Co Benefits of adaptation, mitigation and development:

ICF background paper prepared for DfID

Introduction

This background paper feeds into the adaptation component for the DfID International Climate Fund (ICF) strategy. It attempts to synthesise the evidence base relating to the co-benefits between adaptation and mitigation, and to those between adaptation and development. It does not focus directly on the co-benefits between mitigation and development, of which there are many. It concludes that the co-benefits of adaptation, whilst useful, should not overly compromise programme design, nor dilute achieving primary objectives.

For a long period, climate change mitigation and adaptation were treated separately in the global climate change negotiations. Often both were discussed in isolation from the broader sustainable development agenda. However, there is increasing recognition of the potential to leverage co-benefits as well as a focus on identifying potential trade-offs (co-costs) between the agendas. This is driven both by a value for money (VfM) agenda, and a desire to see development outcomes optimised.

Current trends in climate policy are therefore taking a more integrated and potentially balanced approach: (i) to control and reduce the atmospheric concentrations of greenhouse gases; (ii) to prepare for and reduce the adverse impacts of climate change; (iii) to address development and equity issues, and (iv.) to mainstream climate considerations into broader economic and development planning. These disparate components are reflected in Article 2 of the UNFCCC.

If properly planned, adaptation measures may result in the net reduction of GHG emissions. Programs focussing upon resilient forestry management and the development of eco-system services might both diversify livelihoods away from high emitting activities such as charcoal production, whilst at the same time sequestering carbon through reforestation activities. On the other hand, many adaptation measures may result in higher emissions. For example, a move towards a more fertiliser- and energy-intensive agricultural sector to address food security concerns may result in higher emissions. Increased use of air-conditioning to combat heat stress or diversification away from large hydro due to changes in precipitation may result in higher power sector emissions. The construction of large scale infrastructure, such as sea walls or flood management systems is generally carbon intensive, and can offset any potential mitigation co-benefits. In general, increased levels of economic activity associated with climate resilience are matched by an increase in energy consumption.

Adaptation measures can also result in enhanced development practice, and indeed there is a natural level of overlap between the adaptation and sustainable development agendas. For example, adaptation activities targeting health impacts of climate (changes in patterns of vector-borne diseases and heat stress) will support development and pro-poor and gender issues. However, if not properly planned, adaptation can result in development disbenefits, such as increased irrigation for agriculture resulting in lower availability of water resources downstream for other river basin users.

The nature and strength of co-benefits differs between sectors. There are certain sectors of adaptation activities that are better pre-disposed to delivering co-benefits than others, and these may be further disaggregated to those more aligned with mitigation outcomes and those more aligned with sustainable development outcomes. In the following section, the co-benefits are set out in more detail.

Mitigation – Development Co-Benefits

Mitigation activities may also have significant development co-benefits, although this is not the primary focus of this paper. Mitigation activities, for example moving to cleaner stoves, have been shown to have potentially large health and economic benefits in terms of reduced indoor air pollution (Cifuentes et al., 2001). However, climate change mitigation policies that raise the cost of electricity or cleaner fuels (e.g. Kerosene) may increase indoor pollution in developing countries. (OECD 2009b). Forest based sequestration may result increased opportunities for forest based tourism and recreation.

There have been a number of attempts to quantify the economic co-benefits between mitigation activities and development, most notably in the health sector. Markandya et al. (2009) model the relative economic co-benefits of decarbonisation of electricity production in Europe, China and India (50% abatement target) on public health due to improvement in air quality. The study finds that economic health benefits can offset costs of greenhouse-gas mitigation, especially in India where pollution is high and costs of mitigation are low. In India, the study finds that there is a net economic benefit of between $-4.1 to $-6.4/tco2e abatement, indicating that effectively mitigation investments recoup their costs from a pure public health perspective. Health benefits offset mitigation costs only marginally in China (10% of costs) and Europe (c. 1% of costs).

The studies reviewed in the Intergovernmental Panel on Climate Change (IPCC 2007) fourth assessment report show that moderate carbon dioxide (CO2) reductions (10—20%) in the next 10—20 years also reduce sulphur oxide emissions by 10—20%, and nitrogen oxide and particulate matter emissions by 5—10%. Dependent on the population exposed in the targeted sectors and its vulnerability, this reduction can lead to a few thousand premature deaths avoided in Europe and North America (and Korea), and to several tens of thousands in Asian and Latin American countries.

