The Economics of Early Response and Resilience:
Lessons from Bangladesh

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Acronyms

BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDRCS	Bangladesh Red Crescent Society
BCG	Boston Consulting Group
BDT	Bangladesh Taka (local currency)
CCM	Community Case Management
CFW	Cash for Work
CHW	Community Health Worker
CPP	Cyclone Preparedness Programme
DALY	Disability Adjusted Life Years
DFID	Department for International Development
EACC	Economics of Adaptation to Climate Change
ER	Enhancing Resilience programme
EWS	Early Warning Systems
FTS	Financial Tracking Service
GAM	Global Acute Malnutrition
GDP	Gross Domestic Product
GHA	Global Humanitarian Assistance
HEA	Household Economy Analysis
IFRC	International Federation of Red Cross and Red Crescent Societies
MAM	Moderate Acute Malnutrition
SAM	Severe Acute Malnutrition
UNDP	United Nations Development Programme
VGD	Vulnerable Group Development programme
WFP	World Food Programme

1 Introduction

1.1 Introduction

The impacts of natural disasters and complex emergencies have been increasing over recent decades, putting the humanitarian system under considerable pressure. The costs of humanitarian crises are also growing – not only do disasters and complex emergencies result in significant economic losses, but they also require mobilization of large amounts of humanitarian aid from the international community.

It is widely held that, broadly speaking, investment in early response and/or building the resilience of communities to cope with risk in disaster prone regions is more cost-effective than the ever-mounting humanitarian response. Yet little solid data exists to support this claim, and there is a clear need for a greater evidence base to support reform.

The UK Government commissioned an independent study to contribute to filling these evidence gaps. This report presents the findings from the country study on Bangladesh, and sits within a suite of reports within the Economics of Early Response and Resilience (TEERR) Series (Table 1). More detail and data used to build the findings presented here can be found in the Bangladesh "Country Supporting Document".

1.2 Structure of this Report

This report analyzes available data for Bangladesh. It should be noted that, while the other studies in this series relied heavily on data from the Household Economy Approach (HEA), such data was not available for Bangladesh. The report compares the cost of three scenarios:

- Storyline A: Late humanitarian response;
- Storyline B: Early annual humanitarian response;
- Storyline C: Investment in resilience.

The report is structured as follows:

- **Section 2** provides a very brief overview of the country context.
- **Section 3** assesses the comparative costs, combining national level data and unit costs to derive estimates.
- **Section 4** draws conclusions from the findings.
- **Annex A** contains the detailed calculations from the models.

Table 1: Reports in the Economics of Early Response and Resilience (TEERR) Series

Report Title	Report Content
TEERR Synthesis of Findings:	Summarizes the key findings
TEERR Approach and Methodology:	This report includes the introduction to the study objectives, and the detailed methodology as well as limitations to the analysis.
TEERR Country Reports: • Ethiopia • Kenya • Bangladesh • Mozambique • Niger	The country reports contain a very brief introduction, description of the country/study context, the detailed findings from the analysis, and conclusions/recommendations. These draw together the data presented in the country supporting documents (see below) as well as the HEA report, to model outcomes.
TEERR HEA report:	Contains details of the HEA modelling, assumptions and parameters, as well as modelling output.
Country Supporting Documents	Each country is supported by a report that contains country level detail and data.

2 Country Context

Bangladesh is a low lying alluvial delta located between the Himalayas and the Bay of Bengal. It has a population of over 150 million, is growing at an annual rate of 1.2 percent and has one of the highest population densities in the world placing considerable pressure on the country's natural resources. The most significant feature of the land is the extensive network of large and small rivers that are of primary importance to the socioeconomic life of the nation.

Flooding is a recurrent event in Bangladesh. The majority of its land mass consists of floodplains, and up to 30 percent of the country experiences annual flooding during the monsoon season, while extreme flood events tend to spread over 60 percent of the country. The monsoon rains cause the rivers to overflow and spread vital nutrient rich sediment across the low-lying agricultural and char (sediment created lands within the river systems) lands. This yearly revitalization of the soil has created one of the most fertile regions of the world and is the basis of the agricultural lands of Bangladesh.

The geographic location and geo-morphological conditions of Bangladesh have made it one of the most vulnerable to climate change and variability. Two thirds of its territory is less than five metres above sea level. The combination of frequent natural disasters, high population density and growth, and low resilience against economic shocks, makes Bangladesh particularly vulnerable to these climatic risks. It is ranked as the 5th country in the World Risk Index[1] and ranked 1st (of 162) for floods, 6th (of 89) for cyclones, 3rd (of 76) for Tsunami, and 63rd (of 184) for drought.[2]

Natural disasters have had an enormous impact on the lives and livelihoods of the Bangladeshi people. For the thirty year period, 1980-2010, approximately 191,836 people were killed and it is estimated that over 323 million people were affected--the majority below the poverty line. The direct annual cost to the national economy of natural disasters over the last 10 years (damage and lost production) is estimated to be between 0.5% and 1% of Gross Domestic Product (GDP). As the economy grows, these costs are likely to increase in absolute terms and also as a proportion of GDP, if climate change is not factored into long-term economic planning. The focus on floods and cyclones is based on the sheer number of people affected by these disasters and the frequency of them, as compared with other natural phenomenon.

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[1] United Nations University (2012) *World Risk Report*
http://www.worldriskreport.com/uploads/media/WRR_2012_en_online.pdf
[2] GAR (2009) http://www.preventionweb.net/english/countries/statistics/risk

3 Cost Comparison

This analysis compares the cost of three scenarios:

- Late humanitarian response;
- Early annual humanitarian response; and
- Investment in resilience.

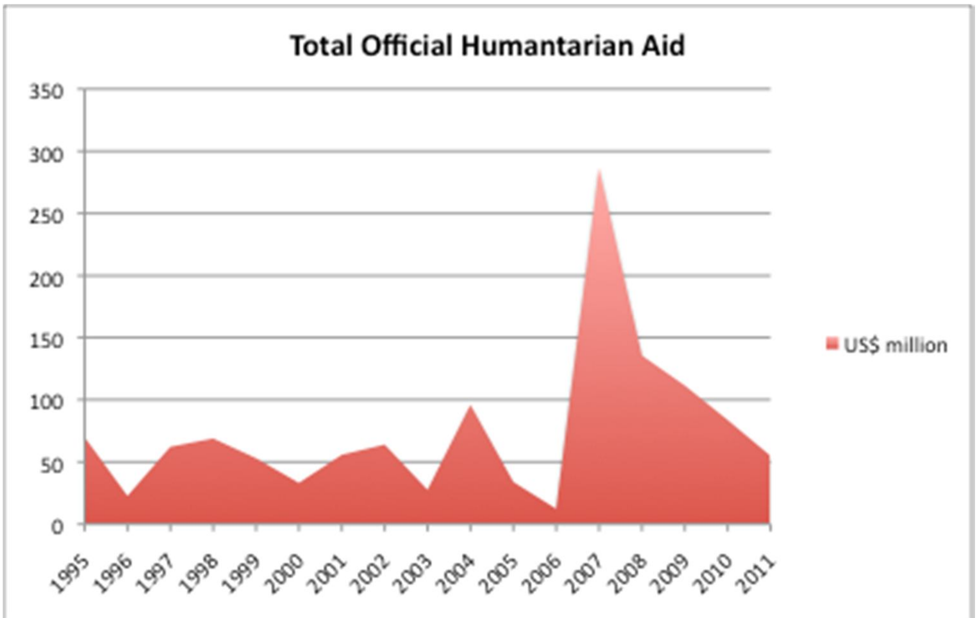
3.1 Late Humanitarian Response

<u>Estimating the cost of late humanitarian response</u>

At the **national level**, total spend on humanitarian aid is estimated by a number of sources:

