Evidence paper on VFM of investments in climate resilient development

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Executive summary

Over recent years, the strength of the evidence base of Value for Money (VfM) for investment in climate resilient development has been increasing. A significant number of studies have been undertaken at a global, national, sector and project level to quantify the costs and benefits of adaptation. A forthcoming EU-funded study (ECONADAPT 2015) has identified more than 500 relevant sources with cost and benefit data, and a recent OECD publication (OECD 2015) summarises much of the emerging evidence from both developed and developing countries. Further insights continue to be generated by the on-going appraisal, evaluation and ex-post analysis of resilience-oriented climate funds (including by the UK International Climate Fund).

The economic returns associated with climate resilient development are reported in the literature as positive for the overwhelming majority of sources reviewed (i.e. benefit-cost ratios of >1). In most cases, benefits are identified as being significantly in excess of the costs (i.e. BCRs in excess of 3:1 and in some cases as high as 50:1). Projects across all sectors report positive returns, including disaster risk reduction, social protection and livelihoods, investment in resilient infrastructure and public goods (e.g. flood prevention), and climate smart agriculture.

However, many of the earlier studies with higher BCRs used classic impact assessment of technical options and did not take into account uncertainty associated with future climate change. There is some evidence that more recent studies may provide more realistic (although still positive) assessment (OECD 2015). The evidence base is weaker for investments in capacity building, reflecting the upstream enabling nature of such activities. There remain gaps in the evidence base, particularly in relation to developing countries and some sectors not covered in this report (e.g. business services, eco-systems).

The case for structuring and sequencing of adaptation options from a risk management perspective is also emerging as a key driver of VfM in climate resilient development (IPCC 2014, Watkiss et al 2014). These frameworks promote iterative adaptation management, targeting early no and low regret adaptation options whilst addressing the need for longer term risk screening and robust decision making under uncertainty. A focus on low-regrets options will tend to promote measures that are lower cost (e.g. capacity building, information services), with potentially wider development co-benefits (OECD 2015).

Such evidence is useful both in project design and appraisal, and in the sharing of best practice. However, care should be taken with the transferability of evidence between projects. This is due to a number of reasons, such as the highly localised nature of climate change costs and benefits, the wide diversity in the scope and methodologies of the identified studies, the different time periods under assessment and the range of metrics used (OECD 2015).

As a result, while the current evidence base provides a strong overall justification for investment in climate resilient development, it is not sufficient to influence resource allocation decisions between projects or sectors without more detailed economic analysis of the specific opportunities and the local context.

Sector	Reported benefit cost ratios	Strength of CBA Evidence (based on number and quality of studies)
Disaster risk reduction and preparedness		
Enhanced hydrological and meteorological information	2-36	Good
Early Warning Systems	2-5	Moderate
Disaster risk management	4-5	Good
Building codes and set-back zones	>1-6	Moderate
Disaster risk finance instruments	2	Moderate
Livelihoods and social protection	1-13	Good
Capacity building for response/recovery	13-28	Weak
Investment in resilient infrastructure and the built environment	<1	Weak
Public goods (e.g. flood defences)	2-50	Moderate
Climate smart agriculture	<1	Good

Table 1 Summary of evidence base

SECTION 1

Summary of VFM Evidence

1.1 Introduction

This paper provides a brief summary of the evidence on VfM frameworks and returns to investment in climate resilient development, drawing on cost-benefit-analyses, ex-post evaluations and other relevant literature. While there have been a number of global and national level studies seeking to quantify the costs and benefits of adaptation, this review focuses primarily on sector- or project-level assessments that may inform the appraisal of new projects, particularly those where cost-benefit analysis has been undertaken. Such information is potentially relevant for resource allocation decisions and in maximising socio-economic returns from programmes and projects.

There are a significant number of sources identified where information of the costs and/or benefits of adaptation is available. For example, the EU-funded ECONADAPT project (forthcoming) identifies 500 relevant studies, and a recent OECD report summarises much of the existing evidence base (OECD 2015). The sectors covered in the note are as follows:

- Disaster preparedness and risk reduction
- Livelihoods and social protection programmes
- Capacity building for local and national government response/recovery capacity;
- Investments in making infrastructure and the built environment more resilient
- Public goods for resilience, such as flood and sea defences;
- Climate smart agriculture.