The IPCC third assessment report and OECD (2000) studies indicate a large range of health co-benefits, (estimated as between US$0.6 to $145/tCO2. This indicates that these benefits are potentially in the same range as the marginal abatement costs of some technology investments in the power sector. Studies included in the IPCC forth assessment report and elsewhere provide a health benefit equivalent $2-$133/tco2 with values in OECD countries of $2-$38. Developing countries have a higher health benefit estimated at $20-133/tco2 abated. Co-benefits increase over time as CO2 reductions increase. Co-benefits in developing countries are higher than those in developed countries due to higher levels of pollution and the spatial distribution of population and economic activities. One study indicates 70 avoided deaths per million tCO2 reduced. Policies that target sources such as domestic stoves are more effective than centralised power solutions due to the localised health impacts (Markandya et al. 2009).

There are however, potentially co-costs between development and mitigation. This may be through increased use of fossil fuels for development, or increased deforestation as a result of economic

development. For example, UNDP as part of its MDG program has installed hundreds of diesel-run generators, known as multi-functional platforms, in rural areas across Burkina Faso, Mali and Senegal to help ease some of the most time-consuming chores for women, such as fetching water, grinding and milling. The scheme freed up a daily average of two to four hours for women in Burkina Faso and contributed to increasing the owners' annual income by an average of US$55 in 2009, producing net profits of US$248 per unit. It however increased GHG emissions, and exposed vulnerable communities to potential international price shocks.

Adaptation – Sustainable Development Co-Benefits

The IPCC has long recognised the potential co-benefits between climate change adaptation and sustainable development issues. Adaptation to climate change represents an additional development challenge, and there are clear ancillary development benefits that can flow from adaptation activities, such as reducing exposure to natural hazards (flood, drought) addressing socio-economic impacts (food and water security, health impacts) or addressing natural resource and biodiversity threats.

Likewise, pure development activities are also likely to result in reduced levels of climate vulnerability, in particular those aimed at poverty alleviation, improved nutrition, infrastructure, education and health. These links are particularly important where adaptive capacity in developing countries is constrained by a lack of resources, poor institutions and inadequate infrastructure (Smith et al., 2003). More developed societies have lower levels of vulnerability to climate change and investment in development is consistent on the whole with improved coping capacity (OECD 2009a). Indeed, robust levels of development may be a pre-requisite for effective adaptation action. More vulnerable countries may experience less effective adaptation outcomes from a cost efficiency and value for money (VfM) perspective.

There is a body of literature that describes the linkages between adaptation and the MDGs in general terms. Given the breadth of both agendas, the linkages described tend to be fairly generic. The EACC report (World Bank 2010) stresses the co-benefits of economic development for adaption, highlighting diversification away from natural resource dependency, increasing resources available for risk reduction to reduce vulnerability. Progress towards the MDG targets – including reducing poverty, providing general education and health services, improving living conditions in urban settlements, and providing access to financing, markets and technologies – will improve the livelihoods of the most vulnerable people and thus their adaptive capacity.

In practice, adaptation and development methodologies overlap considerably. The World Resource Institute (WRI 2007) sets out a framework for assessing these overlaps, ranging on a continuum from development type activities that reduce vulnerability, to those focused on climate change specific-impacts, which derive from climate trends and data. From this perspective, ODA is sensibly targeted at dealing with climate vulnerability.

While climate change may or may not be a primary driver of poverty and inequality, climate policy is increasingly expected to address these concerns. As a result, adaptation funding is increasingly channelled into shorter term development activities, those which support resilience in the face of climate variability (no regrets options), as well as meeting longer term climate impacts. Smithers

and Smit (1997) have explored the co-benefits of long-term adaptation strategies in dealing with short term climate variability and its associated development impacts. Maximising these co-benefits is clearly desirable, so long as policy focus is not distorted too far towards the short or long term.

Adaptation policy may support climate risk proofing of infrastructure (transport, energy) to ensure that development benefits are not degraded over the expected lifetime of the investment. There are potential co-costs of poorly designed development or adaptation strategies. Mal-adaptation may result where development is undertaken without consideration to its effects on climate vulnerability. For example, power and water infrastructure may not be designed to withstand extreme events or changes in heat and water availability.