- The Financial Tracking Service (FTS) estimates **an average spend of $51m per year** on humanitarian aid between 2000 and 2012. However, registration of commitments is voluntary, and therefore not necessarily systematic.
- Global Humanitarian Assistance (GHA) attempts to combine numerous sources of data on humanitarian aid flows, to provide a more complete estimate. Under the GHA, average aid flows between 1995 and 2011 have averaged $75m per year. Between 2000 and 2011 (to be more comparable with FTS estimates), **the average has been $82m per year** (see Figure 1 below – note that the spike in 2007 is in relation to Cyclone Sidr).

Figure 1: GHA Estimate of Humanitarian Aid to Bangladesh (1995-2011)



Data on the **unit costs** of late humanitarian response are as follows:

- Food Aid: According to the World Food Programme (WFP), the cost of food aid in the Chittagong 2012 flood response was $49 per beneficiary (cash and food). According to the Bangladesh Red Crescent Society (BDRCS)[3], the cost of a minimum food basket for a family is Bangladesh Taka (BDT) 3,954 for one month (family size of 5). This is equivalent to $51 per family per month. An average of $50 per beneficiary is assumed here.
- Non-food Aid: According to BDRCS, the cost of non-food items is BDT 175 ($2) per family – this is for kerosene, laundry power, soap, candles, and matches.
- WASH: According to Oxfam[4], the cost of WASH is 6,000 BTK per household (equivalent to $77). Assuming a household of 5 people, this equates to $15 per beneficiary.
- Shelter: According to Oxfam, the cost of temporary shelter is 2,000 TK per household ($26). With a household size of 5, this equates to $5 per beneficiary.
- Nutrition: According to WFP, the cost of nutrition support (blanket supplementary feeding) for Moderate Acute Malnutrition (MAM) was US$52/beneficiary in the 2012 floods.[5] More generally, WFP estimates that the cost of MAM treatment is $46/beneficiary and the package includes 3 months of fortified food supplement and Behavioral Change Communication[6]. The cost of treating Severe Acute Malnutrition (SAM) is $180 per person.[7] In 2009, the average country prevalence of Global Acute Malnutrition (GAM) was 13.5% and SAM was 3.4%.

For the 30 years between 1990 and 2010, an average of more than 10 million people per year have been affected by natural disasters in Bangladesh[8].

Based on the figures presented above, aid (excluding nutrition) is estimated at a cost of $72 per person, or **$720m for an affected population of 10 million**. This is far higher than the actual aid received by Bangladesh, **suggesting that need is nearly 10 times actual aid provided.**

Nutrition is calculated separately based on the lower end of SAM and MAM prevalence rates between 2005 and 2009 to estimate incidence, assuming a 6-month caseload. A study of the 1998 floods revealed that prevalence of GAM was 25.3% in those households that

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[3] Northern Bangladesh Floods Recovery Assessment November 2012 Kurigram, Gaibandha And Jamalpur Districts, IFRC and BDRCS, December 2012

[4] Based on personal communication with Kaiser Rejve, Humanitarian Program Manager and M.B. Akhter, Program Manager, May 12, 2013

[5] Data provided by Ally-Raza Qureshi, Deputy Country Director, WFP Bangladesh

[6] Personal communication, WFP Bangladesh.

[7] Sadler, K., C. Puett, G. Mothabbir, M. Myatt (2011). "Community Case Management of Severe Acute Malnutrition in Southern Bangladesh." Save the Children, Feinstein International Center

[8] Preventionweb – need full reference from Shuman

were “very severely” exposed to floods, as compared with 21% of those that were not exposed. This is a 20% increase, and this figure is applied to the lower bound estimates in “normal” times (14% GAM, 3% SAM) to estimate spikes in need (16.8% GAM, 3.6% SAM). The total population was weighted by 20% to estimate the total number of children under 5. This was then multiplied by prevalence rates, and caseloads were estimated using guidance from Save the Children. T**he total cost of treatment for the whole population of those affected is $557m.** Given that severe floods are estimated to have a 10-year return period (see next section), this is annualized to assume that these costs will only be borne by the humanitarian sector in emergency years, yielding **an average annualized cost of $56m.**

The model is run twice. In the first instance, the lower bound figure of $82m based on historic aid costs is used. In the second instance, the upper bound figure of $720m for aid, and $56m for nutrition, is estimated based on average need and unit costs.

<u>Estimating losses associated with late humanitarian response</u>
A recent report by the International Federation of Red Cross and Red Crescent Societies (IFRC) in Bangladesh[9] details recent severe floods, number of deaths, and economic damage associated with each (Table 2). The average cost is $1.4b per event. This magnitude of flood has an estimated return period of every 5 years, which suggests an average annual loss of $280m related to severe floods alone. Clearly, damages from floods of differing severity, as well as cyclones, and other hazards, would add to this estimate significantly.

Table 2: List of Recent Severe Floods

Year	Inundated Area	Deaths	Economic Damage
1984	50,000km^2	n/a	$0.38 billion
1987	50,000km^2	2,055	$1.0 billion
1988	89,000km^2	2,000-6,500	$1.2 billion
1998	100,000km^2	1,100	$2.8 billion
2004	56,000km^2	700	$2.0 billion
2007	32,000km^2	649	$1.0 billion

On a more comprehensive level, the Economics of Adaptation to Climate Change (EACC) report estimates that the direct annual cost of natural disasters (to the national economy, in terms of damage to infrastructure and livelihoods and losses from foregone production) over the last 10 years has been between 0.5 and 1 per cent of GDP.[10] GDP in Bangladesh in

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[9] IFRC (2012). The long road to resilience: Impact and cost-benefit analysis of community-based disaster risk reduction in Bangladesh.” Geneva.
[10] World Bank (2010). “The Economics of Adaptation to Climate Change: Bangladesh”. Washington, DC.

2012 was $118.7 billion[11], which equates to **estimated annual losses between $594 and $1,187 million.**

Further to this, human loss as a result of cyclones (and associated severe flooding) are significant (and importantly are widely acknowledged to have dropped considerably as a result of government investment in early warning – see following section on early humanitarian response for more detail). In the cyclone of 1991, about 140,000 people died, and this figure is used to estimate loss of life as a result of late response to severe cyclones. The estimated value of lost life years is $13,718 per person.[12] **This equates to a total value of lost life of $1,921 million.** On average, a severe cyclone hits Bangladesh every three years. Cyclones such as Sidr (2009) are estimated to have a return period of every 3-10 years[13]; 10 years is assumed in the model to be conservative.

