ORCHID: Climate Risk Screening in DFID India. Research Report

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Institute of Development Studies

ORCHID Opportunities and Risks from Climate Change and Disasters

ORCHID: Climate Risk Screening in DFID India

Research Report

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Cover image: India. A portrait of Anita Devi, the president of the Musahar Vikas Manch (Musahar Development Forum), standing at a water pump in front of her collapsed house following the 2007 South Asian floods.
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Overview of the Report

This report details a process to screen the DFID India bilateral aid portfolio for climate risks and develop risk reduction and adaptation options to manage risks.

Section 1 outlines the **methodology and approach** to the work. A climate risk management approach is taken, using the ORCHID methodology (Opportunities and Risks for Climate Change and Disasters) for screening and assessment of adaptation options. This used a set of technical inputs on climate variability and change, vulnerability and economic impacts to assess high-risk development programmes in the DFID India portfolio.

In **Section 2**, the results of the **portfolio screening** exercise are presented, including the range of adaptation options suggested to tackle identified risks for selected programmes. Results of an initial multi-criteria analysis are presented by way of suggesting a set of adaptation options most appropriate for integration within programmes.

Section 3 presents an **economic cost-benefit analysis** of two adaptation options to illustrate a method for testing economic feasibility and enhancing the evidence base for adaptation.

Section 4 examines the **strategic implications** of climate change for the DFID India programme from the portfolio screening exercise.

The screening process by researchers and programme staff was facilitated by a set of technical inputs relating to climate vulnerability, historic and future climate impacts, and economic consequences of impacts. These inputs are shown in Parts A–D respectively of the **technical appendix** accompanying this report. In this appendix:

Part A summarises **recent climate variability and future climate change** in India related to primary climate variables of temperature and rainfall.

Part B then examines the implications of these changes for **secondary impacts** on natural and human systems across India.

Part C introduces the concept of **climate vulnerability** and summarises existing work to identify the indicators and distribution of vulnerability in India.

Part D presents evidence of the **economic impacts** of past climate shocks and stresses in India. This gives an indication of the key regions and sectors where climate change damage may be most economically severe.

Contents

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Acronyms

APRLP	Andhra Pradesh Rural Livelihoods Programme
CBA	Cost-benefit analysis
DALY	Disability-adjusted life-year
DFID	Department for International Development
DFID-I	Department for International Development India Country Office
HSDI	West Bengal Health Systems Development Initiative
KMA	Kolkata Metropolitan Area
KMDA	Kolkata Metropolitan Development Authority
KUSP	Kolkata Urban Services for the Poor Programme
MPRLP	Madhya Pradesh Rural Livelihoods Programme
MPUSP	Madhya Pradesh Urban Services for the Poor Programme
NPV	Net present value
ODA	Official Development Assistance
ORCHID	Opportunities and Risks of Climate Change and Disasters (the portfolio screening methodology)
PRIs	Panchayat Raj Institutions
RCH2	Reproductive and Child Health Programme Phase II
RLPs	Rural Livelihoods Programmes
SRD	West Bengal Support to Rural Decentralisation Programme
SSA	Sarva Shiksha Abhiyan (Elementary Education) Programme
TERI	The Energy and Resources Institute, India
UEE	Universal elementary education
ULBs	Urban Local Bodies
WORLP	Western Orissa Rural Livelihoods Programme
WSP	Water and Sanitation Programme

Executive Summary and Key Lessons

The screening results

- The strength of the screening process is that it enables programme staff and partners to think through and act on potential climate risks and opportunities. The screening provides a basis for strengthening existing adaptation processes and for selecting new adaptation options relevant to the DFID portfolio.
- Large numbers of India's poor people depend on climate-sensitive sectors for their livelihoods. Potential exposure to climate risks provides strong justification for undertaking the portfolio screening to integrate adaptation processes. The screening highlights vulnerable sectors and regions, key risks, and opportunities for addressing risks.
- The screening shows that the DFID-I programme already contributes to vulnerability reduction and building of broader adaptive capacity, both as part of good development practice and targeted climate-related efforts.
- Although some development programmes do already consider climate risks, recent disasters show that such risk management urgently needs to be accelerated. The impact of climate change on increasing the disaster burden strengthens the justification for undertaking the work.
- In the face of significant uncertainty in future climate change, many of the recommended adaptation options are focused on extreme events. Disaster risk reduction activities must be a high priority as a first line of defence against future climate change, whilst also ensuring that other development investments reduce the sensitivity of livelihoods to climate shocks and stresses.

The programme cycle

- Climate risk screening must become a regular part of the programme cycle, from dialogue with partners in the design phase, through to implementation and evaluation. While this could feasibly be built into the existing environment screening process, the approach applied here may be better suited to integration within the project risk assessment process.
- Working through support to partner programmes and budgets, DFID-I must consider how it can support the embedding of climate risk management in Indian institutions in the future.
- DFID needs to consider further its strategic priorities for adaptation relating to its different target areas for development cooperation as outlined in its draft country plan for 2008 onwards.

Information and methodology

- Technical inputs on climate hazards and vulnerability remain patchy. Documentation on hazard burdens and vulnerability of human populations remains limited at sub-national scale. Improved analysis is urgently required to help influence decision-makers.
- Future climate change projections contain significant uncertainty and their long-term nature makes them more suitable for horizon scanning and long-term planning than for guiding adaptation priorities for specific projects.
- Cost-benefit analysis of adaptation options is fraught with data and methodological difficulties but demonstrates that common options for improving climate resilience are cost-effective across a range of scenarios.

1: Climate Risk Screening: Methodology and Approach

This section describes the rationale, approach and methodology of the climate risk screening process. It highlights the influence of risk management in framing the approach to tackling climate change adaptation in the context of development cooperation. It then introduces the stages of the ORCHID methodology used for screening the portfolio of development cooperation programmes in the UK Department for International Development (DFID) in its India Country Office (DFID-I).

1.1 Context and Rationale

1.1.1 India climate and development context

The main driver of this study is the impact of climate-related events on poverty in India and the consequent need for adaptation to reduce the risks posed by climate change to people's lives and livelihoods.

As outlined in the technical appendices, climate impacts in India are already significant. About two-thirds of the total sown area in the country is drought-prone with about 40 million hectares of land being flood-prone. Most of the river basins in the north and north-eastern belts of India are prone to flood hazards. 600 million people are dependent on the agricultural sector in India, with two-thirds of the net sown area rainfed.[1] Climate-related extreme events have killed nearly 4.5 million people in India since 1900, inflicting over US$36 billion of damage (OFDA/CRED, 2007).

Climate change impacts will be overlaid onto existing variations in climate (climate variability), altering rainfall patterns, temperatures, sea levels, and wind patterns. These changes pose a range of potential threats for development in India (NATCOM, 2004), including:

- Sensitivity of agricultural yields to changes in climatic variables (precipitation, temperature, humidity), associated shifts in occurrence of crop pests and diseases and implications for food security;
- Reduction in fresh water availability;
- Boundary shifts for different forest types, with consequent implications for species diversity and forest-dependent communities;
- Adverse impacts on natural ecosystems such as wetlands, mangroves and coral reefs and mountain ecosystems;
- Sea level rise along coastal zones;
- Changes in virulence and disease patterns, especially vector-borne diseases, due to prevalence of conducive environments;
- Increased energy demands; and
- Impacts on climate-sensitive infrastructure.

Crucially, the impacts of climate variability and change are not evenly distributed. The poorest people are likely to be hardest hit by the impacts of climate variability and change because they:

- Rely heavily on climate-sensitive sectors such as rainfed agriculture and fisheries;

[1] See technical appendix 3 for detail and references.

- Tend to be located geographically in more exposed or marginal areas, such as flood plains or on nutrient-poor soils;
- Are less able to respond due to limited human, institutional and financial capacity.

Poverty therefore increases exposure while also limiting the ability to cope with climate impacts, and to adapt to a changing hazard burden. Despite significant progress in recent years, over 300 million people live in extreme poverty in India, earning less that US$1 per day, and 500 million earn less than US$2 per day.

Adaptation to the impacts of climate change (see Box 1.1) is therefore a key development challenge in meeting objectives of national and international efforts to reduce poverty. Development programmes, including that funded through bilateral development cooperation such as DFID, therefore need to ensure that they are enhancing coping capacities of poor people as well as enabling adaptation to future shocks and stresses.

Box 1.1: Defining adaptation

The process or outcome of a process that leads to a reduction in harm or risk of harm, or realisation of benefits associated with climate variability and climate change.

(UK Climate Impact Programme, 2003)

Adaptation is about reducing the risks posed by climate change to people's lives and livelihoods.

(3rd White Paper on International Development, 2006)

1.1.2 DFID policy drivers for integrating adaptation

The UK government commitment to integrate adaptation and development is set out under the G8 Gleneagles Plan of Action, an OECD declaration, UNFCCC commitments and the Third White Paper on International Development.

Following a study into the potential impacts of climate change on the Millennium Development Goals (ERM, 2002), a joint multi-agency paper highlighted the urgent need for adaptation to be integrated into the development process (AfDB *et al.,* 2002). The publication of a set of information key-sheets (DFID, 2004) introduced climate change to the organisation, placed it in the context of key development sectors and geographical regions, and outlined practical steps to help development policies and practices build in resilience to climate risks.

The impetus for integrating actions to facilitate adaptation within the context of development cooperation is reinforced by industrialised country commitments under the United Nations Framework Convention on Climate Change (UNFCCC) to provide resources to developing countries to assist adaptation to the impacts of climate change. The incorporation of climate change adaptation into development programmes was given coordinated impetus by the EU Strategy on Climate Change in the Context of Development Cooperation (EC, 2004). DFID then took up the Commission for Africa Report recommendation that 'from 2008 donors should make climate variability and climate change risk factors an integral part of their project planning and assessment' (Commission for Africa, 2005: 51).

These foundations underpinned the high-level political championing of climate change issues since the UK's Presidencies of the EU and G8 in 2005. The G8 Gleneagles meeting invited the World Bank to 'develop and implement best practice guidelines for screening their investments in climate-sensitive sectors to determine how their performance could be affected by climate risks as well as how those risks can be best managed in consultation with host governments and local communities' (G8 Gleneagles Summit 2005: para. 35). This impetus was strengthened by a meeting of OECD Development and Environment Ministers, who pledged that 'they will work to better integrate climate change adaptation in development planning and assistance, both within their own governments and in activities undertaken with partner countries' (OECD, 2006).

Within DFID, high-level policy on climate change issues was provided by the Third White Paper on International Development (DFID, 2006a). Framing a commitment to help developing countries adapt, it argues for reducing the risks posed by climate change to people's lives and livelihoods. It commits the UK Government to implementation of the Gleneagles Plan of Action and to developing guidance with the multi-lateral development banks by 2008 to screen all development investments for the effects of climate change. The White Paper also linked climate change adaptation to the complementary policies and practices of disaster risk reduction, which has received greater attention since the internationally agreed World Conference on Disaster Reduction and related Hyogo Framework for Action in 2005. The DFID policy paper on disaster risk reduction (DFID, 2006b) notes that climate change is contributing to increased disaster risk and calls for the incorporation of future as well as current climate risks in risk reduction efforts.

1.2 Approach: Portfolio Screening and Climate Risk Management

1.2.1 Climate risks, opportunities and development

To remain effective, development programmes must be able to manage the risks posed by both current and future climatic factors.

These drivers for adaptation in the context of development set a foundation for this work to pilot climate risk management in the DFID India portfolio. Without proactive attention to adapt to its impacts, climate change threatens to derail national and international efforts to enhance economic growth and reduce poverty. To remain effective, development programmes must therefore be able to manage the risks posed by both current and future climatic factors. These risks include:

- Direct threats (such as damages from extreme weather to infrastructure built by a project);
- Indirect threats (such as impacts on health that compromise a non-health sector project);
- Underperformance of investments (such as agricultural projects that fail when rainfall decreases);
- Investments that inadvertently increase climate vulnerability ('maladaptation', such as when projects encourage movement to high risk areas).

Equally, climate change may provide more favourable circumstances which can provide opportunities for economic growth and poverty reduction. These include both impacts from changing rainfall, temperature and fertilisation rates, but also opportunities from emerging markets for adaptation and for greenhouse gas mitigation.

A climate risk management approach is used to assess the risks and opportunities of climate change and adaptation to the development agency's portfolios of development projects. Climate risk assessment differs from the regular practice of screening for environmental impacts in its focus on the impacts of the environment on the project's goals and objectives. It also acknowledges that climate impacts are only one element in the spectrum of risks facing an investment (Van Aalst, 2006).

The climate risk management approach therefore acknowledges that:

- Climate risks may not be the most important constraint on poverty reduction and so climate considerations need to be embedded in a process that considers all risks;
- The basis for adapting to the future climate lies in improving the ability to cope with existing climate variations. Climate change projections inform this process to ensure that current coping strategies are not inconsistent with future climate change;
- In tackling current hazards, adaptation processes draw on approaches to disaster risk reduction, as well as tackling gradual changes and new hazards;
- In the light of uncertainty over future climate variability and change, management responses can build in flexibility to cope with a range of different potential future climate regimes;
- Risk management allows examination of how wider existing development processes can contribute to reducing vulnerability to climate change.

1.2.2 Portfolio screening

Portfolio screening refers to the systematic examination of a development agency's set of policies, programmes or projects, with the aim of identifying how climate change concerns can be combined with an agency's development priorities.

Portfolio screening is a means of promoting the auditing or mainstreaming of key issues across the range of an agency's work. Climate change portfolio screening refers to the systematic examination of a development agency's set of policies, programmes or projects, with the aim of identifying how concerns about climate change can be combined with an agency's development priorities, such as poverty reduction, institutional development and capacity-building (Klein *et al*., 2007).

There have been a range of different approaches to screening, some taking a sectoral approach, others focusing on community-based projects, others providing comprehensive cross-programme assessments. Generally, rather than attempt to create new adaptation projects, they seek to identify opportunities for the mainstreaming of adaptation to climate change into Official Development Assistance (ODA) at the national, sub-national and local levels. There are two main goals of portfolio screening (Klein *et al*., 2007):

(a) To ascertain the extent to which existing development projects already consider climate risks or address vulnerability to climate variability and change, and
(b) To identify opportunities for incorporating climate variability and change explicitly into future projects.

1.3 ORCHID: A Methodological Approach to Portfolio Screening

ORCHID is a risk management-based methodological approach to portfolio screening, stressing both risks and opportunities in tackling climate change, and incorporating adaptation as a process rather than a discrete end point.

ORCHID (Opportunities and Risks of Climate Change and Disasters) is based on a risk management approach to portfolio screening. As the name suggests, it stresses opportunities as well as risks in tackling climate change. It frames adaptation to climate change as an iterative process of learning rather than a discrete endpoint, and as such it emphasises its role in raising awareness. Despite significant exposure of the climate change issue, there remains limited understanding of its impacts in developing countries, how it might affect poverty reduction, and how to minimise negative effects through adaptation. DFID programme and advisory staff have been targeted in the first instance, with inputs from the Policy Division complemented by involvement of national and international experts.

The process accepts from the outset that it will not be feasible to reduce all risks and that decisions on risk reduction will involve judgements and trade-offs, particularly in the face of uncertainty about future changes. Nor does it promote across-the-board prioritisation of climate change issues. Instead, it aims to enable a systematic consideration of climate risks and opportunities in the context of development programmes, highlighting where climate factors can best be taken into account. The methodology also acknowledges that climate risks and opportunities are often pre-existing concerns; it therefore seeks to build upon existing risk management practices and processes. The key objectives of the process are outlined in the box below.