As the OECD review concludes, the evidence of the adaptation costs and benefits for these sectors is variable, with some sectors having weaker coverage in the literature (e.g. capacity building, infrastructure). In addition, significant evidence gaps remain in other sectors (e.g. business services, eco-system adaptation (OECD 2015). It should be noted that the nature of VfM analysis is evolving over time, with a shift away from longer term (e.g. post 2050) impact assessment studies (usually at global or sector level), towards shorter-term risk-based assessments, grounded in existing policy frameworks, and incorporating non-technical responses (e.g. capacity building). These assessments may provide a more realistic VfM assessment, as they are more likely to assess the transaction and opportunity costs of early action.

1.2 Sector analysis

This section provides an overview of the literature on the economic returns and VfM considerations for investment in climate resilient development.[1]

1.2.1 Disaster preparedness and risk reduction

- *Enhanced meteorological and hydrological data:* There are a number of studies that assess the value of information and the benefits from improved

[1] A review of the costs and benefits of these studies has been completed, based on an inventory of adaptation studies collated by the EC RTD ECONADAPT project (Watkiss, 2015 forthcoming).

meteorological data, and subsequent use in forecasting, warning, etc. Enhanced meteorological information, forecasting and its use in early warning systems for agriculture, river floods, coastal storms, etc. have been shown to have high benefits (e.g. in the US EASPE, 2002: MMC, 2005; Desbartes, 2012: World Bank, 2011; and for developing countries, World Bank, 2012). There are reviews of the value of information with respect to climate services (Clements, 2013: Watkiss et al, 2014) including in the climate context (Macauley, 2010). Hallegate (2012) reports that investments in enhanced hydrological information has high benefits from the value of information provided and the subsequent improvements in water resource management and reduced water security risks, and that these far outweigh the costs. This is also confirmed by other studies, especially in the context of future climate change risks (Flörke et al, 2011). A review of the literature is provided by Clements (2013) and with updates, a total of 139 studies were identified although with a bias towards OECD countries and agriculture (seasonal forecasts). The studies indicate benefit-cost ratios of between 2 and 36. Ratios vary according to sector, and whether non-market benefits are quantified. Note that benefits vary strongly with the assumptions about use of information and uptake.

- *Early warning systems:* These systems have low costs and high benefits (Hallegate, 2012). The benefits arise from reduced fatalities and injuries (non-market) and reduced damage, thus benefits depend on health valuation. The VfM review (Watkiss et al, 2014) identified 10 studies of flood early warning and 6 studies for coastal wind-storm/storm-surge. Average BCRs were 2:1 to 5:1.

- *Disaster risk management:* A major review of disaster risk management (Mechler, 2012) reports that benefits outweigh the costs on average by 4:1 (in terms of avoided and reduced losses), based on a review of 29 ex ante and ex post studies. This varied on average from 3.9:1 for wind-storms to 5:1 for floods. Cartwright et al. (2013) report high benefit to cost ratios for disaster risk management plans (contingency, awareness) and institutional strengthening (e.g. a cross-sectoral disaster forum) – finding these had amongst the highest BC ratios of all options considered (45:1) in the context of coastal risks in Durban. A number of studies report higher BCRs when capacity building/institutional strengthening are combined with outcome orientated adaptation options, as recommended in the recent DFID supported Zanzibar adaptation plan. Disaster risk management forums/institutional strengthening and awareness raising have also been shown to have high benefits: costs (Hawley et al., 2012).

- *Building codes and set back zones.* For building codes, a number of studies in flood context indicate high BCRs, e.g. 7:1 in Guyana (ECA, 2009); IIASA et al (2009) report flood-proofing brick houses in India and raising houses (by 1 metre) in Jakarta, with BC ratios of 7:1 and 4:1 respectively. Lower BCRs are found in the coastal windstorm context (five studies), with 3 studies finding BCRs <1, and 2 studies finding BCRs >1, thus options can be highly site (and risk) specific, even to individual locations in the same country. For setback zones, in the coastal context (storm-surge), a number of studies report very high BCRs (e.g. ECA, 2009; Cartwright et al, 2013), with highest values amongst all options considered (e.g. Cartwright cites 20:1 to 60:1). However, opportunity costs of land can be an issue.

