Dimensions of Crisis Impacts: Humanitarian Needs by 2015

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DIMENSIONS OF CRISIS IMPACTS: HUMANITARIAN NEEDS BY 2015

EXECUTIVE SUMMARY

The study's objectives

1. This study offers an overview of key global trends and their implications for humanitarian assistance. It provides a sense of the scale of the numbers of people that could be affected by a specific set of *drivers*, *shocks* and *humanitarian crisis agents* between now and 2015 in four broadly defined regions: South Asia, East Africa, Southern Africa and Central Asia. This study reflects the findings of major international organisations such as the United Nations and the World Bank as well as those of leading private and academic research institutions. It relies heavily upon such reports as the World Bank's Natural Disaster Hotspots and more recently the Stern Review on the Economics of Global Climate Change.

2. The study's conclusions indicate that over the next decade the international community will have to respond to the consequences of interactive drivers, shocks and crisis agents which will be significantly triggered or compounded by global climate change. Using the period 2001 to 2005 as a baseline, these inter-related factors will translate into a 25% increase of crisis affected people in those four regions by 2015.[1]

3. These estimates do not represent irrefutable predictions. They are intended as means to illustrate the extent of the challenges that certain broad trends, drivers and shocks could reasonably present to humanitarian donors such as DFID in the next ten years. The methodology that underpins this study is comparable to that used by the UN University's State of the Future Index (SOFI) as well as other studies including the Stern Review and the World Bank's Hotspots Case Studies.

The Global Setting

4. There are several foreseeable threats that could profoundly transform the nuclear confrontations and virulent epidemics such as H5N1 avian influenza planet and expose large swathes of humanity to increased risk. These include. There is nothing to date, however, that appears to equal the potential consequences of global climate change. The Stern Review reflects a broad, international consensus when it notes that "climate change will affect the basic elements of life for people around the world – access to water, food production,

[1] 25% is a mid-range figure, not including shocks, for 2015. The high end figure would go up to 57% increase without shocks, and 200% increase including shocks over the baseline figure.

health and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms."

5. Global climate change is an overarching factor that will directly and indirectly impact upon a range of drivers which will in turn intensify *humanitarian crisis agents* that expose human beings to major humanitarian crises. This study has identified five such drivers -- major demographic shifts, environmental degradation, water dimensions, persistent health threats and inter and intra-state instability. As noted above, each of these directly leads to crisis agents which result in major threats to life and livelihoods.

6. The impact of global climate change within the timeframe of this study is assumed to be less than 1 degree centigrade, which nevertheless means that there will be falling crop yields, particularly in developing countries, disappearance of small mountain glaciers affecting water supplies in several highly populated regions, rising intensity of storms, droughts, flooding and heat waves and the possibility of irreversible changes in the physical environment of the planet.

7. The effects of global climate change will up through 2015 be very regionally specific, with rainfall patterns and dryness unevenly distributed around the world. While this differentiated pattern will continue throughout the 21st century, for the purposes of this study it is important to note that temperature increases will be most severe in areas of high latitudes most likely affecting water resources in South and East Asia, that North Africa and the Mediterranean will experience high levels of drying and that sub-Saharan Africa will be subject to extreme weather changes, eg, high levels of precipitation and longer periods of drought.

8. The drivers identified in this study will be affected not only by the consequences of global climate change, but also by the possibility of high impact, low probability events, or, *shocks*, that could span a spectrum of events from severe increases in oil prices and the collapse of the US dollar to *coup d'etats* and global pandemics. While such drivers and shocks foretell of serious increases in crisis-affected peoples over the next decade, there will be positive drivers that could in principle offset the effects of the former. These include the effects of economic development, increased development assistance as well as scientific and technological innovation. This study, however, has not taken into account their potential impacts in coming to its conclusions about humanitarian crises in the four regions under review within the period 2006 to 2015.

9. The inter-action between global climate change and the drivers that have been identified in this study will result in changes in the dynamics and dimensions of humanitarian crises. Humanitarian crises will increasingly reflect more "synchronous," or, simultaneous collapse of systems. They will increasingly be the result of "multi-hazard impacts," or interactive disaster agents affecting

vulnerable populations. More and more humanitarian crises will “cascade,” from one crisis agent to another; and there will be a growing number of humanitarian crises that will have global impact, eg, interactive across regions and continents.

Regional projections: drivers and shocks

10. This study looks at the possible consequences by 2010 and 2015 of global climate change and a select number of drivers, shocks and crisis agents in four regions of interest to DFID: South Asia, East Africa, Central Asia and Southern Africa.

11. Of the four regions analysed in this report, South Asia, comprising Bangladesh, India and Pakistan, contains the largest combined populations, ie, 1.4 billion in 2005 and 1.62 billion in 2015. The region as a whole is characterised by extreme weather conditions and high population densities in areas vulnerable to these conditions. Combining the potential impacts of major drivers in the region, one can project that – at the medium range -- an estimated 97 million people will be affected by one or more disaster agents in 2010 and an estimated 105 million in 2015. This compares with a 2005 figure of 38 million, and an average figure of 96 million for the period 2000-05. If one reverts to high range estimates and added an incident of Avian Influenza-type epidemic amongst those living in poverty in 2014, the total disaster affected populations could reach 284 million in 2015.

12. One of the most fundamental drivers in the recent history of the Horn of Africa, Kenya and the Sudan has been political transition. This transition has been inconsistent and often violent, burdened by poor governance and corruption. While other regions of the world have had higher flows of refugees and internally displaced persons at any one time, the countries identified in this region have had the largest long-term displaced populations in the world over the past four decades. There appears little indication that this driver will not continue at both intra-state and inter-state levels over the next decade. At the same time, environmental degradation continues to threaten livelihoods for millions in the region, and competition for water and the Nile’s resources serve as an additional threat to human survival. If one combines the potential impacts of major drivers in the East African region, one can project that at least 17.4 million people will be affected by one or more disaster agents in 2010 and 26.1 million in 2015. This compares with an annual average figure over the period 2000-2005 of 11.0 million.

13. Central Asia has been described as a disaster-prone area, exposed to various natural hazards such as floods, droughts, avalanches, rockslide and earthquakes. It is also vulnerable to man-made disasters related to industrial activity (eg, oil and coal production) and the radioactive and chemical dumps inherited from the Soviet period. Several factors - population density in disaster-

prone areas, high overall population growth, poverty, land and water use, failure to comply with building codes and global climate change – make the region particularly vulnerable to natural as well as man made disasters.
Medium range figures for Central Asia – including droughts, floods and conflict-related IDPs and refugees – are 187,000 in 2010 and 239,000 by 2015. If one includes radiation and industrial-related shocks the figure for 2010 increase to 657,000 and to 711,000 for 2015.

14. Not since 1992 has drought impacted the Southern African region as it might do in less than a decade's time. While in 1999 and 2000, Southern Africa suffered devastating floods, it must be assumed that the pattern of droughts that one has seen in the region will also intensify, and that sometime around 2010 will present a shock long overdue. This particular type of shock will compound the impact that HIV/AIDS, persistent decline in income and the possibility of violent political transitions might have upon the region over the next decade. These are the factors that lead one to anticipate that at the medium-range level approximately 14,333,000 will be seriously affected by a combination of cholera, floods, droughts, malaria and HIV/AIDS by 2010 and similarly by 2015, 16,306,000.

15. One of the conclusions that one can draw from the regional studies in ***Chapter II*** is that there will be few if any humanitarian crisis events that will not have synchronistic, multiple, cascading or global-local dimensions. (See: #9, above.) The single humanitarian crisis agent still reflected in much of the present public reportage and to some extent even in humanitarian organisations' preparedness and response activities is increasingly a characteristic of the past, if it ever really was.

Methodological lessons-learned

16. While this report is intended to be speculative and to provide a scale of affected for guiding policy-makers' decisions, it is worth noting that methodological approaches for the future will require changes in the ways that one analyses regions and impacts. For the former, it is increasingly evident that assessing causes and consequences of humanitarian crises require more regional, far less state-boundary driven analyses. To that extent, a region from a humanitarian causation and impact perspective is greater than the "sum of its state parts." In a related vein, far greater analysis needs to be taken to understand not only the interactive nature of individual crisis phenomenon, but also how best to analyse from a statistical point of view the effects of multiple crisis agents across population groupings.

Conclusions and observations:

17. Forecasting is an inherently hazardous business. In so saying, this study accepts that, while the speculative details found in this report may prove to be wrong, the overall trends of growing human vulnerability in these four regions is not. There are no reasons to assume that present trends and, hence, this study's extrapolations are not compelling. This is not to deny the efforts that continue to be made through substantial development initiatives to offset such trends, but to reiterate that this study has not taken these initiatives into account in arriving at its findings.

18. This study also speculates that the changing dynamics and dimensions of humanitarian crises will lead to basic changes in the ways that humanitarian crises will be handled in the future. These changes will directly relate to issues of future operational costs, and include changes in the ways vulnerable people will be affected by future crises, in the types of organisations that provide assistance and the types of instruments and approaches needed to respond to future crises.