Box 1.2: Objectives of the ORCHID process of climate risk screening

- To identify climate-related risks to objectives and activities of DFID programmes;
- To recommend options for enhancing risk management, favouring disaster risk reduction and adaptation measures with a direct impact on the poorest and most vulnerable groups;
- To use this process to raise awareness of climate change and develop ways to embed climate risks as a component of decision-making;
- To assess the process of risk screening and highlight key gaps in evidence.

Figure 1.1: The ORCHID climate risk assessment methodology

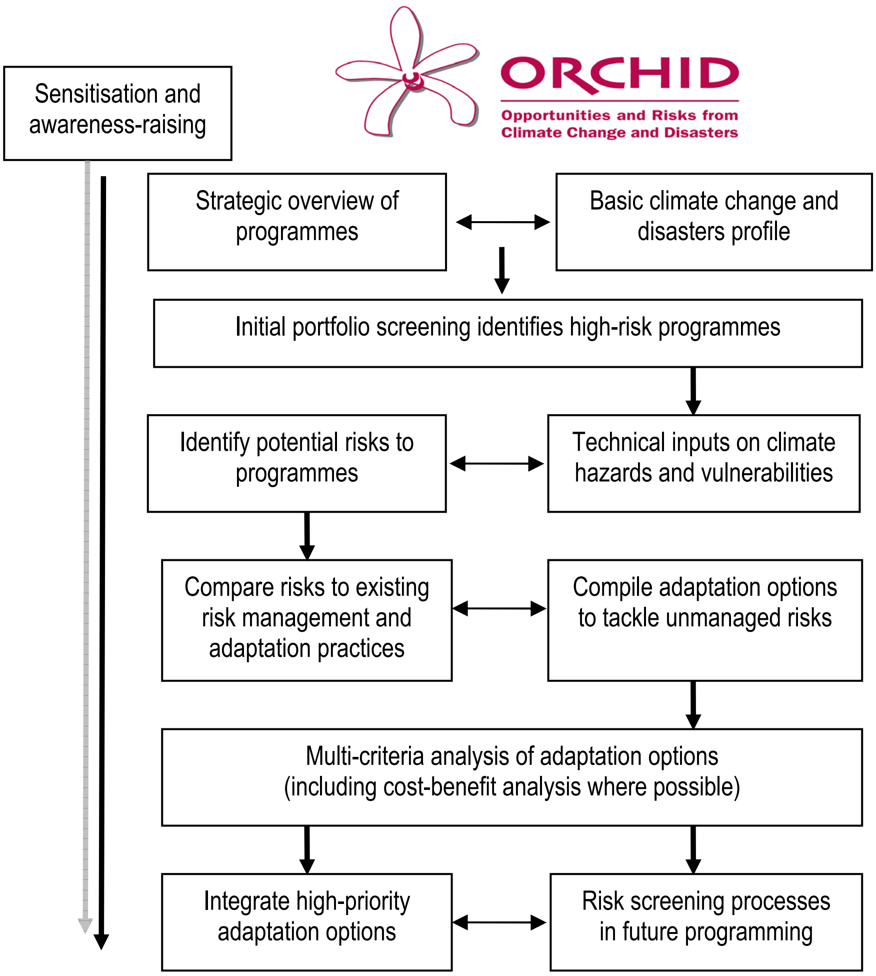


Figure 1.1 illustrates the different stages of the screening methodology. As a first step, the method compares a strategic overview of the programme portfolio with a profile of current and future climate impacts. A set of simple criteria are used in order to identify a subset of programmes in regions and sectors that are considered to be potentially at significant risk from climate impacts, and that at the same time present good opportunities for improving adaptive processes.

For the subset of selected programmes, a more detailed set of technical inputs are then used as the basis for a more in-depth examination of potential risks to programme objectives and activities. These technical inputs relate to the present distribution of climate hazards and their projected future distribution due to climate change, the vulnerability of key systems to these changes, and an assessment of the macro-economic implications of climate shocks and stresses. These are presented in the technical appendix to this report.

The potential risks are then assessed against existing risk management practices. A range of potential adaptation options are then identified for tackling unmanaged risks and exploiting opportunities for strengthening adaptive capacity. As well as discussions with stakeholders, the compilation of options should draw on previous studies, government reports to the UNFCCC, and national adaptation policy priorities.

A multi-criteria analysis is then used to identify high priorities among these adaptation options that can be integrated into the programme objectives and activities. While ideally including inputs from programme beneficiaries, the analysis at this level of screening involved programme staff from DFID and implementing agencies. A range of criteria are developed by stakeholders, commonly including coherence with national policy, flexibility across a range of possible future climate impacts, and cost-effectiveness. Cost-effectiveness is informed where feasible by an economic cost-benefit analysis. As a relatively new area, it has been important to build the evidence base regarding the economic cost-effectiveness of adaptation options. Two examples of cost-benefit analysis of adaptation options are therefore shown in Section 3 of this report.

The multi-criteria analysis is a decision tool to guide the selection process. Although high-rated options are not definitive, the analysis allows more favourable options to be highlighted. The process as a whole also helps identify generic strategic lessons for programming and how to incorporate climate risk management into regular policy and programming.

Table 1.1 illustrates the set of criteria and indicators used for assessing adaptation in DFID India. These were developed in discussion with programme staff, who scored each of the suggested adaptation options against these criteria. The process is naturally imperfect and includes some subjectivity, but provides a valuable tool for systematic comparison of options whilst also acting as a prompt for discussion.

The following section summarises the screening process for the DFID-I portfolio. It presents the key identified climate risks, range of adaptation options, and results of the multi-criteria analysis for ten programmes in the portfolio for which risks and opportunities are high. The results of cost-benefit analysis exercises under two programmes are then presented in Section 3, before a reflection on the strategic implications of the results and the methodology.

Table 1.1: Multi-criteria analysis criteria and indicators

Criteria and Indicator	Score 1, 2, 3, or 4 Description of extreme positions 1 and 4
1. Current and future focus Does option address poverty reduction in the context of current climate variability *and* future climate change?	1 = Considers only current or only future impacts 4 = Considers future impacts in context of current impacts
2. Fit with existing practices Is the option consistent with existing activities and the ways that dealing with climate-related impacts are factored into these activities?	1 = Option introduces something brand new 4 = Option relates directly to existing practices
3. Value added Can the option demonstrate clear value for money from adaptation activities?	1 = Little knowledge of economic cost-effectiveness of impact 4 = Demonstrable benefit to cost ratios
4. Adaptive flexibility Does the option focus on narrow range of future scenarios, or allow flexibility of response?	1 = Option addresses a narrowly defined future climate scenario 4 = Option improves flexibility of response to wide range of future scenarios
5. Unintended impacts Does the option manage any potential negative spin-off impacts ('maladaptation') beyond targeted activity?	1 = Possible negative impacts likely or unavoidable 4 = Negative impacts unlikely or manageable/avoidable
6. Practical considerations Is the option practical and feasible for implementer?	1 = Implementation difficult or impractical 4 = Implementation straightforward and practical
7. Scaling up Does the option maximise opportunities for scaling up and replication?	1 = Scaling up and replication complex 4 = Scaling up and replication relatively straightforward
8. Knowledge level (refer to science inputs summary table) If the option targets a certain climate hazard, what is the knowledge and certainty in projecting change and its impact?	1 = Low level of knowledge and/or confidence 4 = High level of knowledge and/or confidence
9. Policy coherence Does the option reflect existing local and national disaster risk reduction and adaptation plans or studies?	1 = No evidence of policy cohesion 4 = Option reflects existing plans or studies

2: Results of the Portfolio Screening Exercise

2.1 Initial Portfolio Screening

As highlighted in the methodology section, an initial portfolio screening exercise scanned all DFID-India programmes to determine those for which a more detailed climate risk assessment would be undertaken. This initial screening was carried out in collaboration with programme staff using a checklist to select development interventions (projects and programmes) which met criteria supporting their suitability for further assessment. Loosely based on the criteria used in past assessments by the OECD and World Bank (Agrawala, 2005; Burton and van Aalst, 2004), this included identifying those interventions that:

- Operate in climate-sensitive sectors such as water, livelihoods, health, and urban services;
- Contain significant investments in infrastructure;
- Can incorporate activities that could significantly alter the capacity to cope with and adapt to climate-related shocks and stresses;
- Where practical considerations were favourable such as data availability, partners, and practical entry-points.

This initial screening resulted in ten high-priority interventions funded by DFID-I for further assessment. These are shown in Table 2.1, below.

Table 2.1: Interventions prioritised for further assessment

DFID India Programme Area	Intervention	Acronym
National	Water and Sanitation Programme	WSP
	Sarva Shiksha Abhiyan – Elementary Education Programme	SSA
	Reproductive and Child Health Programme Phase II	RCH2
West Bengal	Kolkata Urban Services for the Poor	KUSP
	West Bengal Support to Rural Decentralisation	SRD
	West Bengal Health Systems Development Initiative	HSDI
Andhra Pradesh	Andhra Pradesh Rural Livelihoods Programme	APRLP
Madhya Pradesh	Madhya Pradesh Rural Livelihoods Programme	MPRLP
	Madhya Pradesh Urban Services for the Poor	MPUSP
Orissa	Western Orissa Rural Livelihoods Programme	WORLP

The following sub-sections outline the risk assessment for these ten programmes. They highlight the key current and future climate risks faced in implementation and scope of each programme. They then present the existing climate risk management measures, the potential additional opportunities for climate risk management and adaptation. These are compared using a multi-criteria analysis, and adaptation options are presented in order of their ranking under this analysis. This step included the development of cost-benefit analysis for adaptation to key risks in two of the programmes. Such analysis was limited by the time available and the sufficiency of available data. Results are presented in Section 3 of this report.

In presenting possible adaptation options, the methodology acknowledges that all changes to interventions will need to validate adaptation at the local level during both the design and implementation phases. The method also attempted to document the ‘additionality’ of the future work of each programme through a comparison of three scenarios: a *no programme scenario*, a *with programme* and a *programme plus* scenario. A summary of these scenarios across the ten programmes is presented at the end of Section 2 of the report.

The following sub-sections outline the risk assessment for these ten programmes. They include the potential additional opportunities for climate risk management and adaptation, presented in order of their ranking under the multi-criteria analysis.

2.2 National Water and Sanitation Programme (WSP)

2.2.1 Programme description and objectives

The goal of this programme is to support the achievement of the national targets on scaling up reforms to deliver safe drinking water and sanitation services in India. A major challenge is to increase the ‘reliability, sustainability and affordability’ of the water supply and sanitation services with social structures forming a key component of the programme implementation.

The programme is implemented through Water and Sanitation Programme South Asia (WSP-SA) that provides technical assistance to the Government of India (40 per cent of funds) and State Governments (58 per cent of funds) and 2 per cent developmental partner funds. It engages the Planning Commission, Ministry of Finance and water resources line ministries. The approach of this programme is built around the principle of strengthening the ability of the poor to hold service providers accountable for the delivery of quality water and sanitation services. This approach aims to create an ‘enhanced policy environment for the implementation of scaled-up reforms (by Central, State and local governments) that ensure sustained access by the poor to water, sanitation and hygiene services in India’.

2.2.2 Identified climate risks

- Impacts of extreme events on infrastructure for sanitation and drinking water supplies;
- *C*hanges in water supply and demand under scenarios of changing precipitation patterns, hence compromising water supply sustainability;
- Changes in water availability and quality that could enhance probability of occurrence and spread of water-borne diseases (diarrhoea) and vector-borne diseases (malaria).

2.2.3 Existing climate risk management measures

Though there is limited attention in the programme to the impact of climate variability on the programme objectives and activities, the programme does address the issue of water resource management in several ways. These may provide valuable entry points for potential adaptation options.

Within the first output area for the programme at central government level, the indicators include the sound management of ‘financial, technical and evaluation frameworks to improve the *sustainable* and equitable delivery of urban water and sanitation services’. The programme also supports government in producing guidance notes and best practice in implementation, which contains elements of sustainable water management.

The third output area on state-level implementation includes development of ‘risk management’ approaches around water quality monitoring and surveillance. The fourth output area around strengthening the knowledge base provides further potential entry-points, for example to integrate current and future climatic impact information into best practice guidelines and sharing of experience based on regional and sub-national best practices.

2.2.4 Additional opportunities for climate risk management and adaptation

1. To analyse the potential changes in drinking water supply across the regions covered by WSP, focusing on areas that face extremes of precipitation (high and low). The results of this analysis need to be followed up by incorporating results as part of a dialogue within the process of developing and tendering contracts for service providers;
2. Build awareness of development planners and sanitary engineers on building codes and prevailing practices;
3. Analysis of climate vulnerability of settlements in low-lying areas before initiation of construction activities and incorporating the results in the building codes and urban planning process in the vulnerable regions including drainage types;
4. Facilitating provision of flood warning systems and rapid evacuation procedures during emergencies within the vulnerable areas falling under WSP.

2.2.5 Insights from the multi-criteria analysis

The first option is given the highest score in the exercise because this fits with the advocacy role of WSP in areas that are found to be vulnerable. This option can also demonstrate clearly value for money, in terms of mapping vulnerable areas and then looking at the costs of providing alternate sources of drinking water supply and benefits (in terms of better health/avoided ill-health). Generating awareness comes second since this is a route to ensure that the urban planners are well informed of the issues at stake and risks associated with mal-development. The last two options, though important, get a lower rank because this essentially needs to be up-scaled by the state disaster management agency and task forces.

2.2.6 Programme risk screening summary

Table 2.2: Risk screening summary – WSP

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
Damage to drinking water pipelines and sewerage lines	Helping central government with management of technical and financial frameworks for maintenance of WSP services	▪ Build awareness of planners on building codes and best practices ▪ Analyse drainage timings and patterns during extreme events
Changes in water supply and demand	Helping central government with development of best-practices for water resource management	Analyse spatial and temporal changes in drinking water supply and incorporate the results in contract documents of local service providers
Occurrence and spread of water-borne diseases	State-level water quality monitoring and surveillance to check the nature of secondary order impacts	

2.3 National Sarva Shiksha Abhiyan – Elementary Education Programme (SSA)

2.3.1 Programme description and objectives

SSA seeks to overcome the barriers to education based on social, regional and gender disparities and encourages community ownership of the school system. DFID provides sector budget support to SSA for institutional reforms at the central and state levels in order to improve efficiency of the education delivery mechanisms and institutional structures for the management of elementary school education across the country for all 6 to 14-year-old children by the year 2010.

SSA involves an objective assessment of the current education system including educational administration, achievement levels in schools, financial issues, decentralisation (via involvement of women's groups and members of local government Panchayati Raj Institutions) and community ownership, recruitment of teachers and focus on education of girls, scheduled tribes and castes, and other disadvantaged groups.

SSA adopts the SWAp or the Sector-Wide Approach. SWAp is a process in which funding for the sector supports a single policy and expenditure programme, under government leadership, and adopts common approaches across the sector. This approach seeks to buttress government's role in decision-making and improve coordination between relevant policy stakeholders.

2.3.2 Identified climate risks

The key risks that the programme faces due to climate-related extreme events are either in terms of children dropping out of school or discontinued education because of damage to school infrastructure from extreme events, and health risks due to climate-induced water shortages. Areas exposed to extreme events are those at high risk. Consequent pressure on family livelihoods often forces children to miss school and engage in more intensive domestic or productive activities to support household income. Damage to school infrastructure and a fall in the health of school-going children due to extreme events and water shortages are associated risks.