<u>Total cost of late humanitarian response</u>

Table 3 summarizes the costs and losses described above that are inputted to the model.

Table 3: Summary Table of Cost of Humanitarian Aid and Losses – Late Response

	Amount (USD, millions)
Average Annualized Response Costs 1. Historic: 2. Estimate using unit costs:	 $82m $776m
Average Annualized Losses/Damages:	$594m
Human loss	$1,921m*

*Note that human loss is included every 10th year in the model

The combined impact of the average cost of humanitarian aid year on year, with losses inflated by 5% every five years to reflect increasing caseloads due to erosion of assets,

11 CIA factbook. Note that this estimate is based on the official exchange rate. GDP using a purchasing power parity approach is estimated at $305 billion. https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html

12 The value of lost life is estimated using the World Health Organization guidance and formula. It estimates the years of lost life, based on life expectancy in Bangladesh, life expectancy at death (assumed to be average), and GNI per capita. http://www.who.int/quantifying_ehimpacts/publications/9241546204/en/

13 Teisberg, T. and R. Weiher (2009). "Background Paper on the Benefits and Costs of Early Warning Systems for Major Natural Hazards." The World Bank Group, Global Facility for Disaster Reduction and Recovery.
Subbiah, A.R., L, Bildan, R. Narasimhan (2008). "Background Paper on Assessment of the Economics of Early Warning Systems for Disaster Risk Reduction." World Bank Group, Global Facility for Disaster Reduction and Recovery

results in a **total economic cost discounted over 20 years between $8,479m and $15,292m.**[14]

3.2 Early Humanitarian Response

The main benefits of early humanitarian response that could be quantified for the cost comparison are:

- Reduced unit costs as a result of early procurement;
- Reduced caseloads due to early treatment of malnutrition;
- Reduced losses; and
- Saved lives due to evacuation.

Reduced unit costs as a result of early procurement

Unit costs can be reduced in early humanitarian response either through early procurement and prepositioning resulting in: i) reduced unit costs of food items that can be procured early at a lower price; and/or ii) reduced transportation costs.

Due to the frequency of disasters affecting the country, the markets in Bangladesh have managed to remain resilient in times of disasters with commodities and supplies available almost immediately. Many assessments of flood and cyclone situations have documented the availability of food and materials in local markets immediately after a disaster has occurred. The resilience of markets has been documented by IFRC, Oxfam and the WFP in their assessment activities in response to flood and cyclone events. Further to this, most of the response agencies in Bangladesh already have pipelines in place where supplies are stored and, in the case of floods and cyclones, reports have shown that the level of supplies and food aid are ultimately purchased from the local markets. The government of Bangladesh has its own reserves of rice and wheat that are allocated for humanitarian aid and also to regulate the price of the commodities in the market. The government requires all mills to sell a fixed amount of rice at a pre-negotiated price. Finally, the government has a well-established cash transfer programme that has helped to institutionalize response. As a result, the potential for reduced transportation costs is not so relevant in Bangladesh as it is in other countries.

However, while markets are functioning and therefore facilitate local procurement, there has been a documented increase in the price of relief items during the peak times and immediately after disaster events. The IFRC has documented the market costs in several

[14] See the "TEERR: Approach and Methodology" report for a full description of assumptions underlying the methodology.

assessments.[15] An important note is that while commodities are available in the markets, labour wages were shown to decrease, creating an additional burden on an already vulnerable population. The Bangladesh supporting document has a much more detailed breakdown of the savings in specific commodities, documenting prices both before and after flood events. **For food items, the average price increase that can be avoided by early procurement is 14%** (ranging between a 9% increase for oil and a 39% increase for Atta flour).

Using the estimated cost of approximately $72 per beneficiary for food aid under late humanitarian response, this would equate to a cost under early response of $62 per beneficiary. WFP estimates the cost of cash for work (CFW) as an early response mechanism at $38 per beneficiary (60 days of CFW, based on the Satkhira emergency response of 2012), suggesting an even greater decrease in cost. However, given that the historic estimates of aid seem to fall short of need, the 14% decrease is used here to be conservative.

For an average affected population of 10m each year, **this would equate to a total aid cost of $620m annually.**

<u>Reduced caseloads due to early treatment of malnutrition</u>

The nutrition figures presented above are adjusted to assume that the spike in GAM that occurs as a result of floods (20% increase in very severely exposed households in the 1998 study cited above) can be avoided with early response. Using the lower rates in GAM prevalence (14% GAM and 3% SAM), **the total estimated cost of treatment for the whole population of those affected is $464m.** Given that severe floods are estimated to have a ten-year return period (see next section), this is annualized to assume that these costs will only be borne by the humanitarian sector in emergency years, yielding **an average annualized cost of $46m.**

It is possible that the savings on malnutrition could be even greater. A recent study by Save the Children Bangladesh[16] analysed the effectiveness, in quantitative terms, of community based treatment of SAM (see Section 3.3 below for more detail). They found that **traditional treatment of SAM using inpatient care costs $1,491 per child recovered, as compared with $180 under the early treatment through CCM.** The reason for this is linked to the present "standard of care" for SAM detailed in National guidelines. Current guidance is focused solely on the inpatient management of the condition, which is commonly linked to problems including low coverage and insufficient capacity for good quality treatment.

[15] Northern Bangladesh Floods Recovery Assessment November 2012 Kurigram, Gaibandha And Jamalpur Districts, IFRC and BDRCS, December 2012

[16] Sadler et al (2011)

This figure is not used in the analysis here, because treatment of SAM under a humanitarian emergency is more likely to rely on courses of treatment that do not require inpatient care. However, the lack of early detection will clearly have an impact on caseloads in a humanitarian emergency, and the excessive cost of treating cases under the current system demonstrates significant scope for improved cost efficiencies.

Reduced losses

Two World Bank reports[17] estimate the losses that could be avoided in relation to Cyclone Sidr, and the 2007 floods, if a numeric Early Warning System (EWS)[18] had been in place. Such a system could extend forecast lead times by 5 days, and the areas at risk of heavy rainfall and strong wind could have been identified with greater accuracy. The World Bank estimates the total costs to establish the EWS in Bangladesh at US$2.1m fixed costs, and variable costs at $0.41m per year for 10 years, for a total of $6.2m over 10 years.

