation options are non-technical in nature, or involve qualitative, ancillary or non-market sector benefits (unlike the technical, quantitative focus of mitigation options). This makes the analysis of outcomes and benefits, and subsequent economic appraisal, much more challenging.
- There is usually high variability in the baseline, for example with annual rainfall variability or probabilistic extreme events (e.g. floods and droughts). This makes it difficult to monitor and evaluate short-term adaptation outcomes, because it is difficult to attribute adaptation outcomes against this underlying variability. Furthermore, many of the early adaptation steps to address longer-term climate change which extend beyond normal project monitoring cycles. While process based indicators can be used to address this problem, these are less tangible than outcome based indicators.
- There is a strong overlap between many adaptation activities and existing development. Indeed, adaptation cannot be considered as a stand-alone activity and it needs to be integrated (mainstreamed) with underlying sectoral or development priorities and activities.

While this list of challenges may seem daunting, the iterative framework – and the use of low- and no-regret options - can help in identifying early promising areas for adaptation, i.e. to help select Value for Money. This is already recognised in the ICF thinking on VfM (see box).

However, it is necessary to move beyond this general framework towards a more specific and practical basis, i.e. to allow the selection of early VfM adaptation. This is the focus of this section.

Box 4 Adaptation Value for Money and the ICF

VFM in DFID is about maximising the impact of each pound spent. This is analysed through the lens of the 'three E's': economy (buying inputs of the appropriate quality at the right price); efficiency (how well we convert inputs into outputs) and effectiveness (how well the outputs from an intervention achieve the desired outcome on poverty reduction).



At a project level, DFID guidance supports VFM analysis at three levels:

- *Economy (spending less):* This refers to ensuring lowest cost procurement of goods and services within project design, and focuses on making sure that the unit costs are benchmarked against market norms. For example, from an adaptation perspective, this might involve ensuring that the costs of a water saving technology purchased were in line with international market expectations.
- *Efficiency (spending well):* This refers to ensuring that the choice of goods and services to be procured ensures that the procurement of goods and services results in the envisaged outputs. The input to output ratios are the key consideration. From an adaptation perspective, this might involve ensuring that the technology selected would deliver the desired reduction in volumes used for irrigation compared to similar alternative technologies.
- *Effectiveness (spending wisely):* This refers to the selection of those outputs most likely to result in the desired outcomes (and impacts). From an adaptation perspective, this could be ensuring that the water saving technology selected was the most (cost) effective way of making an agricultural community more resilient. Alternatives to be considered might include, adopting more drought resistant crops, investing in water capture and storage capacity, or diversifying livelihoods away from agriculture.

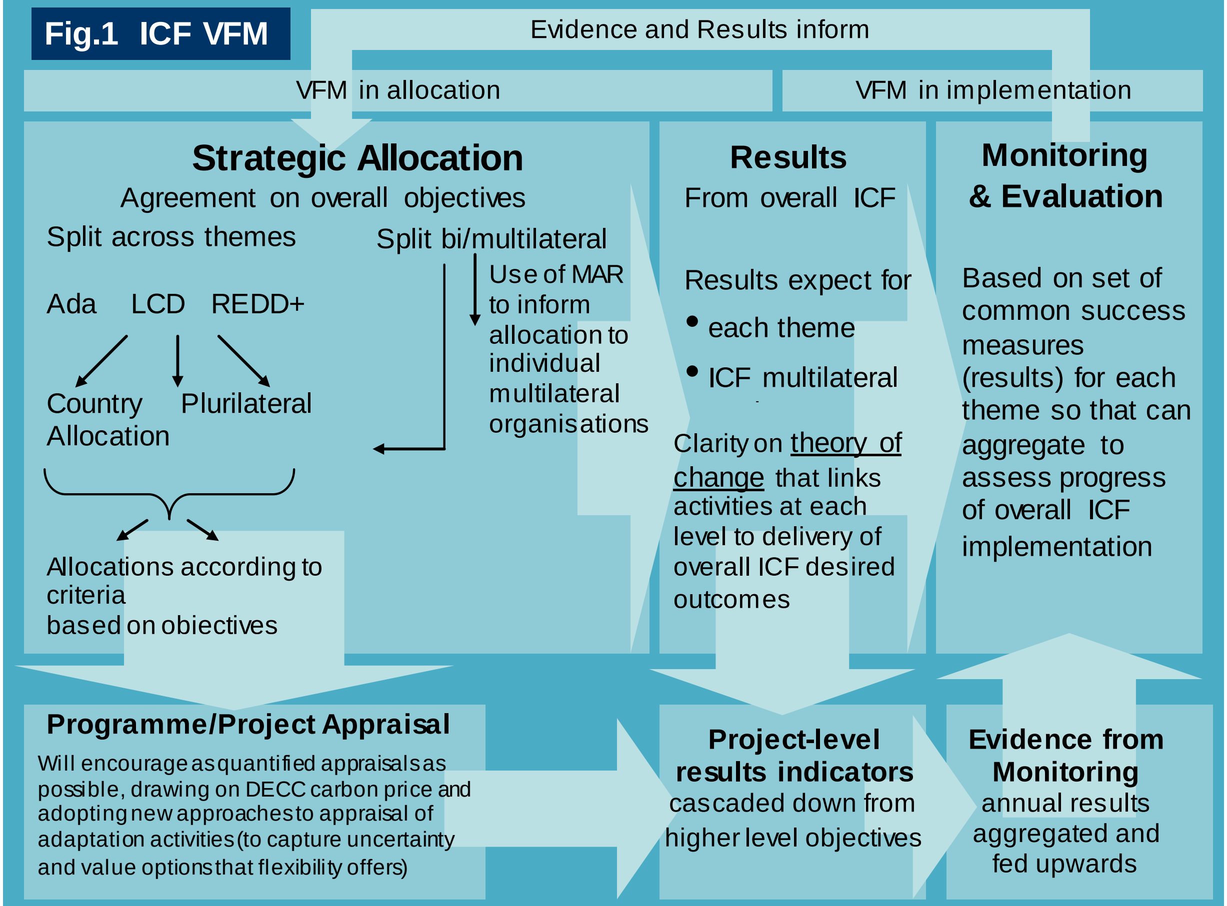
The International Climate Fund (ICF) uses VFM considerations at a strategic level in relation to the allocation of resources and at a project level to improve design and maximise outcomes. This is set out below.

- At a *strategic* level, VFM may be used to support allocation approaches. For example, VFM may inform the balance between capacity building and project investment, or the allocation of resources between countries or sectors on the basis of vulnerability. VFM may be viewed from an operational angle, such as the potential speed of disbursement, absorption capacity of different beneficiaries and delivery channels, and scaling up/leverage potential;

- At an *implementation* level, VFM can drive effective project design through the promotion of **low- and no-regret measures**, the identification of co-benefits (mitigation or poverty reduction), and innovation potential. Results frameworks are used to provide a common set of indicators that can be aggregated.

The promotion of no- and low-regret measures can be considered a supporting factor to ensure effectiveness both at the project and ICF level.

ICF VFM



No- and low-regrets approaches are promoted in ICF guidance as a way of ensuring a fair balance between across competing development priorities. Several no-regret options are identified in the ICF Implementation Plan[2].

- Continued investment in knowledge and climate data – both globally and at country level;
- Integrating adaptation into national plans and budgets to strengthen climate monitoring;
- Strengthening global, regional and national disaster risk reduction strategies';
- Improved watershed management;
- Supporting sustainable agriculture approaches and improved pasture management.

[2] International Climate Fund (ICF) Implementation Plan 2011/12 – 2014/15 Technical Paper

No/Low Regret Options and Early VfM Adaptation

The application of low- and no-regret options within the iterative framework (as set out in the previous chapter) provides a general framework for identifying early adaptation. This was shown in Figure 3 – with the areas shaded in green early priorities. These included:

1. Low and no-regret options (including capacity building) which address the existing adaptation deficit;
2. Low-regret options which build early resilience at low cost, or enhance resilience/flexibility, within near-term policy/infrastructure with a long life-time (as this will be exposed to climate change in the future);
3. Low-regret options that start to prepare for long-term future change today, e.g. as part of iterative plans.

There are therefore a set of early adaptation options that match these intervention areas, and are therefore likely to deliver value-for-money.

However, in identifying these early priorities, there are a number of important considerations.

- The three types of early interventions (in the list above) are very different in nature. They will involve different types of options (technical versus non-technical) which lead to different types of benefits. These differences need to be considered in their appraisal.
- There are issues of the transferability of options, i.e. some 'low-regret' options are highly beneficial in one context but may not be in another, i.e. it depends.
- There are important linkages over time, i.e. to ensure short-term options (1) do not increase vulnerability in the long-term.
- There are often barriers to the implementation of promising options – indeed this is why they have not been implemented already - and these need to be overcome to ensure successful implementation: this often requires complementary portfolios of options, e.g. technical options and institutional strengthening.

More details of promising early adaptation and how to address the issues above are addressed through a typology for early VfM adaptation.

A Typology for Iterative Management and Early VfM Adaptation

To implement the iterative framework/low-regret adaptation concept – and to select and prioritise early adaptation - it is useful to have a more systematic approach for categorising early VfM adaptation.

To do this, the study has built an extended typology (a **classification of types of early VfM adaptation**). This is shown in the Figure below. This provides a way to structure the identification of promising options, in line with the iterative framework and identify <u>interventions which are likely to have good value-for-money</u>.

The typology identifies a set of no and low-regret options (early VfM options) across the three areas of the iterative framework. These are presented in the figure. It is stressed that these activities are complementary and not a linear sequence, though there is a general time dimension from top to bottom.

Note that each of these interventions addresses different elements (applicability) and has different characteristics, also shown in the figure[3]. They also have different information needs, e.g. those towards the top will require information on current variability while those towards the bottom information on uncertainty.

Figure 4 Types of Promising Early VfM Adaptation

EARLY VFM ADAPTATION	Type of early adaptation	Description	Information needs	Examples
1. Low/no regret options to address deficit	a) Good development	Options that are beneficial to do now. Often no-regret, but really just core development.	Baseline development status	Rural roads. Pest management. Access to finance.
	b) Addressing current climate vulnerability	Options that reduce current climate risks, and build resilience (climate relevant development).	Current vulnerability & hazard data	Soil and water conservation. Disaster risk reduction.
	c) Capacity Building	Supporting actions to deliver enabling environment for adaptation.	Baseline and institutional information	Improved climate services (forecasts) Awareness raising. Institutional strengthening.
2. Risk screening, resilience & mainstreaming	a) Low cost, robust and flexible options	Risk screening and mainstreaming climate into plans or investment for future resilience	Future climate risks and uncertainty	Low-cost over-design Upgradeable infrastructure Flexible design
	b) Capacity and information	Information to reduce risks. Capacity building and research to build information and evidence	Baseline information and uncertainty	Risk mapping Siting/land-use plans to avoid future risks. Research and pilots
3. Addressing future climate challenges	a) Iterative adaptation pathways	New interventions for new challenges – information and early action for future decisions	Future climate Thresholds and uncertainty	Iterative plans, with research and monitoring programmes
	b) Trans-formative change	Structural, systemic or societal change recognising limits of adaptation	Societal futures, thresholds, uncertainty	Structural economic change. Population relocation.

[3] This set of options are similar to the prioritises for investment in adaptation set out in the DFID topic guide on uncertainty, but with greater differentiation.

The types of interventions also vary in nature with the type of action.

For those options that address the current adaptation deficit (1), a differentiation is made between options that have a strong overlap with current development (*good development*), which may be more appropriate for implementation through existing country programmes, and options that directly address climate variability (*addressing climate variability*). Both these will be associated with concrete actions (e.g. technical implementation, major investment, scale-up and roll out of promising options, etc.).

Alongside this, there is also a separate category of *capacity building*, reflecting the need for non-technical options to help deliver adaptation. Importantly many of these are qualitative in nature, and have different characteristics to more outcome based options. However, they provide the enabling environment to deliver other options and are thus critical for implementation success.

For those options that focus on mainstreaming and resilience (2), a differentiation is made between resilience building (building resilience into infrastructure or development) using *low-cost options, robustness and flexibility* versus using *information and capacity*. The former is primarily associated with looking to make current investments more resilient, while also noting the trade-off between early action (and costs) and longer-term benefits (hence not all early resilience offers value-for-money). The latter is focused around building and using information to reduce future exposure or impacts, e.g. with risk mapping and screening.