19. In light of these transformations, it is all the more surprising that some of the most important organisations presently responsible for preventing, preparing for and responding to the sorts of humanitarian challenges that are anticipated in the future are failing to do so. Based upon a survey *inter alia* of seven major intergovernmental organisations, three non-governmental consortia and four main governmental aid providers, not including DFID, between 30 October and 24 November 2006, there is no doubt that insufficient effort is being made by "humanitarian organisations" to prepare for the types of threats that are reflected in mainstream scientific and social scientific research.

20. There is considerable technical capacity among humanitarian organisations to address future threats, but there are two fundamental gaps. In general, most organisations that could begin to prepare to address future crises lack the strategic formulation capacity to plan for the future "from the future". Furthermore, the vast majority of organisations interviewed in this context accept that there are few incentives to do such forward planning. They acknowledge that the ethos of the present community is inherently reactive, technically proficient but neither particularly anticipatory nor strategic. This report indicates ways that this latter gap can be overcome by concerned governments.

21. This study at the same time suggests that there are immediate steps that can be taken to engage the scientific and social scientific communities to help humanitarian organisations anticipate potential threats and their impacts far more effectively than is normally recognised.

DIMENSIONS OF CRISIS IMPACTS: HUMANITARIAN NEEDS BY 2015

TABLE OF CONTENTS

LIST OF TABLES

Title **Page**

LIST OF FIGURES

DIMENSIONS OF CRISIS IMPACTS: HUMANITARIAN NEEDS BY 2015

Introduction: the study's objectives and structure

[1] This study offers an overview of key global trends and their implications for humanitarian assistance. It provides a sense of the scale of the numbers of people that could be affected by a specific set of crisis *drivers* and *shocks* between now and 2015 in four broadly defined regions: South Asia, East Africa, Southern Africa and Central Asia. This study reflects the findings of major international organisations such as the United Nations and the World Bank as well as those of leading private and academic research institutions. It relies heavily upon such reports as the World Bank's Natural Disaster Hotspots and more recently the Stern Review on the Economics of Global Climate Change.

[2] The study's conclusions indicate that over the next decade the international community will have to respond to the consequences of interactive drivers, shocks and humanitarian crisis agents which will be significantly triggered or compounded by global climate change. Using the period 2001 to 2005 as a baseline, this will translate into a 25% increase of crisis affected people in those four regions by 2015.[2]

[3] These estimates do not represent irrefutable predictions. They are intended as means to illustrate the extent of the challenges that certain broad trends, drivers and shocks could reasonably present to humanitarian donors such as DFID in the next ten years. The methodology that underpins this study is comparable to that used by the UN University's State of the Future Index (SOFI) as well as other studies including the Stern Review and the World Bank's Hotspots Case Studies.

[4] The report consists of four sections. ***Chapter I: The Global Setting*** provides a broad analysis of *drivers* and *shocks* that will directly influence or cause changes that will threaten the very survival and livelihoods of large numbers of human beings. For the purposes of this study, the changes affected by drivers and shocks will be termed *humanitarian crisis agents,* and the effects of these agents will be to expose human beings to a range of life and livelihood-threatening *humanitarian crises* such as floods, epidemics, conflict and food and water scarcity.

[4] ***Chapter II: Regional projections*** applies drivers, shocks and crisis agents in four regional settings -- South Asia, East Africa, Central Asia and Southern Africa – in order to provide a reasonable order of magnitude about the

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impact that crisis agents will have upon vulnerable populations. A major theme of this study is the interactive nature of a growing number of humanitarian crises. ***Chapter II*** uses a series of case studies found in Annex II to suggest the links between a multiplicity of drivers and crisis agents and various ways in which they might interact: [i] synchronous failures [the Mumbai Case Study], [ii] multi-hazards [the Ferghana Valley Case Study], [iii] cascading hazards [the East African conflict case study] and [iv] global-local links [the Zambezi River Basin case study].

[6] In undertaking this analysis, there has been a variety of assumptions about future trends that have been made, both in terms of substance and quantification. These facets of the study's findings are explored in ***Chapter III: Methodological lessons-learned***.

[7] While this study has been underway, there, too have been parallel activities through the DFID-funded Humanitarian Futures Programme that feeds directly into the study's ***Chapter IV: Conclusions and observations***. The first has to do with preliminary analyses of the anticipatory and adaptive capacities of those organisations responsible for preventing, preparing for and responding to humanitarian crises. The second concerns the changing nature of crisis-affected populations, humanitarian actors and humanitarian instruments and approaches.

[8] A considerable amount of material has been used to prepare this report, and these are referenced in footnotes, and where relevant to the report's main themes, findings and conclusions in ***Annex I: A Survey of Key Sources***. ***Annex II*** of this report, provides case studies designed to explore some of the regional projections found in ***Chapter II***, particularly as they apply to the changing dynamics of humanitarian crises. ***Annex III*** provides additional regional material about regional projections that have not been included in ***Chapter II*** or in ***Annex II***.

Chapter I: The global setting

Global climate change in context

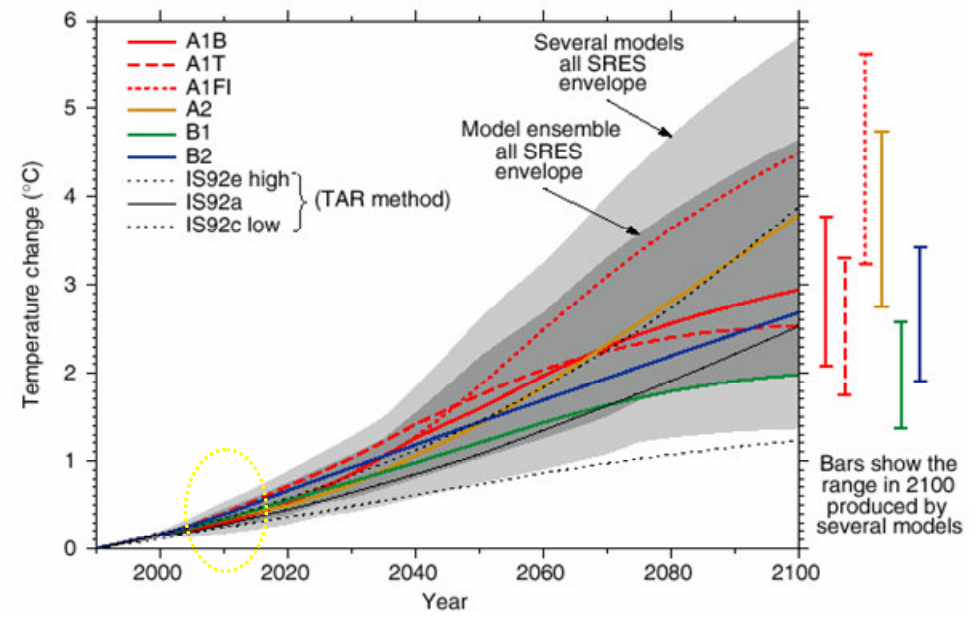

Figure 1: IPCC, The global climate of the 21st century

[9] There are several foreseeable threats that could profoundly transform the planet and expose large swathes of humanity to death-threatening risks. These include nuclear confrontations and virulent epidemics such as H5N1 avian influenza. There is nothing to date, however, that appears to equal the potential consequences of global climate change. The Stern Review reflects a broad, international consensus when it notes that "climate change will affect the basic elements of life for people around the world – access to water, food production, health and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms."[3]

[10] While the Stern Review has come under recent criticism for its use of scientific evidence and its economic conclusions, the scientific community is clear in its belief that global climate change (GCC) is resulting in a warming of the earth's temperature in ways that will fundamentally transform the globe as a whole.[4] While there will be differentiated geographical impacts in the foreseeable future, no region will ultimately escape the GCC's effects. The current levels of greenhouse gases are higher now than at any time in at least the past 650,000 years, and there is no other plausible explanation for this intensified increase

[3] Stern Review: ***The Economics of Climate Change***, p.2

[4] See, for example, Robert Carter et al., "The Stern Review: A Dual Critique," World Economics, Vol.7, No.4, October-December 2006

than human activity.[5] These conclusions underpinned the 2001 Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001), but now more recent studies demonstrate a sizeable probability that the sensitivity of the climate to greenhouse gases is greater than previously thought.[6]

[11] While there is a clear consensus about the broad implications of global climate change, there remains a host of uncertainties. One is the extent to which global climate change could itself be a source of greenhouse gases which would exacerbate rising temperatures beyond even the most recent forecasts.[7] The fact that GCC models still do not take this feedback loop into account means that some core assumptions about potential impacts remain substantively incomplete. Of even greater significance for this study is the fact that the effects of GCC on a more differentiated regional basis also remain uncertain.