As a result of such a weather system, reduced losses are estimated as the result of early harvesting of some crops, and fish, and shrimp, and by reduced losses of household possessions, agricultural equipment, fishery equipment, livestock, and equipment and furniture in offices and schools. In addition, there would have been further reductions in the loss of human life and reductions in the general suffering of the population, but these cost reductions are excluded from this calculation (and this is already covered under a separate calculation in this report). The findings indicate:

- In the case of Cyclone Sidr total monetary damages were estimated at US$1.7 billion, and it is estimated that damages could have been reduced by US$79.14 million (a 5% decrease).
- In the case of the 2007 floods (deemed "moderate"), total monetary damages were approximately $1 billion, and it is estimated that damages could have been reduced by $207.9m (a 20% decrease).
- Both of these events are estimated to have a return period of 5 years in the study, though 10 years has been used in the modelling presented here to be conservative.
- Further to this, the 2008 study estimates the losses associated with a full range of floods in Bangladesh that could be avoided with a numerical EWS in place. They estimate a total avoidable damage cost of $5.2 billion over 30 years (aggregating

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[17] Teisberg, T. and R. Weiher (2009). "Background Paper on the Benefits and Costs of Early Warning Systems for Major Natural Hazards." The World Bank Group, Global Facility for Disaster Reduction and Recovery.
Subbiah, A.R., L, Bildan, R. Narasimhan (2008). "Background Paper on Assessment of the Economics of Early Warning Systems for Disaster Risk Reduction." World Bank Group, Global Facility for Disaster Reduction and Recovery

[18] Numeric weather prediction uses mathematical models to predict the weather and requires computer simulation.

avoided costs associated with floods with a 1, 5, 10, 30 and 50 year return period). This is equivalent to an average annualized avoided loss of $173m.

The potential for reduced losses in a severe cyclone is annualized, assuming a return period of 10 years, equating to avoided annual losses of $8m. This is combined with the average avoided annual losses under flooding, at $173m, **to arrive at a total figure of avoided annual losses of $181m.** This figure is deducted from the total losses assumed under late humanitarian response to estimate losses under early humanitarian response.

Estimating saved lives due to early evacuation

During the 1990s, Bangladesh was lashed by five enormous cyclones. Up to 140,000 people died, most of them during one storm in 1991. But over 2.5 million people were evacuated before the cyclones struck and almost certainly saved lives. This was largely thanks to the cyclone preparedness programme (CPP) initiated in the early 1970s by the IFRC, the BDRCS, and the government of Bangladesh.

The CPP was started after almost 500,000 people died during a cyclone in November 1970. In the cyclone of 1991, about 140,000 people died – but 350,000 were safely evacuated. In May of 1997, a similar cyclone claimed less than 200 lives, while a million people were evacuated into shelters. In the 2007 Cyclone Sidr, only 3,400 died, and in 2009 only 113 died. While direct causality between the CPP and the reduction in lost lives is not proven, evidence from early warning and shelters in other countries has been shown to have a significant impact on reducing loss of life, and hence it can be safely assumed that the CPP has played a role in creating this change.

Over the same period, the CPP was progressively extending its shelters and communications systems. The CPP can now alert around 8 million people across the whole coastal region, of whom it can assist around 4 million to evacuate. The warning system uses Asia’s largest radio network, linking the CPP’s Dhaka headquarters with 143 radio stations. Radio warnings are then relayed by 33,000 village-based volunteers using megaphones and hand operated sirens. The volunteers are also trained to rescue people and evacuate them to shelters, administer first aid and assist in post-cyclone damage assessment and relief.

The cost of the CPP includes the cost of building shelters – 1,600 shelters have been constructed at a cost of US$78k each, for a total of $124.8m. The annual operating costs in 2001 were $460k (funded 56% by government and 44% by IFRC; in the absence of more recent estimates, this figure is used). Running costs for the shelters are estimated at US$780 per year per shelter, or an additional $1.2m, bringing total running costs to $1.7m per year.[19]

Taking a conservative stance, it is assumed that early warning has reduced loss of life by 90% (the figures above suggest this is closer to 98%). The costs of implementing the system are also included in the model.

Total cost of early humanitarian response

Table 4 summarizes the costs and losses described above that are inputted to the model.

The model is run twice:

- In the first model, the actual historic figure on aid costs is used (the lower estimate). This is adjusted for the percentage reduction in food aid costs estimated by the IFRC presented above.
- In the second, the estimated cost based on unit costs per person for the average number of people is used. The aid portion of this is adjusted using the IFRC figures, while the nutrition estimates are adjusted to reflect estimated declines in caseloads.
- Both scenarios use the same figures for estimated losses, loss of life, and cost of the CPP and a numerical EWS.

Table 4: Summary Table of Cost of Humanitarian Aid and Losses – Early Response

	Amount (USD, millions)
Average Annualized Response Costs Historic: Estimate using unit costs:	 $71m $666m
Average Annualized Losses/Damages:	$413m
Human loss	$192m*

*Note that human loss is included every 10th year in the model

The combined impact of the average cost of humanitarian aid year on year, with costs and losses inflated by 5% every five years to reflect increasing caseloads due to erosion of assets, results in a **total economic cost discounted over 20 years between $5,074m and $10,920m.**

It is further estimated that the government has spent approximately $10billion over the last 35 years to make the country less vulnerable to natural disasters. These investments have included flood management schemes, coastal polders, cyclone and flood shelters, the

[19] Cost figures taken from Asian Disaster Reduction Center (n.d.) "Total Disaster Risk Management, Good Practices." http://www.adrc.asia/publications/TDRM2005/TDRM_Good_Practices/PDF/PDF-2005e/Chapter3_3.1.2-1.pdf

raising of roads and highways above flood levels, EWS, community-based disaster preparedness initiatives, as well as introduction of climate resilient rice varieties and other crops, as well as irrigation. The reductions in impact described above are very specific to the activities described. This investment is well above and beyond the evidence provided above, and will have clearly reduced impacts, though no data is available to quantify this.

3.3 Evidence of Additional Benefits of Early Response

The analysis in the previous section presents evidence on the decreased costs/avoided losses associated with early response. This section presents the findings from a WFP study in Bangladesh that has attempted to define some of the wider benefits associated with early response. Further to this, the Save the Children study on early detection and treatment of malnutrition is also presented here, as it elaborates on some of the cost savings that can be achieved.

Cost Benefit Analysis of the WFP Safety Net Programme

A mechanism for early response and future resilience building is a safety net programme. By relying on a combination of cash and food transfers, these programmes are structured to provide reliable and early relief at the first onset of a crisis.

WFP has been running a safety net programme in Bangladesh, and it was the subject of a joint Cost Benefit Analysis by WFP and the Boston Consulting Group (BCG).[20] The analysis focused on two programmes:

- The "Enhancing Resilience" (ER) programme provides cash/food for work and training. Launched in 2008, the programme follows a two-year cycle, and is deployed in those parts of the country that are most vulnerable to climatic shocks. The ER programme is developing flood protection infrastructure through labour-based activities as well as enabling poor households to preserve and accumulate productive assets.
- The "Vulnerable Group Development" (VGD) programme provides food for training. This programme aims at developing marketable skills of women through training, formation of capital through motivating savings and providing scope for future micro-credit. Another important goal of the programme is to build social awareness on disaster management and nutrition through training in groups.

The analysis valued the direct value of the transfer, the return on investment as a result of the additional income, increased productivity, and the change in earnings from a healthier and longer life, and found that the programme had a benefit to cost ratio of 5:1 for the ER

[20] The Boston Consulting Group/World Food Programme (2011). "Country-led Hunger Solutions Task Force: Presentation to the Bangladesh Country Office".

programme, and 12:1 for the VGD programme. In other words, for every one dollar invested in the programme, between 5 and 12 dollars of benefit were returned. Increased productivity accounted for the majority of these benefits (65%).