Finally, for those options that address the future climate challenges (3), a differentiation is made between the *iterative adaptation pathways*, which build adaptation responses with learning, and *transformative adaptation*, which involves major structural or societal changes.

It is stressed that while 'good development' options (at the top) are not really adaptation, they are included as these are often listed in National Adaptation Plans. Similarly, while transformative/transformational adaptation (at the bottom) is not associated with early low-regret actions, there will be a need to start developing the transformative vision for societies/economies early-on, when there are potential limits to adaptation in the long-term, and also identifying potential incremental steps towards this.

The Benefits of Different Interventions

Following from the different characteristics and applications, the different types of early VfM options have different types of benefits. These are mapped out in the figure below.

The second column (the type of benefits) highlights the nature of the benefits of each option. This provides the **justification for its inclusion as an early VfM intervention**.

Those at the top tend to have more outcome-based outputs, which are more quantitative in nature. These can deliver immediate economic benefits (today) as well as building resilience for the future. In contrast, capacity building and information provide non-technical benefits, which are often qualitative in nature, and are thus more process based. However, these still deliver benefits (in economic terms) through the value of information.

The final column highlights that the timing of the benefits also varies. Those at the top lead to more immediate benefits and outcomes. Those at the bottom are more focused on the future, necessitating consideration of discounted benefits and uncertainty.

These differences are important when considering how to assess the options in subsequent appraisal, e.g. in the expected results and for subsequent monitoring and evaluation frameworks. The final column provides a summary of how benefits can be assessed and the potential tools involved. As an example, those options addressing existing climate variability will focus more on the current vulnerability and risk assessment. In contrast, the development of longer-term responses will consider future climate change and uncertainty, and aspects such as robustness or flexibility which require additional attributes to a conventional CBA. The Tookit provides more detailed information on each of these options and how to assess them.

Figure 5 Benefits of promising early (VfM) Adaptation

EARLY VFM ADAPTATION	Type of early adaptation	Type of Benefits	Timing of benefits	Analysis of benefits
1. Low/no regret options to address deficit	a) Good development	Productivity Efficiency Outcome-based	Now	Classic benefit to cost ratio
	b) Addressing current climate vulnerability	Reducing current climate impacts of variability	Now + potential for future resilience to CC	Benefit to cost ratio but requires climate information
	c) Capacity Building	Value of information Enabling environment Process-based	Some benefits now + better adaptation in future	Less outcome based often qualitative Value of information
2. Risk screening, resilience & mainstreaming	a) Low cost, robust and flexible options	Protect investment Reduced risk Robustness/flexibility	Some now, but mostly future Resilience	Requires future climate information (envelope/range)
	b) Capacity and information	Value of information Enabling environment Process-based	Some now, but mostly future Resilience	Less outcome based often qualitative Value of information
3. Addressing future climate challenges	a) Iterative adaptation pathways	Learning, value of information, option value, avoided lock-in	Future. Action to improve future decisions	Qualitative narratives or more complex iterative appraisal
	b) Trans-formative change	Avoiding major irreversibility, major lock-in, option values	Future. Action now to avoid/adjust to major changes	Futures analysis

Overview of Option Types

A brief description of the options is outlined below. For each of these, the Report sets out:

- A description of the option and characteristics, with some examples;
- Why the option represents value for money;

1) Addressing current climate variability and building resilience

1a) Good development

The first area is primarily focused around no-regret options that can be considered 'good development'. These are options that have positive social net present values, i.e. they are good to do anyway. However, these options may not have been implemented already due to various barriers (e.g. access to finance, awareness) or the fact they have non-market benefits, etc.

These options do not have an explicit climate focus, but provide general resilience by improving baseline efficiency or productivity: the logic being that if efficiency levels are higher, then the farmer/community/system will be more resilient to current variability and shocks, as well as future climate change.

As an example, building rural roads will have major benefits to rural communities, which will include greater resilience against current climate variability and extremes (e.g. by providing access to markets, enabling access in the event of disasters, etc.). However, these are not specific interventions that target climate variability or future climate change, and thus there are important issues of whether they are adaptation (i.e. additionality). As a consequence, many commentators do not consider they should be labelled as adaptation, i.e. they are development options, and should really be funded under baseline ODA, rather than earmarked adaptation finance. However, most LDC national climate change strategies include some of these types of interventions, so they are included here for completeness.

This category is extremely broad in nature. Typical examples that are frequently cited in the context of adaptation are:

- Farm-level management, e.g. enhanced management, inputs, technology, access to finance, etc.
- Rural roads (noting that this relates to building new roads: making rural roads more resilient to climate extremes, now and in the future, would fall under in the categories below).

These options are generally focused on concrete actions, e.g. major programme and project implementation. Benefits are associated with current activities and arise immediately.

In many cases, the analysis of options can be undertaken using existing methods (e.g. cost-benefit ratios), noting that in cases where this involves non-market sectors or elements, this is more challenging. However, some studies (e.g. Cartwright et al, 2013) highlight that in the context of adaptation, traditional cost-benefit analysis does not capture inequality and the most vulnerable, as it focuses on more valuable assets and groups. Furthermore, conventional CBA focuses on projects for which costs and benefits are more easily defined, such as infrastructure projects, location-specific actions and the introduction of technologies, rather than the social, ecological and institutional interventions. Berger and Chambwera (2010) also highlight that discounting often works against longer-term more sustainable options.

A key issue is that due to the overlap with current development, in many cases these options will already be in government or development partner support programmes, and thus there are important issues of assessing baseline levels before considering additional adaptation.

Justification for early adaptation (value for money)

Clearly there is an area that delivers value for money through economic efficiency (effectiveness and efficiency), as options that enhance productivity or improve efficiency tend to have high benefit to cost ratios. Furthermore, these benefits are associated with current activities and arise immediately, thus they score well in terms of discounted present values. In many cases these options are already within DFID development portfolios, and BC ratios for these interventions have been previously assessed and compiled, e.g. through the bi-lateral aid review.

1b) Directly Addressing Current Climate Variability (Climate Resilient Good Development)

The next category is the primary area of focus for early no- and low-regrets adaptation action. It is focused on addressing the impacts and economic costs of current climate variability and extreme events, i.e. on reducing the current adaptation deficit. This also involves many existing development options, but the key difference (to 1a above) is that these interventions are explicitly targeted at climate related vulnerability. They can therefore be considered as *climate-resilient good development*.

Targeting these existing climate related impacts provides economic benefits today, and also builds resilience to future climate change. As above, this tends to focus on options that have positive social net present values, i.e. which are good to do anyway, but which for various reasons, are not already in place. Typical examples include:

- Sustainable agricultural management (soil and water conservation). In recent years this has been re-labelled as climate smart agriculture, but includes options that have been advanced for many years, such as soil management (e.g. erosion control), conservation agriculture, agroforestry, rain-water harvesting, etc. These options help address climate variability risks to rain-fed agriculture, e.g. by reducing the effects of soil erosion, or increasing moisture content and thus increasing productivity. These options also have environmental benefits, including reduced greenhouse gas emissions.

- Disaster risk reduction/disaster risk management. There is an obvious overlap between DRM and adaptation, and thus an early focus is preventative action to reduce the impacts of climate-related hazards, i.e. floods, droughts, wind-storms, storm-surge, etc. This includes a focus on DRM options such as early warning systems. However, some of the options that typically fall within DRM may actually be high-regret (e.g. certain types of infrastructure) in the context of a changing climate.

A key difference to the good development options (above) is that options that target climate variability and extreme events are very site and context specific, i.e. they vary with the baseline risks in a country and even local conditions such as local river catchments, highland versus lowland rain-fed agriculture, etc.

As a result, these adaptation options are risk specific, and thus require analysis of baseline risks, and consideration of the transferability of options. Importantly, what might be appropriate (low-regret) in one country or region will not necessarily be appropriate for another.

This links to the information needed to appraise these options, both in relation to current risks and the potential effects of climate change in the future, which can be challenging (see box below). However, there is already existing DFID guidance in many areas, for example the DFID Economists' Guide Chapter on Disaster Risk Reduction or Guidance on Climate Smart Agriculture which provides information on such issues.

Box 5 Issues in assessing climate variability and extremes

For current climate variability, the key issues driving risks include the level of inter-annual variations in rainfall level, the timing of the onset of rains, rainfall during key periods (e.g. crop maturation), the frequency and intensity of heavy precipitation events or dry spell duration, etc. These are typically more difficult to assess, even for current climate variability. They are also much more challenging for future climate change, and it is often difficult to get information on these risks from climate models, and any results that are provided have high uncertainty.

For the analysis of extreme events, e.g. droughts and floods, there are similar challenges. Most current risk assessments build up historic information on extreme events, looking at the probability of events, and building probability loss-damage curves. This requires considerable resources and expertise. In many cases data are not available, thus simplified approaches are needed.

Finally, many of these natural hazards, e.g. major floods or droughts have indirect consequences, and they are thus cross-cutting in nature. This makes the full analysis of risks involved, and for some risks (e.g. droughts), impacts are dependent on complex causal chains that are dictated by meteorology, hydrology, local vulnerability, socio-economic conditions and multiple factors.

In the context of future climate change, it is highlighted that historic climate data (e.g. the historical probability of extreme events) is not a good predictor for the future, because of the influence of climate change on the frequency and intensity of events. This means that the implementation of technical options (e.g. defence infrastructure) using conventional approaches may sometimes lead to mal-adaptation (high cost or capital intensive projects that are targeting existing risks may not be low regret due to future climate change and uncertainty, or at least may be high-regret in some cases).

While the benefits of these options are associated with current activities and arise immediately, many early options will also provide enhanced benefits in the future, under conditions of a changing climate. As highlighted previously, the analysis of these future benefits is more complex, due to uncertainty, and there is a need to make sure that current actions do not increase vulnerability or risk in the future.

Because of this uncertainty, the most promising low-regret options in this category are often focused on non-technical, ecosystem-based, or community-based activities. This uncertainty also means that structural or engineered adaptation, e.g. major flood protection or water storage projects are <u>not</u> considered low-regret, at least in all contexts. For these options, which involve longer time-frames, there is a need consider the effects of future climate change, to consider potential changes and avoid mal-adaptation.

In some cases, it is possible to assess some options using conventional appraisal methods, e.g. cost-benefit analysis. However, in many cases these options involve non-market benefits, e.g. the health benefits of DRM, the ancillary environmental benefits of sustainable agriculture. They may therefore require other techniques, e.g. cost-effectiveness analysis or multi-criteria analysis.

While, this category of options is considered to be one of the main areas of focus for early adaptation, there is often an overlap with current development programmes, e.g. agricultural development or DRR activities. Indeed, in many cases, these options will already be in government or development partner support programmes. An example is highlighted from a recent case study in Ethiopia in the Box.

Box 6 Are promising options already in the baseline?

The Ethiopian Climate Resilient Strategy for Agriculture (see earlier case study) identified the current risks of climate variability and future possible impacts from climate change.
On the basis of this analysis, it short-listed 41 promising adaptation options, through a process of analysis, multi-attribute assessment, expert elicitation and stakeholder consultation.

The study also undertook a policy review, coupled with an investment and financial flow analysis, mapping existing programmatic activities and budgets in the Ministry of Agriculture.
The analysis revealed there was a substantial overlap between activities currently financed under the Federal MoA budget and the 41 promising resilience (adaptation) options identified.

The analysis indicated that over the period 2007-2013, approximately 63% of the MoA budget was planned for resilience-oriented activities, and around 38 of the 41 priority options identified were already included in various plans or programmes (though some gaps were also noted).

This highlights an extremely important point: an adaptation programme that focuses on the existing adaptation deficit needs to undertake detailed baseline analysis, to assess what options are already included, and where additional options or scale-up of existing options is needed.

Justification for early adaptation (value for money)

Again this is an area that delivers value for money through economic efficiency (effectiveness and efficiency), as these options reduce the current impacts and economic costs of climate variability.

As these benefits are associated with current activities and arise immediately, they score well in terms of discounted present values. As an example, a recent review (Mechler 2012) reports that the benefits of investing in DRM outweigh the costs of doing so --- on average, by about four times the cost in terms of avoided and reduced losses (with BCs of 5:1 for floods, 4:1 for windstorms). Similar most reviews of climate smart agriculture report high BCrs. However, in many cases these benefits are dependent on the valuation of health or environmental benefits (non-market sectors), and there can sometimes be important opportunity or transaction costs that need to be factored into the analysis.