- *Disaster risk finance instruments:* High benefits are reported (e.g. CCRIF, 2010: Mechler, 2012), though not expressed as benefit to cost ratios, especially in context of risk pooling for low probability, high-consequence events. There are a number of estimates in LDC context, reporting favourable BC ratios, e.g. of 2:1 for drought (index based insurance in India) from the Risk to Resilience Study (2009). There are some issues of the application of these approaches under a changing climate.

1.2.2 Livelihoods and social protection

Investment in livelihood and social protection can be a low regret measure, allowing poor and vulnerable communities (often living in more environmentally exposed or marginal areas) to cope with both gradual climate stresses and extreme events. More targeted programmes can be developed to orientate social protection programmes (e.g. food for work) towards outcomes that result in improved resilience. DFID guidance on measuring and maximising value for money in cash transfer programmes (DFID 2011) provides estimates of VFM including CBA ratios. The study identifies 8 studies (4 ex ante, 4 ex post) (Bangladesh (2 programmes), Colombia, Ethiopia, Ghana, Mexico, OPTs, Uganda), with BCRs that range from 1.0 to 6.2. As examples, the ex post DFID studies had benefits of 1.8—3.7 (Ethiopia, PSNP) and 3.1-6.2 (Bangladesh). World Bank (2011) reviewed costs and benefits of local protection as part of social protection programmes in Ethiopia, using a multi-criteria CBA (Costing Adaptation through Local Institutions (CALI)). Conway and Schipper (2011) also looked at social protection in Ethiopia under a changing climate. The Economics of Early Response and Resilience (DFID, 2013), and lessons from Mozambique, Bangladesh, Niger, Kenya and Ethiopia provides information on interventions in these five countries. Benefit to cost ratios varied between 2.3:1 and 13.2:1, depending on the country. Hunt (2011) reviews CBA studies in relation to improved water and sanitation (water quality and health) reporting on 7 studies. There are a wide range of results depending on option and context (e.g. OECD vs LDC). BCRs are high, with values of 2-3:1 in most studies, but with one study reporting 5 – 12:1 for LDC context. A recent review was also undertaken for DFID in Africa (ODI, 2014), looking at a range of studies, and providing a critique of appraisal methods, but no specific VFM data were provided.

1.2.3 Capacity building for response/recovery and national planning

Capacity building has been broadly recommended as a low-regret option (IPCC 2014). However, the non-technical nature makes it difficult to assess costs and benefits, thus the literature in this area is generally low. Analysis of the benefits for capacity building is challenging due to their qualitative and upstream nature. Cartwright et al (2013) report high BC ratios for disaster risk management plans (contingency, awareness) and institutional strengthening (e.g. a cross-sectoral disaster forum) – and found these had amongst the highest BC ratios of all options considered. A number of studies report higher BCRs when capacity building/institutional strengthening are combined with outcome orientated adaptation options. Wilby and Keenan (2012) review the benefits of capacity building activities, but without economic quantification. Mullen et al. (2015) undertook an impact assessment of capacity building and training in climate sensitive sectors for India and Vietnam, estimating BCRs for technical assistance from 13:1 to 28:1.

1.2.4 Investment in resilient infrastructure and built environment

Many capital investments (particularly those made through IFIs) focus on improving the resilience of infrastructure and the built environment (power, transport, urban planning). Physical infrastructure for protection often has high benefit to cost ratios in OECD countries (i.e. see Mechler et al. (2012: 2014); MMC, 2005: Rojas et al, 2013 for river floods, and

Hinkel et al, 2014; Brown et al, 2009 for coastal floods). The World Bank EACC study (2010) concluded that the benefits of increased flood protection would significantly outweigh the costs (World Bank 2010). The DFID business case for the Urban Climate Change Resilience Programme (UCCRP) looked at returns associated with reduced flood and drought effects on cities. The Business case reported benefit cost ratios of 1.3:1 (DFID 2013) based on avoided costs of future damage. However, in the developing country context, outside areas of major asset values (i.e. cities), the costs are likely to be prohibitive, and these structures have high maintenance costs. The focus may be shifted towards soft or ecosystem-based (green) protection (see following section).