Early Treatment of SAM

One area that is not addressed so systematically is the case of malnutrition. Bangladesh has the fourth-highest number of children (circa 600,000 at any one time) suffering from severe acute malnutrition (SAM) in the world. A recent study by Save the Children Bangladesh analysed the effectiveness, in quantitative terms, of community based treatment of SAM. The programme employed a cadre of community health workers (CHWs), all local women educated to grade eight, to deliver preventive and curative care to children in target Districts in Barisal Division. In these areas, it has been shown that even where the quality of facility-based services is improved, children from the poorest families are significantly less likely to be brought to health facilities, and may receive lower quality care once they arrive. A household and community component of integrated management of childhood illness is now being rolled out in Bangladesh with the identification and treatment being delivered by CHWs. The addition of the identification and treatment of SAM to the activities of a cadre of CHWs could be an effective mechanism of addressing this common condition.

In the programme site, 724 children under 6 months with SAM were identified, and 11 cases with complications were referred for inpatient care. In the comparison Upazila all children identified with SAM by CHWs were referred. The programme has had very positive effects on the treatment of SAM. Table 5 shows the outcomes for children treated by Community Case Management (CCM) of SAM, as compared with the control community where children were referred to inpatient care. Results show that CHWs were able to identify and treat SAM very early in the course of the disease. This meant that children presented with fewer complications, were easier to treat and there was rarely a need to refer a child for inpatient treatment.

Table 5: Outcomes for Children under CCM and in the Control Group

	Outcomes of Children Treated by CCM of SAM (%) (n=724)	Outcomes of Children Referred to Inpatient Care (%) (n=633)
Cure	91.9%	1.4%
Defaulter	7.5%	7.9%
Death	0.1%	0.3%
Refused hospital referral	n/a	52.9%
Non-responder	0.6%	37.4%

The cost effectiveness of the programme is also significant. Table 6 presents cost per child recovered, amongst other statistics. These figures effectively capture both cost as well as outcomes (in terms of recovery rates). Other studies, which have examined the effectiveness of treatment of SAM in inpatient units that were considerably better resourced than those involved in this study, have demonstrated better outcomes than those presented here. To this end, a "best case" scenario was modelled by applying a modest improvement of 20% to the coverage, recovery, and default rates observed at facility level in the comparison Upazila. Despite this adjustment, **the study nonetheless finds that traditional treatment of SAM using inpatient care costs $1,491 per child recovered, as compared with $180 under the early treatment through CCM.**

Table 6: Cost of Treatment

	Intervention Upazila CCM of SAM	Comparison Upazila Inpatient care *Observed*	Comparison Upazila Inpatient care *Improved*
Total Cost USD	$119,967	$82,324	$90,973
Cost per child recovered USD	$180	$9,149	$1,491
Number of DALYs[21] averted	4,683	67	418
Cost per DALY averted (USD)	$26	$1,344	$214

[21] Disability Adjusted Life Years

Box 1: Multi-year Humanitarian Response

Multi-year humanitarian response can result in the following cost savings above and beyond early humanitarian response: efficiencies in staff costs and proposal writing, prepositioning of stocks, and cost savings from making long term investments.

In the case of Bangladesh, prepositioning is already designed into the system – government and other agencies have established networks and pipelines in place, and rely heavily on local markets for supplies. WFP provided a qualitative analysis of the types of benefits that could be realized through multi-year humanitarian funding, as follows:

- **Pre-positioning food commodities** in hard-to-reach locations during 'normal' times can be a lot cheaper than bringing them in the aftermath of a serious natural disaster (when physical access may be impaired due to flooding, requiring more expensive delivery modalities such as helicopters).
- Economies of scale can also be obtained when WFP is able to **purchase food in larger quantities and when seasonal prices are lowest**. In order to do this, it needs financial resource to be available at the right time.
- With predictable funding, WFP can respond to a disaster very quickly, which – it is known – is essential for **preventing the spread of negative coping mechanisms** (e.g. taking high-interest loans) in the immediate aftermath of a disaster. This can reduce the overall magnitude of the response required in order to enable affected households to 'bounce back'.
- Advance financing would enable WFP to **pre-deploy disaster risk reduction programmes** in vulnerable areas (e.g. the flood plain) and prior to vulnerable periods (e.g. the cyclone seasons). One such WFP programme already exists - the Enhancing Resilience (ER) programme (see previous section for a brief description). This programme requires multi-year and predictable funding in order to be maintained.

3.4 Resilience

Estimating the cost of building resilience

At a national or aggregate level, the cost of building resilience is estimated through a number of government plans.

According to a paper by the Government of Bangladesh/United Nations Development Programme (UNDP), the government has earmarked more than $10 billion in investments for the period 2007 to 2015 to make Bangladesh less vulnerable to natural disasters.[22] This equates to approximately $1.1bn per year.

Along similar lines, the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009 maps out a timeframe and estimated cost to implement the strategy. It is estimated that a

[22] Karim, Z. (2011). "Assessment of Investment and Financial Flows to Adapt to the Climate Change Effects in the Agriculture Sector". Government of the People's Republic of Bangladesh/UNDP.

$500 million programme will need to be initiated in Years 1 and 2 (e.g., for immediate actions such as strengthening disaster management, research and knowledge management, capacity building and public awareness programmes, and urgent investments such as cyclone shelters and selected drainage programmes) and that the total cost of programmes commencing in the first 5 years could be on the order of $5 billion, equating to approximately $1bn per year.[23]

These costs are inputted into the model, at $1,000m per year for the first five years, followed by $500m per year for the five years thereafter. In return, it is assumed that the total losses estimated under early response can be reduced by 10% each year, stabilizing at 10% of the original amount in year 10 to reflect the fact that some risk and loss will always be present. It should be noted that the analysis that follows, which models resilience under climate change, finds that detailed estimates of the cost of adaptation are similar to the costs presented here, and yet are predicted to offset losses in full – suggesting that these assumptions are very conservative, and that the cost of building resilience may be lower still.

Under this scenario, modelled over 20 years at a 10% discount rate, the total cost of building resilience is between $7,761m and $10,485m.

Investment in resilience will yield benefits above and beyond reduced aid costs and losses. For example, the ER and VGD programme are shown to have multiple direct and indirect benefits resulting in returns between $5 and $12 for every $1 spent. Using a very conservative estimate, assuming a return of $1.1 for every dollar spent on resilience, **the resilience scenario results in a cost between $316m and $3,041m over 20 years.**

3.5 Resilience under Climate Change

Climate change is predicted to have a large impact on Bangladesh, and many studies have been conducted addressing the impacts of climate change on the country. In particular, climate change is expected to increase the severity and frequency of natural hazards, as well as exacerbate the vulnerability of some households to such events.