1c) Building Capacity

One type of option that is commonly reported as being low-regret and highlighted in nearly all adaptation plans is capacity building.

Capacity building is a broad term (UKCIP, 2008) that involves: gathering and sharing information, i.e. undertaking research, collecting and monitoring data, and raising awareness through education and training initiatives; creating a supportive institutional framework that might involve changing standards, legislation, and best practice guidance, and developing appropriate policies, plans and strategies; and creating supportive social structures, such as changing internal organisational systems, developing personnel, providing the resources to deliver the adaptation actions, and working in partnership. Typical examples include:

- Strengthening of meteorological and climate forecasting/projections.
- Enhanced monitoring (e.g. physical measurements such as hydrological flows, human disease burden, agricultural pests and disease, etc.).
- Vulnerability or risk analysis and mapping.
- Climate information, knowledge and dissemination (including portals) and services.
- Climate research programmes.
- Training.
- Awareness-raising programmes (on risks or adaptation options).
- New (climate) institutional arrangements or institutional strengthening, etc.

Capacity building is an important precursor or complement to successful adaptation, providing the necessary architecture to enable current and future decision making, providing the necessary baseline information to assess current and future benefits, providing critical early actions to allow later options, etc. It is therefore highly relevant as part of a portfolio of measures, providing enhanced information for current (or future) decisions, providing information to raise awareness, strengthening relevant institutions involved in climate change, etc. It therefore has strong overlaps with other areas, either as part of complementary responses (i.e. investing in seasonal forecasting capability to improve early warning systems) or as part of the evidence base for addressing future climate change (see later).

Following from this, the literature reports that interventions to address the adaptation deficit (1a and 1b above) are more effective when implemented in combination with capacity building. As an example, a portfolio of improved seeds, soil and water conservation, better extension services and improved climate information, was found to be most effective in enhancing agricultural production in climate vulnerable areas of Ethiopia (Di Falco and Veronesi 2012). This highlights that successful adaptation will involve a combination of outcome and process based adaptation (technical and socio-institutional interventions).

Justification for early adaptation (value for money)

These capacity building options are generally low cost to implement, although there are sometimes capital costs associated with equipment (e.g. monitoring stations).

They provide high benefits, which can arise immediately, though these are less direct that the categories above. These benefits arise from providing the information base and enabling environment to improve the effectiveness and efficiency (VfM) of adaptation options (as in 1a and 1b). However, these benefits are often qualitative or non-technical in nature, which makes their analysis more challenging, especially for outcome-based indictors (hence the frequent use of process-based indicators).

Nonetheless, it is possible to assess the benefits of these options, and to demonstrate the justification for them, through the value of information that they provide. This is explained in the box below. When these benefits are included, it is clear that capacity building leads to high benefit:cost ratios: as an example, a review of the cost-benefit studies of enhanced climate services (e.g. seasonal forecasts, information for early warning) have been reviewed and found to produce B:C ratios of at least 4:1 (Watkiss and Hunt, 2014) in terms of current benefits.

Box 7 The Value of Information

In economic terms, investment in capacity building can be justified through the value of information, or through the concept of quasi-option value.

Information has a value, as it leads to different actions with learning, and allows higher benefits or lower costs as a result. It is possible to place an economic value on information. To do this, the analysis calculates the value or cost without information, and then compares this to value or cost if learning from this information takes place and action is taken. The difference between these is the economic value of information (VOI) (Teisberg, 2002).

This can be used for assessing the benefits of enhanced information or capacity for decisions or actions today, but it can also be used to improve the decisions for future decisions as well. Indeed, this future concept of VOI has been used in the analysis of alternative climate change mitigation paths, with analysis of the global economic gains from eliminating uncertainty around climate change earlier. In the context of climate change adaptation, better information about future climate change risks is likely to prove beneficial in making decisions on resource allocation for adaptation options. For example, information on changes in temperature and sea-level, or the severity of future droughts, are likely to be important in leveraging resources to manage infrastructure such as sea walls, reservoirs, etc. (Neumann and Price, 2009). This allows more formal economic analysis, as in real options analysis (see later).

While the capacity building benefits in this category are associated with current activities and arise immediately, e.g. from investing in information or capacity today to reduce the adaptation deficit, they also provide benefits for improved future decision on future climate change (see later categories, especially 2b and 3a).

2) Building Resilience to the Future

This set of options seeks to build resilience to future climate change. This set of options relates to activities that enhance resilience in current (or near-term) decision that will be exposed to climate change in the future. This differentiates them from actions focused on the current climate (in 1 above) and for future decisions and future climate (in 3 below). In terms of early value-for-money, this leads to certain types of interventions, rather than resilience building per se. Two particular areas are highlighted.

2a) Low cost options, robustness and flexibility

A common option recommended for early adaptation option is building climate resilience, particularly for near-term decisions that have long life-times, i.e. major development policies, land-use change, infrastructure, urban planning, etc. This is sometimes referred to as 'climate proofing', though this term is <u>not</u> recommended, as it is mis-leading and is unlikely to represent Value for Money (see box).

Box 8 Climate Proofing versus Building/Enhanced Resilience

The term climate-proofing implies actions to protect against all future climate risks, irrespective of costs. This is problematic for two reasons. First, in many cases it is not possible to do this, i.e. to completely climate-proof and there will always be some residual risks. Second, the over-design of infrastructure and programmes to withstand all future risks is an extremely inefficient use of resources, i.e. it will lead to many cases where benefits exceed costs, and climate proofing is not good value for money (i.e. it is more economically efficient to have some level of residual risks). While it is somewhat more complex, the term building resilience is therefore preferable.

The focus is on building resilience against future climate change. While this may sound sensible, the additional marginal costs of building resilience need to be considered against the benefits, especially because.

- The economic lifetime of an investment or policy may be relatively short, at least with respect to the major changes from climate change. A major road resurfacing project may only have a 15 year lifetime, which makes it unnecessary to design it for the climate of 2050.
- Even if a major project or investment is exposed to future climate change, these risks (and thus the benefits of resilience) will occur in the future, and need to be discounted when comparing to the additional costs of investment today. In many cases, even if there are benefits in the future, it may not make economic sense to increase up-front capital investment.
- Due to the uncertainty with future climate change, the benefits of enhanced resilience may only arise under some rather than all futures.

For these reasons, <u>some early resilience building options will represent value-for-money, but many will not</u>.

One potential set of low-regret/value-for-money options are in cases where it is possible to introduce *low cost resilience*, e.g.:

- Introducing higher safety margins in long-lived infrastructure at the design stage or during replacement cycles, in cases where these have zero or low marginal costs, i.e. low-cost overdesign. This might include, for example, designing storm water drainage capacity to cope with higher future water flows than might arise from future climate change.

In general it is more costly to introduce such measures when retrofitting, thus the focus is on new projects or planned replacement cycles, although there can be some exceptions (such as when retrofitting increases efficiency).

This has a strong overlap with the concepts of risk screening and enhanced resilience, i.e. in looking to build resilience in general development programmes and policies (mainstreaming), as well as in the design of specific adaptation options to address future climate change. It also links closely with the information and capacity (2b) outlined below and the use of risk information, e.g. in siting of infrastructure to reduce risks.

There are also a number of other potentially low-regret/value-for-money options which seek to introduce alternative concepts to *address future climate uncertainty*. A number of options are highlighted:

- One option is to introduce <u>flexibility</u> into the design of infrastructure or policies. As an example, this might involve the use of sea defences that can easily be upgraded in the future with rising sea level (e.g. using soft, ecosystem based options, rather than engineered responses). It can also include flexibility for the future at the design stage, allowing measures or policies to be adjusted later to cope with future climate conditions (e.g. building extra headroom in new developments to allow for further modifications in the future).
- Another set of options is to introduce policies/designs that are more reversible, or to reduce life-times (e.g. of infrastructure) so that future replacement cycles can more easily take account of climate change.

- Finally, an alternative approach is to design development strategies or options to perform well (though not necessarily optimally) over a wide range of future climate conditions, often termed robustness.

However, there are usually additional costs in building in flexibility or robustness, and the benefits need to be traded off against the benefits these deliver. For these reasons, rather than as a general approach for use in all policies, programmes and plans, these types of low-regret/value-for-money areas of focus will be on:

- Critical infrastructure (e.g. hospitals, water and sanitation plants) or critical nodes (e.g. bridges in the road network), as the loss of these has high direct and indirect costs, and/or involve high costs to replace/repair.
- Long-lived infrastructure that will be expensive to retrofit later. This will potentially include major projects/capital investments such as water storage projects, port facilities, hydro-electric plants, etc. where future climate change may affect not just the assets but future operational performance.
- Irreversible decisions (e.g. land-use change, urban plans).

Additional information on the concepts of decision making under uncertainty are provided in the DFID Topic Guide on Uncertainty. Some relevant information on robustness and flexibility, and the Topic Guide, is included in the box.

Box 9 Robustness, Flexibility and Adaptation Decision Making under Uncertainty

Robustness. Robust options (in the climate change literature) are those which perform well over a wide range of future climate scenarios, rather than performing optimally for one single or central future[4]. While some robust options will meet the definition of low-regrets, not all robust options are no- or low-regret options, and their main advantage is that they provide a better hedge to take account of future uncertainty.

There are new decision support tools which can help to identify robust options, notably robust decision making, a decision support tool that aims to help take robust or resilient decisions today, despite imperfect and uncertain information about the future. This approach is premised on robustness rather than economic optimality, and in that case a robust option may offer better value-for-money than one that is not.

Flexibility. Flexible options are those that allow more effective responses in the future through their flexible design[5]. These allow options to be amended, upgraded or altered through learning. An example would be for upgradeable dykes or barriers that allow increases in future heights (for example, with the use of sand dunes and natural vegetation) rather than a one-off irreversible engineered response.

Associated with this are the concepts of learning, the value of information (see earlier) and option values. It is possible to assess flexibility, learning and future option value in economic terms through the use of real options analysis. ROA is an economic decision support tool that quantifies the investment risk associated with uncertain future outcomes. The approach can be used to consider the value of flexibility, e.g. over the timing of a capital investment, or to adjust

[4] Note that this notion of climate robustness differs slightly from that used in statistical analysis, where robust statistics are statistics that perform well for data drawn from a wide range of probability distributions. Perhaps the best-known example of this concept is that of the median which is a robust measure of the central tendency, (average), given alternative distributions. This contrasts with the mean that is a poor measure of central tendency, given its susceptibility to influence from e.g. outliers in a distribution.

[5] The definition of flexibility used in the climate literature differs to its usual use in economics where the flexibility of markets – and specifically the ability for prices and quantities to adjust between equilibria – is important.

the investment as it progresses over time with new information (learning). ROA has been cited as a possible decision tool for adaptation, including in UK's HMT supplementary guidance on adaptation, but in practice it is technically complex and resource intensive to apply.

Topic Guide: Adaptation Decision Making under Uncertainty

The purpose of the Topic Guide: Adaptation Decision Making under Uncertainty is to stimulate thinking about how climate change may alter the long-term outcomes of development interventions today and how they can be better designed from the outset to have outcomes that enhance climate resilience and are themselves robust and adaptable to long-term stresses, like climate change.

The topic guide offers an overview of the latest thinking on how to manage the changing and uncertain climate in development decisions today. The key premise is that climate change will affect the long-term outcomes of many development interventions. Indeed, interventions that are beneficial today may prove to be damaging in the long-term if they do not take account of climate change. This gives a strong rationale for ensuring that programmes and projects are robust and adaptable to climate change. Importantly, climate change and its uncertainties should not be an after-thought in development interventions – they must be addressed from the outset of the process and throughout the project cycle.

The specific challenge addressed in this topic guide is that the future climate is deeply uncertain. This is not just a scientific issue – it has real implications for DFID. If uncertainty is not tackled properly from the outset today, there is a significant risk of taking not enough, too much or the wrong types of interventions. This could mean a lower value for money of investments, or in extreme cases, wasted investments or adverse outcomes.