2.3.3 Existing climate risk management measures

- Sporadic provision of rainwater harvesting systems to provide schools with water for drinking and other purposes.
- Environmental safeguards have been developed by the National Technical Support Group in certain drought-prone areas of the country to be considered during construction and maintenance of school buildings. In areas prone to extreme events special care is taken to ensure that the buildings are designed to withstand such adverse situations. Examples include:
  - (a) Schools in the riverine areas of Assam have been designed as partially prefabricated structures that can be dismantled and shifted to a new location on inundation of the land area;
  - (b) Schools in the coastal areas of Orissa have been designed to function as shelters during floods and cyclones;
  - (c) Design of all buildings, both schools and resource centres, in the seismic areas of Gujarat, North Bihar and Uttaranchal incorporate all the remedial measures recommended in the Indian Standard Codes.
- The SSA is also directly linked with several rural development programmes such as water and health programmes (e.g. Swajaldhara) and vaccination programmes that seek to enhance the wellbeing of communities, thereby contributing to improved adaptive capacities.

2.3.4 Additional opportunities for climate risk management and adaptation

1. Although there are many examples across the country under the SSA that promote climate risk management measures, SSA should explore the scope for replicability of such measures across the country, on a needs basis.
2. SSA often works in coordination with other programmes. However, synergies with disaster mitigation and management programmes need to be bolstered to become comprehensive and strategic rather than partial and uncoordinated, in particular to ensure that school structures are sufficiently resilient to withstand extreme events.

2.3.5 Insights from multi-criteria analysis

Ensuring replicability of climate risk management activities of the SSA takes top priority because of several successful pilot models. These have been effective through ensuring locally appropriate implementation and making best use of available resources. Options 2 and 3 require a high degree of institutional coordination and regular follow-ups and monitoring of progress. Option 4 was ranked lowest because of the need to ensure the educational focus of SSA and potentially problematic issues of ownership and authority of the school building, with additional persons working in the school premises.

2.3.6 Programme risk screening

Table 2.3: Risk screening summary – SSA

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
▪ Increase in school dropout rate ▪ Declining health status of children (due to water-borne diseases, malnutrition)	▪ Synergies with other programmes on livelihood-based initiatives ▪ Rainwater harvesting and water purification techniques to assure quantity and quality of water supply	▪ Climate-proofing and linkages with disaster mitigation and management programmes ▪ Replication of need-based and region-specific initiatives for school infrastructure across the country
▪ Damage to school infrastructure	▪ Environmental standards exist for school buildings adjusted to occurrence of extreme events (prefabricated structures, cyclone shelters as schools, building codes)	

2.4 National Reproductive and Child Health Programme Phase II (RCH2)

2.4.1 Programme description and objectives

The Reproductive and Child Health Programme Phase II (RCH2) is one of the four national-level programmes in which DFID supports the government of India's central programmes, contributing to meeting the MDGs on reducing child and maternal mortality, and communicable disease. This programme seeks to improve access to skilled birth attendance and emergency obstetric care for pregnant women, new-born care, immunisation and other health services for children, and reduce unmet need for contraception. It is the core of the Government's National Rural Health Mission. DFID's support also includes £4.5 million as Technical Cooperation funds for a new National Health Systems Resource Centre and a further £2 million to strengthen health sector procurement.

The RCH programme seeks to reduce disparities in access to and use of essential reproductive and child health services, improve the coverage, quality and equity of these services and strengthen associated institutional mechanisms. RCH2 aims to support a decentralised state- and district-level planning with stakeholder participation. It focuses on those who currently have the poorest reproductive and child health outcomes – by reason of location (urban/rural, geographical terrain), social category, wealth ranking, gender, disability, or age (e.g. adolescents). Environmental management already forms an essential component contributing to the health goals of RCH2.

2.4.2 Identified climate risks

- Damage to healthcare infrastructure such as medical equipments along with damage to the storage facilities having medicines and other healthcare items (e.g. vaccines, sterilisation material, aseptic surgical instruments). Up to 30 per cent of overall RCH2 expenditure is on infrastructure;
- Damage to potable drinking water supplies, leading to spread of water-borne diseases such as cholera and diarrhoea;
- Damage to road and transport infrastructure impeding the supply of healthcare services to the communities;
- Lack of and/or damage to power supply thereby hampering key medical care facilities such as storage of blood samples, neonatal and emergency ward care and storage of vaccines;
- Under extreme weather conditions, associated problems such as waterlogging and collection of debris (inclusive of living and dead material) increase the chances of infection and risk of epidemic outbreaks;
- The level of sanitation within the medical facility might also be affected as a result of climate variability and change (such as excess precipitation, temperature, waterlogging creating favourable conditions for breeding of mosquitoes and increasing chances of malaria).

2.4.3 Existing climate risk management measures

- The RCH2 programme strengthens the broader platform of health services, particularly at primary level across the country; hence this programme is responsible for buttressing the current healthcare systems across the country. This builds the general level of adaptive capacity. Evidence suggests that RCH interventions are among the most cost-effective health interventions available in terms of cost per disability-adjusted life-year (DALY) gained.
- Environmental management is an important part of the design of RCH2. Climate risks, although not identified directly, form a component of existing risk management practices, for example through clinical waste management practices.

2.4.4 Additional opportunities for climate risk management and adaptation

1. Identification of the vulnerable areas which are prone to climatic extreme events and the health facilities in and around these vulnerable areas through regional surveys and GIS mapping of these facilities by state health departments under the National Rural Health Mission (NRHM) or the RCH. The identification and mapping exercise could highlight:
   (a) Access routes available to reach the health facilities;
   (b) Infrastructure required to retrofit/upgrade the health facilities to make them more resistant to climatic variations;
   (c) Current carrying capacity of the facility and the number of cases that the facility could possibly accommodate in cases of epidemics or emergency;
   (d) The ability of the healthcare system to organise periodic outreach visits and provide free/subsidised medical care to the vulnerable areas.
2. Sensitising policy planners and decision-makers regarding the health risks in the region due to exposure to extreme events, and the potential impacts of climate change on incidence of extremes. This is an essential building block for incorporating risk management into the local (state and district) planning process.

3. Convergence with programmes such as the Total Sanitation Campaign, Swajaldhara, an emergent National Sanitation Mission, and other state/central government programmes for providing water supply and sanitation facilities, could be considered during missions to promote maximum coverage, effective maintenance of utilities, and improved health status.

2.4.5 Insights from multi-criteria analysis – RCH2

The multi-criteria analysis initiated a discussion on the need for an integrated approach to internalise health risks due to climate variability and change within RCH2. The analysis failed to disaggregate the individual options, arguing instead for combined implementation given the unlikelihood of success in isolation.

2.4.6 Programme risk screening summary

Table 2.4: Risk screening summary – RCH2

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
▪ Damage to healthcare infrastructure ▪ Damage to drinking water supplies ▪ Damage to communication networks and power supply ▪ Spread of diseases and risk of epidemic outbreaks	Bolsters national health care programme, targeting reducing maternal and infant mortality rates Environmental management practices, including for clinical waste	▪ Health facility mapping in vulnerable areas ▪ Sensitising policymakers to addressing health concerns due to exposure to extreme events in the respective vulnerable regions ▪ Convergence with programmes centred around issues such as sanitation and provision of quality drinking water

2.5 Urban Services for the Poor Programmes (KUSP, MPUSP)

The urban services for the poor projects were considered together under the screening exercise given the overlap in activities and consequent generic potential adaptation options.

2.5.1 Programme description and objectives

A. Kolkata Urban Services for the Poor (KUSP)

The objectives of KUSP include support to infrastructure improvements for slums (focusing on rehabilitating and building assets for water supply, sanitation, drainage and small access roads), and wards and municipalities (focusing on rehabilitating and filling critical gaps in the town network mainly for basic water supply and sanitation services). KUSP attempts to move away from a 100 per cent subsidy programme to a community-owned and outcome-based subsidy programme. It focuses on development planning, supporting municipalities, assessment of infrastructure and services and working with small Urban Local Bodies (ULBs). Slums are prioritised depending on poverty levels and infrastructure conditions.

B. Madhya Pradesh Urban Services for the Poor (MPUSP)

MPUSP seeks to strengthen governance at the state level and within ULBs for affordable and sustainable access to basic services by the poor. In alliance with the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), MPUSP is operational in four highly populated cities of Madhya Pradesh (Bhopal, Indore, Gwalior and Jabalpur). The purpose of the Madhya Pradesh Urban Services for the Poor (MPUSP) programme is sustainable poverty reduction and economic growth in urban areas of Madhya Pradesh. MPUSP combines pro-poor policy change and reform with performance-based access to in-slum infrastructure investment (water, sanitation, solid waste, drainage).

2.5.2 Identified climate risks

- Increase in high-intensity precipitation events could lead to increased waterlogging and subsequent flooding, leading to damage of urban drainage and sanitation infrastructure;
- Consequent contamination of urban water supply, including drinking water, with waste matter, with negative health implications;
- Flood and waterlogging to individual and community toilets could lead to groundwater contamination.

2.5.3 Existing climate risk management measures

A. Kolkata Urban Services for the Poor

- Slum 'in-situ' upgrading, which includes construction of roads, creating proper drainage and sanitation facilities, including construction of both individual and community toilets;
- Provision of potable water supplies;
- Creation of easy-to-maintain infrastructure such as brick roads instead of cement roads;
- Periodic operation and maintenance of existing infrastructure.

B. Madhya Pradesh Urban Services for the Poor

- MPUSP primarily has a governance focus and helps the city municipal corporations to develop drinking water and sanitation standards;
- 'In-situ' slum upgrading activities have been undertaken under the MPUSP. Vertical growth of the slums has been promoted to reduce the spread of the slums in low-lying areas (high-rise settlements) along with slum relocation efforts (to a lesser extent).

2.5.4 Additional opportunities for climate risk management and adaptation

1. Fostering synergies between periodic operation and maintenance activities and disaster management and mitigation activities undertaken by the ULBs.
2. Vulnerability assessment of communities for inclusion in comprehensive urban planning.
3. Create a database to track changes in the local groundwater conditions spatially and temporally, increased surveillance of the quality of drinking water systems, and regular monitoring of borewells and tubewells to check for contamination.
4. Raising the plinth level of the toilets.
5. Better insulation of the toilet pits to reduce the chances of seepage into the soil and groundwater.

2.5.5 Insights from multi-criteria analysis – KUSP/MPUSP

Flooding in the urban areas becomes a problem not only because of excessive precipitation but also because of poor urban planning and inefficient drainage systems. Much of the climate risk mitigation activities such as de-clogging and desiltation and operation and maintenance operations fall within the work mandate of the ULBs. Hence an important role for the USP programmes is to strengthen these ULB activities. Next to this, comprehensive urban planning based on vulnerability assessment of the communities is essential, followed by surveillance systems to regularly monitor the quality of drinking water sources. Structural measures such as raising plinth levels or better insulation of toilets are region-specific measures that are best done on a needs-basis considering the prevailing environmental conditions.

2.5.6 Programme risk screening summary

Table 2.5: Risk screening summary – KUSP/MPUSP

Identified climate risks	*Climate risk management and adaptation*		
	Current practices		**Additional opportunities**
	KUSP	**MPUSP**	
Urban flooding	In- situ slum upgrading (roads, basic drainage, sanitation), vertical slum development to prevent growth in high-risk areas.		▪ Strengthening operation and Maintenance activities with periodic monitoring and evaluation ▪ Comprehensive urban planning, considering climatic risks (includes construction of adequate drainage channels)
Health risks due to contamination of water supplies	Operation and maintenance of existing water supplies and drainage systems	Enabling ULBs to develop and follow environmental standards for sanitation and drinking water	▪ Development of a spatial and temporal database for water quality surveillance ▪ Raising plinth level of toilets ▪ Better insulation of toilet pits to reduce seepage into the soil and groundwater

2.6 West Bengal Programme on Strengthening of Rural Decentralisation (SRD)

2.6.1 Programme description and objectives

The purpose of the SRD programme is to enable decentralisation of governance mechanisms for pro-poor rural development via strengthening of local government bodies such as the Panchayat Raj Institutions (PRIs). In the first two years of implementation (Phase I), the programme has focused primarily on development plans and capacity-building in six districts.

Half the budget allocated for the programme finances a set of activities for improving the policy framework to enable rural decentralisation via local government institutions from district down to village level. This includes capacity-building of the local government to manage, monitor and record their activities. The other half of the programme funding has focused on the creation of local development plans at the Gram Panchayat level.

2.6.2 Identified climate risks

Identified climate hazards include the prevalence of high rainfall, drought and flood, all of which are projected to increase in West Bengal with climate change. Coastal districts of West Bengal are also particularly prone to sea level rises and increased cyclone intensity. Ten out of eighteen districts in the state are prone to multiple natural hazards. Flooding is a frequent hazard and has occurred in 15 of the last 23 years.

The six districts selected for SRD Phase I were Purulia, Birbhum, Malda, Murshidabad, Uttar Dinajpur and Dakshin Dinajpur. There is a proposal to extend this to six additional districts in the second phase. The predominant climate shocks for each of these six targeted districts are shown in Table 2.6.1.

Table 2.6.1: Key climate hazards in SRD Phase 1 districts of West Bengal

District \ Climate hazard	Cyclones	Drought	Floods	Landslides	Sea level rises
South 24 Parganas	X		X		X
North 24 Parganas	X		X		X
West Medinapur		X			
Murshidabad			X		
Malda			X		
North Jalpaiguri				X	

The consequent climate risks to programme activities include:

- *Natural resources-based livelihoods*. The programme helps to create development plans for spending untied poverty funds. Where these plans target livelihoods that are sensitive to variations in climate, particularly agriculture, they are highly exposed to climate shocks and stresses. Typically, 70 per cent of development plans focus on natural resource-based livelihoods;
- *Other livelihood activities.* Livelihood activities in non climate-sensitive sectors may also be at risk of damage and disruption, particularly from extreme events, unless adequate disaster management practices are in place;
- *Maladaptation.* If climate risks are not explicitly considered in the development plans, there is a danger that activities may inadvertently increase vulnerability to climate hazards by promoting livelihoods in riskier locations or sectors;
- *Damage to infrastructure*. Though infrastructure constitutes only a small percentage of DFID investments in the SRD programme, extreme events may nevertheless destroy and damage infrastructure components of the programme. Guidelines issued by the Government of West Bengal, Department of Rural Development, limit the proportion to a maximum of 10 per cent of the available untied poverty funds, although typical plans suggest a much smaller proportion is identified in practice.

2.6.3 Existing climate risk management measures

- *Targeting measures.* The six districts in which the DFID programme is providing assistance have been targeted because of their low ranking with respect to other states in the country, in terms of poverty, social exclusion, health, and education. Exposure and vulnerability to regular climate shocks and stresses have played a role in creating marginal conditions in these districts. Targeting should therefore pick up many of those vulnerable to climate shocks and stresses.
- *Livelihoods climate risk management.* Although focused on natural resources, many livelihood measures identified in the plans work to manage climate risks by encouraging diversification of livelihood resources to absorb the financial stress of any climatic shock, including improving access to markets etc. The nature of these practices and their links to climate shocks and stresses requires further investigation of local development plans. This is essentially being achieved by:

  (a) strengthening natural resource-based livelihoods (drought-proofing, protection from floods, reducing soil erosion, etc.);

  (b) income diversification (livestock, fishery, non-farm activities);

(c) access to markets for higher incomes from existing natural resources activities;

(d) micro-credit facilities.