[12] The Stern Review points to at least four regionally differentiated GCC implications that need to be considered when determining how drivers and crisis agents might relate to climate change. The first involves changes in rainfall patterns and extreme weather events. The consequences of interaction between natural cycles, eg, El Nino, and global climate change in various parts of the world are not well understood. Yet, "this is an area that urgently needs more research because of its potential effect upon billions of people in South and East Asia."[8]. Secondly, while higher latitudes and continental regions will experience generally higher temperature rises, the most dramatic manifestations will be felt in urban areas due to the consequences of urban heat island effect.[9] Such intensified heat patterns will have severe life threatening impacts upon the urban poor, particularly the elderly and very young.[10]

[13] Thirdly, the warming effect of greenhouse gases could lead to a collapse of the North Atlantic Thermohaline Circulation (the Gulf Stream) the current historically responsible for warming parts of European and North American climates. This in turn could result in substantial cooling of these areas, and paradoxically might also be offset by the consequences of greenhouse gases. While the full implications of this pattern remain unknown and purportedly would not be felt until the end of this century, the prospect is that these areas, too, might be subject to abrupt, large-scale changes in climate. As Stern concludes,

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[5] Ibid #3

[6] Ibid #3, p.2

[7] This would be the result of a reduction in absorption capacities which meant that carbon dioxide and methane

[8] Op cit., Stern, p.12

[9] "Urban heat island" is a metropolitan area which is significantly warmer than its surroundings. As population centres grow in size from village to town to city, they tend to have a corresponding increase in average temperature. On hot summer days, urban air can be 2-10°F [2-6°C] hotter than the surrounding countryside. Not to be confused with global warming, scientists call this phenomenon the 'urban heat island effect'"

[10] International Strategy for Disaster Reduction, ***Living with Risk: A global review of disaster reduction***, 2004, p. 17

however, this issue with all its attendant economic consequences requires further research.

[14] Of far greater certainty is the fact that sea levels are clearly rising. Though sea levels will respond more slowly than temperatures to changing green house gas concentrations, they have been rising nonetheless. At current rates sea levels are increasing by 3 mm per year, though as the IPCC notes and Stern reconfirms, this rise is accelerating. Here the growth of urban areas along coastal zones in South Asia as well as East and Southern Africa is an all too apparent link between GCC and range of ensuing drivers and disaster agents.

[15] In one way or another, GCC will be an all pervasive factor in the transformations that affect the global community in the foreseeable and longer-term future. Its consequences will directly and indirectly impact upon sources of conflict as well as competition for land, resources and water. GCC will have a major influence over where and how human-beings will live, and will have both direct and indirect bearings on their health and well-being. The geographic differentiations of GCC's effects that were noted earlier suggest that these effects may be regionally different, but no human-being will escape GCC's transformational consequences.

[16] GCC will impact upon those drivers that directly influence or cause changes in humanitarian crisis agents. GCC, for example, will intensify water evaporation in the soil which in turn will enhance the probability that drivers such as environmental degradation will subsequently lead to a crisis agent such as severe decline in agricultural production. Already recent evidence suggests that an estimated 25 million square kilometres, or about 19% of the Earth's land area, and about 3.4 billion people out of 6.53 billion are highly exposed to one crisis agent, eg, floods. Some 3.8 million square kilometres and 790 million people are exposed to at least two crisis agents, and approximately 105 million people are exposed to three or more hazards, eg, floods, cyclones and landslides. These crisis agents relate to six main "natural hazards," and do not include such crisis agents as conflict or failed states.[11]

[11] Maxx Dilley *et al*., ***Natural Disaster Hotspots: A Global Risk Analysis***, The World Bank, Washington, DC, 2005, p.2. It is important to note that the ***Natural Disaster Hotspots*** analysis refers to "hazards", while this study refers to "crisis agents". The latter term is used to emphasise that factors leading to humanitarian crises will continue to include events such as conflict, failed states, etc. – all crisis agents leading to humanitarian crises. Hazards as used by ***Natural Disaster Hotspots*** refers to natural hazards, principally, six such hazards: earthquakes, volcanoes, floods, cyclones, landslides and droughts.

Highlights of Possible Climate Impacts*

The study assumes that GCC impacts upon drivers and subsequently humanitarian crisis agents will generally reflect a 1 degree centigrade increase.

Temp rise (°C)	Water	Food	Health	Land	Environment	Abrupt and Large-Scale Impacts
1°C	Small glaciers in the Andes disappear completely, threatening water supplies for 50 million people	Modest increases in cereal yields in temperate regions	At least 300,000 people each year die from climate-related diseases (predominantly diarrhoea, malaria, and malnutrition) Reduction in winter mortality in higher latitudes (Northern Europe, USA)	Permafrost thawing damages buildings and roads in parts of Canada and Russia	At least 10% of land species facing extinction (according to one estimate) 80% bleaching of coral reefs, including Great Barrier Reef	Atlantic Thermohaline Circulation starts to weaken
2°C	Potentially 20 - 30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean	Sharp declines in crop yield in tropical regions (5 - 10% in Africa)	40 – 60 million more people exposed to malaria in Africa	Up to 10 million more people affected by coastal flooding each year	15 – 40% of species facing extinction (according to one estimate) High risk of extinction of Arctic species, including polar bear and caribou	Potential for Greenland ice sheet to begin melting irreversibly, accelerating sea level rise and committing world to an eventual 7 m sea level rise Rising risk of abrupt changes to atmospheric circulations, e.g. the monsoon Rising risk of collapse of West Antarctic Ice Sheet Rising risk of collapse of Atlantic Thermohaline Circulation
3°C	In Southern Europe, serious droughts occur once every 10 years 1 - 4 billion more people suffer water shortages, while 1 – 5 billion gain water, which may increase flood risk	150 - 550 additional millions at risk of hunger (if carbon fertilisation weak) Agricultural yields in higher latitudes likely to peak	1 – 3 million more people die from malnutrition (if carbon fertilisation weak)	1 – 170 million more people affected by coastal flooding each year	20 – 50% of species facing extinction (according to one estimate), including 25 – 60% mammals, 30 – 40% birds and 15 – 70% butterflies in South Africa Onset of Amazon forest collapse (some models only)	
4°C	Potentially 30 – 50% decrease in water availability in Southern Africa and Mediterranean	Agricultural yields decline by 15 – 35% in Africa, and entire regions out of production (e.g. parts of Australia)	Up to 80 million more people exposed to malaria in Africa	7 – 300 million more people affected by coastal flooding each year	Loss of around half Arctic tundra Around half of all the world's nature reserves cannot fulfill objectives	
5°C	Possible disappearance of large glaciers in Himalayas, affecting one-quarter of China's population and hundreds of millions in India	Continued increase in ocean acidity seriously disrupting marine ecosystems and possibly fish stocks		Sea level rise threatens small islands, low-lying coastal areas (Florida) and major world cities such as New York, London, and Tokyo		
More than 5°C	The latest science suggests that the Earth's average temperature will rise by even more than 5 or 6°C if emissions continue to grow and positive feedbacks amplify the warming effect of greenhouse gases (e.g. release of carbon dioxide from soils or methane from permafrost). This level of global temperature rise would be equivalent to the amount of warming that occurred between the last age and today – and is likely to lead to major disruption and large-scale movement of population. Such "socially contingent" effects could be catastrophic, but are currently very hard to capture with current models as temperatures would be so far outside human experience.					

** Stern Review: The Economics of Climate Change, p57*

Five drivers in the context of future crisis agents

[17] There are five drivers that this study has identified that will intensify the impacts of *humanitarian crisis agents*, or, factors that will directly threaten human life and livelihoods essential for survival. Each of these drivers will be influenced by global climate change, and analysis of each is consistent with findings undertaken by a range of international and inter-governmental organisations as well as leading research institutes, key examples of which are identified in ***Annex II*** of this report.

[a] demographic shifts. The 2006 global population is 6.528 billion people. Over the next ten years, the world's population as it moves towards 7.9 billion will continue to shift along five important lines. The first is the move from rural to urban centres. In 2005 there were 3.08 billion urban dwellers, and by 2015 there will be 3.8 billion, encompassing 53% of the world's population.[12] Africa has witnessed the highest shift from rural to urban, though at present the latter includes only 38% of the continent's total population. In this context it is the growth of slums that is most worrying. Slums significantly intensify human vulnerability, as overcrowding, fragile infrastructures (and social structures) and low incomes make large numbers of people susceptible to the vagaries of disease and other hazard events (UN-Habitat, 2006).[13] They also provide bases for discontent-based violence which has implications for overall state stability.