Adaptation policy should also ensure that broader development activities incorporate climate risk to ensure that maladaptation does not occur (Klein, 2002; Huq et al., 2003). Agricultural strategies designed without regards to climate policy may not deliver the envisaged results if cropping patterns and growing seasons change. Urban planning on potential flood plains or vulnerable coastal zones may result in widespread damage. Education curricula may be developed without integrating resilience and DRR components. Healthcare systems may be developed against a static climatic baseline, ignoring changes in vector and water borne diseases. Undertaking climate risk management and adaptation capacity building activities with sector planning agencies, utilities, agricultural agencies, coastal management agencies is likely to result in better development policy overall.

Not all adaptation activities will have a development component however. For example, in Nepal, glacial lake outburst floods resulting from glacial melting require specific monitoring and preventative measures beyond poverty reduction and economic development. Likewise, bio-diversity interventions, such as addressing coral bleaching, may require targeted adaptation activities that may not have any direct development benefits. In general, those adaptation measures that are pre-emptive against potential future climate threat in the medium-long term carry an implied future benefit, rather than a current development benefit – i.e. the development benefit is deferred. This is particularly true for the additional costs of climate proofing of large scale infrastructure, such as designing roads for increased rainfall, or upgrading sea defences for long term flooding threat. It is also true for activities relating to DRR and extreme weather events, which are by their nature unpredictable in terms of frequency and intensity. These measures effectively serve to ensure that the adaptation deficit does not increase over time, and that the development baseline is maintained.

Adaptation – Mitigation Co-Benefits

Synergies between adaptation and mitigation policy are found where policies and investments that impact upon GHG emissions also reduce the adverse effects of climate change. Identifying these ancillary benefits can produce win-win scenarios (Kane and Shogren, 2000). There may also be tradeoffs, with adaptation resulting in a net increase in emissions (Cohen et al., 1998). Importantly, adaptation and mitigation differ in a number of ways:

Firstly, the spatial and temporal scales on which they operate are different, with mitigation having global benefits, but adaptation having mostly regional or local benefits. Mitigation benefits are

likely to be realised over a number of decades due to the lag of emissions effects of climatic systems, while adaptation measures may deliver immediate benefits through immediate reduction in vulnerability and increased resilience. The economic benefits of adaptation also increase in proportion to the impacts of climate change, and therefore global mitigation scenarios.

Secondly, mitigation and adaptation benefits and costs cannot be easily compared. The cost-benefit of GHG reductions, expressed in cost per CO_2e avoided can be compared on a global basis between technologies and countries (Moomaw et al., 2001). This is more difficult for adaptation benefits, expressed in terms of avoided monetary impacts, such as avoided loss of life, avoided health impacts, avoided loss of ecosystems etc. These benefits may be valued differently dependent on their socio-economic context, and may flow from either climate variability or longer term climate change. These challenges have been set out by Fankhauser (1998) and Callaway et al. (1998).

Thirdly, mitigation and adaptation policies tend to be managed by different stakeholders. Mitigation is dominated by a relatively small number of sectors, to include energy, transport, and increasingly forestry and agriculture in developing countries. These sectors tend to be strategically managed at a national level and are based around long term infrastructure investments (Klein et al. 2005). Adaptation sectors tend to be broader, including tourism, health, water, coastal zones, biodiversity etc. Actors tend to be more disparate, from individuals to national agencies. There is often a lack of alignment of interests for these organisations to engage, due to the nature of public goods.

Table 1 sets out some of the generic co-benefits and co–costs potentially associated with adaptation activities in relation to mitigation and development.

Table 1. Potential Co-benefits and Co-Costs of various adaptation activities

☺ Co-benefit Identified ☹ Trade off Identified 😐 Lack of overlap for key challenges

Adaptation Category	**Potential Mitigation/Development co-benefits**
Human Health:	*Mitigation:* *Development:* ☺ Adaptation interventions related to changes in patterns of malaria (provision of insecticide treated nets, indoor residual spraying and artemisinin-based anti-malarial combination therapy) and diarrhea (oral rehydration) are likely to result in lower levels of child mortality. Children up to the age of 5 years in developing countries, overwhelmingly bear the disease burden from climate change. 😐 The health adaptation agenda does not however directly engage with the leading causes of maternal mortality in developing regions - hemorrhage and hypertension, which together account for half of all deaths in expectant or new mothers, nor is HIV climate sensitive.
Resilient Agriculture	*Mitigation:* ☺ The use of drought and pest resistant seeds, or implementation of organic farming methods may require lower levels of fertilizer inputs, resulting in higher productivity and lower net emissions per unit output from agriculture

