The Economics of Early Response and Resilience: Lessons from Niger

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June 2013

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Acronyms

ARC	Africa Risk Capacity Facility
CAP	Consolidated Appeal Process
DFID	Department for International Development
EWS	Early Warning Systems
FAO	Food and Agriculture Organisation of the United Nations
FTS	Financial Tracking Service
GAM	Global Acute Malnutrition
GDP	Gross Domestic Product
GHA	Global Humanitarian Assistance
GNI	Gross National Income
HEA	Household Economy Analysis
MAM	Moderate Acute Malnutrition
MT	Metric Tonnes
NFI	Non Food Items
PLW	Pregnant and Lactating Women
RFE	Rainfall Estimates
SAM	Severe Acute Malnutrition
SWC	Soil and Water Conservation
U2	Children Under Age 2
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 Niger, and sits within a suite of reports within the Economics of Early Response and Resilience (TEERR) Series (Table 1). The study relies heavily on the Household Economy Approach (HEA) to model impacts of crises. More detail and data used to build the findings presented here can be found in the "TEERR HEA report" as well as the Niger "Country Supporting Document".

1.2 Structure of this Report

This report analyzes available data for Niger, along with HEA modelled data, to compare 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 from a bottom-up perspective – using disaggregated project and sector level estimates to compare the cost of response.
Section 4 assesses the comparative costs from a top-down perspective – using aggregate level costs and losses for the country as a whole.
- **Section 5** draws conclusions from the findings.
- **Annex A** contains data provided by WFP for this analysis.
- **Annex B** contains detailed calculations that support the analysis.

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

Niger, a landlocked nation of the West African Sahel, is one of the world's most vulnerable countries, second only to Eritrea, according to the 2012 World Risk Report.[1] Niger is ranked last, at 186th place, in the 2012 edition of the UN Human Development Report.[2]

In Niger, environmental fragility, high population growth and pervasive extreme poverty combine to limit the population's ability to absorb and recover from recurring drought. Niger's environment is extremely fragile: three quarters of the country receives less than 300mm of annual precipitation, confining agriculture to the southern third of the country. Drought is a common feature of the climate, affecting Niger in one out of every three years[3].

Demographic factors explain why droughts have broad social impacts. Niger remains a very rural society: with 8 of every 10 Nigeriens living in rural areas that rely on rain-fed agriculture, droughts affect large sections of the population. The country's population, estimated at some 17 million in 2013, is increasing by 3.9% annually, representing one of the highest demographic growth rates in the world. Strong demographic growth has strained social service provision and natural resources. Growth in the rural population has meant that farmers have brought ever more marginal land under cultivation, especially in the drought-prone agro-pastoral zone.

Pervasive poverty in Niger means that capacities to prepare for, and absorb and recover from, drought are limited. Although there has been some progress in reducing poverty levels in recent years, 59.5% of Nigeriens continue to live below the national poverty line; Gross National Income (GNI) per capita stands at $360. Literacy rates are very low, especially for women, of whom only 15% were able to read and write in 2005[4]. Due to severe poverty, Nigeriens are on the edge between survival and insecurity; the onset of a moderate drought can prove a tipping point for the most vulnerable.

While surveys have confirmed the existence of widespread chronic food and nutrition insecurity, acute needs arise every year during the annual lean season, regardless of whether there has been a drought. Droughts tend to magnify the seasonal increase in these acute needs. Niger is in the midst of a protracted food crisis whose severity varies by season

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[1] United Nations University (2012) Environmental degradation increases disaster risk worldwide . http://www.ehs.unu.edu/article/read/worldriskreport-2012
[2] UNDP (2013) Human Development Report. http://hdr.undp.org/en/statistics/
[3] World Bank (2013). "Agricultural Sector Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management."
[4] World Bank (2013) World Development Indicators. http://data.worldbank.org/country/niger#cp_wdi

and according to the performance of annual rains. It is difficult to make a distinction between people who are chronically hungry, and those who are only hungry during the lean season.

Government surveys conducted since 2005 indicate that in a typical year, at least one household out of five is food insecure in the aftermath of the harvest; this proportion - itself subject to seasonal increases - rises during drought years. For instance, during the 2010 lean season, close to half of the population was moderately or severely food insecure.

Over the past decade, successive drought episodes have affected household food security in pastoral and agro-pastoral areas the most, and especially for the poorest in those areas. Households in the agricultural zone were somewhat less affected. Successive drought events have led to an erosion of household assets and livelihoods, reduced productive capacity, longer migration cycles, weakened social networks and increased dependence on aid. Low production and low incomes force households to sell their food stocks at harvest at low prices, to meet urgent vital needs, leaving them without reserves and therefore dependent on purchases during the lean season when food prices are highest.

Even when a food crisis is followed by a good crop, households remain food insecure due to reduced livestock holdings, loss of assets and the general weakening of their livelihoods. This insight is confirmed by a trend analysis of household food security indicators from 2007 through 2011. That analysis show that the recovery times for household food security indicators is at least 3 years in drought-affected districts of pastoral and agro-pastoral areas of Niger. Good agro-climatic conditions in the year following a drought are not sufficient to bring household food security indicators back to pre-crisis levels.

3 Bottom-up Assessment

3.1 Introduction

The HEA modelling estimates the food deficit for drought in agricultural and agro-pastoral areas of Niger, in 28 livelihood zones with a population of approximately 5.2m people (out of a total population of 17m).

The modelling conducted for this analysis uses historic data to identify high, medium and low magnitude droughts, their characteristics, and their return period. These were then introduced into a 20-year HEA model (see “TEERR HEA Report” for more detail) that assumes the following drought recurrence:

- High magnitude drought: once every 6 to 7 years
- Medium magnitude drought: once every 5 years
- Low magnitude drought: once every 5 years

The severity of drought in Niger is such that drought events are skewed towards either the more severe / high magnitude or lower magnitude events, with few drought events occurring in the middle-range between high and low between the 1996-2012 period over which rainfall estimates (RFE) were analysed. This means that medium magnitude drought events in Niger are still quite severe, particularly when augmented by pests such as locusts, which occurred, for instance, in the 2004 drought. The resulting 2005 food crisis was also due to the instability in markets in Nigeria, which caused grain prices to double in Niger. The presence of these additional factors are likely to have increased the actual impacts of that drought to an equivalent of a high magnitude drought.

Each year of the model feeds into the next, with each drought event affecting levels of need in subsequent years. The model provides an estimate of the number of people with a food deficit, as well as the total magnitude of that deficit, for each of the 20 years. These are then valued using data on the cost of response.

The timing of droughts of different magnitude in the model has minimal impact on the total need estimated by the HEA. In other words, whether a high magnitude drought happens in the first year, or the 10th year, the total impact on the estimated food deficit will alter only slightly as a result of herd dynamics – the majority of the impact on food deficit will not change. However, the modelled cost of response will vary in this regard with respect to discount rates – in other words, a loss today is valued more highly than a loss in a later year. As a result, if a high magnitude drought is accounted for in the middle of the 20 year model, the losses will be understated in comparison with a high magnitude drought in year one (which is the scenario used in the model presented here). This can be controlled for by lowering the discount rate, and this is done in the sensitivity testing. This has no impact on the comparison between scenarios, however; because the timing of the high magnitude drought is the same in all of the modelled storylines, they are comparing like with like.