The following analysis is built from evidence presented in the World Bank Economics of Adaptation Study (EACC) for Bangladesh[24], which details damages and losses in relation to cyclones and floods, and the required costs necessary to offset these losses.

Cyclones

[23] Ibid.
[24] World Bank (2010).

Average severe cyclones (equivalent to Sidr) are estimated to have a return period of once every 3 to 10 years. The EACC report assumes 10 years to be conservative. Damages and losses associated with such an event are estimated for the current year, for a baseline scenario in 2050 (in other words without climate change) and for a climate change scenario in 2050. The climate change cost includes the baseline costs (it is not additional).

The analysis then estimates the total costs that would be required to adapt to climate change in 2050. These costs are the estimated investment required to offset the damages and losses. The baseline investment costs equate to approximately $60m per year over the investment time horizon of 40 years (2010 to 2050).

The findings are presented in Table 7.

Table 7: Cyclone Damage and Losses, and Adaptation Costs (Severe Event)

USD Millions	Current	Baseline 2050	Climate Change 2050
Total Damages and Losses per severe event	$1,802m	$4,607m	$9,166
Cost of Adaptation Investment Recurrent (per year)		 $2,462m $50m	 $4,888m $50m

Floods

The costing for floods is much more limited. The "current" figure in the table below is taken from the estimates presented earlier in this report, as it was not calculated in the EACC report.

The analysis does not specify how damages and losses due to flooding will change under climate change. However, the modelling does indicate that the total area that is flooded will increase by 4%, exposing more assets and activities to risk. This is not the only factor that will affect damages and losses – for example, depth, duration, and the value of assets in those locations will all impact damages and losses. However, for the sake of this analysis, 4% is used as a reasonable approximation.

Table 8: Flood Damage and Losses, and Adaptation Costs (Annualized)

USD Millions	Current	Baseline 2050	Climate Change 2050
Total Damages and Losses per severe event	$280m		$291m
Cost of Adaptation Investment Recurrent (per year)			 $2,671 $54m

The cost of adaptation for inland flooding includes road and railway height enhancement, embankments, coastal polders, and an erosion control programme. The cost of protecting against existing risk was not estimated; rather the incremental cost to climate proof for high value assets is listed above. **Full protection in 2050 will also require addressing the existing risks of flooding, which are likely to be of the same of order of magnitude or larger. For this reason, the costs presented in Table 8 are doubled in the analysis.**

The model used in this report is adapted using the data presented above, to create a "Climate Change Scenario". Under this scenario, the following changes to the model are made.

Late humanitarian response

- The original model used estimated average annual losses for floods (1-in-5 year events) at $280m. Total annualized losses due to natural disasters are estimated at $594m. Given that floods and cyclones are the two major natural disaster events, accounting for the bulk of recorded losses, it is assumed that the remainder of the average annual losses is attributable to cyclones (approximately $314m).
- According to the EACC report, cyclone losses are expected to increase 5-fold by 2050 under climate change. This equates to average annual losses under climate change of $1,570. Losses from floods are estimated to increase by 4%, estimated at average annual losses of $291m. This equates to average annual losses of $1,861m in 2050.
- The coastal population in Bangladesh is expected to rise from 3.5m in 2007 (Sidr), to 10m in 2050. This increase is used to estimate the increase in aid/nutrition under a 2050 climate change scenario (a threefold increase).
- Loss of life is similarly inflated according to population growth, but the proportion of lost lives to the total population is assumed to stay stable.
- The same assumptions under early response are applied here. Losses were assumed to reduce to 68% of the total under late humanitarian response, as a result of the CPP and the numerical EWS, and the same proportion is applied under the 2050 climate change scenario. The cost of the CPP is inflated three-fold to account for coastal population growth.

- The total cost of adaptation for cyclones is $4,888m, and the cost for floods (doubled per note above) is $5,342m, giving a total investment cost of $10,230m (this is very much in line with the Government of Bangladesh/UNDP and the BCCSAP estimates provided earlier). Ongoing recurrent costs are estimated at $104m ($50m for cyclones and $54m for floods). The full investment cost is spread over the first 5 years of the model, with recurrent costs persisting for the remaining 15 years in the model. It is assumed in the EACC report that these costs will fully offset the losses associated with drought and cyclones. To be conservative, 10% of aid and losses under early response are included in the model each year.

3.6 Bangladesh - Comparison of Costs

The modelling suggests that early response could reduce humanitarian spend and losses by $3.4 to $4.4 billion over a 20 year period, or an average of $219m per year.

Table 9: Baseline Scenario: Summary of National Level Cost Estimates over 20 years (discounted)

	Humanitarian	**Early Response**	**Resilience**	**Resilience – With benefits**
Model 1: Historic Aid Costs	$8,479m	$5,074m	$7,761m	$316m
Model 2: Unit costs of Aid	$15,292m	$10,920m	$10,485m	$3,041m

The modelling indicates that resilience costs less than late humanitarian response under both models. This is purely a cost comparison. When the potential additional benefits of resilience are included, the costs are significantly lower than even early response. **Under model 2, investing in resilience could save a minimum of $12 billion over 20 years.** While there is still a cost associated with building resilience, the assumptions around the benefits are so conservative (1.1:1) that it is certain that these costs would be diminished if not reversed as a result of additional development gains not modelled here.

These factors are combined to model the "value for money" of investing in resilience. The costs of building resilience are offset against the benefits – the reduced aid cost, as well as a very conservative assumption around the additional benefits that would accrue from investments in resilience that deliver significant health, education and other gains. **When the costs of building resilience are offset against the benefits, the benefit to cost ratio is between 5.0 and 6.4 : 1. In other words, for every $1 spent on resilience, between $5.0 and $6.4 of benefits are gained.**

Table 10: Climate Change Scenario: Summary of National Level Cost Estimates over 20 years (discounted)

	Humanitarian	Early Response	Resilience	Resilience – With benefits
Model 1: Historic Aid Costs	$26,213m	$15,474m	$10,577m	$598m
Model 2: Unit costs of Aid	$46,651m	$33,010m	$12,331m	$2,352m

When the costs are considered in a future climate change scenario in 2050, the findings are even more staggering. Under climate change, early response could save between $10.7 billion and $13.5 billion, and resilience could save between $15.6 billion and $34.3 billion over a 20-year period, based only on a cost comparison. When the costs of building resilience are offset against the benefits, the benefit to cost ratio is between 8.4 and 11.9 : 1. In other words, for every $1 spent on resilience, between $8.4 and $11.9 of benefits are gained.

4 Conclusions

4.1 Conclusions

The evidence above clearly points to the following conclusions:

Early response is far more cost effective than late humanitarian response. The assumptions used in this analysis were conservative, and the findings nonetheless indicate that early response can decrease costs and losses substantially. National level figures, modelled over 20 years, suggest that savings from early response could reduce humanitarian spend and losses by $3.4 to $4.3 billion over a 20 year period, or an average of $215m per year. A perceived risk in responding early is that humanitarian funds will be released incorrectly to situations that turn out not to be a disaster. However, these figures suggest that donors could mistakenly release funds two to three times in Bangladesh before the cost is even equivalent to the cost of humanitarian aid in one event.