	☹ Increased use of fertilizers to counteract declining yields can lead to higher agricultural emissions. ☹ Increased use of irrigation and water pumping infrastructure can increase energy demand. *Development:* ☺ New climate resilient agricultural models may lead to improved food security and address hunger concerns, although these can be potentially disruptive from a social perspective. Poverty will be reduced through increased productivity of smallholder farmers, improved water retention techniques and diversified production. Agricultural resilience will likely result in the development of rural extension services, shift to added value processing, funding for agricultural research, introduction of more resilient and productive crops, seed distribution, development of sustainable agricultural practices, provision of financing schemes for small holders, establishment of commodity trading and export platforms, market linkages, rural employment programmes. Developed country adaptation practices can lead to more stable and lower food prices that alleviate both poverty and hunger. ☺ Adaptation programs for agriculture often have a high gender component due to the make up of employment in the rural economy. Micro-finance initiatives targeted at resilient farming and animal husbandry that combine training and credit services, primarily accessed by women, or in agricultural initiatives designed for women's groups. ☺ The development of more sustainable agricultural systems is likely to indirectly impact positively in reducing levels of child mortality. While not the only factor, low levels of complementary feeding between 6-24 months and lack of (quality) food for the under fives are significant mortality factors. ☹ Use of increased irrigation upstream to counteract lower precipitation may result lower levels of water availability downstream and affect other river basin users.
Disaster Risk Reduction (DRR)	*Mitigation:* ☺ Efforts may be undertaken to stabilize degraded soils at risk of land slide and erosion through reforestation programs that can sequester carbon *Development:* ☺ Improving planning and response capability ensures that economic and socially contingent damages of climate related events are limited, and poverty and livelihood effects minimised. ☺ Climate DRR programmes focused on education can support both gender and poverty alleviation. Given that women are more vulnerable to the impacts of climate related disasters, adaptation initiatives have the potential to address gender development issues.
Sustainable Forestry and Ecosystem Services:	*Mitigation:* ☺ Improved forest management and protection, and the development of sustainable ecosystem services can result in avoided deforestation or reforestation. ☺ The negative emissions of unsustainable use of wood and charcoal for fuel and cooking can be mitigated through avoided deforestation. ☺ The planting of trees in urban areas can result in carbon sequestration as well as reducing urban heat stress. In this case, adaptation does not have immediate benefits as the trees must grow to produce shade.

	Development: ☺ The development of resilient forestry management models can underpin poverty reduction and improve food availability for marginal rural communities. This is also true of marine eco-system approaches and fisheries. ☺ Forestry and eco-system interventions may result in increased economic opportunities related to tourism. ☺ will reduce the burden on women to provide fuel wood services, and create economic opportunities. ☺ Managed eco-system services can support the protection and promotion of biodiversity. The protection of forests with improved land use and watershed management, biodiversity conservation. For example, the Noel Kempff Mercado Climate Action Project in Bolivia has the triple aim of sequestering CO2, preserving one of the richest and most biologically diverse ecosystems in the world and fostering sustainable development in local communities. The USD 11 million project, which spans over 1.5 million hectares, is a partnership of the Government of Bolivia, the Friends of Nature Foundation, the Nature Conservancy and three energy companies (American Electric Power, Pacifi- Corp and BP Amoco).

Applying co-benefits to programme and policy design

From an adaptation perspective, co-benefit information may be useful for:

- Policy identification: Adaptation options in certain sectors are more likely to be aligned with potential mitigation and/or development outcomes. For example, adaptation activities related to forestry and agriculture will have direct influence upon levels of GHG emissions.
- Policy prioritisation: Co-benefits and co-costs may potentially alter the outcome of a policy appraisal exercise, depending on their weighting against initial objectives. For example, co benefits may be included within multi-criteria analysis.
- Policy justification: Co-benefits of adaptation may provide economic justification when used as part of a cost-benefit analysis for interventions that might not otherwise be considered cost-effective.

From the earlier discussion, it is clear that climate adaptation initiatives should not be implemented without consideration of wider environmental and economic concerns. It is also reasonable that that potential mitigation and development co-benefits be recognised despite their different spatial and temporal scales. There is an intuitive appeal to identifying synergies and carrying out mitigation and adaptation activities simultaneously, while at the same time supporting development, natural resource management, biodiversity conservation and addressing desertification.