It should be noted that the aim of the study is to test a methodology for evaluating the *economics* of building resilience, particularly as compared with humanitarian response. Economic analysis is only one facet of the analysis – social, moral, political and institutional factors all have a bearing on prioritization. As a result, ***this study is not trying to provide a list of interventions that should be prioritized for reducing the impact of crises – rather it is providing insight into the economics of various choices, to contribute to a much wider decision-making framework.*** Along similar lines, this study is not looking to evaluate what types of interventions deliver impact at scale – this is dependent on a whole host of factors that are outside the scope of this analysis. Rather, it is attempting to assess the level of impact that could occur if things are done differently, using specific measures as proxies.

3.2 Late Humanitarian Response

<u>Unit cost of late humanitarian response</u>
Food Aid: According to the World Food Programme (WFP) (see Annex A), food aid under late humanitarian response costs $1,171 per MT (this equates to $51 per beneficiary based on the total deficits modelled under the HEA, which is roughly in line with other estimates listed in the country supporting document). This is combined with the total deficit measured in Metric Tonnes (MT) for each of the 20 years in the HEA modelling (see caseloads below).

Non-food Items: The Consolidated Appeal Process (CAP) for Niger details costs by sector for humanitarian response. The total amount allocated for food and non-food items (NFI) is approximately $371m, of which NFI is $95m, or 25% of the total cost. Therefore total food aid costs are marked up by 25% in each year of the model to account for NFI.

Malnutrition: In a non-crisis year, Global Acute Malnutrition (GAM) prevalence in Niger is around 11-13% of the population. Severe Acute Malnutrition (SAM) prevalence is typically around 2%, suggesting that Moderate Acute Malnutrition (MAM) prevalence is around 10%. In 2005 and 2010 – crisis years – GAM prevalence increased to 15-17%. SAM prevalence is typically around 3% in crisis years, resulting in a MAM prevalence of about 12% (using a conservative figure). (See Table 2 for full details – note that all of these figures are from the lean season).

Table 2: GAM and SAM Rates from the Bi-Annual SMART Surveys[5]

	2012	2011	2010	2009	2008	2007
GAM (%)	14.8	12.3	16.7	12.3	11.6	12.3
SAM (%)	3	1.9	3.2	2.1	2.8	2.5

The population in 2013 was 16.9m people, and it is assumed that children U5 and pregnant and lactating women (PLWs) are treated collectively, and represent 25% of the population affected (the cost of treating PLWs is similar to the cost for children, based on the WFP supporting document). Based on these figures, and estimating incidence using a factor of 1.6 times prevalence, for a 6-month period of humanitarian response, the estimated number of cases of SAM in a non-crisis year are 109,850, and the number of cases of MAM are 659,100.[6] In a crisis year, the estimated number of cases of SAM is 164,775, and the number of cases of MAM is 878,800.

However, it is also documented that the total number of children requiring assistance for SAM never seems to fall far below 300,000 in Niger, and in 2012 this figure rose to 393,000[7]. In Niger, it is typically found that caseloads exceed figures presented in prevalence surveys, and there are a variety of explanations for this (including issues over survey data, and influx of Nigerians who require treatment). This elevated caseload is the number of people that WFP typically treats in an emergency, and hence these figures are used in the SAM calculations.

As a result, in a late humanitarian response, it is assumed that 1,043,575 children under 5 and PLWs require treatment for acute malnutrition (based on GAM rates). Of this, 370,000 require treatment for SAM, and the remainder of cases – 673,575 – are treated for MAM. It should be noted, however, that data on actual caseloads of MAM was not available as it was for SAM, and hence MAM figures are likely to be underestimated here.

The costs of treating MAM and SAM are only included in high and medium magnitude drought events. In low/no magnitude drought events, there is unlikely to be a humanitarian

[5] Data is a compilation from several sources:
http://www.unicef.org/wcaro/wcaro_Enquete_nutrition_Niger_2009_ECHO_UNICEF.pdf
http://www.google.it/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=9&ved=0CHMQFjAI&url=http%3A%2F%2Fochadms.unog.ch%2Fquickplace%2Fcap%2Fmain.nsf%2Fh_Index%2FCAP_2011_Niger_FR%2F%24FILE%2FCAP_2011_Niger_FR.doc%3FopenElement&ei=QDKjUc_zFo6qOu7qgPgG&usg=AFQjCNGdQG3BPIoRrNy0aknWoXe4EY8y8g&sig2=0v95LjWwZTPKp-93BJO8cQ
http://www.unocha.org/cap/appeals/appel-global-pour-le-niger-2012
http://foodsecuritycluster.net/sites/default/files/Note_Synth%C3%A8se_Enquete_Nutrition_2012_VF.pdf

[6] Save the Children guidance on calculating SAM and MAM prevalence and incidence is used to make these calculations.

[7] See Niger country supporting document for greater detail.

response, and therefore these costs are not included. However, it should be noted that Niger has a running caseload of SAM and MAM cases every year, that are treated by either humanitarian or development actors, and therefore these costs do persist; they are just not included in this model as it is estimating humanitarian costs.

Caseloads

The HEA model assumes that late humanitarian response occurs after the onset of medium- to high-risk coping strategies, including the sale of productive assets (including sale of excess livestock that threaten medium- to long-term herd viability; excess labour migration; sending children away to live with other families, etc), and after significant livestock deaths have occurred. The model output includes caseloads in each year, both in terms of number of people who have a food deficit, as well as the total magnitude of that deficit (measured in MT). Caseloads differ in each year, depending on the magnitude of the drought and what has preceded it. Annex B has a full screen shot of the modelling.

Losses

A cost benefit analysis of the Africa Risk Capacity (ARC) Facility[8] estimated that late response (i.e. 6 months +) costs an additional $1,294 per household. This estimate includes reduced income potential of children under age 2 (U2) who receive reduced nutrition, reduced household growth due to reduced consumption and increased distress sales, plus direct losses from livestock deaths. This estimate was made for six African countries, including Niger (generalized across all six countries – these results are not specific to Niger, and therefore must be viewed as ballpark estimates only). These losses are multiplied by the total number of people facing a deficit each year.

Total cost of late humanitarian response

The total cost per person under a high magnitude drought in the HEA modelling (excluding losses) works out at $92 per person. Overall, the Government's support plan for food security and nutrition (the "plan de soutien"), costed at USD 425 million, estimates a cost of approximately $106 per targeted beneficiary, which suggests that the modelling is close to reality, but may be underestimating some costs.

These costs could be further elevated. For example, in the 2010 drought, which was considered a late response, WFP initiated protected blanket feeding to all households with a child under 2. This cost an additional $30 per household, covering 6.4m households, for a total additional cost of $200m (in one event). While this figure is not included in the model, it provides a good example of the high costs that can be incurred when a crisis is not addressed early.

[8] Clarke D and R. Vargas Hill (2012). "Cost-Benefit Analysis of the African Risk Capacity Facility."