The central message from this topic guide is that accounting for the changing and uncertain climate need not be complicated and should not paralyse action. This topic guide introduces a range of concepts and tools for dealing with the changing and uncertain climate in designing and implementing development interventions – many are suitable for all development professionals, but in the final Chapter, we also include a set of more involved methods for those interested in quantitative options appraisal.

The topic guide begins with a brief introduction to the main issues concerning climate change adaptation and climate-resilient development from a DFID perspective. Section II then introduces climate uncertainty and explains where this is important in development interventions, giving a number of case study examples. Sections III and IV then consider what practical steps development professionals can take to address the changing and uncertain nature of climate in their work. The first part discusses the design and implementation of policies and programmes that are robust to uncertainty. The second part focuses on more technical issues for quantitative options appraisal.

Justification for early adaptation (value for money)

The justification for early adaptation – and value for money – is more complex in relation to future resilience, and involves real trade-offs between the level of action and the benefits that are realised.

Enhanced resilience offers potential benefits through the protection of assets or policies to future change - either in terms of the protection of asset/investment in itself to future damage from climate change - or the performance of the policy or asset over its intended lifetime (and thus the delivery of the stream of anticipated benefits). However, as highlighted in the text above, these future (discounted) benefits need to be considered against the additional costs today. For this reason, the focus of early value-for-money is likely to be in the cases where low-cost (over-) design is possible, or when investing in critical infrastructure or irreversible decisions.

In the context of flexibility, the primary benefits are linked to the value of information (from learning) and the ability to better resolve future uncertainty. In value-for-money terms, the primary focus is likely to be on large, irreversible up-front capital investments, where there is an opportunity cost of waiting (e.g. where there is a large existing adaptation deficit or a loss of revenue from delaying a project or policy).

Finally, for robustness, the primary benefits are through enhanced performance (and the delivery of more certain benefits) in the context of future climate change uncertainty, i.e. the potential to deliver higher present values across a range of futures, rather than an optimal response to one central future. Again, this will have highest application – in VfM terms – for major or irreversible decisions with long-life times.

2b) Information and capacity

A closely related option, though separated because of the nature of the benefits, is around *information and capacity* to build resilience or reduce future risks.

This particularly relates to adaptation options that build information that can be used in near-term decisions to take account of future climate change. Examples include:

- Risk/hazard mapping and the use of this information in siting infrastructure or land-use planning to reduce exposure to the future risks of climate change. This might use information (risk maps) to inform set-back zones in low lying coastal areas at risk of future sea-level rise (climate risk screening).

- It might also include the use of similar information to raise awareness for individuals to change decisions, or to change regulations or standards to reflect future impacts.

Note that this also needs to include the investment in capacity and communication/ dissemination of this information, to ensure it reaches those end-users who can derive benefits from it.

Justification for early adaptation (value for money)

The main benefits of investing in information and capacity to improve near-term decisions to address future climate change are through the value of information (see earlier). As an example, risk mapping has the potential to provide information to reduce future property damage (e.g. from flooding associated with climate change). It also helps people to make decisions on where to live and what prevention measures to take (World Bank, 2010).

Investing in information and supporting capacity has potentially high benefit:cost ratios, and as it generally involves low costs, it is a low-regret option.

However, while the generation of information (e.g. risk maps) are low cost, the implementation of these in decisions such as land-use policy has a more complex balance of costs and benefits.

For example, the use of this information in land-use planning produces benefits of considerable value, but the cost of producing these benefits is high also. As an example, set-back zones or land-use constraints are likely to lead to high opportunity costs, e.g. from the foregone opportunity of the use of the land. This may be a particular issue if large areas are included or high protection levels are put in place (against risks that may or may not occur). Similarly, options that seek to increase standards (e.g. building codes) will involve increase costs (generally speaking) and there is therefore the issue of discounted and uncertain future benefits, and the level of protection (or over-protection) included. For this reason, while producing this information is a value-for-money option, the subsequent use of it will require a much more considered analysis.

3) Early Action for Addressing Future Challenges

This final category of adaptation sits within the final part of the iterative framework, in relation to the long-term risks of climate change. These have to address the high uncertainty involved.

3a) Iterative Adaptation Pathways

This category of action focuses on longer-term challenges, i.e. on future decisions to address future climate change. While these major events happen in the future, postponing adaptation may not be sensible if future impacts are potentially large or even catastrophic, irreversible, or if adaptation responses have a long lead-time.

The value-for-money focus is not on identifying large-scale interventions today, but instead on early low-regret / value-for-money options that are a priority for early adaptation, i.e. to start preparing for these future challenges. These involve iterative plans to take account of uncertainty, with early monitoring and pilots, to ensure future options are kept open and lock-in is avoided.

These approaches are often known as adaptive management**,** though the term adaptation pathways is also becoming widely used (Downing, 2012). The approach was recently recommended in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) (IPCC, 2012) and the IPCC 5th Assessment Report, which used the term iterative climate risk management.

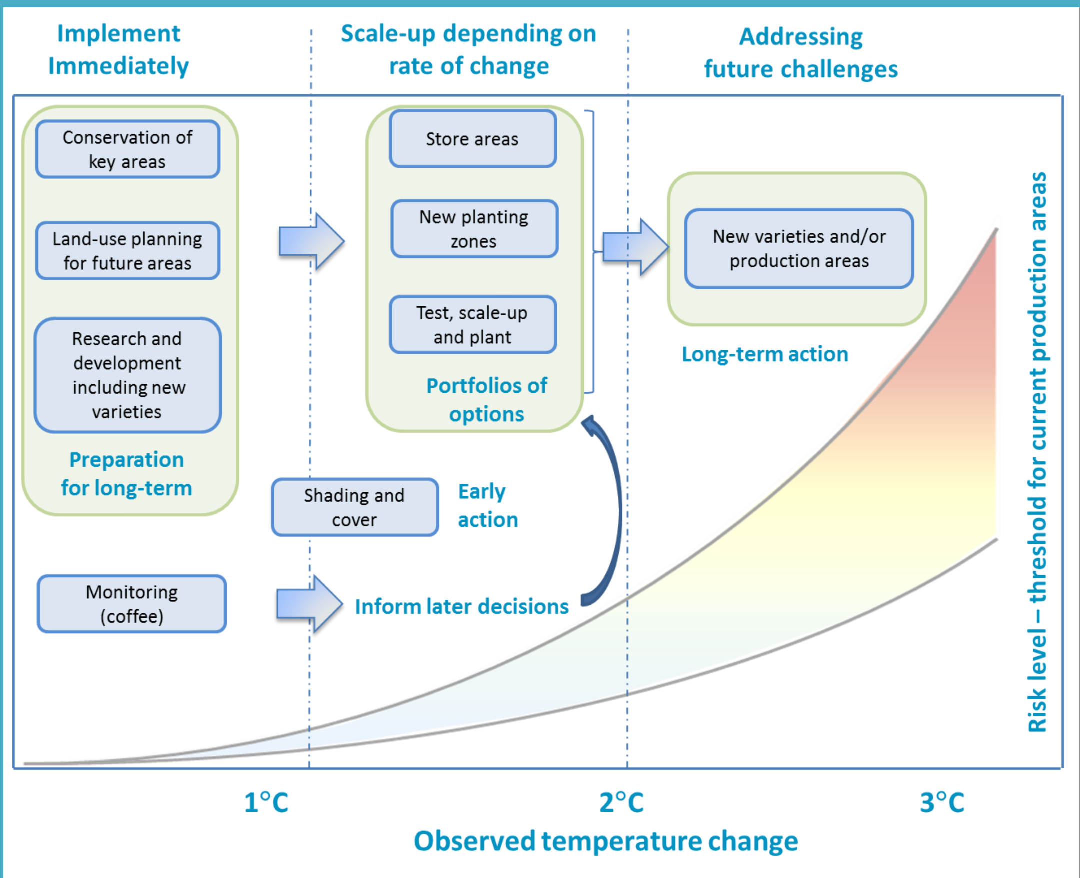
Adaptive management is an established approach that uses a monitoring, research, evaluation and learning process to improve future (management) strategies. In the adaptation context, the approach identifies possible future risk or impact thresholds associated with major future climate change. It then assesses options (or portfolios of options) that can respond. This may start with early measures (e.g. to address current climate variability) and then progress to more major (and expensive) interventions. Importantly indicators are identified to allow the monitoring of risks over time, and provide the cycle of evaluation and learning to update plans in the future. The focus is on the management of uncertainty over time, allowing adaptation to develop within a process of learning and iteration. The results of these iterative assessments are often presented as pathways or route maps. While most applications have been at the project level, notably for sea level rise (e.g. Thames Estuary 2100 project, EA, 2009), there are now examples emerging of more strategic or even national level plans (see the box below for an example from Ethiopia).

The advantage of this approach is that rather than taking an irreversible decision now about the ‘best’ adaptation option – and investing in an option which may or may not be needed depending on the level of climate change that arises - it encourages decision makers to adjust plans over time as the evidence emerges (Reeder and Ranger, 2011), such that that options can be brought forward– or delayed to a later time period – depending on how climate change actually evolves.

Box 10 An iterative example: Future Climate Risks to Ethiopian Coffee Production

An example is taken from the Ethiopia Climate Resilience Strategy, with a work-stream on coffee. Coffee dominates Ethiopian exports and future sector development is a major part of the country growth plans. However, research shows the current variety of export coffee (Arabica) could be affected if temperatures increase significantly from today, shifting many current coffee production areas out of their optimal range, and reducing quality and yield, potentially dramatically. The problem is that it is not clear if or when this might happen, and major impacts could start to in the next few decades or in the longer-term i.e. after 2060, according to whether temperature increases are at the higher or lower range of the model projections.

The iterative approach recognizes this could be a major challenge, but also that there is high uncertainty. In response, it planned a number of short- and long-term responses, which are inter-linked. There is an immediate need to develop a monitoring, awareness and capacity building programme, which is currently missing, and will provide the evidence and early signs of changes in yield and quality. A second set of early responses is to investigate and promote early adaptation options, which can help current plantations, such as the use of shade trees. Finally, a third set of actions is needed to start planning for major future temperature rises, which includes a number of options, (i) to develop an R&D program to develop or adopt new strains of Arabica that are resilient to the potential increase in temperatures – noting this would take up to 25 years (i.e. there is not time to wait for climate change to occur before starting this strategy) (ii) to identify potential new areas for production under future climate envelopes, and investigate the potential for production shifts. These options can be rolled out more quickly if temperature increases are rapid, or yield quality starts to fall, but if the rise is slower, then lower cost options should be sufficient.



As these iterative adaptation pathways tend to be aligned to specific sectors or risks, there is a large variation in the possible options. However, typical examples of low-regret/early value for money action in these pathways include:

- The development of the iterative risk plans, to identify major risks and develop response plans and early actions.

- Enhanced monitoring, climate information and early research. These are linked to the iterative plans, and are designed to provide information or to pilot promising options. For example, they might be associated with tide gauge or sea surface temperature monitoring, to start tracking coastal changes, or they might be focused on pest and disease surveillance or forest health to look at early signs of a changing climate.

Justification for early adaptation (value for money)

It is highlighted that the early actions in this category are unlikely to be large-scale investment (though these may come later) and low-regret options will be focused on information and some early actions to target the current adaptation deficit. They are therefore low cost.

The benefits of these plans are mostly focused on the future, and they do not generally generate immediate outcome-based benefits. Their main benefit is the value of information produced (see earlier box), noting there are formal economic techniques that can help identify and value this information. These early steps can also be seen from a risk or insurance based perspective.

3b) Transformation

The final category is transformation or transformative adaptation. This term is not well defined in practical terms[6], but relates to long-term major, irreversible or systemic risks (structural/societal/economic), which are beyond the limits of conventional adaptation. These may require major long-term economic or societal transformation (e.g. major population shifts, major livelihood shifts).

Justification for early adaptation (value for money)

It is stressed that transformative adaptation is <u>not</u> an early value-for-money or low-regret priority today. However, there may be an early low-regret option to start developing the <u>transformative vision</u> - and identifying potential incremental steps towards this - when there are possible limits to adaptation in the long-term.

To illustrate, short-term adaptation may sustain current livelihoods or patterns of development in locations that will be unsustainable in the long-term e.g. due to the exceedance of major bio-physical, societal or economic thresholds. In such a case, the early value-for-money option will be to identify these risks, along with a long-term vision of what transformational change might look like. It will also identify any short-term actions that prevent future lock-in, and identify the intermediate (incremental) steps towards the long-term vision, taking account of uncertainty.