2.6.4 Additional opportunities for climate risk management and adaptation

1. Although the programme currently targets poor districts, the criteria can be expanded to include vulnerability to climate hazards while selecting new districts under the programme. This could combine selection based on poverty criteria with selection of sensitive ecosystems such as the Sunderbans or mountain regions.
2. Development of training modules on climate risk and disaster management as part of capacity-building activities under SRD and integration with local developmental plans.
3. In future processes for creating local development plans, create guidelines for how to consider climate vulnerability reduction across all activities, including natural resources activities, livelihood diversification, and market access.
4. Integrate disaster management within guidelines for consideration within the process for creating local development plans. This is salient given that the Disaster Management Act (at state level) designates local government as the first point of contact in disaster response. However, it remains up to villagers to decide whether this should form a significant component of eventual plans.
5. Develop a climate vulnerability atlas for the state, based on hazard profiles, sensitivity of ecosystems, and human vulnerability. The nodal agency for this activity, however, should be the department of relief within the state and the exercise could link with the UNDP disaster management programme. Furthermore, vulnerability assessment of Gram Panchayats within the selected districts could also be considered. This could also serve as an input to local developmental plans

2.6.5 Insights from multi-criteria analysis

Discussions during the multi-criteria analysis did not achieve consensus on priorities for adaptation options. These options were all considered as possibilities for implementation and require consultation with a broader range of stakeholders.

2.6.6 Programme risk screening summary

Table 2.6.2: Risk screening summary – SRD

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
Risks to livelihoods; in sectors that are directly dependent on natural resources	Targeting of vulnerable communities through poverty-based criteria Enabling communities to build resilience to climatic shocks by income diversification ▪ Soil and water conservation ▪ Improved access to information ▪ Access to finance facilities	▪ Include climate sensitivity in programme targeting ▪ Integrate climate risk management into training modules ▪ Explore vulnerability reduction mechanisms for climate-sensitive livelihood sectors during preparation of local (district/ block/ village) development plans ▪ Integrate disaster management within local developmental plans of action ▪ Develop state- and district-level climate vulnerability atlas to target interventions

2.7 West Bengal Health Systems Development Initiative (HSDI)

2.7.1 Programme description and objectives

HSDI is designed to support the Health Sector Strategy of the Government of West Bengal. The purpose of the programme is to improve access of the poor to health services. The programme is expected to contribute directly to the achievement of some key health outcomes: reduction by about a third in the infant mortality rate and maternal mortality rate; 50 per cent increase in the proportion of professionally attended deliveries and child immunisation in the selected districts; increase in the coverage of child immunisation in the economically backward districts; and, reduction in the share of communicable/maternal/neonatal factors in the state's overall burden of disease. The programme would also help direct additional financial resources to three areas that are currently under-funded: primary sub-sector, rural areas, and recurrent expenditures on drugs.

2.7.2 Identified climate risks

- Extreme events may damage infrastructure components related to the programme. Although HSDI does not fund infrastructure directly, the effectiveness of its finances relies on adequate provision and functioning of health services buildings and related infrastructure.
- Disruption to health service provision via indirect impacts on components of the system, such as transport routes for supplies, patients and medical staff, and electricity provision for cold storage and sterilising equipment.
- Extreme events leading to both direct injuries sustained during the events and indirect impacts due to water-borne diarrhoeal diseases and malaria epidemics. Other indirect health impacts may include drop in food intake (decrease in nutrition and immunity) making communities in affected areas more vulnerable to other infectious diseases.

2.7.3 Existing climate risk management measures

The DFID funding to the HSDI is based on key objective areas laid out in the West Bengal Health Sector Strategy. These relate more to fundamental issues of improving health coverage, management and service delivery than to coverage of specific shocks or disease outbreaks. As a sector-wide budget support programme, DFID-I therefore has little direct impact on procedures that might relate to attention to climate-related impacts and risks.

The Health Sector Strategy, which guides actual implementation, refers to the duty of health services to respond after disaster events, but there is no strategy or guidelines for these arrangements to date. Discussions around response to climate risks will therefore need to be balanced with other priorities to ensure that response is both sufficient and proportionate. The Government of West Bengal has already prepared an Action Plan in conformity with the Biomedical Waste Management (Management & Handling) Rules 1998. Implementation of the Action Plan will be taken up incrementally with an initial focus on larger facilities.

2.7.4 Additional opportunities for climate risk management and adaptation

1. Establish a programme to ensure that health service infrastructure as well as additional human resources (for rapid response during disasters and health emergencies) in the state are provided and maintained to the minimum standard stipulated in guidance manuals. This would attempt to bring infrastructure up to a level where they are resilient to current climate shocks and stresses, serving as an improved baseline for considering the potential additional hazard burden from climate change.
2. Minimise the contributions of health services to environmental hazards and enhanced vulnerability, as climate change impacts will be in addition to existing stresses. This includes ensuring that health facilities, sanitary facilities, equipment, and medical waste disposal do not increase the vulnerability of the communities to other climate risks.

3. Strengthening the disaster response role of health centres in accordance with national and state laws, particularly in areas prone to extreme impacts such as riverbanks, coastal zones, or mountainous areas. This could include health camps (including vaccination and immunisation) in such areas during normal periods as well as emergency response plans for the provision of clean drinking water and health packs for use during and following extreme events.

2.7.5 Insights from multi-criteria analysis

There was little difference in these options as priorities, with all encountering potential difficulties of implementation within a sector support programme. It is recommended that the concepts be taken forward for further scoping prior to possible integration.

2.7.6 Programme risk screening – HSDI

Table 2.7: Risk screening summary – HSDI

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
Damage to health infrastructure	Programme currently lacks specific attention to climatic shocks	▪ Ensure development of and compliance with building codes and standards
Damage to provision of health services	Health Sector Strategy includes responsibilities for disaster response, but little guidance or coordination	▪ Better integration with state- and district-level disaster management agencies and rapid action forces to improve the disaster response role of health centres
Health risks due to spread of diseases		▪ Ensure sanitation within the health facility premises
Impacts on management of resources		▪ Ensure additional human resources and backup medical supplies for use during emergencies

2.8 Rural Livelihoods Programmes (APRLP, MPRLP, WORLP)

The ability of the rural poor to enhance their livelihoods is constrained by a range of inter-related structural, social, economic and institutional barriers. This is due to a range of factors including under-productive landholdings, periodic droughts and floods, insecure land tenure, over-reliance on agriculture, inadequate infrastructure development, and lack of access to agricultural inputs, extension services, credit and markets. Three Rural Livelihoods Programmes (RLPs) supported by DFID-I have been selected for the screening process.

2.8.1 Programme description and objectives

A. Andhra Pradesh Rural Livelihoods Programmes (APRLP)

The rural livelihoods programme in Andhra Pradesh seeks to promote livelihood improvements by increasing land and water productivity, involving natural resources and non-farm activities and making available better livelihood opportunities for the poorest people. The main objective of Andhra Pradesh RLP is to strengthen the ongoing watershed programme by providing support to incorporate equity and gender concerns, strengthen the livelihoods of poor people, strengthen capacity-building systems that create sustainable people's institutes and create opportunities for new learning. This programme is coming to an end, and therefore provides an opportunity to reflect on the potential for other livelihood programmes to promote climate-resilient and adaptive livelihood activities, rather than take on changes within its own project design.

B. Madhya Pradesh Rural Livelihoods Programmes (MPRLP)

The Madhya Pradesh RLP works through local government institutions (PRIs) to develop capacity within villages for the regeneration of natural resources, local-level planning, and undertaking entrepreneurial activities in addition to enabling backward and forward linkages for the development of sustainable livelihoods. While Phase I of MPRLP focused more on agriculture and water conservation, Phase II focuses on the livelihoods component, including issues related to out-migration, livestock management, and financial services such as micro-enterprises (especially for the landless). Phase II also addresses the provision of equitable access for the tribal population and migrant families and raising their awareness of their legal entitlements.

C. Western Orissa Rural Livelihoods Programmes (WORLP)

WORLP is a watershed-based livelihoods approach targeting the poorest 290 watersheds in Western Orissa and is rooted in the Gram Panchayats. The programme is being implemented by the Orissa Watershed Mission under the guidance of the Government of Orissa Department of Agriculture and the national Ministry of Rural Development. DFID provides funding to extend the regular government-funded livelihoods programme to poor and marginal groups in the poorest 30 watersheds. These groups often fall outside regular targeting, because watershed approaches use a farmer user-group structure primarily to improve soil and water conservation, thereby naturally favouring landowning farmers. To meet its objectives WORLP works in alliance with several programmes including the National Rural Employment Guarantee Act.

2.8.2 Identified climate risks

The main identified risks to the programme are:

- Drought and extreme weather damage to agricultural and forest production;
- Extreme weather damage to assets, housing, and infrastructure;
- Health risks through changes in malaria and water-borne disease distribution.

2.8.3 Existing climate risk management measures

A. Andhra Pradesh Rural Livelihoods Programmes (APRLP)

Water and soil conservation practices are central to the programme. However, at present, the impact of climate risks on programme activities requires greater consideration. The Government of Andhra Pradesh has already completed the establishment of institutional arrangements required to up-scale APRLP approaches to cover all watersheds in the state. There is a clear commitment to providing the resources and support required to mainstream APRLP approaches beyond the end of the project. There is considerable support for the district-level institutions (particularly the District and Cluster Livelihoods Resource Centres), which are key to securing the long-term sustainability of livelihoods promotion approaches.

B. Madhya Pradesh Rural Livelihoods Programmes (MPRLP)

The MPRL programmes explore engagement of the forest-based communities in developing forest-based carbon markets and already have a membership in the Chicago Climate Exchange forum as an offset trader. Phase II focuses on afforestation activities with special focus on the Jatropha plant. The opportunities arising out of the climate change issue also have the potential to contribute to improved adaptation processes through enhanced income generation. To avoid out-migration and dependence on agriculture, training in non-farm activities such as diamond polishing (prevalent in western MP) and other vocational activities is carried out, helping to manage climate risk by reducing the climate-sensitivity of livelihoods. The programme also focuses on the development of agri-technologies and livestock care.

C. Western Orissa Rural Livelihoods Programmes (WORLP)

The programme already recognises the need to diversify livelihoods that are based on natural resources and hence demonstrates a core consideration in promotion of effective adaptation. In addition, resilience-building and climate risk reduction elements are directly addressed through water and soil productivity enhancement. These include the promotion of drought-resistant seed varieties, improved fertiliser and mulching practices, composting, and water management practices such as conservation achieved through foot pump irrigation, in turn allowing diversification of crops across more seasons. In addition, the programme has targeted marketing and other aspects of enhancing agricultural yields.

Reducing risks from existing climate variability can therefore be considered as being actively addressed at present through the DFID component of the WORLP programme, although future changes in climate risks have not yet been considered other than through a vision of reducing the climate-sensitivity of livelihood practices..

2.8.4 Additional opportunities for climate risk management and adaptation

A. Andhra Pradesh Rural Livelihoods Programmes (APRLP)

1. Target DFID funding at off-farm activities, especially in areas where there is strong organisational capacity, and support opportunities for regeneration of common property resources with potential for income generation.
2. Enable convergence of APRLP, particularly at district levels and below, with programmes such as the AP Rural Employment Guarantee Scheme (APREGS).
3. Facilitate the use of information technology in planning, implementation, monitoring and evaluation of watersheds.
4. Facilitate technologies for the development of drought-resistant cultivars (cultivable varieties) and to enable agro-forestry practices.

B. Madhya Pradesh Rural Livelihoods Programmes (MPRLP)

1. Extension services to analyse current cropping patterns in partnership with rural communities and to facilitate development of locally appropriate climate-hardy cultivars and to enable agro-forestry practices.
2. Bolster existing structural measures for climate risk management such as land, water and soil conservation activities.
3. Enhance non-structural measures such as strengthening of non-farm income generation options for rural households, education and awareness regarding climate variability and change, and social protection mechanisms such as ration cards and grain banks for climate shocks.
4. Explore the scope of low carbon energy sources such as renewable energy for agricultural and household (such as smokeless *chulhas* for cooking) purposes.

C. Western Orissa Rural Livelihoods Programmes (WORLP)

1. The DFID-funded component of WORLP is currently only working in 30 of the 290 watersheds, so one option may simply be to replicate and scale up the successful approaches to promote more resilient livelihoods activities across the watersheds of Western Orissa.
2. Investigate the potential for rural livelihoods activities to tap into carbon markets in order to acquire monetary gains from conservation and management of natural resources, whilst at the same time ensuring that these practices actively reduce climate-related vulnerability. This is particularly salient in the context of common property resources, and may be included as part of the DFID Climate Change Innovation Programme.

3. Enhance existing extension activities for water conservation, particularly focusing on small-scale and subsistence farmers.
4. Facilitate technologies for the development of drought-resistant cultivars (cultivable varieties) and to enable agro-forestry practices.
5. Explore the role of renewable energy such as solar lighting systems.

2.8.5 Insights from multi-criteria analysis

Several options were identified as being common to all the programmes. Others are more relevant for specific contexts indicated under each programme above. Vulnerability assessment of the livelihood profile of the region was preferred because it provides an opportunity for implementable action based on the assessments, moving beyond scientific acknowledgment of the risks. Improving information-sharing mechanisms has been highlighted as key for strengthening and maintaining livelihoods, especially in the face of climate variability and change.

These common strategies include:

1. Documenting and scaling up good practice. Bolstering soil and water conservation practices will be especially crucial in a changing climate, while there are also examples of disaster risk reduction practices, social protection mechanisms such as ration cards and grain banks for climate shocks, and the targeting of less climate-sensitive off-farm activities.
2. Exploring the potential for rural livelihoods activities to tap into carbon markets in order to acquire monetary gains from carbon-saving conservation and management of natural resources, whilst at the same time ensuring that these practices actively reduce climate-related vulnerability. This is particularly salient in the context of the forthcoming DFID India Climate Change Innovation Programme.
3. Analysis of current cropping patterns by extension services in partnership with rural communities with a view to achieving the integration of locally appropriate climate-resilient crop varieties and livestock into agricultural, livestock-rearing and agro-forestry practices. This can help improve performance in the face of drought, flood, heat/cold stresses, or increased salinity.
4. Undertaking vulnerability assessment of livelihood profiles to feed into policy and programme decisions. Lack of this field information hampers higher-level decision-making regarding how to strengthen adaptive processes.
5. Strengthening information-sharing and dissemination mechanisms with community ownership, given that understanding and awareness of climate change as a global phenomenon with local implications is limited within poor communities.

2.8.6 Programme risk screening

Table 2.8 summarises these synthesised risks, current risk management practices, and adaptation options for the rural livelihoods programmes.