Humanitarian costs and losses are modelled over 20 years, using a discount rate of 10%.[9] The total cost is listed in Table 3.

Table 3: Late Humanitarian Response to Droughts

	Value (US$)
Humanitarian Costs only	$1,198m
Costs and Losses	$4,844m

3.3 Early Humanitarian Response

Unit cost of early humanitarian response

Critically, efficiencies may be found by leveraging the annual post-harvest period, a time of year when local markets are most competitive and when food and nutrition assistance needs have not yet reached their annual peak.

Food aid: According to WFP (see Annex A), food aid under early humanitarian response costs $1,046 per MT (this equates to $41 per beneficiary based on the total deficits modelled under the HEA). The price difference as compared with late humanitarian response is as a result of lower cereal prices (18% savings of unit costs). Logistics costs actually increase marginally (by approximately 1%). Within this, some savings are made – for example, external costs are decreased due to regional purchasing. But this is offset by increases in other costs – for example logistics and other operational costs increase, because the volume of aid decreases and hence does not benefit from economies of scale. Nonetheless, the overall cost per MT decreases from late humanitarian response.

NFI: Using the CAP allocation of an additional 25% for NFI, food aid is inflated by 25% each year in the model.

Malnutrition: The cost of treatment of SAM and MAM is the same under early humanitarian response as it is under late humanitarian response (caseloads change however, addressed below).

The use of cash transfers in lieu of food transfers could reduce this cost even further. WFP estimates that food aid for 180 days, based on a standard ration, costs between $114 and $117 per beneficiary (note that this differs from the figures estimated under the HEA because the HEA estimates the total deficit for each household, rather than relying on a fixed figure of 180 days). Cash transfers, equivalent to 180 days of food transfers under early

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

response, cost $68 per person. The model uses the cost of food aid to remain conservative, but this would reduce the cost of early response even further.

Caseloads

An early response has been defined in the HEA modelling as a response at the time of early warning of the drought – before the onset of high-risk coping strategies uptake (including sale of productive assets) and before significant livestock deaths.

When these parameters are inputted to the HEA model, the model predicts that, in a high magnitude drought, caseloads are 51% of those in a late response. Reduced caseloads are predicted in low and medium magnitude droughts, fluctuating between 41% and 52% of the total in late response (depending on what kind of drought event has preceded it), and with only a small drop in non-drought years (78-85% of the total in late response - because there is no event to cope with, the model does not predict a large change in caseloads).

Under early humanitarian response, it is assumed that an effective response will hold cases of SAM and MAM at their baseline (non-crisis) levels (which are nonetheless high), and will succeed in halting the spikes that occur as a result of late response. It should be acknowledged that this is not necessarily what occurs in reality currently – for instance, in the 2010 crisis in Niger, in which response was earlier than normal, there were still spikes. However, in this model we are assuming that the funds allocated are used before the spike occurs, and to the extent that is necessary to prevent a spike.

Losses

ARC estimates that early response (i.e. 4-6 months after first failed rain) costs an additional $49 per household – this is the cost of reduced nutrition for U2s losing 14% of lifetime earnings.

Total cost of early humanitarian response

Humanitarian costs and losses are modelled over 20 years, using a discount rate of 10%. The total cost is listed in Table 4.

Table 4: Early Humanitarian Response to Droughts

	Value (US$)
Humanitarian Costs only	$621m
Costs and Losses	$699m

Box 1: Multi-year Humanitarian Response

The Niger supporting document highlights potential efficiencies as a result of multi-year funding:

- Multi-year response is critical to ensuring more efficient programs in Niger. Every year, the country faces a high level of food and nutrition needs; in drought years, these peaks swell. A multi-year funding scenario would allow a response to baseline levels of need while adapting to increases in needs.
- Under the hypothesis of multi-year response, in-kind food assistance costs would decline thanks to increased ability to resort to regional sources of supply. Timeliness would improve as well, as increasing reliance on regional sources of supply would reduce lead times. For all programs - in-kind food, nutrition and others - the quality of programs would improve, as multi-year funding would smooth the pipeline and make funding breaks less likely.
- Food procurement could be further streamlined, for example by striking longer term deals with suppliers in the West African region. The share of external transport costs in overall budgets would decline somewhat, the cost of shipping goods from overseas is estimated at some $100 per ton for Niger. The certainty that multi-year funding brings would constitute a major incentive for the private sector to set up local production of Supercereal, Supercereal+ , or Plumpy Sup® and Plumpy Doz®. Already, Plumpy Nut® is produced in Niger, at a level that allows savings of $2-$3 per child per year.
- Increasing reliance on regional supply sources – notably from Nigeria – would allow gains in timeliness (assuming stability in the region). The lead time for local food procurement is 2.5 months, compared to 4 months for international procurement. This would increase flexibility of programming and allow activities to scale up more effectively in the event of an increase in needs in Niger. Multi-year planning would also make it easier to plan cash distributions ahead of time[10]. In the specific case of regional procurement, multi-year funding would help WFP put into place the staffing and systems required to make the country a reliable supply base for WFP.
- The pipeline breaks that commonly affect food and nutrition programs would become less likely under a scenario of multi-year funding. Pipeline breaks can be caused by a variety of factors, but a primary one is related to blocks in funding flows. Pipeline breaks caused by the variability in funding force providers of humanitarian assistance to reduce rations or swap products, with impacts on service provision to beneficiaries.

It is estimated that the total cost per MT of food under multi-year funding would reduce costs from an early response cost of $1,046 per MT to $1,021 per MT – this is primarily due to a further decrease in operational costs.

[10] The Cash Learning Partnership (CaLP) aims to improve the quality of emergency cash transfer and voucher programming across the humanitarian sector, and is well organized in Niger, along with a strong micro-finance network. As a result of these and other initatives, the capacity to make cash transfers in the Niger is strong. However even with all of these arrangements in place, multi-year has advantages as it provides certainty/visibility to agencies to undertake the time consuming upstream targeting work, such as targeting or setting up a registry of vulnerable persons, keeping qualified staff on board, etc. A break in the cash 'pipeline' is also possible with effects on beneficiaries and project objectives, in the same way as food.

3.4 Resilience

Building resilience will require a suite of interventions, and may differ depending on the specific context. However, for the purposes of this analysis, a simple soil and water conservation (SWC) intervention has been chosen to represent a resilience intervention that a) is appropriate for a wide range of types of livelihood zones in Niger; and b) has enough documented impacts in rural communities in Niger to allow for modelling. In fact, the data presented below comes from interventions that WFP has been using consistently in its cash for work operations, and hence is evidence based. It is unlikely that the capacity would exist to implement this practice in one year – more likely it would take place over several subsequent years. Having said this, because this practice is widely used through WFP cash for work programmes, it is possible that it could be pushed out to a wider population quite quickly using this channel.

The HEA modelling was used to estimate the changes in caseloads and food deficits that would result from a greater investment in agriculture as a core resilience building measure.