A second demographic issue is that of age distribution where much of the developing world will have large youth bulges. It is estimated that globally 27.4% of the world's population is below 15 years of age, and that in over 100 countries, 40% of the population is between 15 and 29 years of age.[14] These "bulges," which should in theory provide economic dividends to their respective societies, pose serious threats to social

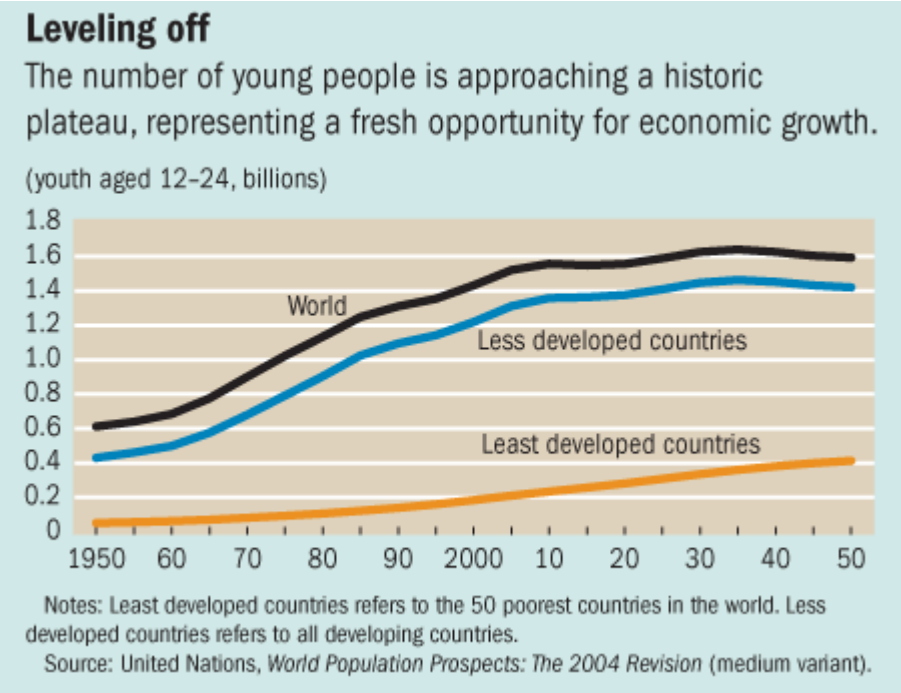
[12] At the beginning of the 20th century, there were fewer than ten cities in the world with a population of more than one million. By the first decade of the 21st century, there will be approximately 450 cities with one million or more. The term, "urban", increasingly reflects reclassification of rural areas[12] and the conversion of rural land to human settlements and infrastructure. Urban growth in the future will be focused upon smaller and medium-sized conurbations. These will be the areas which by the year 2012 will hold at least 54% of the world's people: approximately 79% of those in the developed world and 46% from the developing world.

[13] UN-Habitat's 2003 Global Report on Human Settlement notes that the world's slums are growing, with the number of people living in such dire conditions now at the 1 billion mark – making up 32 per cent of the global urban population. This crisis if not addressed will see this figure double in the next 30 years. In developing regions, slum dwellers account for 43 per cent of the population in contrast to about 6 per cent in more developed regions. In sub-Saharan Africa the proportion of urban residents in slums is highest at 71.9 per cent whereas South-central Asia accounted for 58 per cent, east Asia for 36.4 per cent, western Asia for 33.1 per cent.

[14] CIA World Fact Book, 2004. UN Population Fund

structures and stability in a growing number of developing countries.[15] A serious source of HIV/AIDS, the "bulge" also represent a growing portion of many nations' present and former orphans. It, too, is increasingly correlated directly with conflict and instability.[16]

Figure 2: Young people in developed & developing worlds



Thirdly, international migration from the developing to the developed world will increase, and this will place burdens not only on host countries but more significantly will deplete many countries of origin of much needed human resources.[17]

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[15] See: Laurie Garrett, "The Lessons of HIV/AIDS", Foreign Affairs, July/August 2005. According to Garrett, HIV/AIDS has killed over the past two decades at least 26 million people, orphaning more than 12 million children and today the virus afflicts 40 million people directly. It is interesting to note that USAID et al still maintain that there is insufficient data, computer modelling and empirical analysis of the disease to give policymakers sufficient guidance on prevention and treatment. [See: Karen Stanecki, The AIDS Pandemic in the 21st Century, USAID/US Department of Commerce, Washington, DC, March 2004

[16] See, for example, Richard Concotta, State of the World 2005 Global Security Brief #2: *Youth Bulge, Underemployment Raise Risks of Civil Conflict* , Washington, DC

[17] It is quite likely that significant numbers will not permanently settle in host countries, but rather move back and forth from their countries of settlement and their countries of origin. Such temporary migrants could be seen as the source of potential safety nets for their countries of origin through remittances and the source of development through knowledge transfer. DFID is involved in the early stages of considering the possibility of a Diaspora Fund which would link such remittances to more formal safety net and development initiatives.

Finally and of considerable consequence are those demographic shifts which result from other drivers. One case in point is the demographic flows that would stem from significant depletion of water sources.[18] Another would be the persistent movement of displaced peoples in countries where livelihoods are under threat. These sorts of shifts feed directly into crisis agents that expose severe human vulnerability.

[b] water dimensions. In terms of generating humanitarian crisis agents, water is a major driver. A growing body of opinion regards the pursuit of adequate water supplies as a major source of future conflict, even more so than competition for fossil fuels.[19] The abuse of water -- its degradation and pollution – leads to life-threatening illnesses and disease; its mismanagement results in the breakdown of agricultural systems, environmental degradation and mass displacement of peoples.

Today, approximately 10% of the world's population suffer from water stress (1000-1700 cu.m, per capita per year) or water scarcity (1000 cu.m per capita per year). Estimated annual water availability per person in 2025 reveals that at least 40% of the world's 7.9 billion people may face serious problems with agriculture, industry or human health if it relies solely on natural endowments of freshwater. Today, water tables are falling on every continent (UNWWD, 2003/9), agricultural land is becoming brackish, ground water aquifers are being polluted throughout extensive portions of South, East and Central Asia and throughout many parts of Africa. 1.1 billion people do not have access to safe drinking water and 2.4 billion people lack adequate sanitation.

About 80% of all diseases in the developing world are water-related, and urbanisation is increasing water demands faster than many systems can supply. Agriculture accounts for 70% of all human usage of fresh water. Of identified "hotspot countries", two out of six of the most severe crisis hazards directly pertain to water availability and management, ie, floods and droughts.

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[18] "By far the greatest long-term threat is one that our media hardly ever discuss, since it is too long-term and insufficiently fashionable: the growing shortage of water, due to a combination of over-population, appallingly inefficient use and conservation, and the effect of global warming on the Himalayan glaciers. If present trends continue, it is virtually certain that in fifty years time, much of Pakistan will be as dry as the Sahara – but a Sahara with a population of hundreds of millions of human-beings. The same will be true of northern India." A. Lieven,

[19] See, for example, Marq de Villiers, ***Water Wars: Is the World Running Out?***, London, Phoenix Press, 2001. The warning by the 1995 World Bank Vice President ,Ismail Serageldin, is particularly relevant, namely, that "the wars of the 21st century will be fought over water, not oil". In this context it is worth noting that 19 international rivers – including the Nile, the Ganges/Brahmaputra and the Congo and Niger – are each shared by five or more nations and are vital for the survival of each.

[c] environmental degradation. Topsoil loss, spreading deserts, shrinking forests and grand-scale pollution in the first instance pose a direct threat to the capacity of certain regions in Africa and Asia to feed themselves.[20] Drought problems are exacerbated by deforestation, soil erosion and inappropriate land use, while floods are caused often by the silting up of rivers and the loss of the soil's absorptive capacity. These are both legacies of poor agricultural practices that destroy groundcover and other natural environmental defences as well as by the first effects of global warming (World Bank/IEG, 2006/4ff).

Environmental degradation will directly affect food production in all its forms in many parts of Asia and Africa. While in all likelihood there will be adequate food by 2015 to feed the world's population, agricultural resources and products will continue to be unequally distributed in geographical terms and in terms of socio-economic access (FAO, 2003).

Environmental degradation, linked to deteriorating livelihood opportunities in rural areas, will result in significant population moves to coastal areas or urban conurbations. There, too, will be a growing number of "environmental migrants" – who move across "marginal lands," in an effort to find ways to maintain their traditional livelihoods. Rather than move to urban areas and/or coastlines, they will be subsistence farmers or those who provide services to such farmers. Conservative estimates ten years ago indicated that 630 million people would live in these sorts of low productivity areas, and there is no suggestion that this trend has changed.[21]

[d] persistent health threats. Chronic and infectious disease will remain a significant factor in humanitarian requirements in the foreseeable future. Despite biotechnological innovations, infectious disease will directly threaten the lives of the poor in both the developed and developing worlds. As for major pandemics, WHO regards HIV/AIDS, tuberculosis and malaria as global pandemics that are debilitating developing countries in particular and compounding the effects of poverty and social inequities.

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[20] Should China continue on its present levels of coal combustion, chronic acid deposition problems will lead to serious soil degradation that could dramatically affect China's overall grain production. China might have to resort to large-scale purchases which could affect overall availability, as is already evident in countries such as Malawi and other SADC countries. See, for example, Jean-Christophe Servant, "China's Trade Safari in Africa," Le Monde Diplomatique, May 2005, and People's Daily, "Malawi wishes to Develop Better Economic Trade Relations with China," 12 October 2005.