[6] The IPCC AR5 defines transformation as *a change in the fundamental attributes of natural and human systems. Transformation could reflect strengthened, altered, or aligned paradigms, goals, or values towards promoting adaptation for sustainable development, including poverty reduction.*

SECTION 4

Evidence of Iterative Frameworks and VFM

Key Messages from this Section

- This section provides evidence of how iterative climate risk frameworks can improve value for money.
- It provides information from a series of case studies.
- These provide examples of the impacts of current climate variability and future climate uncertainty.
- They then move to the practical application of iterative thinking, demonstrating how the previous sections can help to identify and sequence early adaptation and deliver value for money, at the national, sector and project level.

Introduction

A series of country case studies were undertaken to provide input to this Report. These included a combination of desk based and field based studies, focusing on Ethiopia, Tanzania (Zanzibar), Nepal and Rwanda, with additional supplementary country information.

These case studies provide practical information on how iterative frameworks can help deliver value for money, at the national, sectoral and project based level. This chapter summarises the case studies, by examining three key questions:

- What are the Risks of Current Climate Variability?
- What are the Implications of Future Climate Uncertainty?
- How to Apply Iterative Frameworks and VfM Adaptation?

They therefore provide practical examples of the tasks and information needed to work with an iterative framework. They also demonstrate how the application of these frameworks – using the information from previous sections - can help in the identification and prioritisation of early value-for-money adaptation.

What are the Risks of Current Climate Variability?

The case studies highlighted that the current costs of climate variability in developing countries are high. A synthesis of the case study findings is provided below.

Nepal. Nepalese agriculture is predominantly small-scale, and is heavily dependent on natural rainfall. As a result, climate variability has large impacts on crop yields, and there are large annual variations in production. The sector is also affected by climate extremes, notably floods associated with the monsoon, but also periodic droughts.

Current rainfall variability and low season river flows also affect hydro-electricity plants, which dominate generation, and thus lead to rolling blackouts in many months of the year.

These interruptions have a high economic impact, with the value of lost load equivalent to 0.3% of GDP in dry years.

Water-induced disasters associated with the monsoon rains, notably floods, are frequent and lead to loss of life and major damages. The direct impacts of these events are large, estimated at an average economic cost equivalent to 1.5% of GDP/year. In exceptional years, the economic damages cane be much larger, equivalent to 5 % of GDP, and have wide ranging indirect and macro-economic costs.

Source: MoSTE, 2014.

Kenya. Kenya is affected by periodic floods and droughts related to El-Niño Southern Oscillation (ENSO) events. The 1998-2000 drought was estimated to have economic costs of $2.8 billion from the loss of crops and livestock, forest fires, damage to fisheries, reduced hydro-power generation, reduced industrial production and reduced water supply. The 1997/98 floods affected almost 1 million people and were estimated to have total economic costs of $0.8 to $1.2 billion arising from damage to infrastructure, public health effects and loss of crops. The continued annual burden of these events leads to large economic costs (possibly as much as $0.5 billion per year, equivalent to around 2 % of GDP) and reduces long-term growth.

Source: RECC study (SEI, 2009)

Ethiopia. Ethiopia experiences high levels of current vulnerability. Major droughts and floods occur frequently and lead to large impacts, affecting millions of livelihoods. The economic costs of the largest droughts have been estimated at 1 to 4% of GDP. The costs of floods are more localised but have large local costs. In addition to these impacts, soil erosion is an additional hazard of current climate variability, linked strongly to rainfall in the hills and highland, and water induced soil erosion in Ethiopia is estimated to cost 2 -3% of agricultural GDP per year.

Source: Ethiopia (FDRE) Climate Resilience Strategy: Agriculture (Watkiss et al, 2013).

Samao. Samoa is periodically affected by major cyclones, which lead to damage from high wind-speeds and storm surges. These lead to major damage and losses, with the largest loss events estimated at over 30% of GDP, associated with damage to buildings and infrastructure.

Source: World Bank EACC Samoa study (2010).

The case studies provide evidence that there are large economic costs from current climate variability and natural hazards in LDCs today, and thus there is a major adaptation deficit. These existing costs are a priority area for early adaptation, as tackling the deficit provides immediate economic benefits, as well as building resilience to future climate change.

Interestingly, the case studies above reveal much higher economic costs than the recent estimates in the IPCC SREX (2012), which reviewed losses from current natural disasters and reported a value of 0.3% of GDP (on average) for low-income countries.

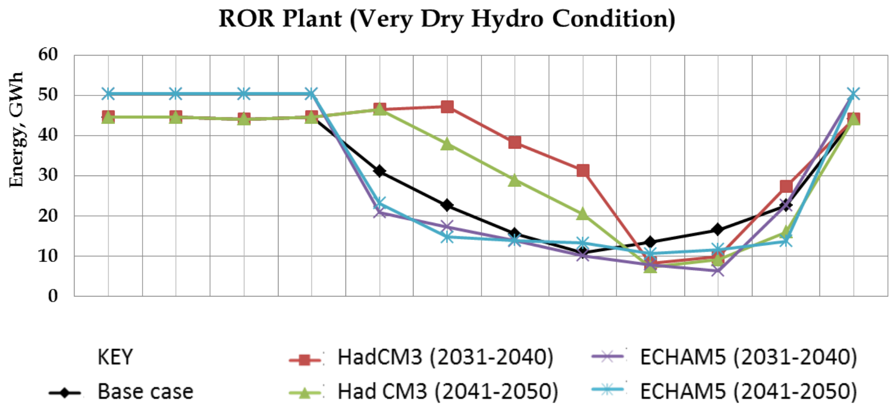
The higher values found in the case studies may be affected by the countries chosen, but is also due to the wider coverage (climate variability as well as natural hazards). As a result, the evidence from the case studies strengthens the case for early low-regret adaptation to address the deficit as a priority area for delivering value for money adaptation.

What are the Implications of Future Climate Uncertainty?

The second area that the case studies explored was in relation to the future risks of climate change. The analysis revealed that the climate is already changing in these countries, and there are potentially high impacts from future climate change, but also high uncertainty. This cautions against the optimisation of adaptation and strengthens the need for iterative frameworks. A synthesis of the case study findings is provided below.

Nepal. Analysis of the future projections of climate change in Nepal show rapid increases in temperature across the country, but the changes in precipitation are more varied, with high spatial and temporal differences. Depending on the future time period and the region of the country, there are even differences in whether increases or decreases in average rainfall will occur. This uncertainty cascades through to the analysis of potential risks, and thus the adaptation responses that are appropriate. As an example, an analysis of the future impacts of climate change on the hydroelectricity sector, using scheduling and power generation investment models, found very different results according to two different climate models (see figure below).

Figure 6 Example of the differences in future generation for different climate futures, showing different climate futures above and below the current base case.



The first model projected a decrease in low river flow during the dry season (as shown by the lines below the black baseline), which increased the capacity required on the system to meet future electricity demand, increasing investment costs (from now to 2050) by an estimated US$2.6 billion present value. This involves a high cost adaptation response.

In contrast, the second climate model run actually projected an increase in low river flow, i.e. a benefit (the lines above the baseline), reducing investment costs, and thus no adaptation response is needed.

This highlights the level of future uncertainty and how this can affect the adaptation response. An optimised response to either of the individual model results would be unlikely to be efficient, because it runs the risk of over- or under-investing in adaptation. Even the use of (probability weighted) expected values would not address this problem, because this would lead to a response that tends towards the centre (i.e. the sum of an increase and a decrease across the two models), also implying minimal response.

What the case study does illustrate is that there are potentially large impacts on the hydro-electricity sector in the future, but these are highly uncertain. An adaptation response that looks to build low-cost resilience, and start planning for major future changes with an iterative response, is therefore likely to deliver value for money.

Source: Based on information in MoSTE, 2014.

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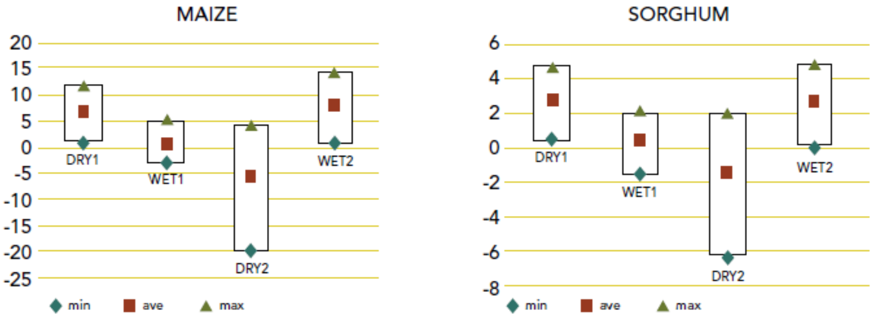
Ethiopia. The modelling of future climate change in Ethiopia is very challenging and any results are characterised by high uncertainty. As highlighted in an earlier section, it is difficult to project future rainfall, and the models show the future annual rainfall could change by +/- 30% over the next 30 – 40 years.

This uncertainty leads to a large range of future impacts, as can be shown with an example in the agriculture sector. As an example, crop modelling assessments have found that the range of future climate projections leads to highly uncertain outcomes for crop yields. This is shown in the Figure below. With climate change, under future dry scenarios, there are large potential reductions towards 2050 (e.g. with up to a 20% reduction in maize), but under wetter scenarios, there are actually increases in in yields projected.

Figure 7 Example of the differences in agricultural production for different climate futures, showing the potential increases or decreases according to different wet or dry projections.



Source: World Bank EACC (2010), Ethiopia (FDRE) Climate Resilience Strategy: Agriculture (Watkiss et al, 2013).

Again, this makes an optimised adaptation response challenging to identify. While agricultural responses tend to have a short time-scale, they do not always involve low-regret actions. For example, a typical response to decreasing yields (or the risk of decreasing yields) would be to increase irrigation and fertiliser use, noting these would have high capital and operational costs, cross-sectoral impacts on water availability for other sectors, and impacts on the environment.

As with the previous example, a focus on low-regret adaptation offers better value for money, e.g. by addressing existing variability problems with the use of climate smart agriculture, by building capacity in the sector, and by starting some early monitoring and research programmes (e.g. to track observed changes, to develop new cultivars or techniques) to allow improved decisions and responses as future risks emerge.

Similar findings were also found in the other case studies, including the uncertainty and adaptation responses to changing rainfall extremes in Rwanda, or the level of sea-level rise on Zanzibar. Further, an important finding was that impact of future climate change on extreme events – which are particularly important in economic costs – are very uncertain.

Together the case studies emphasize that planning long-term responses to central trends, i.e. ignoring uncertainty, is unlikely to deliver good value-for-money, as future benefits may only be realised under some but not all futures. It also demonstrates that it is extremely difficult to design optimal strategies for future climate change, i.e. to maximise the economic efficiency of resilience. This provides strong evidence that the iterative framework proposed – and the focus on mainstreaming and iterative planning for future risks - are important in delivering value for moeny, and should be included as part of an overall portfolio of early adaptation.

How to Apply Iterative Frameworks and VfM Adaptation?

The final case study activities tested the concepts and methods advanced in this report, applying the iterative frameworks and low-regret typology to identify value-for-money adaptation. The case studies included:

- A field based study supporting national adaptation strategy and action plan development in Zanzibar, Tanzania, applying the concepts and methods advanced in this report, as part of technical support to the government. The case study applied the iterative framework and VfM thinking to help identify, sequence and prioritise adaptation. This case study has high relevance for the use of iterative frameworks and early VfM adaptation in National Adaptation Plans (NAPs).
- A desk based study of sectoral adaptation in Ethiopia, reviewing a technical support programme developing the Climate Resilient Strategy for agriculture which applied iterative frameworks for developing sectoral adaptation plans. This provides case study information on the use of these approaches to prioritise adaptation options and investment profiles. This case study has high relevance for the development of sector adaptation and investment plans, which are an area of possible DFID programme or sector budget support.
- A field based study on a national climate fund, the FONERWA fund in Rwanda, and the experience in applying value for money criteria to the appraisal process for project applications. This has high relevance for VfM in project appraisal and support, as well as appraisal criteria and methods.

To complement these case studies, a review was undertaken of an ICF concept note, to understand the information needed to inform the Toolkit.