<u>Unit Costs of Resilience</u>
Specifically, preventative interventions recommended by the World Bank (2012) include soil and water conservation. These programs are implemented through cash/food for asset schemes, and significant field testing has been conducted of such schemes. It's estimated that a hectare of severely degraded land yielding approximately 100kg of coarse grain can be rehabilitated by digging half-moons. The cost of this intervention is a one-time cost of $465[11], and the intervention has shown yields to improve to 450kg/hectare (poor farmers typically average a farm size of one hectare). This evidence is supported by other studies.[12] The fertility of the recovered land can be maintained for years, should the farmer adopt appropriate techniques, with no ongoing maintenance spend required. Nonetheless, the model assumes that 5% of the total cost in year 1 is required for a subsequent 9 years, to allow for good practices, technical support, and capacity building.

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[11] This cost includes 313 half moons on a hectare of land, and estimates the labour cost required to achieve this.

[12] A 2008 evaluation of the WFP programme found that, using demi-lunes, "production on rehabilitated land was on average 3 to 4 times more than non-rehabilitated land."
Further to this, a study on rainfed agriculture found that rainfed crops in semi-arid regions in Africa and Asia reveal large yield gaps, with farmer's yields being 2-4 times lower than achievable yields. In particular, Niger's rainfed yields are found to be 30% of achieveable rainfed yields.
Sources: Koure, A (2008). "MISSION D'EVALUATION DES OPERATIONS DE VIVRES CONTRE TRAVAIL (VCT) EXECUTEES DANS LE CADRE DES ACTIVITES DU PROGRAMME ALIMENTAIRE MONDIAL AU NIGER DEPUIS 2004". WFP. Rockstrom, J, N Hatibu, T. Oweis and S Wani (2007) "Managing Water in Rainfed Agriculture." In Molden, D. (ed.) (2007). "Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture". IWMI, Earthscan.

However, the estimated unit cost of food aid that is required to meet ongoing food deficits under such a scenario is forecast to increase (some humanitarian aid requirements will persist). This is because the volumes of food aid have decreased, and hence economies of scale that come about as a result of pushing through large volumes of aid at one time, are no longer relevant. The figures are based on a WFP multi-year funding proposal, in which the unit cost of direct and indirect support increases as a result of decreased caseloads, raising the estimated cost of logistics by 14%. As a result, the cost of food aid increases from $1,046 per MT under late humanitarian response, to $1,147 per MT.

Caseloads

This increase in yields was inputted to the HEA model, to estimate the impact on household economies of improved yields, using local market prices appropriate to the level of drought. The model incorporates the change in the size of food deficit, and values on-going aid using the cost of early response.

The number of beneficiaries decreases to 5% of the total number of beneficiaries under late response in a high magnitude drought (this figure drops to 1% of the number of beneficiaries in late response under all other events).

Under the resilience scenario, SAM and MAM cases are assumed as a cost only in high magnitude drought years. Because the number of beneficiaries drops so significantly in medium years, it is assumed that these no longer trigger a humanitarian emergency, and therefore a humanitarian cost is not included. Caseloads are assumed to be equivalent to those that would occur under early response, though over time, resilience efforts should begin to lower these caseloads.

Losses

It is assumed that losses are minimal under a resilience scenario – they are not accounted for in the model. However, it is assumed that there is some residual risk – i.e. that humanitarian needs are not completely avoided. The HEA model accounts for ongoing food deficits (as described in the preceding section on caseloads) and these are included as a cost in the model, using early response cost estimates.

Benefits of Resilience

The analysis is run twice:

1. Storyline C: Direct benefits from SWC practices as it relates to improved yields. The analysis above relied on empirical evidence on the impact of a specific intervention – SWC practices – and the effect that improved yields have on the household economy.
2. Storyline C – with benefits. Activities to build resilience, in this case SWC, will result in numerous other benefits. For instance, SWC can facilitate greater diversity of crops

grown, and hence contribute to increased incomes (for higher value crops than maize), improved nutritional outcomes, decreased health costs and improvements in education. These have been shown in the literature to deliver returns that are quite substantial. However, because it is not known the degree to which SWC will contribute to wider gains, a very conservative assumption of benefits of $1.1 for every $1 spent are assumed in the model, in addition to the decreased caseloads as a result of increased yields.

Costs of building resilience are assumed for the first 10 years, and the benefits of those investments are assumed to persist for another 10 years.

Further evidence shows that yields can be increased to 1 MT per hectare, by investing in a package of seeds, fertilizers and tools at a cost of USD $65 per farmer per year. That farmer also requires support in order to spend enough time in their field, so will require an unconditional cash transfer on top of the package, at a cost of approximately USD 70 per month, or an estimated $210 for three months (this is the maximum figure that could be expected). This equates to a total cost of $275 per hectare/farmer in the first year; by the second year, the unconditional cash transfer is unnecessary. The increase in yield was inputted into the HEA model, with the result that **no deficit** was present in any year in the HEA model. Unfortunately, the HEA model is not designed to show the surplus, and hence it was not possible to model the impact of this improvement on household economies.

Along similar lines, monitoring data from the Food and Agriculture Organisation's (FAO) post-harvest/off-season seed distribution program in Niger demonstrates that the average producer, benefiting from a seed package including 10kg of onion, 10kg tomato, 10kg cabbage, 10kg carrot and 10kg lettuce and 25kg potatoes costing $38 was able to produce 976kg of vegetables. After accounting for production costs, it's estimated that the farmer would have a profit of $319, representing an 8:1 benefit to cost ratio (and suggesting that the assumed benefit ratio of 1.1:1 is indeed very conservative).

Table 5: Investment in Resilience

	Value (US$)
Cost of Resilience	$354m

3.5 Niger - Comparison of Costs for Agricultural and Agro-pastoral Areas

Table 6 summarizes the findings from the model parameters discussed above. It presents a comparison for the cost of aid alone, and then a second model that incorporates potential losses (though this must be viewed with some caution as it is not based on Niger-specific data). The findings are specifically for the livelihood zones modelled within Niger, with an estimated population of 5.2m people (approximately 30% of the total population of Niger).

Table 6: Cost Comparison of Response for Storylines (USD million) – Niger

	Storyline A	Storyline B	Storyline C	Storyline C – with benefits
	Late Hum. Response	Early Response	Resilience	Resilience
Aid Alone, discounted	**$1,198m**	**$621m**	**$354m**	**($1,246m)**
Aid + Losses, discounted	**$4,844m**	**$699m**	**$354m**	**($1,246m)**
Sensitivity: Aid alone: 0 discount rate	**$2,259m**	**$1,192m**	**$475m**	**($2,942m)**

Early response is significantly less expensive than late response, saving between $577m and $4,145m over 20 years, depending on the model. Resilience saves even more money still. On a pure cost comparison, SWC practices could save between $844m and $4,490m over 20 years as compared with late response.

When the discount rate is reduced to 0, to account for the fact that each magnitude drought could occur at any point in the model, the case for resilience is strengthened further, as the difference between scenarios becomes more pronounced (saving $1.8 billion undiscounted).

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 13.2 : 1. In other words, for every $1 spent on resilience, $13.2 of benefits are gained. If the avoided losses are incorporated to this analysis, the benefit to cost ratio rises to 31.5:1.**

4 Top-down Assessment

The top down assessment uses national level estimates on humanitarian costs, and efforts to build resilience, to make an assessment from an aggregate level.