Table 2.8: Risk screening summary – Rural Livelihoods Programmes

Identified climate risks	*Climate risk management and adaptation*	
	Current practices	**Additional opportunities**
Drought and extreme weather damage to agricultural and forest production Extreme weather damage to assets, housing, and infrastructure Health risks through changes in malaria and water-borne disease distribution	APRLP ▪ Water and soil conservation ▪ Support to district-level institutions to support livelihood resilience against extreme events MPRLP ▪ Enable access of forest-based communities to revenues from carbon markets ▪ Capacity-building of rural communities through vocational training ▪ Support to development of agri-technologies and livestock management WORLP ▪ Supporting climate-resilient livelihood opportunities ▪ Soil and water conservation ▪ Support towards development of climate-hardy agricultural practices and crop varieties	▪ Scaling up and documenting existing good practice ▪ Support to disaster risk reduction activities at community level ▪ Exploring role of carbon markets to boost rural livelihoods ▪ Breeding of climate-hardy crop varieties and livestock (such as drought-tolerant, flood-tolerant, saline-tolerant, etc.) ▪ Vulnerability assessment of livelihood profiles to feed into policy and programme decisions ▪ Strengthening information-sharing and dissemination mechanisms with community ownership

2.9 Summary of Interventions and Adaptation Options

Table 2.9 below summarises the additional benefits of the suggested adaptation options by comparing the prevailing climate risks, how the existing programme improves climate risk management, and how adding adaptation components enable the programme to address risks more comprehensively.

Table 2.9: Interventions and adaptation options summary

DFID-supported programme	Key climate risks identified	Existing risk management and adaptation processes	Additional adaptation options (ongoing or suggested)
WSP	▪ Damage to drinking water pipelines and sewerage lines ▪ Changes in water demand and supply ▪ Occurrence and spread of water borne diseases	▪ Helping central government with management of technical and financial frameworks for maintenance of WSP services ▪ Helping central government with development of best practices for water resources management ▪ State-level water quality monitoring and surveillance to check the secondary order impacts of climatic events	▪ Improve compliance and awareness of planners on building codes and best practices ▪ Vulnerability and risk assessment exercises before infrastructure construction ▪ Incorporate analysis of projected changes in drinking water supply in contracts of service providers ▪ Integrate flood and disease warning and evacuation plans
SSA	▪ Discontinuation of education ▪ Damage to school infrastructure	▪ Synergies with other programmes on livelihood-based initiatives ▪ Rainwater harvesting and water purification techniques to assure quantity and quality of water supply ▪ Environmental standards exist for school buildings adjusted to occurrence of extreme events (prefabricated structures, cyclone shelters as schools, building codes)	▪ Replicate need-based and region-specific initiatives for school infrastructure across the country ▪ Link disaster mitigation and management programmes, especially for school infrastructure
RCH 2	▪ Damage to healthcare infrastructure ▪ Damage to drinking water supplies ▪ Damage to communication networks and power supply ▪ Spread of diseases and risk of epidemic outbreaks	▪ Bolstering national health care programme, targeting reducing maternal and infant mortality rates	▪ Health facility mapping in vulnerable areas ▪ Sensitise policymakers to climate-related health impacts ▪ Converge with other programmes, including sanitation and provision of quality drinking water
KUSP / MPUSP	▪ Urban flooding ▪ Health risks due to contamination of water supplies	▪ In-situ slum upgrading ▪ Operation and maintenance of existing water supplies and drainage system ▪ Enabling Urban Local Bodies to develop and follow environmental standards for sanitation and drinking water	▪ Strengthen operations and maintenance activities with periodic monitoring and evaluation ▪ Integrate climate risk management in urban planning systems ▪ Develop a spatial and temporal database for water quality surveillance ▪ Tackle flood impacts through raising plinth levels and better insulation of toilet pits

SRD	▪ Risks to livelihoods in sectors directly dependent on natural resources	▪ Enable communities to build resilience to climatic shocks by income diversification	▪ Include climate sensitivity in programme targeting ▪ Integrate climate risk management into training modules ▪ Create guidance for exploring vulnerability reduction mechanisms for climate-sensitive livelihood sectors in preparation of local development plans ▪ Integrate disaster management within local developmental plans of action ▪ Develop state- and district-level climate vulnerability atlas to target interventions
HSDI	▪ Damage to health infrastructure ▪ Damage to health service provision ▪ Health risks due to spread of diseases ▪ Impacts on management of resources	▪ Lacks specific attention to climatic shocks, but provides overall support to West Bengal Health Sector Strategy in improving health coverage, management and service delivery	▪ Ensure development of and compliance with building codes and standards ▪ Better integration with state- and district-level disaster management agencies, additional resources and rapid action forces to improve the disaster response role of health centres ▪ Ensure sanitation within the health facility premises
Rural Livelihoods Progs (RLPs)	▪ Drought and extreme weather damage to agricultural and forest production ▪ Extreme weather damage to assets, housing, and infrastructure ▪ Health risks through changes in malaria and water-borne disease distribution	Andhra Pradesh RLP ▪ Water and soil conservation ▪ Support to district-level institutions to support livelihood resilience against extreme events	▪ Facilitate use of IT in watershed planning and implementation ▪ Locally appropriate climate-hardy cultivars and agro-forestry practices ▪ Enhance water conservation and irrigation measures, focusing on small-scale and marginal farmers
		Madhya Pradesh RLP ▪ Enable access of forest-based communities to revenues from carbon markets ▪ Capacity-building of rural communities by vocational training ▪ Supporting development of agri-technologies and livestock management	▪ Locally appropriate climate-hardy cultivars and agro-forestry practices ▪ Bolster existing climate risk measures including land, water and soil conservation ▪ Enhance non-structural measures including non-farm opportunities and social protection measures ▪ Explore joint development/adaptation benefits of low carbon energy sources
		Western Orissa RLP ▪ Supporting climate-resilient livelihood opportunities ▪ Soil and water conservation ▪ Supporting development of climate-hardy agricultural practices and crop varieties ▪ Targeting off-farm activities for income generation ▪ Enabling convergence with other state programmes such as Rural Employment Guarantee Scheme	▪ Replicate and scale up successful approaches to other areas ▪ Investigate potential to tap into carbon market for adaptation and monetary benefits ▪ Enhance water conservation and irrigation measures, focusing on small-scale and marginal farmers ▪ Locally appropriate climate-hardy cultivars and agro-forestry practices ▪ Explore joint development/adaptation benefits of low carbon energy sources

3: Cost-benefit Analysis of Selected Adaptation Options

3.1 Sarva Shiksha Abhiyan – Rainwater Harvesting

Sarva Shiksha Abhiyan (SSA) is the Government of India's flagship programme for achievement of universal elementary education (UEE) in a time-bound manner, as mandated by the 86th amendment to the Constitution of India making education for children aged 6–14 years free and compulsory. SSA is being implemented in partnership with state governments to cover the entire country and address the needs of 192 million children in 1.1 million habitations.

Schools in drought-prone areas such as Rajasthan (parts of eastern and western areas of the state), Andhra Pradesh (Rayeseema region) and Maharashtra (interior), experience extreme water shortages, especially in the summer season due to the drawing down of water bodies and the water pipelines of municipalities and water supply boards. In such a situation water is generally purchased at high rates from various private distributors, with costs varying largely according to the location of the schools. Given limited monetary resources, schools cannot afford water resources at such costs, which may lead to reduced water supply, with severe consequences for sanitation conditions and ultimately leading to children dropping out of school.

One potential intervention strategy is to transfer the practice of rainwater harvesting, which is the collection and storage of rainwater from roofs or from a surface catchment. As an adaptation strategy this practice is not new, but the existing examples permit a cost-benefit analysis to provide information on economic decision-making criteria.

The rainwater is generally stored in tanks or directed into mechanisms which recharge groundwater. Rainwater harvesting can provide lifeline water for human consumption and reduce water bills, as well as provide a host of other benefits. Traditionally, rainwater harvesting has been practised in arid and semi-arid areas, and has provided domestic water, water for livestock, water for small-scale irrigation and even water for drinking, as well as a way to replenish groundwater.

A cost-benefit analysis is performed on the improved provision of water through rainwater harvesting for sanitation in an example school, focusing on a drought-prone area in eastern Rajasthan. In the absence of such facilities, the typical costs that school authorities incur average around 30 paise per litre of water. The direct economic benefits of rainwater harvesting are thus to reduce this expenditure. The project is financially efficient only when the present discounted benefits, in this case savings for not having to purchase water, exceed the present discounted costs of construction and maintenance of the rainwater harvesting facility.

3.1.1 Cost-benefit analysis of rainwater harvesting in a primary school in eastern Rajasthan

Cost estimates

Based on a rapid appraisal survey in one of the primary schools in the Tonk district of Rajasthan, the water requirement per year is calculated to be 51KL, as indicated in Table 3.1.

3.1.2 Assessing cost frequencies and benefits of rainwater harvesting

As rainwater harvesting is the process of collecting and storing rainwater for school activities, it depends completely on the local rainfall. Measured average decadal rainfall in eastern Rajasthan over the last 135 years is shown in Figure 3.1.

Table 3.1: Example school water requirement per year based on data collected from the survey

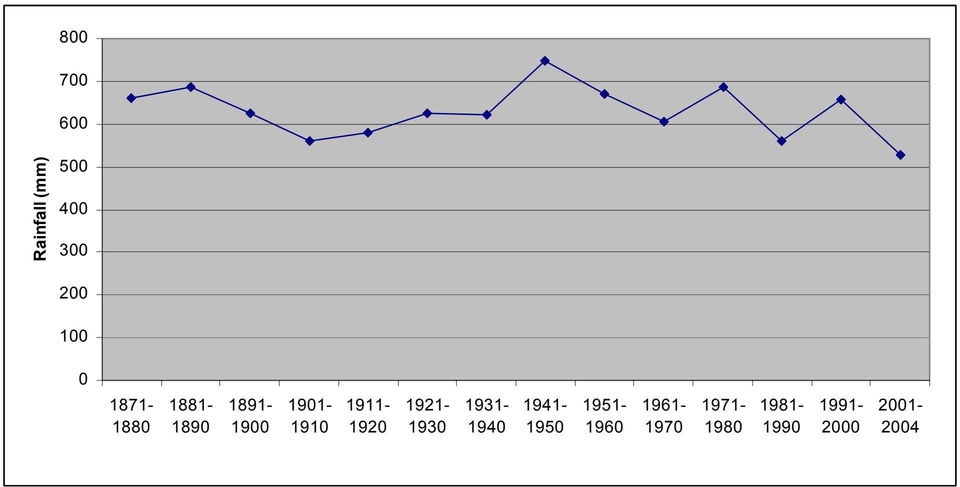
Category	Number	Unit
Students	50	
Staff	10	
Total	60	
Minimum water requirement per day	40	litres/capita
For 3 hours (stay in school)	5	litres/capita
Working days	171	days (104 weekend days and 3 months holiday)
Total annual water requirement	51,300	litres

The total construction cost of a 50KL (approximate) capacity tank is presented in Table 3.2.

Table 3.2: Cost estimate for construction of a 50KL rainwater harvesting tank

Component	Amount (Rs.)
Brick and reinforced cement concrete work	95,000
Gutter fittings, downpipes and pour flush system	20,000
Preliminary treatment unit, hand pump, and labour	20,000
Total	135,000

Figure 3.1: Average decadal rainfall in eastern Rajasthan



Source: Indian Meteorological Department

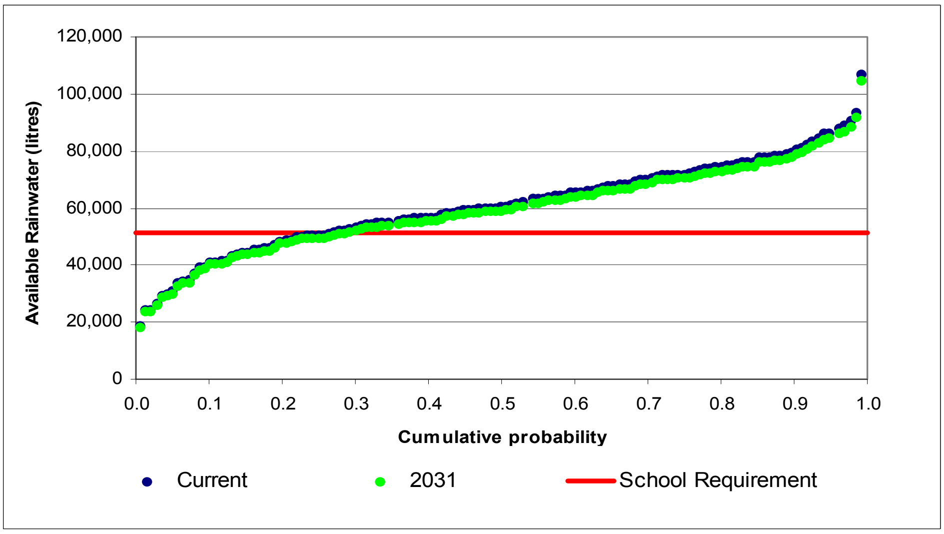
It is observed that the average decadal rainfall after 1940 has experienced a declining trend. Climate change analysis based on the PRECIS model by IITM for the monsoon season projects a further decline in rainfall in the region of 8 per cent of the current average by 2100. This yields an annual expected decline of about 0.086 per cent. Based on the above historical data, current annual rainfall statistics were estimated and then adapted for the end-of-analysis climate conditions based on consultation with TERI experts (25 years from now, in 2031).

Annual rainfall in eastern Rajasthan historically varies between about 200 to 1100mm, with a standard deviation of 167mm. In order to capture this high inter-annual variability, which can have a major impact on such a rainfall-dependent project's performance, a probabilistic analysis is appropriate and even necessary.

Given an average school roof area for rainwater collection of about $120m^2$ and estimated probabilities of annual rainfall, the probable available rainwater under current and future (climate change impacted, year 2031) conditions was calculated. Figure 3.2 presents a graph of the cumulative probability of these rainwater harvesting volumes now and in 2031, also showing the threshold where it is insufficient for the school's requirements and additional purchases will be needed.

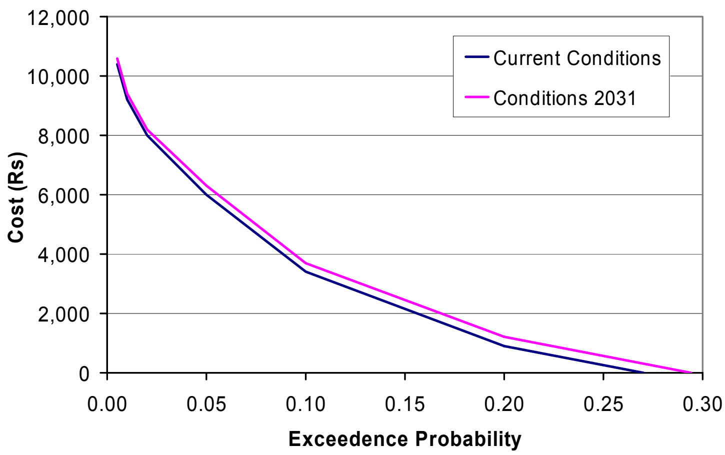
In many years more than enough rainwater is available; the actual amount collected being limited by the size of the storage tank. However, because the tank can store enough water to fulfil annual school requirements, during years with sufficient rainwater, all school requirements are indeed met through the rainwater harvesting system.

Figure 3.2: Projected rainwater harvesting now and in 2031



This probability distribution was then used to calculate the expected annual additional water purchases. For normal years, water purchases are not required. However, for drought years when rainwater harvesting is insufficient, additional water will need to be purchased to meet school requirements (assumed at the same price as when all water is purchased, 0.3 Rupees/litre). Based on the above figures, the cost frequency curves were estimated under current and future scenarios, presented in Figure 3.3.

Figure 3.3: Probability of additional cost due to insufficient rainwater harvesting



The annualised cost of additional water purchase under current and future conditions is obtained from the area under the cost frequency curves. Based on a trapezoidal integration these annualised costs are presented and compared to the current situation without rainwater harvesting in Table 3.3.