[21] West African states such as Cote d'Ivoire, Ghana, Guinea Bissau and Sierra Leone present good examples of such stranded minorities where, for example, plantation workers have no identity rights, no cash to go home and no legal frameworks or systems to protect them. Norman Myers and Jennifer Kent expand upon a similar theme in ***Environmental Exodus: An Emergent Crisis in the Global Arena*** [Climate Institute, Washington, DC, 1995],

More than six million people die annually of these diseases.[22] In some states, particularly in sub-Saharan Africa, the prevalence of certain types of disease is ignored, though their effects on social structures are considerable.[23] The growth of urbanised poor, living in inadequate housing conditions and with limited access to clean water and sanitation facilities, will clearly unleash a host of health related crisis agents. In addition, the threat of pandemics has to be taken into account as a potential global "shock." Based upon analyses, for example, of the threat of Avian Influenza, pandemics could have profound impacts upon societies and their very survival.

Of major importance is the inter-relationship between health and environmental issues. Life-threatening health hazards will increasingly result from chemical and radioactive waste materials due to environmental degradation and collapsing infrastructures will be borne by air as well as by water. In a related vein, the increasing flow of industrial waste will also contaminate rivers and streams that will threaten the lives of growing numbers of people as will the seepage of such toxic waste into aquifers and wells.

[e] intra and inter-state instability. Instability as noted here represents a potential driver as well shock. It is a driver because the prospect of its persistence and drag on human development indirectly impacts upon crisis agents and human vulnerability to such agents. It is a shock in the sense that the timing and manifestations of some aspects of instability, eg, *coup d'etats*, remain uncertain. Conventional inter-state conflict will continue in various areas around the world. On the other hand, there are growing indications that so-called "resource wars", eg, fights over water sources, will become increasingly likely.[24]

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[22] Globally, about 8000 people die of AIDS-related conditions daily, notwithstanding the ability of antiretroviral therapy to delay disease progression and improve quality of life significantly. The tuberculosis epidemic continues to be a major public health problem globally, with currently 8.8 million new cases a year and about two million deaths worldwide. Malaria causes annually about 300 million cases of acute illness, of which more than a million are fatal. [World Health Organisation, ***WHO and the Millennium Development Goals***, 2001] In addition to these existing pandemics, there, too, are threats from Avian Influenza, SARS and Ebola.

[23] Other major diseases, often called "neglected diseases", affect at least one billion people, cause immense suffering and often lifelong disabilities, but rarely kill. Many of these can be found in Sub-Saharan Africa, including Buruli ulcer, Chagas disease, lymphatic filariasis [elephantiasis], schistosomiasis, intestinal parasites, leprosy, leishmaniasis, human african trypanosomiasis [sleeping sickness], onchocerciasis, dracunculiasis [guinea-worm disease] and trachoma.

[24] In a major Chatham, House address in March 2006, the then British Defense Secretary John Reid warned that global climate change and dwindling natural resources are combining to increase the likelihood of violent conflict over land, water and energy. Climate change, he indicated, "will make scarce resources, clean water, viable agricultural land even scarcer" -- and this will "make the emergence of violent conflict more rather than less likely." Reid's comments indicate, no society, however affluent, will escape involvement in these forms of conflict. Concerns over the link between climate change and resource wars have been well analysed by

One of the central political trends over the next ten years will also be "adjustments" in the nation-state construct.[25] The process by which states disintegrate, merge, become part of regions, change boundaries and so on will become a source of serious conflict and, in many instances, social disintegration and realignment. Such conflicts will reflect a variety of inter-acting forces, including remnants of nationalism, religious and ethnic identification and economic and other functional alternatives to state structures.[26] Over the next decade one will also witness urban conurbations plunged into periods of intense and costly anarchy – including cities in the developed world as well as in the developing world.[27]

Practices associated with corruption and poor governance may well continue to inhibit efforts to reduce poverty and discontent. Hence, indirectly poverty which stems from such practices will fuel discontent that could lead to violence and the vulnerabilities associated with such violence.

Peter Schwartz and Doug Randall in ***An Abrupt Climate Change Scenario and Its Implications for United States National Security,*** Global Business Network, October 2003.

At the same time, as rightly noted by Michael Renner in ***The Anatomy of Resource Wars***, Worldwatch Paper #162, October 2002, there are resource conflicts of another dimensions that will increasingly prove difficult to address as resource scarcity increase: "In several countries around the developing world, abundant natural resources help fuel conflict, either by attracting predatory groups seeking to control them or by financing wars that were initially caused by other factors. Prominent examples include Sierra Leone, Angola, Democratic Republic of the Congo, Sudan, and Afghanistan. Conflict has also erupted in several countries where the benefits of mining and logging projects—oil in Columbia and Nigeria, timber and natural gas in Indonesia, and copper in Bougainville/Papua New Guinea—accrue to a small elite while the social and environmental burdens are borne by local communities. Governments, rebels, and warloads have made billions of dollars by selling conflict commodities and have used the money to arm themselves and line their own pockets. But the cost of these conflicts has been extraordinary—more than 5 million people killed during the 1990's, as many as 20 million driven from their homes, and considerable environmental destruction."

[25] The literature pertaining to fundamental state transitions is extensive, compelling and with very practical consequences for policy-makers attempting to determine the extent to which governments in the future will have the capacity or interest in providing safety nets to mitigate vulnerability to crisis drivers. One prime example is Manuel Castell's ***The Power of Identity [Blackwell Publishers, 1997],*** see Section 5, "A Powerless State", pp.243ff

[26] Indicative of this pattern is Monty Marshall's ***Conflict Trends in Africa, 1946-2004: A Macro-Comparative Perspective*** – A Report prepared for the Africa Conflict Prevention Pool, HMG, UK. The author sees that the vast majority of armed conflicts in Africa have been societal [ethnic, community and revolutionary wars]. He regards two distinct trends as all-encompassing, ie, "state-formation instability" and "post-formation instability."

[27] Paris in November 2005 is but one of a list of growing cases of extreme violence in the developed world. Recent riots in Khartoum and Juba after the 30 July 2005 death of John Garang de Mabior reflects the potential explosiveness in developing world cities. For the latter, see: Khalid Mustafa Medani, "Black Monday: the political and economic dimensions of Sudan's urban riots," Middle East Review, 9 August 2005.

Future humanitarian crisis agents and future humanitarian crises

[18] The five sets of drivers noted above will directly influence *humanitarian crisis agents*. These in turn will be responsible for exposing vulnerabilities that will threaten the lives of a growing number of human-beings as well as livelihoods essential for their survival. Indicative *humanitarian crisis agents* are grouped under each of the five drivers, below. While such drivers and crisis agents foretell of serious increases in crisis-affected peoples over the next decade, there will be positive drivers that could in principle offset the effects of the former. These include the consequences of economic growth, increased development assistance as well as scientific and technological innovation. This study, however, has not systematically analysed such potentially positive drivers as countervailing factors in its projections on crisis-affected peoples.[28]

[a] demographic shifts will increasingly place people in physical and economic situations where their vulnerability is exposed

[i] **deteriorating life support systems**, characterised by collapsed infrastructures, inadequate and non-potable water, high levels of toxic waste, high levels of life-threatening malnutrition, intra-communal violence, all frequently associated with slums
[ii] **internal displacement**, resulting in loss of livelihoods and breakdown in minimal safety nets
[iii] **economic migration**, leading to refugee-like survival situations
[iv] **abandoned groups** of elderly and very young in rural settings, requiring survival assistance

[b] environmental degradation will create new crisis agents and intensify so-called natural crisis agents

[28] The uneven progress on the Millennium Development Goals to date might, however, be seen as a worrying indication that more positive drivers will not offset the impact of the negative drivers by 2015. While this study has not done an analysis of positive drivers, the World Bank's cautious note is worth bearing in mind: "For the poorest countries many of the goals seem far out of reach. Even in better off countries, there may be regions or groups that lag behind. Countries need to set their own strategies and work together with the global partners, to ensure that poor people are included in the benefits of development. …These assessments are based on performance. They are not final verdicts, but they are a warning. Too many countries are falling short of the goals or lack the data to monitor progress. Now is the time to take actions to accelerate progress, not five or ten years from now."
[http://ddpext.worldbank.org/ext/GMIS/gdmis.do?siteId=2&menuId=LNAV01HOME4] In a related analysis, the President of the World Bank noted in the 20 April 2006 launch of the IMF-World Bank Global Monitoring Report that "less than 10 years remain until 2015, the target year for the MDGs. We are making progress in many countries, and this shows that development efforts can deliver results. But with just a decade to achieve the goals, it's urgent for both developing countries and the donor community to improve governance to ensure we get the results we seek."