4.1 Late Humanitarian Response

The cost of humanitarian response is estimated using two components:

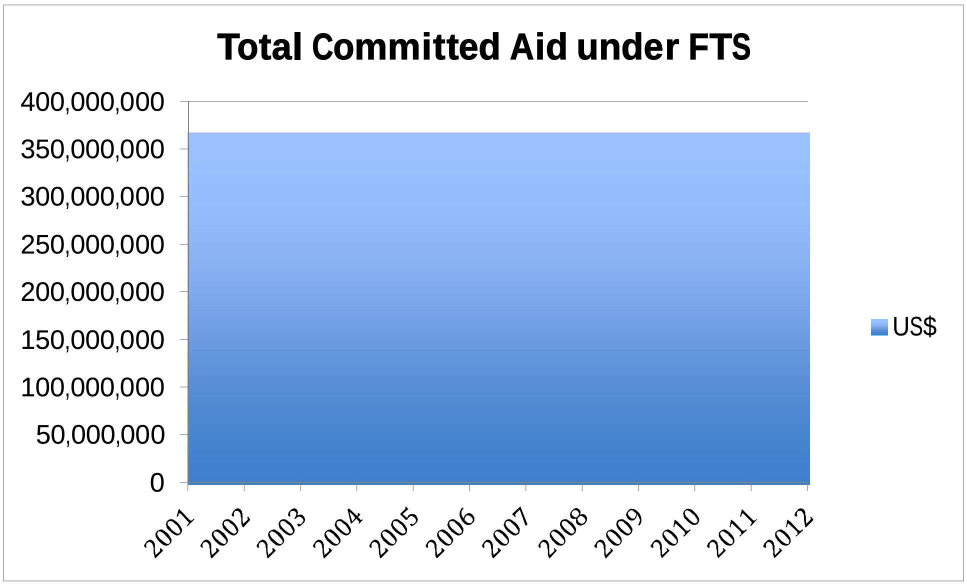
- The cost of food aid and non-food aid; and
- Estimated losses.

Estimating the cost of food and non-food aid:
A number of sources report on humanitarian aid flows – two of these are recorded here, the Financial Tracking Service (FTS) and Global Humanitarian Assistance (GHA).

The FTS reports humanitarian aid registered on the financial tracking service. However, registration of commitments is voluntary, and therefore not necessarily systematic. Under the FTS, average aid flows between 2000 and 2012 have averaged **$106m per year.**

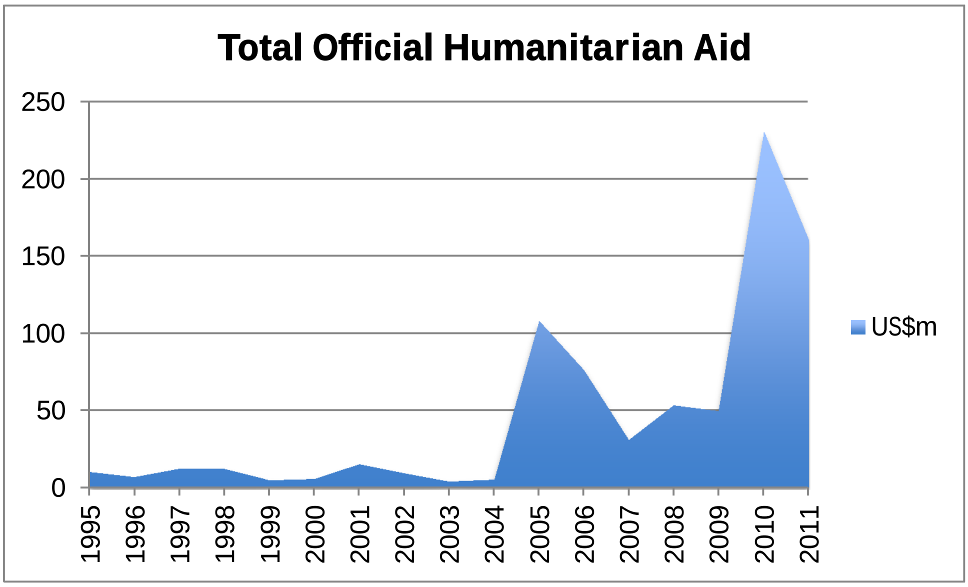
GHA attempts to combine numerous sources of data on humanitarian aid flows, to provide a more complete estimate. Under the GHA, average aid flows between 1995 and 2011 have averaged $47m per year. Between 2001 and 2011 (to be more comparable with FTS estimates), **the average has been $68m per year**.

Figure 1: FTS estimate



Source: FTS http://ochaonline.un.org/AppealsFunding/FinancialTracking/tabid/2665/language/en-US/Default.aspx

Figure 2: GHA estimate



Using data on historical modelled food security needs, the ARC study estimates **the average annual modelled response cost to drought (1983-2011) at US$72m**. The maximum historical modelled response cost is US$507m. These costs specifically pertain to the humanitarian response costs that would be required for food security needs in response to drought.[13]

However, each of these estimates takes an average over a long time frame, and therefore masks the significant increases in aid that have been required in the more recent past.

This is further reflected in the Government's Annual Support Plan (*plan de soutien*), which reflects overall needs for food security and nutrition assistance during the year. It has allocated **an average of $231m per year over the six years between 2008 and 2013.** Responses commonly include a combination of cash for work, cash transfers, food for work, seed distribution, cattle feed, MAM treatment, SAM treatment, and subsidized grain sales. UN agencies implement the lion's share of the *plan de soutien*. Overall one notes an increasing trend in the annual budgets of the national support plan. During the 2010 crisis, total needs reached $263m, two years later, they exceeded $429m. The cost of the 2012 *plan de soutien* stood at 7.1% of Niger's Gross Domestic Product (GDP), underlining both the scale of budgetary allocations, and the increasing commitment of government and donors to provide meaningful responses to the food crises that the country faces.

[13] Clarke, D. and R. Vargas Hill (2012). "Cost Benefit Analysis of the African Risk Capacity Facility". Commissioned by the WFP in cooperation with and on behalf of the African Union Commission to contribute to the evidence base for the African Risk Capacity (ARC) facility.

As a result, it is estimated that the GHA and the FTS estimates are likely to be significant underestimates. In November 2011, the 2012 consolidated appeal stood at $229m. By the time of its revision in April 2012, needs had reached a total of $487m. Neither the FTS nor the GHA got close to this estimate for 2012.

Further to this, in recent years, food and nutrition programs have become more complex in Niger. Whereas the emergency response in 2005 covered a short time frame, with emphasis on general food distributions, the 2012 response was implemented from late 2011 through 2012, and had a much stronger focus on nutrition, namely through the use of specialized nutritious foods for the prevention of moderate acute malnutrition. The reader is therefore warned that historical cost analysis offers comparisons between very different assistance programs. Considering the extent to which assistance programs have been transformed in Niger, one is essentially comparing apples to oranges when comparing the cost per beneficiary of response in 2005 to the costs in 2012. The rising trend in budgetary requirement for successive WFP emergency operations in Niger also illustrates this change (2005: $57m, 2010: $213m, 2012: $235m).