1.2.5 Public goods (e.g. flood and sea defences)

Mangroves (coastal wetlands) provide coastal protection against storms and coastal erosion, by reducing the energy of near-shore waves (a valuable ecosystem service). They also act as natural inter-tidal filters and help prevent saltwater intrusion. Mangroves also provide other services, such as wood, fibre and food (through their role as important breeding grounds for fish and crustaceans). A number of studies have assessed the BCRs of restoration and rehabilitation of mangroves. The cost of restoration are low, and the ecosystem values high, thus giving high BCRs. A number of studies find mangroves offer the highest benefit to cost ratios of all coastal resilience options (ECA (2009) and CCRIF (2010). Watkiss et al (2014) identified 7 studies, and BC ratios from 2:1 to as high as 50:1.

1.2.6 Climate smart agriculture

In the developing country context, there has been significant analysis of climate smart options due to their potential for addressing existing climate variability and the impact of rain-fed agriculture. Studies on climate smart agriculture generally provide high benefit-cost ratios (e.g. Branca 2011, Branca et al. 2012 in Malawi: ECA, 2009 in Mali, Lunduka 2013). This is also reflected in assessments of agricultural development strategies ((Ranger and Garbett-Shiels 2012: Watkiss et al., 2014). These positive ratios derive from agricultural productivity benefits with the potential for additional revenue streams (e.g. agro-forestry). There are also potential mitigation and/or food security benefits. While not usually assessed, it should be noted that under conditions of future climate change, the economic benefits of resilience should increase. It should be noted that benefit-cost ratios are highly site-specific (land use, agro-ecological conditions etc.). They are also dependent on the choice of discount rate due to the longer-term nature of benefits of soil improvement or agro-forestry (McCarthy et al. 2011, Kato et al. 2009, Tenge et al. 2007) and may be less suited to conventional CBA. There may be also be associated opportunity or transaction costs (e.g. foregone crop income) which can act as a barrier to adoption. Economic benefits (e.g. GHG emission reductions) may not accrue to local farmers. As a result, costs are likely to be higher than those cited in the literature, particularly for poorer producers.

1.3 Towards an integrated VFM framework

Value for money in climate resilient development derives not only from the returns of individual project activities or investments, but also from their sequencing and linkages. DFID has produced a framework, report and tool on early Value for Money (VFM) adaptation (Watkiss et al. 2014). This uses an iterative climate risk management approach, as recommended in the recent IPCC 5th Assessment Report (IPCC, 2014). This framework can help in sequencing adaptation activities over time and for identifying early actions that offer good returns on investment. Critically, it does this by considering the phasing and timing of adaptation. The framework identifies three sets of VfM interventions for early adaptation, which are all forms of early low-regret options. These are:

1. Immediate actions that address the current adaptation deficit and also build resilience for the future (IPCC, 2014; Watkiss et al, 2014). This involves early capacity-building and the introduction of low- and no-regret action (technical and non-technical), as these provide immediate economic benefits: such actions are usually grounded in current (development) policy.

2. The integration of adaptation into immediate decisions or activities with long life-times, such as infrastructure or planning (Ranger et al, 2014). This involves different options and approaches to the low-regret actions above, because of future climate change uncertainty. It involves a greater focus on climate risk screening, identification of the risks of lock-in, and for appraisal, a shift away from standard appraisal to methods that consider flexibility or robustness.

3. Early actions (today) to start planning for the future impacts of climate change, taking account of the high uncertainty. This early action may be due to the long life-times of decisions, or the potential magnitude of future risks. Such problems can be addressed using adaptive management, the value of information and future options/ learning (Reeder and Ranger, 2011).

The three categories can be considered together in an integrated adaptation strategy or an adaptation pathway (Downing, 2012).

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