Resilience saves even more money still, on the order of $12 billion over 20 years as compared with late response. This figure is based on the modelling that accounted for the actual estimated unit cost of aid, and the number of people requiring aid each year (as opposed to the actual disbursed aid, which seems to be well below estimated levels of need).

When the costs are considered in a future climate change scenario in 2050, the findings are even more staggering. Under climate change, early response could save between $10.7 billion and $13.5 billion, and resilience could save between $15.6 billion and $34.3 billion over a 20-year period, based only on a cost comparison.

Resilience building and climate change adaptation measures should be the overwhelming priority response. The losses associated with climate change suggest that investment in long-term resilience/adaptation are imperative.

Annex A: Model Calculations

Historic Aid model

USD MILLIONS																
YEAR	Late Humanitarian Response					Early response							Resilience			
	Aid (needs)	Losses	Loss of Life	Total	Present Value	Aid (needs)	Losses	Loss of life	Cost - CPP	Cost - EWS	Total	Present Value	Cost	Residual Risk	Benefits	Present Value
0	82	594		676	676	71	413		124.8	2.1	610	610	1,000	484	0	1,484
1	82	594		676	615	71	413		1.7	0.4	486	441	1,000	435	0	1,305
2	82	594		676	559	71	413		1.7	0.4	486	401	1,000	387	0	1,146
3	82	594		676	508	71	413		1.7	0.4	486	365	1,000	338	0	1,006
4	82	594	1,921	2,597	1,774	71	413	192	1.7	0.4	678	463	1,000	405	0	960
5	86	624		710	441	74	434		1.7	0.4	510	317	500	254	0	468
6	86	624		710	401	74	434		1.7	0.4	510	288	500	203	0	397
7	86	624		710	364	74	434		1.7	0.4	510	262	500	152	0	335
8	86	624		710	331	74	434		1.7	0.4	510	238	500	102	0	281
9	86	624		710	301	74	434		1.7	0.4	510	216	500	51	0	234
10	90	655		745	287	78	455		1.7		535	206		53	0	21
11	90	655		745	261	78	455		1.7		535	187		53	0	19
12	90	655		745	237	78	455		1.7		535	170		53	0	17
13	90	655		745	216	78	455		1.7		535	155		53	0	15
14	90	655	1,921	2,666	702	78	455	192	1.7		727	191		73	0	19
15	95	688		783	187	82	478		1.7		561	134		56	0	13
16	95	688		783	170	82	478		1.7		561	122		56	0	12
17	95	688		783	155	82	478		1.7		561	111		56	0	11
18	95	688		783	141	82	478		1.7		561	101		56	0	10
19	95	688		783	128	82	478		1.7		561	92		56	0	9
Total	1,767	12,801	3,842	18,410	**8,454**	1,520	8,900	384	157	6	10,967	**5,072**	7,500	3,377	0	**7,760**

BCR

BCR	4.94				
COSTS		BENEFITS			
Cost	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
1,000	1,000	192	1,100	1,292	1,292
1,000	1,000	241	1,100	1,341	1,341
1,000	1,000	289	1,100	1,389	1,389
1,000	1,000	338	1,100	1,438	1,438
1,000	1,000	2,192	1,100	3,292	3,292
500	500	456	1,100	1,556	1,556
500	500	507	1,100	1,607	1,607
500	500	557	1,100	1,657	1,657
500	500	608	1,100	1,708	1,708
500	500	659	1,100	1,759	1,759
0	0	692	1,100	1,792	1,792
0	0	692	1,100	1,792	1,792
0	0	692	1,100	1,792	1,792
0	0	692	1,100	1,792	1,792
0	0	2,594	1,100	3,694	3,694
0	0	727	1,100	1,827	1,827
0	0	727	1,100	1,827	1,827
0	0	727	1,100	1,827	1,827
0	0	727	1,100	1,827	1,827
0	0	727	1,100	1,827	1,827
7,500	7,500	15,034	22,000	37,034	37,034

Estimated Need Model

USD MILLIONS												
YEAR	Late Humanitarian Response					Early response						
	Aid (needs)	Losses	Loss of Life	Total	Present Value	Aid (needs)	Losses	Loss of life		Cost	Total	Present Value
0	776	594		1,370	1,370	666	413		124.8	2.1	1,206	1,206
1	776	594		1,370	1,245	666	413		1.7	0.4	1,081	983
2	776	594		1,370	1,132	666	413		1.7	0.4	1,081	893
3	776	594		1,370	1,029	666	413		1.7	0.4	1,081	812
4	776	594	1,921	3,291	2,248	666	413	192	1.7	0.4	1,273	870
5	815	624		1,439	893	699	434		1.7	0.4	1,135	705
6	815	624		1,439	812	699	434		1.7	0.4	1,135	641
7	815	624		1,439	738	699	434		1.7	0.4	1,135	582
8	815	624		1,439	671	699	434		1.7	0.4	1,135	530
9	815	624		1,439	610	699	434		1.7	0.4	1,135	481
10	856	655		1,510	582	734	455		1.7		1,191	459
11	856	655		1,510	529	734	455		1.7		1,191	418
12	856	655		1,510	481	734	455		1.7		1,191	380
13	856	655		1,510	438	734	455		1.7		1,191	345
14	856	655	2,017	3,527	929	734	455	202	1.7		1,393	367
15	898	688		1,586	380	771	478		1.7		1,251	299
16	898	688		1,586	345	771	478		1.7		1,251	272
17	898	688		1,586	314	771	478		1.7		1,251	247
18	898	688		1,586	285	771	478		1.7		1,251	225
19	898	688		1,586	259	771	478		1.7		1,251	205
Total	16,723	12,801	3,938	33,462	**15,292**	14,353	8,900	394	157	6	23,810	**10,920**

BCR

BCR	6.41				
COSTS		BENEFITS			
Cost	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
1,000	1,000	291	1,100	1,391	1,391
1,000	1,000	399	1,100	1,499	1,499
1,000	1,000	507	1,100	1,607	1,607
1,000	1,000	615	1,100	1,715	1,715
1,000	1,000	2,528	1,100	3,628	3,628
500	500	872	1,100	1,972	1,972
500	500	985	1,100	2,085	2,085
500	500	1,099	1,100	2,199	2,199
500	500	1,212	1,100	2,312	2,312
500	500	1,325	1,100	2,425	2,425
0	0	1,391	1,100	2,491	2,491
0	0	1,391	1,100	2,491	2,491
0	0	1,391	1,100	2,491	2,491
0	0	1,391	1,100	2,491	2,491
0	0	3,388	1,100	4,488	4,488
0	0	1,461	1,100	2,561	2,561
0	0	1,461	1,100	2,561	2,561
0	0	1,461	1,100	2,561	2,561
0	0	1,461	1,100	2,561	2,561
0	0	1,461	1,100	2,561	2,561
7,500	7,500	26,092	22,000	48,092	48,092