[i] **land destruction** threatening livelihoods and also intensifying competition for increasingly scarce resources
[ii] **flooding impacts** destroying infrastructure, shelter and livelihoods and often clean water sources
[iii] **landslides** destroying homes, infrastructures, areas for agricultural and industrial production
[iv**] weakened infrastructures**, leading to collapse of infrastructures, industrial and domestic structures, waste storage sites

[c] water dimensions will require ways to be found to address scarcity, to avoid violent competition over water and to have adequate infrastructures to meet burgeoning sanitation and potable water needs

[i] **drought** will be more frequent and endure for longer periods, affecting industrial as well as agricultural production[29]
[ii] **flood-drought cycles** will lead to periods of intense flooding, followed by prolonged periods of drought, overall resulting in periods of severe water shortages
[iii] **water pollution** may frequently be linked to other drivers such as environmental degradation, and result in large-scale disease, mass poisoning, decline in agricultural production
[iv] **water resource conflicts** could create destitution, internal displacement and refugees
[v] **migration** may ensue in the aftermath of major declines in water availability, leading to vulnerabilities similar to those of the displaced

[d] persistent health threats, particularly chronic and infectious disease, will continue to be a major driver, exacerbated by global climate change and the impact of other drivers. It will feed into the following types of crisis agents:

[i] **emerging large-scale epidemics and pandemics** resulting, for example, from various forms of influenza, eg, H5N1 Avian Influenza
[ii] **re-emergent diseases**, due to a combination of poverty, breakdown in social services, sanitation systems and infrastructure, will be reflected in life-threatening forms of polio, Ebola fever and diphtheria
[iii] **persistent health hazards** such as malaria, cholera tuberculosis, diarrhoea and dengue hemorrhagic fever will continue to affect populations in a growing number f areas throughout the world, threatening the lives of large numbers of people principally in vulnerable societies

[29] Drought is defined as 50% or less of the median for three months, according to Maxx Dilley et al***, Natural Disaster Hotspots***, World Bank, Washington DC, 2005, p. 30

These do not include so-called “neglected diseases”, referenced in footnote #23, above

[iv] **new forms of health hazards** such as radiation and other chemical poisoning – carried by air and water – in the aftermath of industrial collapse or exposure of industrial/nuclear waste sites will increasingly be crisis agents that will dramatically shorten the lives of people, if not be directly responsible for a growing number of deaths

[v] **indirect consequences of fatal disease.** The persistence of HIV/AIDS has to be calculated not only in terms of its direct impact upon mortality, but also upon its impact upon the orphans and elderly who lose livelihood support with the demise of those who could have provided for them.

[e] intra and inter-state instability will be exacerbated by global climate change, as the scramble for scarce resources, eg, water and arable land, become more intense, and as populations seek survival and livelihoods in already overstressed areas. States’ capacities or interest in providing social safety nets will most likely decline as will their means to do so:

[i] inter-state and inter-communal resource wars, resulting in destruction of communities and flows of refugees and IDPs

[ii] intra-communal conflicts in urban areas, principally violence in slums that will lead to large numbers of peoples in need of medical and food assistance

[iii] ethnic violence, made distinctive by the trans-border alliances that will fuel conflict, leading to IDPs, refugees and communal destruction

[iv] wilderness crises where displaced populations in remote areas fall outside the interest or capacities of states to assist

Table 1: Drivers, Crisis Agents and Humanitarian Crises

This table is designed to show the inter-relationships between global climate change and the effects that GCC could have upon specific drivers (paragraph #17, above), humanitarian crisis agents (paragraph #18, above) and various types of humanitarian crises at regional and global levels.

Global climate change	Specific Drivers	Humanitarian Crisis Agents	Humanitarian Crises	Regional/Global
In less than four decades time 200 million people may become permanently displaced due to rising sea levels, heavier floods and more intense droughts. Declining crop yields especially in Africa are likely to leave hundreds of millions without the ability to produce or purchase sufficient food – particularly if the carbon fertilisation effect is weaker than previously thought.[30]	**Demographic shifts.** Population movement will often exacerbate GCC impacts by increasing society's exposure to environmental stresses, according to the Stern Review [p.59]. In addition, these stresses will interact with or intensify social tensions and conflict.	[1] densely populated slums, resulting in weak health and water infrastructure and intense poverty	[1] epidemic disease, with particular impact for very young and ageing populations [2] severe malnutrition [3] intra-communal violence	Major increases in urban/slum populations i large coastal cities, including Shanghai, Mumbai, Calcutta, Karachi, Buenos Aires
		[2] coastal populations increase substantially both in urban and rural areas as potential impacts of hurricanes, cyclones and tsunamis intensify in terms of impact and frequency	[1] destruction of infrastructure and livelihoods base [2] serious injuries among population with no health support systems [3] housing and shelter leaves extensive portions of population exposed	South Asian and Far Eastern coastal areas; portions of Horn of Africa, though populatio density relatively small, south eastern and w coast portions of Sub-Saharan Africa at considerable risk
		[3] internal displacement, leading to loss of livelihoods, breakdown in even minimal safety nets	[1] severe malnutrition [2] epidemic disease [3] inter-communal violence	Large swathes of Central Asia and Sub-Sah Africa, the latter principally occurring in Wes and East Africa
		[4] economic migration, requiring refugee-like support	[1] severe malnutrition [2] epidemic disease [3] inter-communal violence	Portions of the Caucasus, focusing on Azerbaijan, Georgia as well as Central Asia Iran
		[5] decline of rural economies in established communities, leading to numbers of abandoned young and elderly fending for themselves in situations increasingly lacking security and access to food, water, health	[1] elderly and non-productive communities facing starvation, lack of water and health care	Rural areas of Bangladesh, India and Pakis as well as most countries in Sub-Saharan A

[Table cont…]

[30] Commentary in column 1 of Table 1 combines materials from the Stern Review, the IPCC 2001 Report and ISDR. It should be emphasised that these notations are indicative, that is to say that they do not include all the factors that could impact upon each of the specific drivers noted in column 2.

Global climate change	*Specific Drivers*	*Humanitarian Crisis Agents*	*Humanitarian Crises*	*Regional/Global*
GCC will affect species' distribution that will affect agricultural production, eg, native pollinators. Rising surface ozone to affect wide range of natural and agricultural plant production due to poisonous consequences of high levels of ozone. Forests and crop lands to be	**Environmental degradation.** All aspects of the use of available land and water will be affected by environmental degradation.	[1] combination of soil salination, deforestation and pollution, resulting in competition for scarce resources, decrease in livelihoods and breakdown in food chain	[1] decline in food availability [2] destruction of infrastructure [3] intra-communal violence [4] water depletion	North and western China, most of Central Asia, areas in central India, Horn of Africa, East and Africa and South America and South East Asian
		[2] increased flood propensity, destroying agriculture production and related activities	[1] severe malnutrition [2] epidemic disease, particularly water-borne [3] inter-communal violence	Central Asia and South Asia, Southern Africa, S east Asia
		[3] landslides, destroying homes, productive areas and threatening human lives	[1] exposure due to lack of shelter [2] epidemic disease	Central Asia, South Asia, South East Asia and w portions of South America
		[4] weakened infrastructure due to intensified erosion, including effects on industrial structures and relate storage sites	[1] large-scale poisoning stemming from toxic materials [2] forced migration due to depletion of land usage	Caucasus, Central Asia, Eastern Europe, Medite region
GCC to alter patterns of water availability by intensifying the water cycle. Droughts and floods to become more severe in many areas. There will be more rain at high altitudes, less rain in the dry sub-tropics and uncertain but probably substantial changes in tropical areas, including flash floods.	**Water dimensions** require an ability to find ways to address scarcity, to avoid violent competition over water sources and to have adequate infrastructures to meet burgeoning sanitation and potable water needs	[1] drought will be an increasing problem due to intense and extended periods of dryness, paradoxically mixed with intense levels of precipitation	[1] severe food shortages leading to acute malnutrition and famine	water shortages, predominantly in Africa, the Mi East, Southern Europe and parts of South and C America. South and East Asia to be faced with rainy seasons and drier dry seasons
		[2] flood-drought cycles will be more intense as melting glaciers and loss of mountain snow increases flood risk during wet season and threaten dry-season water supplies. Damaging floods, affecting agricultural production, homes and industry	[1] severe food shortages [2] severe impact upon very young and ageing populations, particularly in urban areas [3] intensification of deep poverty	Himalaya-Hindu Kush region which feeds seven Asia's largest rivers, including 70% of summer fl the Ganges which provides water to around 500 people. In China 23% of the population [250 mill in western region that depends on melting glacia Similar situation in South America, eg, the Ande p.63]
		[3] water pollution will result from infrastructure breakdowns in urban and rural areas, compounded by industrial and fertiliser run-offs and dumping	[1] lack of potable water will intensify diseases, leading to epidemics as well as more general effects on human health [2] polluted water will negatively affect agriculture, and lead to severe food shortages [3] sources of pollution could lead to violent inter-communal as well as inter-state conflict	South America along Amazon basin, major Sout Central American cities; South Asia particularly coastal areas, Central Asian population centres
		[4] conflict increasingly possible, though not inevitable, as nations seek to control waterways and even divert them for their own individual use	[1] resource wars will lead to destruction of communities, and create IDP and refugee situations	India and China as well as other South Asian co countries, including Pakistan and Bangladesh. C depending upon the Nile.
		[5] migration may result as consequence of major declines in water availability, leading to vulnerabilities similar to those of the displaced	[1] communities seeking water in areas under severe water stress become IDPs or trans-national migrants, requiring survival assistance, including shelter, food, water	South Asia, principally Pakistan and northern In western and northern China