Table 3.3: Summary of annualised water costs

	Current (Rs)	2031 (Rs)
Without rainwater harvesting	15,390	15,390
With rainwater harvesting	1,545	1,617
Savings (= annual benefits)	13,845	13,773

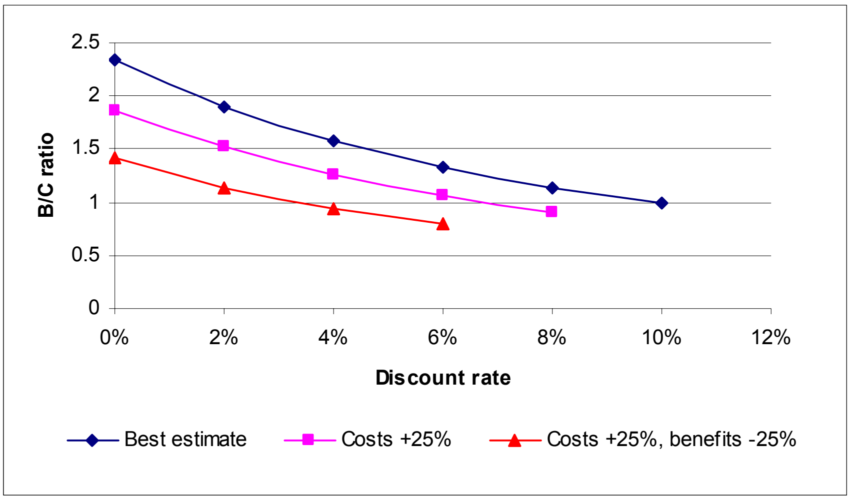
3.1.3 Results

Table 3.4 shows the cost-benefit analysis. For each given year over the time horizon of 25 years, costs, benefits and net benefits are displayed both in discounted and non-discounted terms in constant 2007 values. A social discount rate of 8 per cent was used.[2]

The analysis yielded for a discount rate of 8 per cent a net present value (NPV) of Rupees 19,064, a benefit/cost (B/C) ratio of 1.136 and an estimated internal rate of return (IRR) of close to 9.84.

A sensitivity analysis was performed to account for uncertainties in assumptions and to understand the robustness of these results. The effect of different discount rates, costs and benefits on the benefit/cost ratio is presented in Figure 4.4.

Figure 3.4: BC ratios for RWH option for best estimate and sensitivity analysis



For the best estimate case, a range of 2.4–1 is calculated at social discount rates below 10 per cent; thus, for this set of assumptions, the option would be economically beneficial. Other adverse scenarios in terms of increased costs and reduced benefits are also presented. Under these scenarios the project is economically efficient only until 6 per cent and 4 per cent social discount rates respectively.

[2] There is considerable literature on estimating appropriate discount rates. One of the most important studies by the Planning Commission was carried out by MN Murthy of the Institute of Economic Growth (IEG, India), yielding a value of 8 per cent, especially for infrastructure projects.

Table 3.4: Overview of cost-benefit analysis calculations for SSA rainwater harvesting

Year	Analysis year	Benefits = Savings	Discounted Benefits	Construc-tion Cost	Mainten-ance	Total Costs	Discoun-ted Costs	Net Benefits	Discounted Net Benefits
2007	1	13,845	13,845	135,000	0	135,000	135,000	-121,155	-121,155
2008	2	13,842	12,816	0	500	500	463	13,342	12,353
2009	3	13,839	11,864	0	500	500	429	13,339	11,436
2010	4	13,836	10,983	0	500	500	397	13,336	10,586
2011	5	13,833	10,167	0	500	500	368	13,333	9,800
2012	6	13,830	9,412	0	500	500	340	13,330	9,072
2013	7	13,827	8,713	0	500	500	315	13,327	8,398
2014	8	13,824	8,066	0	500	500	292	13,324	7,774
2015	9	13,821	7,467	0	500	500	270	13,321	7,197
2016	10	13,818	6,912	0	500	500	250	13,318	6,662
2017	11	13,815	6,399	0	500	500	232	13,315	6,167
2018	12	13,812	5,924	0	500	500	214	13,312	5,709
2019	13	13,809	5,484	0	500	500	199	13,309	5,285
2020	14	13,806	5,076	0	500	500	184	13,306	4,892
2021	15	13,803	4,699	0	500	500	170	13,303	4,529
2022	16	13,800	4,350	0	500	500	158	13,300	4,193
2023	17	13,797	4,027	0	500	500	146	13,297	3,881
2024	18	13,794	3,728	0	500	500	135	13,294	3,593
2025	19	13,791	3,451	0	500	500	125	13,291	3,326
2026	20	13,788	3,195	0	500	500	116	13,288	3,079
2027	21	13,785	2,957	0	500	500	107	13,285	2,850
2028	22	13,782	2,738	0	500	500	99	13,282	2,638
2029	23	13,779	2,534	0	500	500	92	13,279	2,442
2030	24	13,776	2,346	0	500	500	85	13,276	2,261
2031	25	13,773	2,172	0	500	500	79	13,273	2,093
								NPV	**19,064**
								B/C	**1.136**
								IRR	**9.84%**

The analysis did not consider monthly patterns of rainfall, which may make it possible to store water from one year to the next. This would improve the rainwater harvesting performance during drought years, leading to an increase in the benefit/cost ratio. A further climate change adaptation could be to use an even larger storage tank, such that all the water during above-average rainfall years could be collected and stored. In the current approach only 51KL can be collected – any additional rainfall when the tank is full is not collected. While a larger tank would increase the initial construction costs, the benefits would also increase through saving water from one year to use in the next.

3.1.4 Impact of possible water price dynamics

As previously described, an average water price of 0.3 Rupees/litre was used for this analysis. Generally, however, water prices fluctuate depending on supply and demand. In order to understand the sensitivity of the system to such changes, a further cost-benefit analysis was performed assuming that during the most severe droughts water prices increase to 0.4 Rupees/litre, while during very wet years they decrease to 0.2 Rupees/litre. For years in between these extremes, water prices were linearly interpolated depending on annual rainfall.

While these assumptions ensure that the average price stays at 0.3 Rupees/litre, for wet years they may sink below actual marginal delivery costs, which would not be realistic. However, because during wet years no water purchases additional to rainwater harvesting are needed, the error in this assumption will not lead to an error in total water costs for rainwater harvesting, while underestimating the costs without rainwater harvesting. Therefore the savings due to rainwater harvesting will be underestimated, such that the cost-benefit analysis will be conservative, underestimating economic performance.

Figure 3.5 shows the cost-frequency curves if the school purchased all required water, based on the above fluctuating price assumptions, as well as additional costs incurred when rainwater harvesting is insufficient. The resultant annualised water costs are listed in Table 3.5.

Figure 3.5: Cost-frequency curves resulting from dynamic water pricing and rainwater harvesting (year 2031)

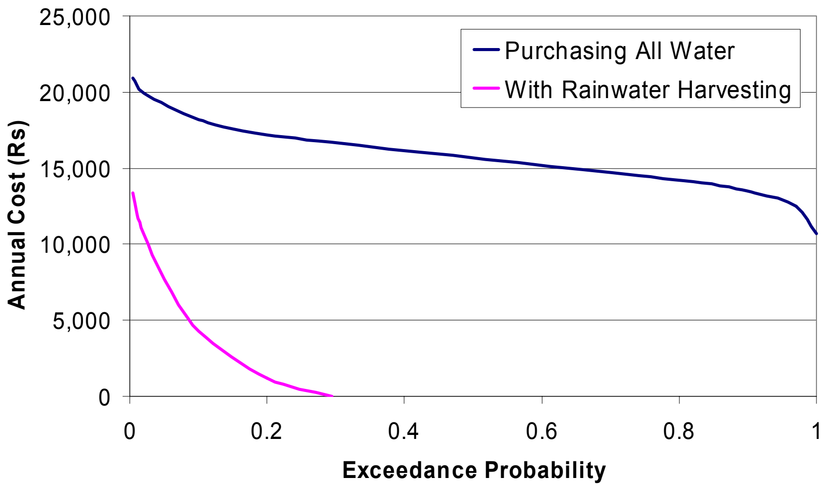


Table 3.5: Summary of annualised water costs assuming of dynamic water pricing

	Current (Rs)	2031 (Rs)
Without rainwater harvesting	18,702	18,914
With rainwater harvesting	1,924	1,992
Savings (= annual benefits)	16,778	16,992

As can be seen when compared to Table 3.3, under the assumptions of dynamic water pricing, average annual water costs for both the with and without rainfall harvesting scenarios increase. But the costs without rainwater harvesting increase more, therefore leading to greater savings and thus benefits from rainwater harvesting.

This is then reflected in improved economic efficiency metrics (using best estimates and a social discount rate of 8 per cent), with a net present value of Rupees 53,732, a benefit/cost ratio of 1.38, and an internal rate of return of 13.1 per cent. It can be concluded that the realities of fluctuating water prices, which are assumed to increase during droughts, will make the rainwater harvesting project more economically efficient.

3.1.5 Conclusions

In the above analysis the benefits of rainwater harvesting are computed in terms of the reduced costs of purchasing water by school authorities. Based on historical data and climate change assumptions, a probabilistic cost analysis could be incorporated into the CBA. Such an approach enhances the strength of the analysis, as annual climate-related uncertainties are better accounted for.

It must be kept in mind that rainwater harvesting may improve the sanitation conditions of schools, leading to a reduced disease burden and fewer school dropouts, which have positive societal values. In extreme weather conditions nearby villagers can also benefit from the stored water, which can be used for various household activities other than drinking water thus reducing expenditures. This, however, is only valid under the assumption that the storage tanks can hold enough water to serve both the school and at least some of its neighbours.

In any case it is expected that if these indirect benefits were introduced it would significantly improve the economic efficiency of the project under all analysed scenarios. The absence of secondary data proved to be a major constraint in this analysis. Further, fluctuating water prices, concerned primarily with price increases during droughts, further improve the economic efficiency of rainwater harvesting in this example.

3.2 Kolkata Urban Services for the Poor (KUSP) – Flood-proof Sanitation

Kolkata, the capital of West Bengal, is one of the major metropolitan cities of India. About 14.96 million people live in the Kolkata Metropolitan Area (KMA), consisting of 41 Urban Local Bodies (ULBs) spread over an area of 1380 square kilometres. The slum population is estimated at 1,490,811 (Census, 2001), which is about 10 per cent of the total population under KMA.

In 1999 the Government of West Bengal and DFID agreed to collaborate on the development of the ‘Kolkata Urban Services for the Poor’ (KUSP) programme, aiming to: improve urban planning and governance, increase access to basic services for the poor, and promote economic growth in the KMA. The project supports provision of infrastructure in slums, fills critical infrastructure gaps at the town level and in some cases also supports infrastructure that serve two or more municipalities.

While a range of projects are undertaken in this programme, the focus of this cost-benefit analysis is on Integrated Low Cost Sanitation (ILCS). The focus is based on discussions with area experts and implementing organisation officials, and also focuses on the potential threat poor sanitation may cause to the overall health conditions of slum dwellers. Major activities under this project include:

- Providing low-cost toilets to the urban poor;
- Discontinuation of the system of carrying faecal matter on the head of sweepers and retraining sweepers into a different profession.

Groundwater, accessed through shallow hand pumps, is a major water source in slum areas, although there is some limited piped water supply from the Kolkata Metropolitan Development Authority (KMDA). Due to open drains and sewage lines, water contamination is a serious issue, resulting in various water-borne diseases like diarrhoea. With apparently increasing rainfall and a rising water table in these areas, the situation, in the absence of any mitigative strategies, is expected to further deteriorate in the coming years. Also, waterlogging, particularly during the monsoon season, results in the breeding of malaria-carrying mosquitoes.

Flooding in the slums of Kolkata is generally caused by local rainfall, not through riverine flooding. Due to the lack of proper drainage and the concentration of rainfall during the monsoon season, floods are a relatively frequent occurrence. In terms of reducing the impacts of floods on the KUSP, frequently recurring floods, rather than extreme events, are of the greatest concern.

Many of the impoverished sites encompass *bustees* (a cluster of poorly constructed houses where people of the lowest sections of societies reside), which are mostly legally recognised and registered slums. The typical streets in these areas are narrow with little space between houses, piped municipal water supply is intermittent, and several households share one or two latrines and water taps. Most sewage is collected in open gutters, which overflow when it rains.

There is a substantial burden of diarrhoeal diseases, including cholera, in Kolkata slums. In order to reduce these health problems caused by water contamination and prevent waterlogging in latrines, drains and other sewage lines, two major adaptation interventions are recommended. They are:

1. Reinforced concrete construction of private twin pit toilets.
2. Raising the floor level of both the community as well as private toilets in the slum areas under the Kolkata Metropolitan Development Authority.

3.2.1 Option 1: Reinforced concrete construction of private twin pit toilets

There are various forms of sanitation facilities, ranging from cheaper community toilets to costlier individual facilities for each household. In pit latrine systems, faecal matter is stored in a pit and left to decompose. Unless specifically designed, pit latrines do not require periodic emptying; once a pit is full it is sealed and a new pit dug. If the faecal matter is left to decompose in dry conditions for at least two years, the contents can be safely emptied manually and reused.

Other designs use two alternating pits, reducing the need for new pits. Here, small quantities of water are used. Ventilation to remove odour and flies is incorporated into certain designs, while others are very basic and use traditional materials and approaches. For practicable pit latrines and soakaways, they should be 30 metres away from any groundwater source and the bottom of any latrine should be 1.5 metres above the water table. Some of the advantages of twin pit toilets are:

- They are cheap to construct;
- They can be cleaned by residents themselves;
- There is low or no maintenance cost;
- They create no environmental hazards;
- They do not produce foul smells or breed insects;
- They prevent groundwater contamination and reduce the incidence of water-borne diseases, particularly in areas where dependency on groundwater is very high.

3.2.2 Cost estimates

Reinforced twin pit toilets have been constructed in 339 slums, catering to the needs of more than 80,000 slum dwellers. It is estimated that in all 10,000 private twin pit toilets are going to be operational by early 2008. Close to 1000 community toilets are also expected to be built. Total beneficiaries will be more than one hundred thousand.

Materials used for these toilets include bricks, cement, sand, stone chips, mild steel reinforcement, pans and traps, wood and corrugated iron sheeting. Based on the current cost of these materials and the requirement to produce a single twin pit toilet, the average cost per unit was estimated at Rupees 7,500 at 2007 prices, as shown in Table 3.6.

Table 3.6: Costs estimation of a single twin pit toilet in Kolkata

Material	Unit price (Rupees)	Requirement	Construction Cost (Rupees)
Bricks	3300 / 1000	1015	3349.5
Cement	4750 / MT	200kgs	894
Sand	328 / Cu.M	$0.3m^3$	98.4
Stone chips	965 / Cu.M	$0.50\ m^3$	482.5
Mild steel reinforcement	32000 / MT	15.8kgs	505.6
Pan and trap	150 / piece	1	150
Woodwork and galvanised corrugated iron sheeting	366 / sq.M	$3.5m^2$	1281
Labour	100 per day	4 for 2 days	800
Total			**7561**

3.2.3 Assessing risks and benefits

Health benefits

As indicated earlier, poor sanitation and usage of contaminated water have serious health consequences in terms of cholera, diarrhoea, typhoid, hepatitis A, malaria and filarial, constituting 80 per cent of the country's disease burden (NICED, 2004). The poor are most constrained in terms of ability to afford recurrent treatment or losses of working days due to illnesses. Interestingly, the total cost to the family is found to be much higher when earning members are suffering from water-borne disease vis-à-vis a younger family member (non-earning). Precise information about diarrhoea and its incidence, causation, consequences and trends is therefore necessary for informed policymaking.