For these reasons, **the model uses the Government's figure of $231m per year** as this is the comprehensive and official estimate of the amount of aid required for current response. It is likely that this may even be an underestimate, given the upward trend in these figures, and given that the 2013 plan de soutien exceeded $300m.

Estimating Losses

Very limited data is available on the economic losses associated with major events. A World Bank report[14] estimates the crop losses alone associated with several significant drought events. It defines events as "catastrophic", with a return period of 3 events in every 20 years, and "severe", with a return period of 4 in every 20 years (comparable to the high and medium events included in the modelling presented in this report). Crop loss data was recorded as follows (all are reported in 2010 US$):

- Catastrophic: 1997 drought, recorded losses of $135.8m; 04/05 drought, recorded losses of $129.5m.
- Severe: 1995 drought, recorded losses of $122.1m; 2009 drought, recorded losses of $55.6m. The 2009 losses are suspiciously low and are excluded from the analysis.[15]

[14] World Bank (2013). "Agricultural Risk Assessment in Niger: Moving from Crisis Response to Long-Term Risk Management." World Bank, Washington, DC.

[15] It is common knowledge in Niger that the 2009 losses were purposefully underestimated by the government. Pers comm., Jean-Martin Bauer, WFP, May 2013.

These estimates are acknowledged in the report to be a significant understatement, due to the limited focus on crop losses. Livestock losses in particular would be estimated to add significantly to these estimates, but are not possible to calculate.

In order to incorporate these loss estimates into the model, the average losses were calculated for catastrophic droughts, and for severe droughts. These were then multiplied by their estimated return periods, to estimate average annualized losses. This results in an estimated average annual loss due to crop production alone of $44m.

Total cost of late humanitarian response

Table 7 summarizes the costs and losses described above that are inputted to 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 (noting that this could be much higher given the very high rates of population growth in Niger), results in **a total economic cost discounted over 20 years of $2.7 billion.**

Table 7: Summary Table of Cost of Humanitarian Aid and Losses

	Amount (USD, millions)
Average Annualized Response Costs	$231m
Average Annualized Losses/Damages:	$44m

4.2 Early Humanitarian Response

Estimating the cost of food and non-food aid:

Based on WFP data, the cost of food aid procured early is 89% of food aid procured late.

Estimating caseloads

Not only will costs decrease under early response, but caseloads will also be smaller due to early response. According to the HEA modelling, caseloads from early response to a high magnitude drought are 51% of caseloads under late response.

Estimated total decrease in aid cost

The HEA modelling suggests that early humanitarian response is 42% of the total cost (aid and caseloads) of late humanitarian response in a high magnitude drought. Given that food aid is the bulk of humanitarian spend, and given that these reductions in cost are likely to be similar for non-food items (which can also benefit from savings due to early procurement), these figures are applied to the total cost of humanitarian aid under each of the scenarios presented above. These reductions are applied to the total aid figures in the model to estimate the early response costs.

Estimated losses

The ARC data suggests that losses in a drought can be decreased significantly, with losses in early response equivalent to only 4% of losses in late response. The significant reduction comes about because the ARC modelling was able to incorporate losses in lifetime earnings and household consumption that account for a range of direct and indirect losses.

However, the losses accounted for in the model are more representative of direct losses, and hence this level of reduction may not be appropriate. No other figures exist, and so, to be conservative, it is assumed that early response and preparedness can reduce losses by half. However, it should be noted that this is an assumption with little empirical evidence.

The total cost of early response, discounted over 20 years, is $1.2 billion.

4.3 Resilience

Overall, the costs of resilience are encapsulated in the I3N plan – a government plan to build resilience. It's estimated that some $2 billion are required to implement the 2012-2015 investment plan, or $500m per year. (The total cost is estimated at USD 117 for each Nigerien man, woman and child over that period. (Additional interventions would be required to complement the existing plan, which is largely agriculture-focused.) The total figure is applied in the model every year, for 10 years, extending the estimated costs over a longer time frame (benefits are assumed to carry on for the full 20 years in the model).

Resilience will not eliminate aid needs, and hence residual risk is also accounted for in the model. HEA modelling indicates that the total aid cost under a scenario with SWC practices is only 5.5% of the cost of early response, under a high magnitude drought. Under medium and low magnitude events this drops to less than 1%. The 5.5% figure is used in the model to be conservative. This figure is further expected to decrease by 10% each year, stabilizing at 10% in year to represent the fact that there will always be some residual risk.

4.4 Niger - Comparison of National Level Costs

The modelling suggests that, at a minimum, early response could reduce humanitarian spend and losses by $1.5b over a 20 year period, or an average of $75m per year.

Table 8: Summary of National Level Cost Estimates over 20 years (discounted) - Niger

	Humanitarian	Early Response	Resilience	Resilience – With benefits
	$2.7 billion	$1.2 billion	$3.4 billion	($1.7 billion)

The modelling indicates that resilience costs more as an initial investment, although the costs of late humanitarian response are likely to be a significant underestimate due to the 3lack of data on damages. Further, investment in resilience will yield benefits above and beyond reduced aid costs. For example, the improved seeds are shown in the bottom up assessment to have a return of $8 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 *benefit* of $1.7 billion over 20 years.**

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 2.3 : 1. In other words, for every $1 spent on resilience, $2.3 of benefits are gained.**

5 Conclusions

5.1 Conclusions

The evidence above clearly points to three 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. Modelling of household level data for 5.2m people in the pastoral and agro-pastoral regions in the south of Niger suggests that early response could save between $577m and $4.2b over 20 years. When this is modelled on a national scale, $1.5b over 20 years, or approximately $75m per year, could be saved through early response alone. And these figures represent direct cost savings only – inclusion of benefits for communities would inflate these figures even higher. 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 four times in Niger before the cost is even equivalent to the cost of humanitarian aid in one event.

Resilience saves even more money still. On a pure cost comparison, SWC practices alone would decrease aid costs from $609m to $354m over a 20 year period. This represents a lower bound estimate, as it does not account for the significant indirect benefits that can occur (more sustainable livelihoods lead to ongoing economic, social and community benefits), and is only a test of a single measure. At a national scale, while resilience is more expensive on a pure cost comparison, when benefits are incorporated using a very conservative estimate, there is a clear argument for greater investment in resilience.

Early response and resilience building measures should be the overwhelming priority response. These two categories of response are not mutually exclusive. The findings in this study fully support an economic imperative for a shift to greater early response and resilience building.

Annex A: WFP Data

The following information was provided by WFP in Niger, in support of this study. The tables estimate costs and caseloads associated with the response scenarios for slow onset crises, rapid onset crises, and treatment of Moderate Acute Malnutrition (MAM).