National Level Planning and Adaptation Plans: Zanzibar

The first field-based case study tested the concepts of iterative frameworks and early VfM adaptation, through the provision of technical support to the *Climate Change Strategy and Action Plan for Zan*zibar, one of the two countries that comprise the United Republic of Tanzania. This provided practical evidence on the application of the concepts in this report to the national level. The case study is summarised below.

Context, Existing Climate Variability and Future Climate Change

Zanzibar's economy, employment and livelihoods are associated with highly climate sensitive activities, notably agriculture, tourism and coastal zone activities. Furthermore, as a small developing island, it is highly vulnerable to sea-level rise, with around 25% of the land and over 45% of the population in the low elevation coastal zone. The islands are already experiencing the impacts of rising water and wave heights, acting with socio-economic change (e.g. mangrove loss), which is leading to increased erosion and large areas of salt-water intrusion. Looking forward, there are potentially large impacts from climate change, from a combination of sea level rise, storm surges and increased wind speeds, as well as sea surface temperature and ocean acidification. These could be very significant given the low-lying nature of the islands. There are also risks to the agricultural sector from changes in future rainfall and temperature, and potential risks to the tourism sector. However, all of these areas are characterised by high uncertainty, e.g. in relation to the level of sea-level projected, or the shifts in the terrestrial climate.

Application of the Iterative Framework and VfM Adaptation

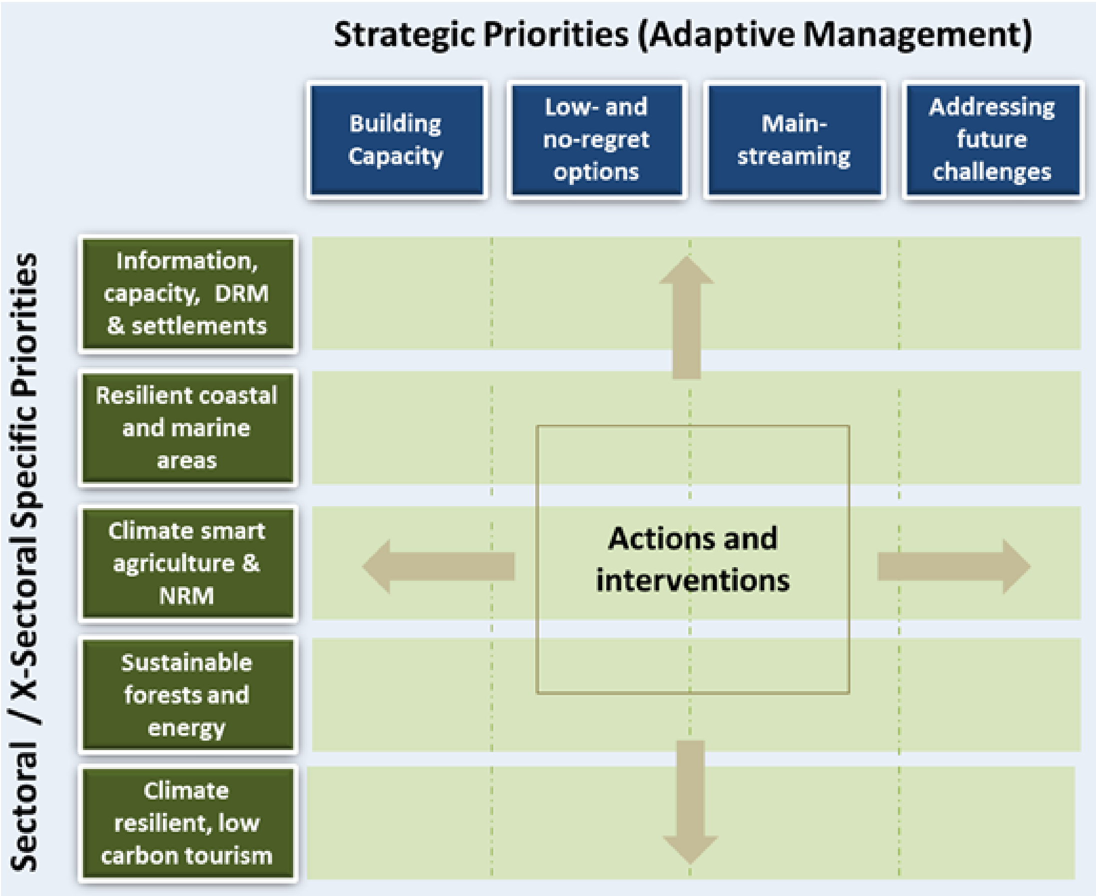
An iterative framework was applied to help develop the framing of the risks in the Strategy, starting with current climate variability and then looking at long-term climate change (including uncertainty).

In turn, this led to the identification of a large number of possible risks and associated adaptation responses. A key lesson from the case study was the need to prioritise this long-list, as the large number of options was a barrier to progressing the strategy and action plan. At the same time, there was a need to align adaptation options within the existing institutional and policy landscape, taking account of existing government programmes and development partner assistance. To address this, the Strategy developed an adaptation action plan that was based on the iterative framework outlined in this report. This included the three complementary areas of adaptation around:

- Addressing the adaptation deficit, though in the action plan, capacity building and low and no-regret options were included as separate interventions;
- Mainstreaming climate change;
- Early actions to address future challenges.

These priority early VfM adaptation areas were mapped against sectoral/cross-sectoral priorities for the islands, shown below.

Figure 8 Matrix used for mapping out early VfM adaptation



This matrix was then used to identify and sequence early adaptation for the prioritised action plan, focusing on those areas likely to deliver greatest value for money. The results – showing the highest priority areas – are shown in the Table below. Following the typology advanced in this report, this includes include a mixture of immediate economic benefits, the value of information, mainstreaming priorities, and early action to start preparing for future major change. Examples include option of enhanced meteorological information and services, improved early warning systems, climate smart agriculture, ecosystem based adaptation, and early research and monitoring.

Figure 9 Strategic Priorities, using the Typology of Early VfM Adaptation

	Building capacity	Low- and no-regret options	Main-Streaming	Addressing future challenges
Climate information, capacity, DRM and Sustainable Settlements	-Enhanced capacity & co-ordination (including community level). -Investment plans, climate finance & M&E. -Awareness raising. -Governance. -Education (+curriculum). -Enhanced met services.	-Enhanced communication. -Enhanced forecasting. -Strengthening of DRM. -Enhanced EWS (including community level).	-Enhanced climate risk screening. -Risk mapping & spatial planning including Zanzibar land-use plan. -Sector mainstreaming.	-Enhanced research with linkages to URT, regional, SIDS and global.
Resilient coastal and marine areas & ecosystem services	-Enhanced coastal and marine monitoring (data, physical, ecosystems). -Capacity and awareness (including community groups, policy makers).	-Salt water intrusion programme. -Mangrove & shoreline restoration (inc COFM) -Enhanced conservation & fishery resource management (inc. community level).	-Enhanced climate risk screening. -Strengthening Integrated coastal zone management / Community ICZ.	-High resolution risk elevation mapping. -Research and pilot studies (e.g. cage-culture, livelihood diversification). -Study on blue carbon.
Climate-smart agriculture and natural resource management	-Information support and awareness raising (e.g. extension service, indigenous knowledge, etc.).	-Good practice (value chain). -SALM (e.g. soil management, agro-forestry, rain-water harvesting).	-Sustainable land use planning. Integrated water management.	-Research and pilots (e.g. new varieties, new practices, future risks such as cloves).
Climate resilient, low carbon tourism	Survey/ assessment/pilots -Awareness raising. -Analysis of sustainability criteria. -Capacity inc. community empowerment.	-Energy and water efficiency programs. -Enhanced awareness and enforcement.	-Investment and development planning controls. -Risk screening.	-Long-term sustainable tourism planning. -Research on tourism development & climate change.

Source: Zanzibar Climate Change Strategy (2014).

The case study provides important evidence that iterative frameworks are practical to implement, and are useful in the early identification, sequencing and prioritisation of adaptation within a real policy setting.

Sectoral Adaptation (Investment) Plans: Ethiopia

The second case study was a detailed desk based review of a sectoral adaptation strategy in Ethiopia, based on the Ethiopian (FDRE) Climate Resilience Strategy for Agriculture (Watkiss et al, 2013). This strategy is interesting because it applies the iterative framework identified in this report to the sectoral level, working towards the development of sector adaptation investment plans, which are a likely priority for development partner support.

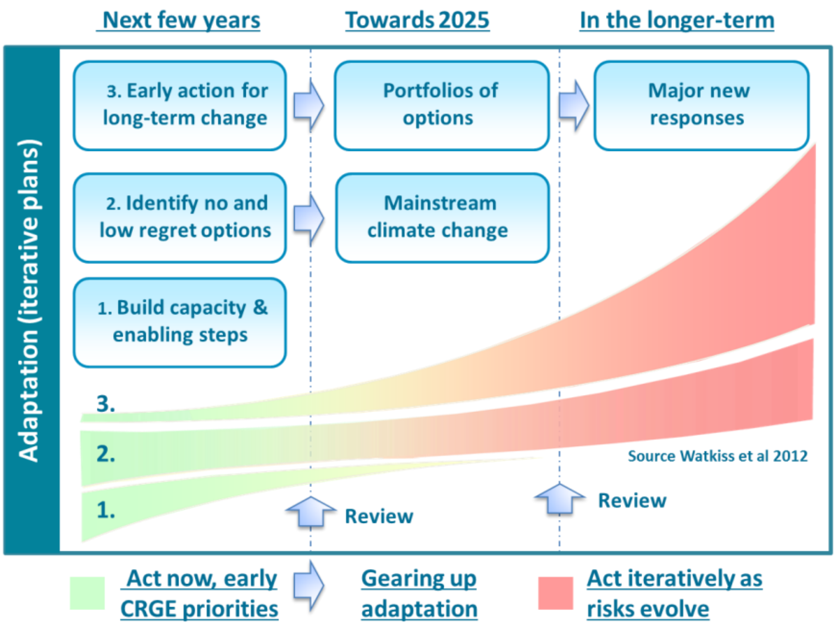
Context, Existing Climate Variability and Future Climate Change

The background context for Ethiopia was presented earlier in this chapter. Ethiopia has a high current adaptation deficit and has the potential to be severely affected by future climate change, but future projections for the country are highly uncertain.

Application of the Iterative Framework and VfM Adaptation

Recognising the high impacts of current climate variability in Ethiopia, and the future uncertainty, the Strategy applied an iterative framework for adaptation. This was very similar to the framework in this Report, and considered the three main areas of early adaptation, as shown below. The iterative framework was aligned to the Ethiopian development and growth planning windows, thus the mainstreaming objective was aligned to the FRDE Growth and Transformation Plan, with the 5 year cycles and the Vision date of 2025.