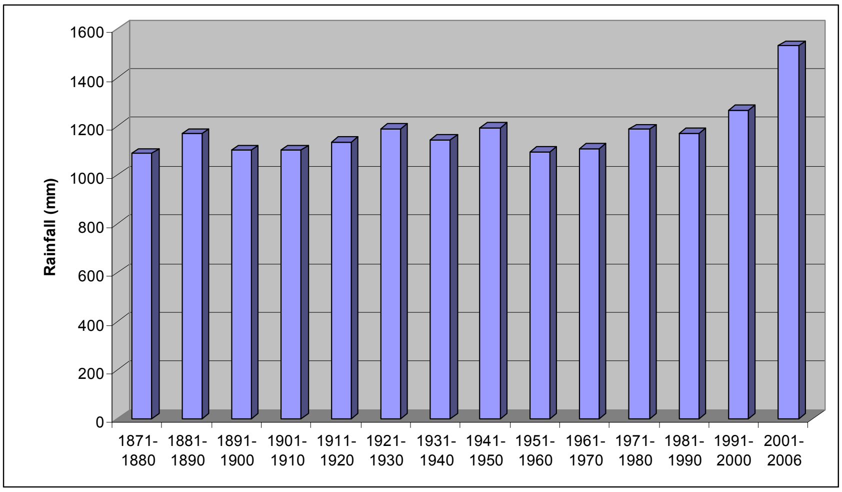
In 1993 the Harvard School of Public Health, in collaboration with the World Bank and WHO, assessed the global burden of disease (NICED, 2004) The study introduced a new metric, the disability-adjusted life-year (DALY), to quantify the burden of disease. The use of DALY allows researchers to combine years of lost life (YLL) from premature death and years of life lived with disabilities into a single indicator. DALYs for a disease or health condition are calculated as the sum of the YLL due to premature mortality in the population and the equivalent 'healthy years' lost due to disability (YLD) for incident cases of the condition (NICED, 2004).

In a study conducted by NICED, an estimation of DALY in India was made for diarrhoeal episodes for adults and children (NICED, 2004). Based on 2003 figures, the total DALY for India due to diarrhoea were 10,087,187 for children, while for adults it was estimated at 12,239,580. Given the total episodes for adults and children, the DALY per episode was estimated. The total loss in number of working days per episode is estimated by assuming that on an average an individual works for 300 days per year. The average weighted financial loss is estimated by multiplying the urban wage rate of labourers (weighted by rates for child and adult labour). It was found that the loss in current prices was close to Rupees 1800 per episode. In the presence of appropriate adaptation strategies, the benefit of eliminating diarrhoea per capita per episode can be assumed to be the same (1800 Rupees).

Climate risks

Measurements indicate an increasing trend in annual rainfall in Gangetic West Bengal, (see Figure 3.6). The average decadal rainfall in the late 20th century was estimated at 1100mm. This increased to 1267mm between 1991 and 2000 and to 1530mm between 2001 and 2006.

Figure 3.6: Average decadal rainfall in Gangetic West Bengal between 1871 and 2006



Source: India Meteorological Department

The average annual rainfall for the meteorological region (Gangetic West Bengal) is 1171mm with a maximum of 1601mm and minimum of 837mm. Table 3.7 presents in detail the summary statistics of rainfall in the region, as well as during the specific period when the diarrhoea and cholera study was undertaken by NICED (as previously described). It can be seen that the annual probability of above-average rainfall is 45 per cent.

Table 3.7: Summary statistics of rainfall in Gangetic West Bengal (1871–2006)

Average	1171mm	
Minimum	837mm	
Maximum	1601mm	
Std. Dev.	187mm	
Number of years (1871–2007)	136	
Years above average	61	45%
Rainfall pattern for the survey period (May 2003–April 2004)		
Annual rainfall during period	1528mm	
Total population survey in Kolkata slum	62329	
No. of episodes of the above population for the said period	3284	

Source: NICED (2003)

In the absence of local flood statistics, and considering the previously reviewed direct link between rainfall and local flooding/water-logging, simplified rainfall statistics are used as a proxy for flood probabilities. A full probabilistic analysis could unfortunately not be performed due to the lack of data on diarrhoeal cases caused by floods (there is only one data point for the 12-month period May 2003 to April 2004, as described above).

Flood probability is therefore incorporated into the cost-benefit analysis in a deterministic manner, such that the benefits for a given year are multiplied by the average annual flood probability. An underlying assumption is that any above-average rainfall causes flooding. This approach also assumes that the project is concerned with the frequency of any flooding, rather than focusing on extreme events, as previously described.

The average annual flood probability is likely to be affected by climate change. Based on the climate change projections reported in the ORCHID Bangladesh report (Islam and Mechler, 2007), it is assumed that the average regional increase in rainfall in the next 20 years will be between 5–7 per cent, between 2025 and 2055 10–13 per cent, and between 2056–2085 15–26 per cent. This yields an average annual increase of close to 0.25 per cent. Table 3.8 presents these assumptions relating to changes in climate conditions in Kolkata.

Table 3.8: Projected rainfall increases (ORCHID Bangladesh Report)

Decade	Ref. Year	Base Year	Range Increase	Avg. Increase	Avg. Annual Increase
2020s	2025	2003	5–7%	6.00%	0.27%
2050s	2055	2003	10–13%	11.50%	0.22%
2080s	2085	2003	15–26%	20.50%	0.25%

Based on the above figures, the expected average annual increase in probability of above-average rainfall due to climate change during the 25-year period of the CBA is computed to be 0.61 per cent. A time period of 25 years was used based on expert discussion, and at the end of this period the expected average annual flood probability will have increased from 45 per cent to about 58 per cent (again keeping in mind the assumption that any above-average rainfall will causing flooding).

3.2.4 Cost-benefit analysis: Option 1

Benefits from the project are thus calculated as the Rupee value of total avoided losses (loss of income and medical expenses) due to twin pit toilet construction considering the number of beneficiaries served and annual probability of above-average (flood-causing) rainfall. An annual population growth rate in the slums of approximately 2 per cent is also considered (India Census, 2001). It is assumed that the number of beneficiaries served will grow at the same rate as overall slum growth (such that slum growth is spatially evenly distributed).

In Table 3.9 we present the overview of the CBA calculations for the twin pit toilet at 8 per cent discount rate. We use an 8 per cent discount rate for infrastructure projects as indicated from the Planning Commission studies of MN Murthy of the Institute of Economic Growth (IEG, India).

According to the analysis shown in Table 3.9 for a discount rate of 8 per cent, the net present value (NPV) is Rupees 10.29 million with a benefit-cost ratio (B/C ratio) close to 1.091 per cent and an internal rate of return (IRR) of 9.03 per cent.

In order to account for the inherent uncertainty in the modelling assumptions, a sensitivity analysis is performed, the results of which are shown in Figure 3.7. Increased costs (by 25 per cent), as well as increased costs (again by 25 per cent), combined with reduced benefits (by 25 per cent), are tested over a range of discount rates. For the best estimate case, a range of 2.57–0.75 is calculated, indicating that the option is economically beneficial for social discount rates below 9 per cent. With costs increased by 25 per cent, the project is only economically beneficial below a social discount rate of 8 per cent, and with the very pessimistic assumptions of both increased costs and reduced benefits, the project is only economically beneficial below a 4 per cent social discount rate.

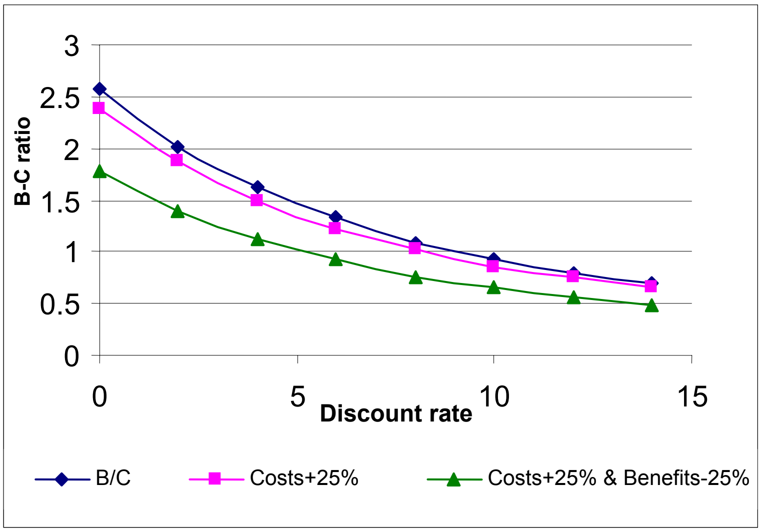
Based on the above metrics, it can be concluded that while the project is indeed economically beneficial, it is only just so, and depending on any number of factors could actually turn out to be economically inefficient. Considering the uncertainty inherent in such an analysis, a B/C ratio well above 1 would be preferable to ensure satisfactory confidence that the project is indeed economically efficient.

Table 3.9: Overview of CBA calculations for twin pit toilets with 8 per cent as discount factor

Calendar Year	Analysis Year	Building Costs	Total Benefits	Net benefits	Discounted costs	Discounted benefits	Discounted net benefits
2007	1	83250000	5186879	-78063121	83250000	5186879	-78063121
2008	2	9000000	6414193	-2585807	8333333	5939068	-2394265
2009	3	9000000	7655922	-1344078	7716049	6563719	-1152330
2010	4	9000000	8912064	-87936	7144490	7074684	-69806
2011	5	9000000	10182620	1182620	6615269	7484530	869261
2012	6	0	10447753	10447753	0	7110565	7110565
2013	7	0	10719419	10719419	0	6755052	6755052
2014	8	0	10997772	10997772	0	6417095	6417095
2015	9	0	11282972	11282972	0	6095839	6095839
2016	10	0	11575181	11575181	0	5790472	5790472
2017	11	0	11874564	11874564	0	5500221	5500221
2018	12	0	12181293	12181293	0	5224348	5224348
2019	13	0	12495542	12495542	0	4962151	4962151
2020	14	0	12817487	12817487	0	4712963	4712963
2021	15	0	13147313	13147313	0	4476148	4476148
2022	16	0	13485204	13485204	0	4251099	4251099
2023	17	0	13831352	13831352	0	4037240	4037240
2024	18	0	14185952	14185952	0	3834022	3834022
2025	19	0	14549203	14549203	0	3640924	3640924
2026	20	0	14921310	14921310	0	3457448	3457448
2027	21	0	15302482	15302482	0	3283120	3283120
2028	22	0	15692932	15692932	0	3117491	3117491
2029	23	0	16092879	16092879	0	2960132	2960132
2030	24	0	16502547	16502547	0	2810636	2810636
2031	25	0	16922164	16922164	0	2668614	2668614
						NPV	10295318
						B/C Ratio	1.091
						Estimated IRR	9.03%

However, only limited aspects of benefits (directly reduced losses of wages and medical treatment costs) were considered in the analysis. Additional indirect benefits in terms of socioeconomic and livelihood resilience in the slums, as well as environmental protection, have been omitted due to their complexity, and would ultimately increase the benefits of the project. Additionally, cost-benefit analysis (CBA) is only one aspect of decision-making and should not be used as the sole criterion for selection.

Figure 3.7: Benefit-cost ratio under different discount rates



3.2.5 Option 2: Raising the floor level of both community as well as private toilets in the slum areas under the KMDA

In Kolkata a majority of slum areas are located on the banks of canals like Beliaghata, Khiddirpore and Adi Ganga. A large proportion of the open and closed drains carrying sewage water from Kolkata have their outlets in these canals. As a result, the slum health situation worsens significantly during the monsoon season when these canals overflow and the slum areas become waterlogged. Because of low floor levels of these *bustees* and community toilets, healthy living becomes an issue of utmost concern.

To prevent water-logging, especially in community and private toilets, and to make toilets usable during the monsoon season, it is recommended that the average floor heights of these toilets be raised. Based on the data provided by KUSP officials, the existing floor heights of the toilets are between 400mm and 600mm from ground level. Given that this region has experienced increased rainfall, the chances of increased flood heights are high. However to arrive at a unanimous figure of the required increase in toilet platforms to account for higher floods was not possible. As indicated in the ORCHID Bangladesh report, the average floor height should be close to 3 feet from the ground level (0.91 metres). We assume this figure for our analysis as the topographical features of Kolkata are similar to that of Bangladesh, as are the weather conditions. An additional 410mm has therefore to be added to the existing level.

The materials required for construction and the total cost for retrofitting per toilet (twin pit toilets) is obtained from detailed discussion with local contractors and KUSP officials as presented in Table 3.10.

Table 3.10: Retrofitting cost per toilet

Item	Requirement	Rate (Rs)	Total costs
Bricks	350	3300 / 1000	1155
Cement	40kgs	4.75 / kilogram	190
Sand	0.1	328 / m^3	32.8
Labour	3 unskilled	100 / day for 2 days	600
Total cost			1977.8

Source: Estimates provided by KUSP

3.2.6 Cost-benefit analysis: Option 2

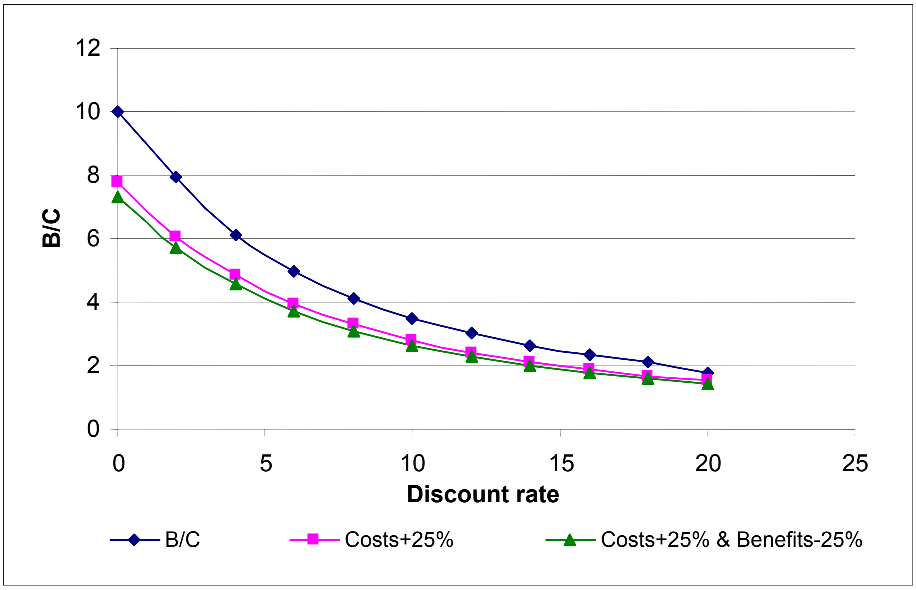
Based on these cost estimates as well as the same assumptions with regards to benefit development used with Option 1, the cost-benefit calculations were made again using a suitable discount factor of 8 per cent. The results are presented in Table 3.11.