Drought

Late humanitarian assistance		
Assumptions		
Rations have to be provided for 180 days and food is purchased after the post-harvest period		
Requirements for food assistance during	180	Days
	GFD ration	
cereals (grams)	500	
pulses (grams)	100	
oil (grams)	20	
Total	620	
Food purchase at peak of lean season	rate/MT (USD)	Cost
cereals (USD)	489.00	394.35
pulses (USD)	608.00	98.06
oil (USD)	1192.00	38.45
Total (USD)		**530.87**
	rate/MT	
External	118.57	
Logistics costs	309.53	
Other Operational costs	87.13	
Direct support Costs	50.38	
Indirect support costs	74.67	
Total	**640.28**	
USD /MT		**1171.15**
USD/pers assisted (180 day ration)		**130.70**
Cash/per assisted		**51.45**

Early humanitarian assistance		
Assumptions		
This ration covers general food distributions. Post-harvest purchases assumed.		
Requirements for food assistance during	180	Days
	GFD ration	
cereals (grams)	500	
pulses (grams)	100	
oil (grams)	20	
Total	620	
Food purchase at harvest time	rate/MT (USD)	
cereals (USD)	323.00	260.48
pulses (USD)	608.00	98.06
oil (USD)	1192.00	38.45
Total (USD)		**397.00**
	rate/MT	
External	89.66	
Logistics costs	330	
Other Operational costs	98.85	
Direct support Costs	52.35	
Indirect support costs	78.28	
Total	**649.14**	
USD /MT		**1046.14**
USD/pers assisted (180 day ration)		**116.75**
Cash/per assisted		**67.64**

Multi-year humanitarian assistance		
Assumptions		
More regional procurement. Lower external transport cost.		
Requirements for food assistance during	180	Days
	GFD ration	
cereals (grams)	500	
pulses (grams)	100	
oil (grams)	20	
Total	620	
Food purchase at harvest time	rate/MT (USD)	
cereals (USD)	323.00	260.48
pulses (USD)	608.00	98.06
oil (USD)	1192.00	38.45
Total (USD)		**397.00**
	rate/MT	
External	83.69	
Logistics costs	330	
Other Operational costs	79.15	
Direct support Costs	52.35	
Indirect support costs	78.28	
Total	**623.47**	
USD /MT		**1020.47**
USD/pers assisted (180 day ration)		**113.88**
Cash/per assisted		**67.64**

Annex B: Model Calculations

The following screenshots show the results of the modelling for the cost comparison.

Bottom-up

MODEL 1: Aid costs only													
USD													
YEAR	Humanitarian Cost		Early Response: FOOD COSTS		Resilience				Resilence with Benefits				
	aid	PRESENT VALUE	aid	PRESENT VALUE	Cost per farmer	Ongoing aid	Total Cost	PRESENT VALUE	Cost per farmer	Ongoing aid	Potential benefits	Total Cost	PRESENT VALUE
0	340,948,758	340,948,758	176,578,735	176,578,735	155,318,977	75,767,233	231,086,210	231,086,210	155,318,977	75,767,233	(170,850,875)	60,235,335	60,235,335
1	37,387,603	33,988,730	33,976,139	30,887,399	7,765,949	71,457	7,837,406	7,124,915	7,765,949	71,457	(170,850,875)	(163,013,468)	(148,194,062)
2	226,620,616	187,289,765	80,268,223	66,337,374	7,765,949	76,596	7,842,545	6,481,442	7,765,949	76,596	(170,850,875)	(163,008,329)	(134,717,627)
3	36,388,235	27,339,019	33,993,966	25,540,170	7,765,949	71,457	7,837,405	5,888,359	7,765,949	71,457	(170,850,875)	(163,013,469)	(122,474,432)
4	68,571,218	46,835,065	44,648,016	30,495,196	7,765,949	73,613	7,839,561	5,354,526	7,765,949	73,613	(170,850,875)	(163,011,313)	(111,338,920)
5	34,919,640	21,682,349	32,509,519	20,185,854	7,765,949	71,515	7,837,464	4,866,448	7,765,949	71,515	(170,850,875)	(163,013,411)	(101,218,503)
6	341,683,017	192,871,156	123,611,235	69,775,320	7,765,949	75,767,725	83,533,673	47,152,581	7,765,949	75,767,725	(170,850,875)	(87,317,201)	(49,288,284)
7	39,252,331	20,142,653	33,668,230	17,277,126	7,765,949	71,470	7,837,419	4,021,835	7,765,949	71,470	(170,850,875)	(163,013,456)	(83,651,678)
8	72,319,302	33,737,488	44,256,499	20,645,983	7,765,949	73,629	7,839,578	3,657,221	7,765,949	73,629	(170,850,875)	(163,011,297)	(76,045,973)
9	36,102,427	15,310,953	32,202,081	13,656,826	7,765,949	71,527	7,837,476	3,323,855	7,765,949	71,527	(170,850,875)	(163,013,399)	(69,133,594)
10	154,856,277	59,703,798	77,638,698	29,933,079		74,614,187	74,614,187	28,766,999		74,614,187	(170,850,875)	(96,236,688)	(37,103,409)
11	36,440,984	12,772,343	32,154,352	11,269,904		71,529	71,529	25,070		71,529	(170,850,875)	(170,779,346)	(59,857,119)
12	155,886,651	49,670,291	77,578,808	24,718,999		76,740	76,740	24,452		76,740	(170,850,875)	(170,774,135)	(54,413,902)
13	36,300,350	10,514,918	31,632,899	9,162,924		71,548	71,548	20,725		71,548	(170,850,875)	(170,779,327)	(49,468,688)
14	290,686,459	76,546,830	122,434,692	32,240,881		22,116,384	22,116,384	5,823,935		22,116,384	(170,850,875)	(148,734,490)	(39,166,440)
15	41,053,224	9,827,816	32,741,934	7,838,159		71,504	71,504	17,117		71,504	(170,850,875)	(170,779,371)	(40,883,224)
16	76,166,343	16,576,015	43,104,627	9,380,823		73,673	73,673	16,033		73,673	(170,850,875)	(170,777,202)	(37,166,095)
17	37,682,327	7,455,247	31,305,508	6,193,628		71,559	71,559	14,158		71,559	(170,850,875)	(170,779,316)	(33,787,777)
18	158,662,266	28,536,803	76,587,065	13,774,857		76,794	76,794	13,812		76,794	(170,850,875)	(170,774,081)	(30,715,220)
19	37,481,676	6,128,553	30,748,610	5,027,643		71,576	71,576	11,703		71,576	(170,850,875)	(170,779,299)	(27,923,780)
Total	2,259,409,705	**1,197,878,551**	1,191,639,836	**620,920,879**	225,212,517	249,431,713	474,644,230	**353,691,396**	225,212,517	249,431,713		(2,942,373,262)	**(1,246,313,392)**