However, the decision to include or avoid the use of co-benefits in program design and appraisal raises a number of questions:

1. Can (or should) the mix of adaptation, mitigation and development outcomes be optimised, whether in overall economic terms, from a social acceptance perspective, or equally between objectives?

2. How can boundaries be set so that co-benefits do not supplant the original adaptation objective based on regional need?
3. Do the tools and methods exist to make trade-offs between co-benefits in a robust and transparent manner?
4. Is the use of co-benefits likely to prejudice against interventions where the benefit is purely adaptive (i.e. with no development or mitigation outcome), such as sea defences?
5. Finally, are adaptation programmes pursuing an integrated co-benefit strategy likely to face additional implementation challenges?

Klein et al. 2005 have set out some of the potential issues relating to integrated policy design. Firstly, the integration of mitigation and adaptation policies may complicate the level of institutional complexity due to the often differing sets of stakeholders involved. Secondly, it may be the case that in searching to establish synergies, the priority adaptation (or mitigation) activities may be diluted by valuable, but less important co-benefits. Finally, where overlaps are pursued, it may not be clear whether the investments represent best value, or if more efficient outcomes would have been achieved by splitting the budget and pursuing adaptation/mitigation/development outcomes separately. Too much focus may be placed on integrated programme design, rather than on providing greatest impact and best value.

The evidence indicates that there is unlikely to be an optimal mix of response options. The choice of response will be very region specific, driven by changing costs and benefits, and social preferences (Arrow et al., 1996; To´th et al., 2001).The optimal mix of program design should therefore be based upon local development considerations, rather than ex-ante assumptions about co-benefit maximisation. Indeed, local preferences for program focus may change over time as knowledge of climate impacts develops (Lempert et al., 2000).

The mix of mitigation and adaptation or development benefit outcomes sought is also predicated on the choice of analysis tools and decision framework criteria. A number of frameworks have been set out by To´th et al. (2001). These include cost benefit analysis, cost effectiveness analysis, tolerable windows approach, game theory, and multiple criteria analysis. The choice and structure of the analysis framework will to some extent determine the outcome.

Given the level of uncertainty both about climate effects and the efficacy of responses, robustness in setting out a business case may be considered a better route than optimisation (Lempert and Schlesinger, 2000). This may involve an assessment of what approaches are justified from a social, environmental and economic perspective, and how to include different elements within such a mix. One set of adaptation options may be less cost effective, but more socially or environmentally acceptable.

Conclusions

This paper draws a number of conclusions:

- Given the prevailing uncertainties relating to the pace and extent of climate change, it is sensible to seek out co-benefits between adaptation, and mitigation and/or development. This ensures that any adaptive capacity contributes to reducing global climate change impacts, while building resilience to current climatic variability. There are obvious benefits from being able to deliver win-win options through well designed policy or investment.

- Those sectors that offer the most obvious co-benefits between adaptation and mitigation are forestry and agriculture. The linkages between adaptation and development are much broader, covering most of the sectors reviewed. It should be noted that there are a number of adaptation sectors that provide neither development nor mitigation benefits. These are primarily related to longer term risk mitigation activities related to disaster risk reduction and infrastructure protection. It is important that co-benefits do not prejudice against such interventions.

- There are challenges associated with a focus on co-benefits. Firstly, there is a risk of increased project and institutional complexity in delivering multiple outcomes. Secondly, it may prove more cost effective to pursue mitigation and development objectives separately. Thirdly, the use of co-benefits requires clear definition of criteria for their use as there is danger that a given course of action might be justified on the basis of selective use of costs/benefit data.

- Co-benefits can play a useful role in prioritising adaptation interventions. There are a number of potential methods, for example through inclusion in multi-criteria analysis or cost-benefit analysis. However, donors should not lose sight of the primary intervention objective. Initial selection of priorities should be done on the basis of adaptation outcomes. A secondary exercise may then be used to determine prioritisation of those initial interventions chosen on the basis of mitigation or development co-benefits.

- In conclusion, DfID should avoid creating a culture of economic optimisation or balancing of co-benefits, but rather examine which co-benefits make sense from a local socio-economic perspective. An optimal mix may not be possible due to the fact there are potentially multiple scenarios of climate change, and economic development.

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