Table 3.11: CBA calculations for raising toilet elevations with 8 per cent social discount rate

Year	Analysis Year	Costs	Total benefits	Net benefit	Discounted costs	Discounted benefits	Discounted net benefits
2007	1	21955800	5186363	-16769437	21955800	5186363	-16769437
2008	2	2373600	6412926	4039326	2197778	5937894	3740117
2009	3	2373600	7653666	5280066	2034979	6561785	4526806
2010	4	2373600	8908584	6534984	1884240	7071921	5187681
2011	5	2373600	10177679	7804079	1744667	7480898	5736231
2012	6	0	10441706	10441706	0	7106450	7106450
2013	7	0	10712223	10712223	0	6750517	6750517
2014	8	0	10989384	10989384	0	6412200	6412200
2015	9	0	11273346	11273346	0	6090638	6090638
2016	10	0	11564271	11564271	0	5785015	5785015
2017	11	0	11862324	11862324	0	5494551	5494551
2018	12	0	12167673	12167673	0	5218506	5218506
2019	13	0	12480491	12480491	0	4956175	4956175
2020	14	0	12800955	12800955	0	4706884	4706884
2021	15	0	13129245	13129245	0	4469996	4469996
2022	16	0	13465546	13465546	0	4244902	4244902
2023	17	0	13810048	13810048	0	4031021	4031021
2024	18	0	14162944	14162944	0	3827804	3827804
2025	19	0	14524431	14524431	0	3634725	3634725
2026	20	0	14894713	14894713	0	3451285	3451285
2027	21	0	15273996	15273996	0	3277008	3277008
2028	22	0	15662493	15662493	0	3111444	3111444
2029	23	0	16060420	16060420	0	2954162	2954162
2030	24	0	16467999	16467999	0	2804752	2804752
2031	25	0	16885457	16885457	0	2662825	2662825
						NPV	93412258
						B/C	4
						IRR	41%

From the above exercise it is observed that the NPV of the project is 93.95 million with a benefit-cost ratio of 3.99. The internal rate of return is estimated at a very high figure of 41 per cent. The results of a sensitivity analysis on the CBA under different discount rates for this option are presented in Figure 3.8. Interestingly, it is observed that even under increased cost and reduced benefit conditions, the proposed adaptation strategy can be considered economically beneficial over the full range of tested social discount rates. Compared to Option 1, Option 2 is therefore not only more economically efficient, but also its economic performance is less sensitive to possible errors in modelling assumptions or unaccounted for/unpredictable dynamics.

Figure 3.8: Benefit-cost ratio under different social discount rates



3.2.7 Conclusions

Due to a lack of appropriate flood and loss data for the specific location and health impacts, a fully probabilistic risk analysis could not be incorporated into the CBA. A deterministic approach, utilising average annual flood probabilities based on simplified assumptions was instead applied, such that the resulting economic performance metrics are still considered sufficient to support decision-making. Changing annual flood probabilities due to climate change were also incorporated, although the uncertainty around these projections was not factored into the calculations.

These construction-based flood risk reduction strategies proved to be quite expensive. However, they are still considered economically beneficial, with Option 2 (raising toilet elevations) being more economically efficient and less sensitive to system dynamics than Option 1 (construction of new twin pit toilets).

The quantification of the benefits was restricted to the reduced burden of diseases like diarrhoea, typhoid and malaria. There are further water-borne/water-related diseases which were not considered due to a lack of data. There are also other direct and indirect benefits which were not factored into the analysis but would increase the (gross and net) benefits and should be considered during decision-making and planning processes, for instance:

- Reduced contamination and improved groundwater quality in the KMA area;
- Improved sanitation conditions for these areas leading to improved hygiene conditions;
- Reduced overall disease burden for the city and other adjoining areas;
- Improved general wellbeing of the residents of Kolkata.

The CBAs performed in this study demonstrate that although limited data were available, some general conclusions on project economic efficiency could still be made. CBA is only one of many components of project decision-making and planning, and should therefore not be relied upon as a sole criterion for ultimate design selection and implementation.

4: Strategic Lessons from Screening Exercise

While the process of climate risk screening provides valuable lessons for integrating climate risk management and adaptation, this piloting process is necessarily bounded to a snapshot of current DFID activity during 2007. This section presents some of the strategic implications for the DFID-I.

4.1 Climate Risk Exposure of the DFID-I Portfolio

The total estimated proportion of the DFID-I portfolio likely to be affected by climate risks ranges between 26 and 49 per cent. This provides good grounds for screening to assess existing risk management and scope further measures to tackle climate change.

As a foundation to assessing climate risk and adaptation options, a simple risk exposure calculation was performed during the initial screening exercise. This helped produce a picture of the potential extent to which development activities in the DFID-India portfolio are affected by climate risks. The estimate is calculated based on the sectoral composition of the portfolio, in line with an established OECD methodology (Agarwahl, 2005) that formed the basis for the subsequent method of estimation by the World Bank.

Put simply, this approach operates on the premise that development activities in sectors relating to water resources, infectious diseases, or natural resources are more likely to be affected by current climate variability and weather extremes, and consequently also by changing climatic conditions. Those relating to financial reform, civil society capacity-building, gender equality, human rights or governance reform meanwhile, are much less likely to be directly affected by climatic circumstances.

Using this approach, estimates are made of the proportion of the aid portfolio affected by climate risks. In calculating a conservative (low) estimate, programmes relating to rural livelihoods, urban services, water and sanitation, and environment are included as sensitive to climate risks. The medium estimate adds disaster relief and recovery activities to this list, which are generally reactive and short-term, with commonly partial treatment of risk as a result. A final high estimate also includes health programmes where they relate to climate-related infectious disease and/or infrastructure components that may be affected by climate risks, as well as themselves influencing vulnerability. The large health programmes included in the high estimate bias the sample because in reality only a relatively small percentage of their investment is based on climate-sensitive disease or infrastructure, and because engineering components are more likely to already consider climate-related hazards. Multilateral Trust Fund contributions are not included in these estimates due to difficulties in disseminating sectoral activities.

Taking a snapshot of the DFID-I portfolio in early 2007, the results of the sensitivity estimates are shown in Table 4.1. They suggest that a significant proportion of the DFID-India portfolio is potentially exposed to climate risks. In the state programmes this proportion is especially high (50 per cent at low and 70 per cent at high estimates), because spending is dominated by livelihoods and urban services programmes. For the national and non-partner-state programmes, the proportion is considerably lower (4.4 per cent without health programmes, but 31 per cent with health programmes).

The total estimated proportion of the portfolio likely to be affected by climate risks ranges between 26 and 49 per cent. This range is comparable with wider multi-donor estimates undertaken by the OECD (OECD, 2006). The estimates provide good grounds to justify the screening process to ensure that the current level of risk management is sufficient and to investigate the necessity of integrating further measures in light climate change.

Table 4.1: Estimated climate risk exposure of DFID-I portfolio

	Proportion of DFID-I portfolio in climate sensitive sectors		
Programme Sample	***Low Estimate***	***Medium Estimate***	***High Estimate***
National Programme	0.3%	0.6%	29%
Programmes outside main partner states	54%	54%	54%
Subtotal: Non-partner states	*4.4%*	*4.6%*	*31%*
Madhya Pradesh Programme	61%	61%	81%
Andhra Pradesh Programme	85%	85%	85%
West Bengal Programme	46%	46%	79%
Orissa Programme	24%	39%	40%
Subtotal: Partners states	*50%*	*54%*	*70%*
Grand Total	**26%**	**28%**	**49%**

4.2 Strategic Implications for the Country Programme

4.2.1 Looking back: The DFID-I country plan 2004–8

As a recently emerging issue, previous DFID country plans for India have not prioritised climate risk management. Sustainable natural resource management has not featured prominently, while disaster risks were rated as low.

The screening process, while directed at the 'micro' level of projects/programmes, also provides lessons for the country programme as a whole. The DFID Country Plan for India 2004–8 spells out its plans for supporting Indian initiatives to alleviate poverty. The failure to directly refer to climate change reflects its recent emergence as a development topic. The incidence of disaster events, including slow-onset events such as drought, are noted as a risk to poverty reduction, but are rated low given a growing capacity in disaster preparedness and management.

The risks section of the Country Plan notes that environmental degradation is a long-term constraint to livelihoods. This has particular salience for climate change due to its potential to alter the productive potential of agriculture. Despite potential impacts on economic growth and poverty reduction, the sustainable use of natural resources and environmental services is not highlighted in the plan. Sustainability is expressed in terms of the sustainability of economic growth or access to services, rather than the use of environmental goods and services.

This lacuna is illustrated in the Government of India's 10th 5-year plan, which highlights access to sustained access to good drinking water as a major target. While India's progress towards the MDG target is good, the DFID country strategy notes that not all sources are sustainable, both in terms of reliability/access and in terms of environmental sustainability. Addressing these pre-existing challenges becomes even more urgent in light of future uncertainty of water availability due to climate change.

4.2.2 Looking forward: the DFID-I Country Plan, 2008 onwards

Supporting adaptation will require a more considered approach as DFID support becomes increasingly upstream, towards budget support and national programming.

In undertaking this study in consultation with programme staff, the screening was able to facilitate greater reflection regarding climate change and its interaction with poverty reduction and bilateral development cooperation. It is unlikely that this would have been achievable with a more short-term approach.

The generation of a range of adaptation options presented in Section 2 has helped to broaden understanding of adaptation as part of a wider process contributing to vulnerability reduction. Nevertheless, there remains an ongoing need for sensitisation around the climate change process, and the resultant growing importance of climate shocks and stresses in the range of hazards affecting livelihoods in India.

The screening confirms that strengthening climate risk management should be a priority for programmes already directly tackling climate shocks and stresses, particularly in the livelihoods, water resources, and agriculture sectors. This will require enhanced engagement with sustainable natural resource management, but evidence from existing programmes illustrates that climate risks are often already managed as part of plans and activities. As a first step, there remain limited connections with disaster risk reduction measures, including preparedness and early warning, and related institutions, particularly at regional and local levels.

Portfolio screening can contribute to learning and additional actions for individual interventions. However, this incremental approach may be less effective in tackling strategic issues, and the 'beyond aid' agenda. As DFID-I moves increasingly towards large-scale programmes led by Indian partners, including budget support processes, the integration of climate risk management, including the potential impacts of climate change, will need to be embedded into Indian institutions. This means facilitating not only inward-looking screening processes, but also the strengthening of Indian capacity to analyse and act on climate risks and opportunities as they relate to national and regional policies. This may imply a greater role for technical assistance for Indian institutions rather than implementation.

As a baseline, such capacity strengthening might include programmes in key sectors to sensitise stakeholders on climate issues, developing applied analytical tools and approaches, and an expanding suite of broadly replicable adaptation options. Such changes also require a better understanding of the barriers to action constraining effective and long-term decision-making on different scales. Adaptation processes therefore need to consider incentive structures, and could integrate adaptation as part of development visioning exercises, particularly at state and sub-state level.

4.2.3 DFID's plan for working with Three Indias

Strategies need to be developed for differentiated engagement on climate change adaptation with the 'Three Indias' identified in the draft Country Assistance Plan. The screening exercise provides some initial indications of future DFID-I engagement on adaptation through these perspectives.

The post-2008 draft Country Assistance Plan builds on DFID's role in assistance to three perspectives in India's development process. Developing understanding of how to engage on climate change issues with these different perspectives requires further consideration by a broad range of stakeholders as part of the consultation process. The screening exercise provides some initial indications of future DFID-I engagement on adaptation through these perspectives.

For **poorest India**, adaptation is likely to be focused on strengthening coping and adaptive capacities in the face of more frequent and/or more intense climate shocks to their livelihoods. Public policy measures can play a crucial role, including continuing support for access to basic services and social protection measures.

Supporting health systems to analyse climate impacts and create flexibility for changing disease distributions will be central to ensuring that access is matched by service provision, as well as ensuring that health infrastructure is resilient enough to withstand extreme events.

Resilient education infrastructure is similarly important to ensure coherent education provision as well as potential community shelter in emergencies.

Relevant social protection measures might include social transfers, public works programmes, social service provision, and micro-credit schemes, among others. Livelihood promotion and diversification should build on a growing awareness of climate impacts to ensure that dependence on climate-sensitive activities is managed.

Equally, infrastructure improvement for poor groups, such as slum upgrading, will need to ensure that standards of protection are capable of withstanding at a minimum the present-day impacts of climate hazards. Where feasible, these can also build in a degree of additional protection to account for incremental additions to the hazard burden due to climate change. Climate change provides an impetus for ensuring that at least basic levels of protection are afforded to the most vulnerable members of society.

Support should also be able to prepare civil society for the opportunities for poverty reduction presented by institutions and mechanisms related to climate change. These include the growing number of adaptation funding mechanisms from bilateral and multi-lateral sources, from private foundations and voluntary sources, as well as those through the UNFCCC and Kyoto Protocol. Potential poverty reduction and global environment co-benefits through participation in formal and informal carbon markets provide another avenue for support, and frame the future DFID-I Climate Change Innovation Programme.

Engagement with **developing India**, where assets and adaptive capacity are generally higher, will build on the interventions for poorest India. Ensuring that policy and planning integrate climate risk management will enable developing India to continue progress towards MDGs and other development goals. Climate-sensitive sectors are the priority for addressing climate change through plans and policies, particularly within the water and agriculture sectors. DFID-I will need to work towards support mechanisms for an enabling environment that facilitates the routine assessment of climate risks and opportunities. This will include knowledge exchange on climate change risks, and in-country analysis of India’s global role, as well as supporting key institutional planning and policy processes.

Increased attention will also be needed to support rural agriculture and sustainable natural resource use. Support may include weather-based insurance programmes, enhanced water and soil conservation measures, extension services and knowledge transfer, development and dissemination of improved early warning systems, and more widespread disaster risk reduction measures. At the same time, climate change also provides renewed impetus for livelihood diversification to reduce over-reliance on the natural environment in an uncertain climate future.

As greater numbers migrate to urban areas, adaptation will need to address urban climate shocks, including flooding, heatwaves and windstorms. Planning systems are a particularly important target for improving climate risk management, especially in infrastructure development and land use planning.

For **global India**, national climate change adaptation can build on cooperative processes for creating an enabling environment for both the public and private sectors. DFID entry points for global dimensions of adaptation for India include facilitating dialogues across sectors, applied research cooperation and an extended role for private sector investment in reducing climate vulnerability.

The inputs, process and results of this screening exercise demonstrate that for the country as a whole, engagement must be underpinned by a broad-based strengthening of analytical capacity for change impacts across sectors and scales. Working to strengthen international climate change architecture under the UNFCCC so that it operates with a focus on the poor and most vulnerable will be central to such engagement. Internationally, a framework for action will require supporting better analysis of the implications of different policy options for

India, the development of international adaptation financing, and consideration of how carbon markets can contribute to poverty reduction.

Adaptation is a necessity given that anomalous climate patterns are already evident and that an inevitable amount of change is now locked into the climate system. However, adaptation remains a palliative approach rather than a ‘cure’. Efforts to work with India and other nations to create an effective and equitable international climate change agreement for the post-2012 period therefore remain an urgent priority for tackling climate change impacts.

Finally, the trans-boundary nature of climate change impacts, both across Indian states and internationally, are a vital entry point for international cooperation. Disaster early warning systems that connect preparedness plans across borders and water-sharing agreements are likely to become increasingly important to ensure resilience and equitable water management across regions. Facilitated efforts to promote dialogue and knowledge transfer will be crucial to successful intra- and inter-national cooperation in these areas.

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