BCR

BCR	13.22				
COSTS		BENEFITS			
Cost per farmer	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
155,318,977	155,318,977	265,181,524	170,850,875	436,032,399	436,032,399
7,765,949	7,059,953	37,316,146	170,850,875	208,167,020	189,242,746
7,765,949	6,418,140	226,544,019	170,850,875	397,394,894	328,425,532
7,765,949	5,834,672	36,316,778	170,850,875	207,167,653	155,648,124
7,765,949	5,304,248	68,497,606	170,850,875	239,348,480	163,478,233
7,765,949	4,822,043	34,848,125	170,850,875	205,699,000	127,722,895
7,765,949	4,383,676	265,915,293	170,850,875	436,766,167	246,543,115
7,765,949	3,985,160	39,180,862	170,850,875	210,031,736	107,779,491
7,765,949	3,622,872	72,245,673	170,850,875	243,096,548	113,406,334
7,765,949	3,293,520	36,030,900	170,850,875	206,881,775	87,738,068
0	0	80,242,090	170,850,875	251,092,964	96,807,207
0	0	36,369,456	170,850,875	207,220,330	72,629,462
0	0	155,809,911	170,850,875	326,660,786	104,084,193
0	0	36,228,803	170,850,875	207,079,677	59,983,606
0	0	268,570,075	170,850,875	439,420,949	115,713,270
0	0	40,981,720	170,850,875	211,832,595	50,711,039
0	0	76,092,671	170,850,875	246,943,545	53,742,110
0	0	37,610,768	170,850,875	208,461,643	41,243,025
0	0	158,585,473	170,850,875	329,436,347	59,252,023
0	0	37,410,100	170,850,875	208,260,974	34,052,333
225,212,517	200,043,261	2,009,977,992	3,417,017,492	5,426,995,484	2,644,235,204

Resilience with Benefits			
ng aid	Potential benefits	Total Cost	PRESENT VALUE
767,233	(170,850,875)	60,235,335	60,235,335
71,457	(170,850,875)	(163,013,468)	(148,194,062)
76,596	(170,850,875)	(163,008,329)	(134,717,627)
71,457	(170,850,875)	(163,013,469)	(122,474,432)
73,613	(170,850,875)	(163,011,313)	(111,338,920)
71,515	(170,850,875)	(163,013,411)	(101,218,503)
767,725	(170,850,875)	(87,317,201)	(49,288,284)
71,470	(170,850,875)	(163,013,456)	(83,651,678)
73,629	(170,850,875)	(163,011,297)	(76,045,973)
71,527	(170,850,875)	(163,013,399)	(69,133,594)
514,187	(170,850,875)	(96,236,688)	(37,103,409)
71,529	(170,850,875)	(170,779,346)	(59,857,119)
76,740	(170,850,875)	(170,774,135)	(54,413,902)
71,548	(170,850,875)	(170,779,327)	(49,468,688)
116,384	(170,850,875)	(148,734,490)	(39,166,440)
71,504	(170,850,875)	(170,779,371)	(40,883,224)
73,673	(170,850,875)	(170,777,202)	(37,166,095)
71,559	(170,850,875)	(170,779,316)	(33,787,777)
76,794	(170,850,875)	(170,774,081)	(30,715,220)
71,576	(170,850,875)	(170,779,299)	(27,923,780)
431,713		(2,942,373,262)	**(1,246,313,392)**

BCR

BCR	31.45				
COSTS		BENEFITS			
Cost per farmer	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
155,318,977	155,318,977	1,105,263,142	170,850,875	1,276,114,016	1,276,114,016
7,765,949	7,059,953	203,798,636	170,850,875	374,649,511	340,590,464
7,765,949	6,418,140	772,063,785	170,850,875	942,914,660	779,268,314
7,765,949	5,834,672	199,809,735	170,850,875	370,660,610	278,482,802
7,765,949	5,304,248	385,964,637	170,850,875	556,815,511	380,312,486
7,765,949	4,822,043	192,391,237	170,850,875	363,242,111	225,544,772
7,765,949	4,383,676	1,112,580,516	170,850,875	1,283,431,391	724,463,561
7,765,949	3,985,160	211,301,114	170,850,875	382,151,989	196,104,395
7,765,949	3,622,872	443,280,364	170,850,875	614,131,239	286,496,755
7,765,949	3,293,520	198,314,170	170,850,875	369,165,044	156,562,016
0	0	566,505,822	170,850,875	737,356,697	284,282,926
0	0	200,088,283	170,850,875	370,939,157	130,011,912
0	0	652,123,580	170,850,875	822,974,454	262,225,023
0	0	199,347,234	170,850,875	370,198,109	107,233,206
0	0	1,130,771,835	170,850,875	1,301,622,710	342,757,941
0	0	217,621,611	170,850,875	388,472,486	92,997,225
0	0	466,910,555	170,850,875	637,761,430	138,795,469
0	0	205,957,415	170,850,875	376,808,289	74,549,511
0	0	675,416,470	170,850,875	846,267,345	152,208,621
0	0	205,108,245	170,850,875	375,959,119	61,472,320
225,212,517	200,043,261	9,344,618,387	3,417,017,492	12,761,635,879	6,290,473,737

Top-down

USD MILLIONS										
YEAR	Late Humanitarian Response				Early response		Resilience			
	Aid (needs)	Losses	Total	Present Value	Aid+losses	Present Value	Total	Residual Risk	Benefits	Present Value
0	231	44	275	275	119	119	500	7	(550)	(43)
1	231	44	275	250	119	108	500	6	(550)	(40)
2	231	44	275	227	119	98	500	5	(550)	(37)
3	231	44	275	207	119	89	500	5	(550)	(34)
4	231	44	275	188	119	81	500	4	(550)	(31)
5	243	46	289	179	125	78	500	3	(550)	(29)
6	243	46	289	163	125	71	500	3	(550)	(27)
7	243	46	289	148	125	64	500	2	(550)	(25)
8	243	46	289	135	125	58	500	1	(550)	(23)
9	243	46	289	122	125	53	500	1	(550)	(21)
10	255	49	303	117	131	51		1	(550)	(212)
11	255	49	303	106	131	46		1	(550)	(193)
12	255	49	303	97	131	42		1	(550)	(175)
13	255	49	303	88	131	38		1	(550)	(159)
14	255	49	303	80	131	35		1	(550)	(145)
15	267	51	318	76	138	33		1	(550)	(131)
16	267	51	318	69	138	30		1	(550)	(120)
17	267	51	318	63	138	27		1	(550)	(109)
18	267	51	318	57	138	25		1	(550)	(99)
19	267	51	318	52	138	23		1	(550)	(90)
Total	4,978	948	5,926	**2,700**	2,565	**1,168**	5,000	44	(11,000)	**(1,741)**

BCR

BCR	**2.31**				
COSTS		BENEFITS			
Cost	PRESENT VALUE	Avoided Aid and Losses	Potential Addl benefits	Total Benefit	PRESENT VALUE
500	500	268	550	818	818
500	455	268	550	818	744
500	413	269	550	819	677
500	376	270	550	820	616
500	342	271	550	821	560
500	310	285	550	835	518
500	282	286	550	836	472
500	257	286	550	836	429
500	233	287	550	837	391
500	212	288	550	838	355
0	0	302	550	852	329
0	0	302	550	852	299
0	0	302	550	852	272
0	0	302	550	852	247
0	0	302	550	852	224
0	0	318	550	868	208
0	0	318	550	868	189
0	0	318	550	868	172
0	0	318	550	868	156
0	0	318	550	868	142
5,000	3,380	5,877	11,000	16,877	7,817