Figure 10 The Iterative framework used in the CR Strategy



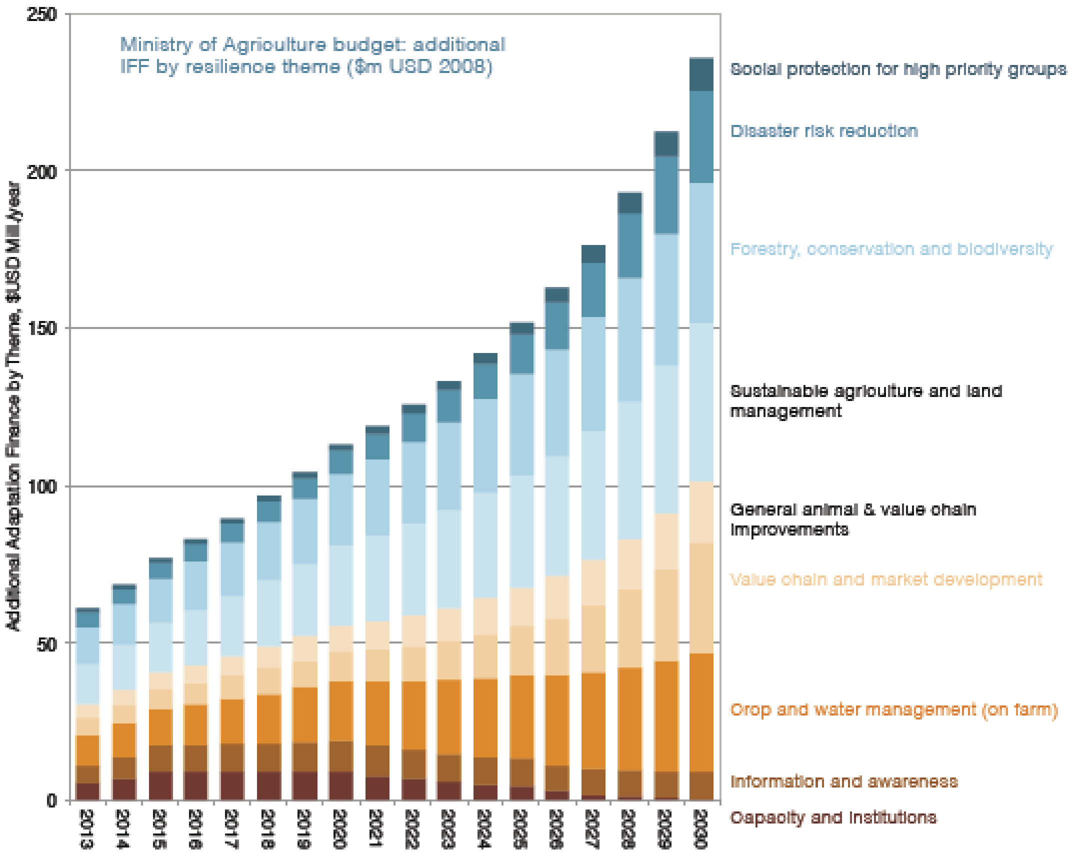
The analysis first used a vulnerability and risk analysis to identify and quantify key current risks of climate variability, notably around floods, droughts, rainfall variability and soil erosion. These were identified as the priority for early capacity and early low-regret (VfM) options, i.e. to deliver value-for-money by addressing the existing adaptation deficit.

For the mainstreaming analysis, a two stage process was used. First the study undertook a climate risk review of existing policies and programmes. This placed the analysis of impacts and adaptation within the institutional structure of Government, and took account of the existing programmes and policies. Second, the study undertook an investment and financial flow analysis (IFF) – a form of Public Financial Management assessment. This provided baseline information on the likely sector development plans and investment levels (on and off budget, public and private) now and through to 2025. The aim was to assess the level of ‘climate readiness’ of the current policy framework and to identify opportunities for mainstreaming, as well as finance gaps to deliver this.

The mainstreaming analysis provided some critical lessons, which help inform the evidence base on the application of iterative frameworks. Again, it found that the iterative approach was useful in building up a prioritised plan for adaptation. However, it also found there was a substantial overlap between existing activities (currently financed under the Federal Ministry of Agriculture (MoA) budget) and the promising early VfM adaptation options identified in the Strategy analysis. The analysis indicated that over the period 2007-2013, approximately 63% of the MoA budget was already undertaking resilience-oriented activities.

Nevertheless, this still meant there were major gaps for adaptation, and the analysis estimated that the investment needed to fill this was around $130 million per year in 2013-14, rising to $240 million per year by 2020 and more than $500m per year by 2030, as shown in the figure below. The size of the gap was estimated up by identifying early VfM adaptation and the phasing of options over time, e.g. with more capacity building and information and awareness in early years, then the subsequent scale- up later on.

Figure 11 Additional investment needs for mainstreaming in Ethiopia (agriculture)

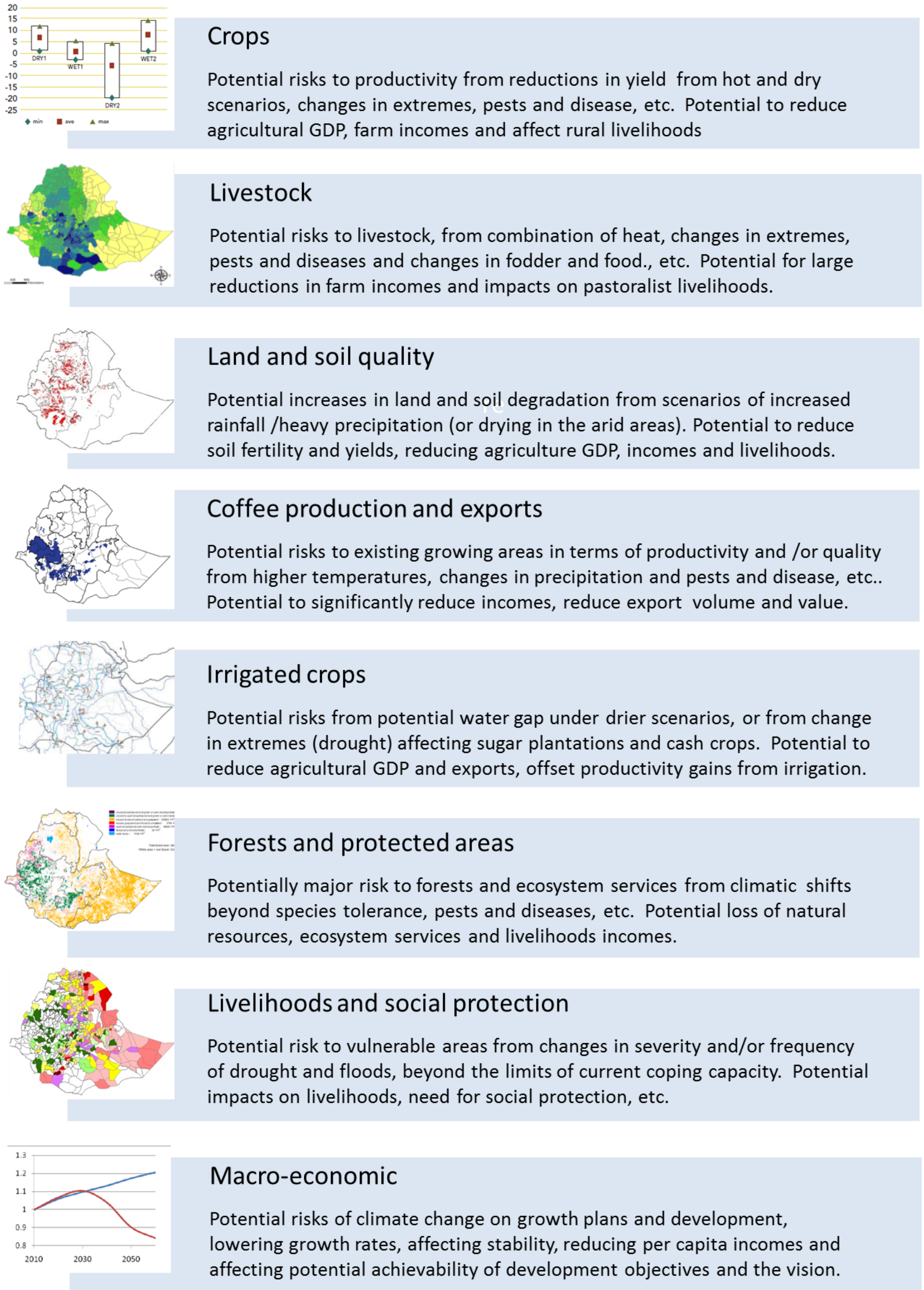


It is stressed that the low value attached to social protection and DRR in the figure is due to the fact these areas are already heavily funded and have climate resilience already factored into future budget profiles.

At the current time, these sector plans are being translated through into detailed programmatic sector plans for adaptation finance.

Finally, for the longer-term challenges, a combination of existing information (climate projections and modelling studies) and qualitative narratives were used, to identify the major future challenges. Seven broad major risks were identified and assessed, all of which could have potentially large impacts on the economy and livelihoods of Ethiopia by 2050.

Figure 12 Key Challenges for Ethiopia from Climate Change



For each of these, an iterative framework was developed; identifying early actions to start preparing for these long-term but uncertain risks. An example for coffee was presented in the previous chapter. Detailed programmes for early action and for adaptation finance are being develop for the most important of these early areas.

Project Level Adaptation and VfM: Rwanda

The final case study was a field based study looking at a national climate fund, the FONERWA fund in Rwanda. This case study was selected because this fund was capitalised by DFID, and at the request of DFID, there is a VfM criteria included in the appraisal criteria for projects applying to the fund. This therefore provides useful direct practical experience of some of the challenges with a VfM metric in the context of adaptation.

Context

Periodic floods and high levels of soil erosion already cause major economic impacts and reduce economic growth in Rwanda. Recognising these threats, and also the high vulnerability of the country to fossil fuel price shocks, Rwanda developed a Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development (RoR, 2011).

Following this, in 2012, the Government established an Environment and Climate Change Fund – FONERWA – a national basket fund through which environment and climate change finance is channelled, programmed, disbursed and monitored. The Fund was organised around four thematic windows:

1. Conservation & sustainable management of natural resources;
2. Renewable energy, R&D and technology transfer and implementation;
3. Environment & climate change mainstreaming;
4. Environmental Impact Assessment (EIA) monitoring & enforcement.

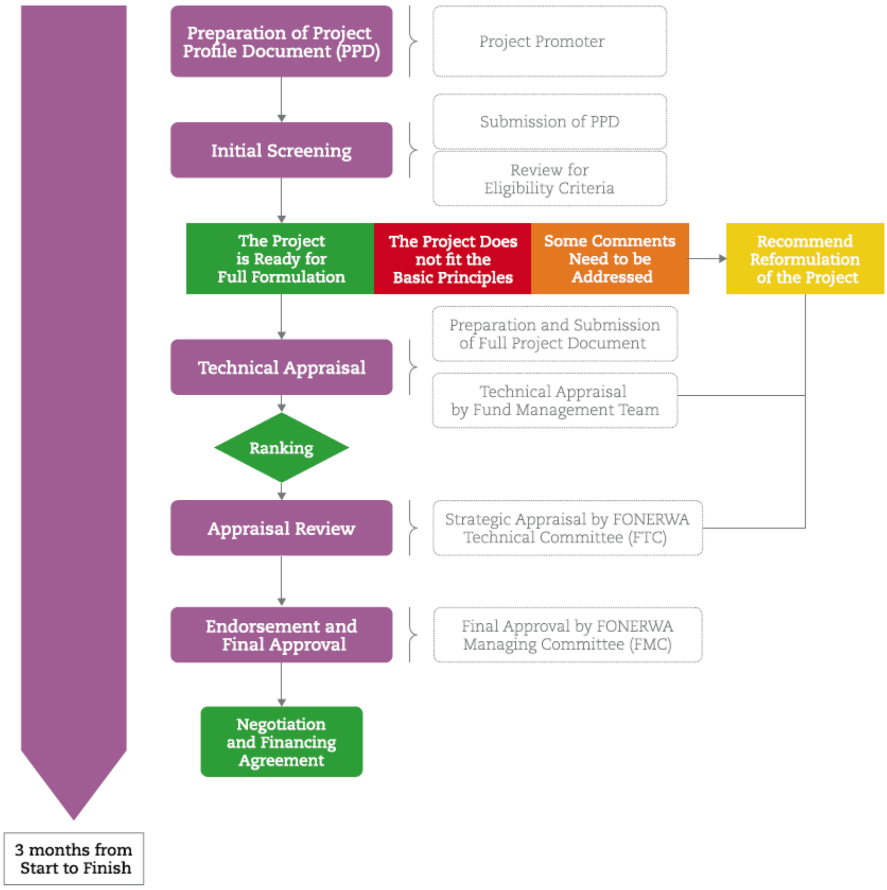
DFID funded a 2-year operational period for the fund (2012-2014), during which time a Fund Management Team, based in Government, established Fund resource facilities and management systems. DFID also provided the initial capitalisation for the Fund.

The FUND is being dispersed (initially) through a project application process. Applications are made by line ministries, Government agencies, Districts, civil society organisations (CSOs) (including academic institutions) and the private sector.

Funding rounds are held and applications progress through a project/ programme proposal screening process (see figure below). The 6 key steps of the proposed screening process include: (1) Submission of a Project Profile Document (PPD),
(2) Review for Eligibility Criteria,
(3) Preparation and Submission of Full Project Document (PD),
(4) Technical Appraisal and Short-listing of PDs,
(5) Appraisal Review and
(6) Decision Making.

Only those projects and programmes that clearly demonstrate a contribution to FONERWA's outputs/outcomes, and are results-based, are supported. One of the key criteria in the screening and appraisal process is value for money and VfM considerations are given high weight (i.e. it is one of the 11 scoring components) as part of the appraisal process.