[Table cont…]

Global climate change	*Specific Drivers*	*Humanitarian Crisis Agents*	*Humanitarian Crises*	*Regional/Global*
GCC's impact on health will be reflected in at least five ways, ie, food and water borne disease, vector-borne infectious disease, injuries resulting from a wide-range of crises, eg, landslides, and malnutrition. There are aspects of GCC's impact that remain uncertain, such as the extent deaths would be due to thermal extremes in already sick/frail persons.[31]	**Persistent health threats** will remain a major driver affecting humanitarian crisis agents.	[1] emerging disease such as various forms of influenza, eg, H5N1 Avian Influenza, will emerge and persist in part for reasons of poverty and complex factors involved in stemming their spread	[1] epidemics affecting high proportion of urban population, with epicentre in slums [2] pandemics affecting large numbers of people at regional and global levels	Far East and following on to all continents, wit continent as a whole the least prepared
		[2] re-emergent disease not only due to resistant strains, but also to poverty, breakdown in sanitation systems and infrastructure, will be reflected in diseases as Lassa and Ebola fever, Lyme disease and diphtheria	[1] overstretched health capacities unable to cope with rising numbers of affected [2] disabled "breadwinners" lead to greater family vulnerability	Global issue, but poorest countries to be least deal with consequences
		[3] persistent health hazards such as HIV/AIDS, malaria, cholera tuberculosis, dengue hemorrhagic fever will continue to affect large swathes of populations, directly in terms of health and broader societal consequences	[1] deterioration of work force [2] mounting tolls of life threatened victims [3] ageing and very young populations highly vulnerable directly to certain diseases, eg, dengue, and indirectly because of lack of family support through death of AIDs victims	South Asia,most states in Sub-Saharan Africa, lesser extent in South East Asia when it come support services
		[4] new forms of health hazards such as radiation and other chemical poisoning – carried by air and water – in the aftermath of industrial collapse or exposure of industrial/nuclear waste sites will increasingly be crisis agents	[1] long-term provision of life-saving assistance will be required [2] mass migration from affected areas, leading to refugee and IDP-type assistance requirements	Central Asia, Eastern Europe, Caucasus

[Table cont…]

[31] World Health Organisation, ***Global Environmental Change***, http://www.who.int/globalchange/climate/summary/en/index6.html

Global climate change	*Specific Drivers*	*Humanitarian Crisis Agents*	*Humanitarian Crises*	*Regional/Global*
GCC will impact upon the availability of resources required for human survival and livelihoods. The increasing scarcity of water and arable lands in some regions, the availability of much needed resources in other regions are indications of the sorts of interactions between GCC and conflict.	**Intra and inter-state instability** will be an increasingly critical driver that influences humanitarian crisis agents over the next decade. A growing number of states will not have the capacity of interest to protect portions of their populations, and, hence, social safety nets will be on the wane in many regions.	[1] inter-state and inter-communal resource wars, resulting in destruction of communities and flows of refugees and IDPs	[1] destruction of means of livelihoods [2] large scale injured and wounded populations [3] disease outbreaks [4] refugee and IDP situations, requiring appropriate assistance [5] severe malnutrition, particularly for highly vulnerable groups such as elderly, children, women [6] high incidence of severe trauma	East and West Africa, South Asia, South East A including Indonesia, Central Asia
		[2] intra-communal conflicts in urban areas, principally violence in slums that will lead to large numbers of peoples in need of medical and food assistance	1] destruction of means of livelihoods [2] large scale injured and wounded populations [3] disease outbreaks [4] refugee and IDP situations, requiring appropriate assistance [5] severe malnutrition, particularly for highly vulnerable groups such as elderly, children, women [6] high incidence of severe trauma	East and West Africa, South Asia, South East A including Indonesia, Central Asia
		[3] ethnic violence made distinctive by the trans-border alliances that will fuel conflict, leading to IDPs, refugees and communal destruction	1] destruction of means of livelihoods [2] large scale injured and wounded populations [3] disease outbreaks [4] refugee and IDP situations, requiring appropriate assistance [5] severe malnutrition, particularly for highly vulnerable groups such as elderly, children, women [6] high incidence of severe trauma	East and West Africa, South Asia, South East A including Indonesia, Central Asia, Eastern Euro
		[4] wilderness crises where displaced populations in remote areas fall outside the interest or capacities of states to assist	1] destruction of means of livelihoods [2] large scale injured and wounded populations [3] disease outbreaks [4] refugee and IDP situations, requiring appropriate assistance [5] severe malnutrition, particularly for highly vulnerable groups such as elderly, children, women [6] high incidence of severe trauma	Central Asia, western and norther China, Cauca north Africa, Central Africa

[19] As Table 1 demonstrates, the interaction between global climate change and drivers clearly spills over into the impact that humanitarian crisis agents have upon humanitarian crises. *Shocks*, however, are rare events or have never happened, and, while by definition they cannot be anticipated with any degree of certainty, they nevertheless need to be built into attempts to calculate future humanitarian crises and their consequences. As with drivers, shocks, too, can be positive; yet for reasons noted in the earlier discussion on drivers (See: para. # 18) the positive aspects of some types of shocks (eg, biomedical breakthroughs, fusion-based energy) are not taken into account in this study.

[20] To the discussion on shocks should be added the concept of "discontinuities". In other words, there is a point when systems absorb stress over long periods without much outward sign of damage until accumulated stress leads to explosion or implosion. One analyst uses "acid rain" as a relevant example. A forest ecosystem can successfully buffer stress for long periods and its ecosystem changes are hardly visible. "Yet even while the ecosystem remains apparently unchanged and healthy, it moves ever closer to the limits of its resilience – and thereafter towards an abrupt collapse."[32]

[21] For the purposes of this study, shocks can include any substantial unanticipated event, ranging from a sharp rise in fuel prices, a *coup d'etat*, a major nuclear explosion, the collapse of the North Atlantic Thermolhaline Circulation[33] or indeed even a "near Earth object (NEO)" hitting the planet at a rate of 40kms/second, vaporising and exploding in the atmosphere. [34] To some extent, the introduction of shocks and discontinuities relates to the Stern Review's discussion on the effects of non-linearities (Stern, p.59). Here, however, what is of particular relevance is the capacity of different regions to handle shocks and discontinuities, and in this regard it is interesting to note that the IPCC Working Group II saw Africa's "adaptive capacity" as "low due to lack of economic resources and technology", and that of Asia's developing countries as "low and vulnerability is high."[35]

[22] In this study's ***Chapter II: Regional projections,*** each of the regional analyses include shock elements to suggest how such elements might impact

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[32] John McNeill in ***Something New Under the Sun*** [2000] suggests that there could well be one discontinuity series after another, or side by side with each other. The McNeill reference as well as the quote in the text comes from Myers and Kent, ibid.# 8, ***Atlas of Planet Management***, p.272.

[33] The THC has a significant warming effect on the climates of Europe and parts of North America. A "complete collapse" of the THC, though not currently predicted to happen, could have a dramatic cooling effect on those regions.

[34] This prospect can be found in the recent work of the former President of the Royal Society, Sir Martin Rees, ***Our Final Century***, Random House, London, 2003, p.91. Rees sees that there is a 50% likelihood that this sort of event could happen during this century.

[35] The Stern Review also flags the importance of adaptive capacities, and in commenting on the impact of climate change on agriculture, notes in the Review's Part V some of the key determinants required to promote successful adaptation.

upon drivers and humanitarian crisis agents when it comes to forecasting numbers of affected people.

Changing dynamics of humanitarian crises

[23] Future crises will be more interactive, global and synchronous.[36] Different disaster agents will be more prone to cascade into others, and individual agents, eg, pandemics, to become more global. "Synchronous failures," or the simultaneous collapse of survival systems including infrastructures and economic systems will severely threaten peoples, particularly in urban conurbations. The changing dynamics of future crises are suggested in aspects of the regional projections found in ***Chapter II***, and these dynamics are tested in the contexts of particular scenarios, or, case studies found in ***Annex II***, more specifically:

> [i] synchronous failures suggests the simultaneous collapse of systems, from technical and economic, to infrastructural and societal. This is suggested in ***Annex II****'s Mumbai case study*;
> [ii] multi-hazard impacts reflects the interaction between several types of disaster agents on vulnerable populations, as described in ***Annex II****'s Ferghana Valley case study*;
> [iii] cascading crisis agents, like dominoes, views inter-active disaster agents in terms of one type of agent triggering another, as described in ***Annex II****'s East African displacement case study*;
> [iv] global-local crisis agents looks at inter-relatedness in terms of the impact of a global event, eg, El Nino, upon a local event, eg, disaster in the Zambezi River basin as noted in ***Annex II****'s Zambezi River basin case study*.