TEERR: Bangladesh

Historic Aid + Climate Change Model

YEAR	Late Humanitarian Response					Early response						
	Aid (needs)	Losses	Loss of Life	Total	Present Value	Aid (needs)	Losses	Loss of life		Cost	Total	Present Value
0	2,328	1,861		4,189	4,189	1,998	1,265		374.4	2.1	3,640	3,640
1	2,328	1,861		4,189	3,808	1,998	1,265		5.1	0.4	3,269	2,972
2	2,328	1,861		4,189	3,462	1,998	1,265		5.1	0.4	3,269	2,702
3	2,328	1,861		4,189	3,147	1,998	1,265		5.1	0.4	3,269	2,456
4	2,328	1,861	5,763	9,952	6,797	1,998	1,265	576	5.1	0.4	3,845	2,626
5	2,444	1,954		4,398	2,731	2,098	1,329		5.1	0.4	3,432	2,131
6	2,444	1,954		4,398	2,483	2,098	1,329		5.1	0.4	3,432	1,937
7	2,444	1,954		4,398	2,257	2,098	1,329		5.1	0.4	3,432	1,761
8	2,444	1,954		4,398	2,052	2,098	1,329		5.1	0.4	3,432	1,601
9	2,444	1,954		4,398	1,865	2,098	1,329		5.1	0.4	3,432	1,456
10	2,567	2,052		4,618	1,781	2,203	1,395		5.1		3,603	1,389
11	2,567	2,052		4,618	1,619	2,203	1,395		5.1		3,603	1,263
12	2,567	2,052		4,618	1,472	2,203	1,395		5.1		3,603	1,148
13	2,567	2,052		4,618	1,338	2,203	1,395		5.1		3,603	1,044
14	2,567	2,052	6,051	10,670	2,810	2,203	1,395	605	5.1		4,208	1,108
15	2,695	2,154		4,849	1,161	2,313	1,465		5.1		3,783	906
16	2,695	2,154		4,849	1,055	2,313	1,465		5.1		3,783	823
17	2,695	2,154		4,849	959	2,313	1,465		5.1		3,783	748
18	2,695	2,154		4,849	872	2,313	1,465		5.1		3,783	680
19	2,695	2,154		4,849	793	2,313	1,465		5.1		3,783	619
Total	50,170	40,106	11,814	102,090	**46,651**	43,058	27,272	1,181	471	6	71,989	**33,010**

BCR

BCR	8.39				
COSTS		BENEFITS			
Cost	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
2,046	2,046	1,959	2,251	4,210	4,210
2,046	2,046	1,959	2,251	4,210	4,210
2,046	2,046	1,959	2,251	4,210	4,210
2,046	2,046	1,959	2,251	4,210	4,210
2,046	2,046	7,665	2,251	9,915	9,915
104	104	2,057	2,251	4,308	4,308
104	104	2,057	2,251	4,308	4,308
104	104	2,057	2,251	4,308	4,308
104	104	2,057	2,251	4,308	4,308
104	104	2,057	2,251	4,308	4,308
104	104	2,160	2,251	4,411	4,411
104	104	2,160	2,251	4,411	4,411
104	104	2,160	2,251	4,411	4,411
104	104	2,160	2,251	4,411	4,411
104	104	8,151	2,251	10,401	10,401
104	104	2,268	2,251	4,519	4,519
104	104	2,268	2,251	4,519	4,519
104	104	2,268	2,251	4,519	4,519
104	104	2,268	2,251	4,519	4,519
104	104	2,268	2,251	4,519	4,519
11,790	11,790	53,920	45,012	98,932	98,932

TEERR: Bangladesh

Estimated Need + Climate Change Model

USD MILLIONS												
YEAR	Late Humanitarian Response					Early response						
	Aid (needs)	Losses	Loss of Life	Total	Present Value	Aid (needs)	Losses	Loss of life		Cost	Total	Present Value
0	2,328	1,861		4,189	4,189	1,998	1,265		374.4	2.1	3,640	3,640
1	2,328	1,861		4,189	3,808	1,998	1,265		5.1	0.4	3,269	2,972
2	2,328	1,861		4,189	3,462	1,998	1,265		5.1	0.4	3,269	2,702
3	2,328	1,861		4,189	3,147	1,998	1,265		5.1	0.4	3,269	2,456
4	2,328	1,861	5,763	9,952	6,797	1,998	1,265	576	5.1	0.4	3,845	2,626
5	2,444	1,954		4,398	2,731	2,098	1,329		5.1	0.4	3,432	2,131
6	2,444	1,954		4,398	2,483	2,098	1,329		5.1	0.4	3,432	1,937
7	2,444	1,954		4,398	2,257	2,098	1,329		5.1	0.4	3,432	1,761
8	2,444	1,954		4,398	2,052	2,098	1,329		5.1	0.4	3,432	1,601
9	2,444	1,954		4,398	1,865	2,098	1,329		5.1	0.4	3,432	1,456
10	2,567	2,052		4,618	1,781	2,203	1,395		5.1		3,603	1,389
11	2,567	2,052		4,618	1,619	2,203	1,395		5.1		3,603	1,263
12	2,567	2,052		4,618	1,472	2,203	1,395		5.1		3,603	1,148
13	2,567	2,052		4,618	1,338	2,203	1,395		5.1		3,603	1,044
14	2,567	2,052	6,051	10,670	2,810	2,203	1,395	605	5.1		4,208	1,108
15	2,695	2,154		4,849	1,161	2,313	1,465		5.1		3,783	906
16	2,695	2,154		4,849	1,055	2,313	1,465		5.1		3,783	823
17	2,695	2,154		4,849	959	2,313	1,465		5.1		3,783	748
18	2,695	2,154		4,849	872	2,313	1,465		5.1		3,783	680
19	2,695	2,154		4,849	793	2,313	1,465		5.1		3,783	619
Total	50,170	40,106	11,814	102,090	**46,651**	43,058	27,272	1,181	471	6	71,989	**33,010**

BCR

BCR	**11.87**				
COSTS		BENEFITS			
Cost	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
2,046	2,046	3,863	2,251	6,113	6,113
2,046	2,046	3,863	2,251	6,113	6,113
2,046	2,046	3,863	2,251	6,113	6,113
2,046	2,046	3,863	2,251	6,113	6,113
2,046	2,046	9,568	2,251	11,819	11,819
104	104	4,056	2,251	6,306	6,306
104	104	4,056	2,251	6,306	6,306
104	104	4,056	2,251	6,306	6,306
104	104	4,056	2,251	6,306	6,306
104	104	4,056	2,251	6,306	6,306
104	104	4,259	2,251	6,509	6,509
104	104	4,259	2,251	6,509	6,509
104	104	4,259	2,251	6,509	6,509
104	104	4,259	2,251	6,509	6,509
104	104	10,249	2,251	12,500	12,500
104	104	4,472	2,251	6,722	6,722
104	104	4,472	2,251	6,722	6,722
104	104	4,472	2,251	6,722	6,722
104	104	4,472	2,251	6,722	6,722
104	104	4,472	2,251	6,722	6,722
11,790	11,790	94,939	45,012	139,951	139,951