The first FONERWA round (in 2013) led to a large number of applications (hundreds) but only a small number of these passed the screening process



In terms of the PD Assessment Guidelines (for applications to the Fund, the following VfM aspects are highlighted.

Value for Money (Economy):
-Briefly describe how the required inputs have been identified and how the GoR procurement procedures will be used to ensure they are obtained cost effectively
-Provide identified unit cost measures of selected project outputs? (Please see VfM guidelines on how to determine these.

Value for Money (Efficiency):
-Briefly explain how the provision and operation of project inputs produce the expected outputs
-What is the Net Present Value (NPV) and benefit cost ratio for this project (Please see VfM guidelines on how to determine these measures.

Value for Money (Effectiveness):
How does your project demonstrate effectiveness:
- How will it show the outputs meet the project objectives?
- Which indicators will you measure to demonstrate effectiveness?

Case Study Findings

The case study undertook interviews with the FONERWA management team to gain experience on the operational application of VfM, then followed this up with a questionnaire. This provided valuable lessons on the understanding (and understandability) of the VfM concepts for adaptation, in this case for demand-led and country-aligned projects.

Overall it was found that a large number of the initial project applications were focused on resilience building. However, most of these were focused on addressing current climate variability. Some of the strongest applications included sustainable livelihoods considerations (with lasting income generation potential), which contributed to the overall VFM and desirability through ensuring community interest after the project-funding period. An indicative list of the most popular proposed interventions in applications to date included[7]:

- Riverbank and lakeshore protection/restoration
- Rooftop rainwater harvesting
- Erosion control and prevention (e.g. terracing, bamboo planting)
- Community conservation/capacity building programs for national parks
- Integrated land and water management
- Agroforestry and tree planting (plantation establishment and fruit trees)
- Ecosystem rehabilitation and watershed protection
- Community capacity building and awareness raising activities (targeting women/girls)
- Disaster management and relocation of communities in high-risk zones
- Sustainable alternative livelihoods and non-timber products.
- Radio programs (env./CC)
- Integrated agricultural systems
- Organic fertilizers
- Remote sensing surveys and use of other ICT for env/CC assessment
- Education programs for youth through school programs
- Rehabilitation and protection of dams
- Integrated 'Green Villages' for District demonstration
- Participatory forestry management programs

Most of these align with the early VfM options advanced in this report, and there is a high overlap with the options discussed in the Toolkit.

However, discussion with the management team revealed that VFM and M&E sections of project applications were the weakest portions of most applications. This was attributed to:

1) A poor grasp of basic VFM concepts, despite PPD training sessions on the subject;

2) Varying levels of capacity among applicants (among higher-quality applicants, VFM considerations were presented more comprehensively). Basic VFM considerations at the PPD stage often alluded to economy considerations such as procuring required project inputs 'at the best price', but not providing much detail.

What is needed to improve VfM Analysis?

The case study also asked the management team what additional information would be useful for informing project applications and the analysis of VfM in the future. This provides key information for the design of the Toolkit, i.e. on the type of information that could be useful in other practical project based examples. The management team highlighted two key areas.

Context specific unit costs. The management team reported that a particular challenge for applicants in performing cost-benefit assessments – which make up a significant proportion of PD VFM scores – was the limited access to unit costs (and unit benefits) that were specific to the Rwanda context.

This includes unconventional costs/benefits related to environment and climate interventions in unique or sub-national areas. It was found that international NGOs and advanced private sector actors had a competitive advantage in access to information, due to access to or awareness of relevant international, regional or national research or proxy studies.

[7] Source: FONERWA management team, survey results.

The team thought it would be beneficial to compile a database of relevant unit costs to enable more sophisticated and comprehensive CBAs and other VFM considerations.

Valuation of monetary benefits. Many applications found it challenging to provide monetary values for project elements that were not easily costed (e.g. quantified economic benefits of erosion control or capacity building). Strong VFM submissions had high quality CBAs with comprehensive and referenced benefits and accurate unit costs; solid M&E plans and procurement processes; proven effectiveness of proposed interventions, as well as strong linkages to FONERWA indicators. Amongst high-quality applications, high VFM was often supported by evidence of successful past experience in similar interventions.

Benefits that were not been included due to difficulty monetizing and that would be relevant in early VfM adaptation assessment included:

- Household harmony;
- Increased confidence;
- Reduction in gender inequality;
- Cultural significance and social status with asset ownership or improved wealth;
- Reduction in soil degradation;
- Environmental benefits (reduced pollution);
- Maintained and increased carbon capture in soil;
- Increased resilience to droughts;
- Reduction in loss of life or injury as a result of landslides;
- Improved long term learning ability of children.

Related to this, the management team suggested that identification and dissemination of BC ratios for similar project interventions (or preferably Rwanda-specific ratios) could be useful for building capacity.

ICF Concept Note and Business Case Applications

The final part of the case study analysis drew lessons from the ICF Concept Note process, considering a major adaptation application.

This found that the iterative adaptation concept advanced in this report was useful in framing the concept note proposal, e.g. in highlighting the high current risks of climate variability, and using this as an initial prioritisation step for adaptation, as well as the priorities for mainstreaming adaptation through existing programmes or sector budget support.

It also found that the concepts introduced in the VfM typology were useful in framing adaptation benefits, particularly for non-technical interventions, e.g. such as through the value of information from enhanced meteorological services.

Discussion with the concept team identified particular information needs. These include:

- Information on the market failures that the adaptation intervention addresses;
- Information on BC ratios for possible options, as part of the value for money section.

These have therefore been included in the Toolkit.

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SECTION 5

The Early VFM Adaptation Toolkit

Key Messages from this Section

- The information from the study has been used to build an early VfM Adaptation Toolkit.
- The Toolkit is a word based document, structured around the six steps in the adaptation policy cycle.
- For each step it provides relevant context and support, potentially useful sources of information, case study application and examples.
- It therefore provides potentially useful information for DFID officers in designing adaptation, from concept notes through to business cases.

Introduction

The aim of the early adaptation toolkit is to help DFID advisers to design adaptation projects or portfolios of projects that maximise value for money. The toolkit is a word-based document, structured around the adaptation policy cycle outlined in Section 2. Steps 1 to 5 are aimed at advisers who are developing a Strategic Case. Step 6 is aimed primarily at DFID economists for use during the economic appraisal of programme options.

The steps are summarised below.

Outline of the adaptation policy cycle

The toolkit starts with background information and introduces the adaptation policy cycle (shown earlier in this report in Section 2). It presents a DFID specific version of this policy cycle, aligning to the business case process and outlines how this cycle can be aligned to iterative adaptation frameworks.

Step 1. Identify risk, vulnerability and impacts

This step provides a general introduction to the identification of climate risks (vulnerability, impacts and risks), and then focuses on the information needs for implementing an iterative adaptation framework. It also provides sources of potentially useful information for this step and provides examples of country case study applications.

Step 2. The theory of change (part, 1 without programme scenario)

This step sets out the theory of change for climate change adaptation, highlighting the challenges around adaptation in the context of long-term and uncertain future benefits. It then outlines how an iterative framework and portfolios for adaptation can address these challenges and help maximise value for money. This involves a set of complementary actions (a portfolio) that:

- Tackles the current adaptation deficit,
- Mainstreams climate change into development, and
- Starts preparing for future (and uncertain) long-term challenges.

The rationale for such a framework is outlined, and how it can maximise value-for-money for ‘early’ adaptation, i.e. over the next 5 – 10 years. The step also explains the concepts of early no- and low-regret adaptation, how these fit within the iterative framework and how they provide value-for-money.

Step 3. Identify possible adaptation options & sequence over time

This step provides information to help identify and sequence early VfM adaptation. It outlines the types of interventions that can be included within an iterative framework and why each of these is likely to deliver value-for-money. It then provides a description of these interventions, and outlines their potential benefits.

Step 4. Early prioritisation of options (listing of promising options)

This step provides information to help in prioritising adaptation options for different types of climate risk. It outlines a number of specific options, identifying those which are likely to deliver value-for-money.

Step 5. Theory of change part 2, with programme scenarios

This step sets out the theory of change, for the adaptation programme intervention, including monitoring and evaluation frameworks.

Step 6. Appraisal of adaptation options

This step provides some general guidance on the economic appraisal of adaptation options, and provides information of potential relevance for business cases. This includes information on:

- The rationale for options (in addressing market failures);
- Appraisal and Decision Support / Analysis of Uncertainty;
- Costs and benefits (including existing BC ratios) of promising options;
- Transferability, barriers and additionality;
- The analysis of value for money.

It also includes worked examples and further information sources.

SECTION 6

Conclusions

Key Messages from this Section

- This chapter presents the conclusions and recommendations of the report.
- It sets out the likely development of these approaches and the toolkit for climate finance effectiveness in the future.

Conclusions

This report sets out to address the challenges with the identification, sequencing and early appraisal of adaptation, in the context of delivering value for money. It outlines the benefits of using iterative frameworks (iterative climate risk management) to help in sequencing adaptation activities over time and for identifying early actions that are likely to offer good returns on investment, i.e. that deliver VfM.

These approaches are considered relevant for DFID regional or country adaptation programmes, as well as DFID support to National or Local Adaptation (e.g. financing of National or sector plans). They are also relevant for mainstreaming adaptation into general office programmes or activities.

The Report outlines the latest thinking on how to maximise value for money in adaptation programming using these iterative frameworks. It also provides examples of promising early adaptation interventions and outlines the evidence (justification) for these choices.

Iterative frameworks

The report outlines that there are a set of challenges for adaptation, which start with current climate variability and then move to the major risks of future climate change in the future, with associated uncertainty. In response, it recommends a set of iterative adaptation responses, which involve complementary responses that cover different policy challenges over different time-periods. These are:

- Addressing current risks (the adaptation deficit);
- Mainstreaming climate into development and infrastructure (e.g. to address future exposure);
- Building iterative responses to address future, uncertain long-term risks.

In each area, the types of interventions that are likely to offer value for money are identified, noting that these will vary across the three areas, with a balance of concrete action, non-technical and capacity building, and information for future decisions under uncertainty. Importantly, the report recommends that a good adaptation programme will comprise of a portfolio of interventions that cover all three aspects.

Value for money options

To implement the iterative framework – and to select and prioritise early adaptation – the report presents a more systematic approach for categorising early VfM adaptation. A typology has been developed to provide a way to structure the identification of options, in line with the iterative framework, and allow identification of interventions which are likely to deliver good value-for-money. This shows there is a set of value for money options, which vary in nature. These also have different types of benefits. These include more quantitative outcome-based outputs, which deliver immediate economic benefits (today) as well as building resilience for the future. It also includes capacity building and information which are non-technical and thus more qualitative/process based, noting these still have real economic benefits through the value of information. It also outlines a set of value for money options for dealing with future climate change, either in resilience building or addressing future challenges, but highlights which actions may, and may not, deliver value for money.

Case studies

A series of country case studies have been undertaken to support this report. These provide examples which build the evidence base on VfM. The case study include a combination of desk based and field based studies, focusing on Ethiopia, Tanzania (Zanzibar), Nepal and Rwanda. The cases studies first provide examples of the impacts of current climate variability and future climate uncertainty. They then move to the practical application of iterative thinking, demonstrating how the previous sections can help to identify and sequence early adaptation and deliver value for money, at the national, sector and project level. They also identify some potential areas for the future development of VfM concepts for adaptation.

Early VfM Adaptation Toolkit

The information from the study has been compiled into an Early VfM Adaptation Toolkit. This is a word based document, structured around the six steps in the adaptation policy cycle, i.e.:

- Step 1. Identify risk, vulnerability and impacts;
- Step 2. The theory of change;
- Step 3. Identify possible adaptation options and sequence these over time;
- Step 4. Early prioritisation of options (listing of promising options);
- Step 5. Theory of change part 2, with programme scenarios;
- Step 6. Appraisal of adaptation options.

For each step it provides relevant context and support, potentially useful sources of information, case study application and examples. The final step (6) includes more detailed information on cost-benefit ratios and value for money analysis for a large number of promising early adaptation options, i.e. as potential information for economic appraisal and business cases.

Next Steps

A number of future next steps have been identified. The most important of these is to test further the toolkit with real case studies, working with country offices on proposed adaptation programmes (or support to national government), and to use the lessons from this to further improve and update the information and toolkit.

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