[36] Stern, too, notes that the "combined effect of impacts across several sectors could be very damaging and further amplify the consequences of climate change. Little work has been done to quantify these interactions, but the potential consequences could be substantial. For example, in some tropical regions, the combined effect of loss of native pollinators, greater risks of pest outbreaks, reduced water supply and greater incidence of heat waves could lead to much greater declines in food production than through the individual effects themselves." [Stern Review, p.59]

Chapter II --Regional projections: drivers, shocks, crisis agents and affected

[24] In projecting numbers of potentially crisis-affected peoples in four regions (ie, Central Asia, East Africa, South Asia, Southern Africa), this study looks at both a multidecadal timeframe and a recent five year timeframe – from 2000 to 2005. Where the five year timeframe is not in itself sufficiently statistically informative to construct a forecast, these data may nonetheless be presented for context. Forecasts are built on what was assessed to be the most reliable methods, between growth trends in terms of population, demographic movements, disease patterns, hazards and conflict affected, other statistical extrapolations, such as baseline averages and 'set-piece' scenarios. This latter method has been employed either where official data is uncertain or where periodic events make this a more reasonable approach than trending, and is indicated when used. ***Annex III*** provides specific data, charts and tables upon which many of ***Chapter II***'s more general findings are based.

[25] The inter-relationship between drivers, crisis agents and humanitarian crises, themselves, can be seen in a general context in Table 1, above. In the regional analyses that follows, some and on occasion all of the five drivers discussed in ***Chapter I*** have been incorporated in a regional context, linking them to regionally relevant crisis agents. It is the interaction between these two that result in this study's projection of crisis-affected peoples. The results of this interaction can be significantly skewed by *shocks*. None of the shocks that are used in the regional analyses are implausible. All have some grounding in possible fact, but they remain uncertain, *viz*, high impact, low probability.

[26] As noted in the World Bank's *Natural Disasters Hotspots*, "the fact that some areas of the world are subject to multiple hazards will not surprise many residents of those areas;" but what the Bank's findings reveal and what this study confirms is the "substantial overlap between different types of hazards and population concentrations."[37] Geophysical hazards tend to cluster along fault-lines characterised by mountainous terrain; hydro-meteorological crisis agents (eg, floods, landslides, cyclones) strongly affect eastern coastal regions of major continents as well as some interior regions in North and South America, Asia and Europe. "Of particular concern in these areas are possible interactions between different hazards (Ed: crisis agents), for example, landslides triggered by cyclones or flooding, or earthquakes that damage dams and reservoirs neded for drought and flood protection."[38]

[27] This study adds to these findings by suggesting that the concentration of hazards, or, crisis agents, and populations also have to link into factors of violence, eg, inter and intra-state and communal conflict. It is the inter-active cycle between so called "natural hazards" (ie, nature-driven crisis agents),

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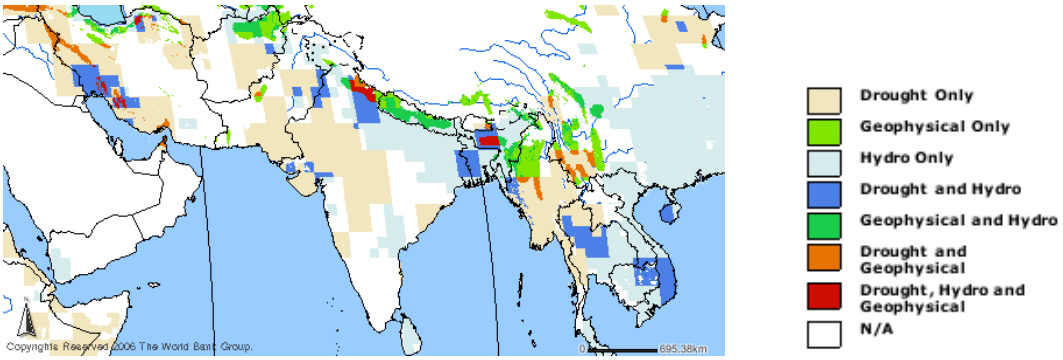
[37] Op cit., Maxx Dilley, ***Natural Disaster Hotspots, A Global Risk Analysis***, p.2
[38] Ibid

discontent, resource competition and alienation which would seem to be the hallmark of many humanitarian crises in the future. For at least three out of the four regional projections discussed below, that would seem to be the case.

[28] Crisis Affected Peoples in Bangladesh, India and Pakistan – 2005 to 2015 –

Figure 3: World Bank Natural Disaster Hotspots: South Asia



The population of Bangladesh, India and Pakistan in total in 2005 was 1.4 billion. In a decade that figure will increase by 16% to 1.62 billion. The region as a whole is characterised by extreme weather conditions and high population densities in areas vulnerable to these conditions. If one combines the potential impacts of major drivers in the region, one can project that an estimated 97 million people will be affected by one or more disaster agents in 2010 and an estimated 105 million in 2015 (See: Annex III, Figure 31). This compares with a 2005 figure of 38 million, and an average figure of 96 million for the period 2000-05.

[a] At the high range for these projections in 2010 and 2015, these figures would increase to 115 million and 127 million respectively. If in addition to the high range Influenza-type epidemic amongst those living in poverty in 2014 to these calculations, the total disaster affected populations could reach 284 million in 2015.

[b] An indicative example of the impact of inter-active drivers is the Mahashtra cloudburst of 2005, which centred on Mumbai and its suburbs. ***Case Study #1*: *Synchronous Failure in Mumbai***, Annex II, examines the effects of increased weather extremes in Mumbai against the drivers of demographic change, water management and epidemics.

[c] While Mumbai presents a clear example of the consequences of extreme weather fluctuations, water management failures and demographic trends, it appears that large swathes of South Asia are also becoming increasingly vulnerable to similar interactive patterns.

Table 2: Numbers of crisis affected, South Asia

	2001-05	2010			2015		
(000s)		Low	Mid trend	High	Low	Mid trend	High
Drought & Famine	60,014	33,835	49,283	64,732	32,876	51,125	69,373
Flood	36,328	39,184	47,358	49,766	41,993	53,044	57,350
Fecal-oral epidemics	38	285	320	383	306	434	521
Total excl Av. Influenza	**96,379**	**73,304**	**96,961**	**114,881**	**75,175**	**104,603**	**127,244**
Avian Influenza	n/a	48,986	122,466	146,959	52,380	130,951	157,141
Total incl Av. Influenza	**96,379**	**122,290**	**219,426**	**261,840**	**127,555**	**235,553**	**284,385**

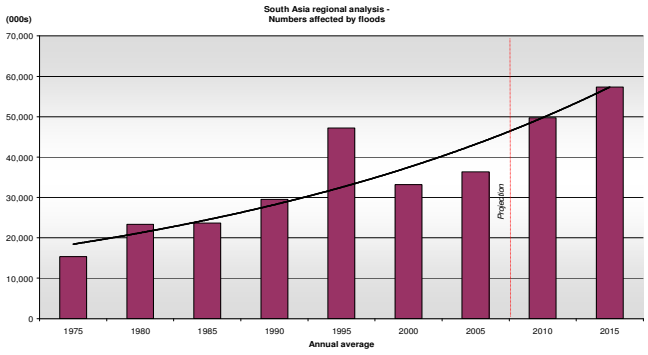
Drivers and humanitarian crisis agents

[d] There are four main drivers that influence the crisis agents that result in the projected numbers of affected peoples in this regional scenario.[39]

[i] water management. South Asia experiences high variability in rainfall, reflected in frequent episodes of flooding. According to the IPCC's assessment of climate change, increased Asian summer monsoon precipitation variability is a likely outcome of Global Climate Change during the next century, leading to increased flood and drought magnitude.[40]

Floods, a key regional crisis agent, have affected increasingly large numbers of people (See: Figure 4 below). At the current rate of increase, it is forecast that 49.8 million in 2010 and 57.3 million in 2015 will have been directly affected by floods. This forecast does not, however, take into account factors that will mitigate against such prospects such as urban reconstruction proposals planned for Mumbai.

Figure 4: South Asia – Numbers Affected by Floods 1975-2015



From 2000 to 2005, an annual average of 39 million people were affected by flood in South Asia (See: Annex III Figure 24). An extrapolation from the numbers affected within this period produces an estimate of numbers affected in 2010 and 2015 at 34 million and 35 million respectively. Analysis of this five year period shows that the apparent growth rate of numbers affected does not reflect growth rates in the long term trend. However, of the six years within the analysis, four are within

[39] As noted throughout the text, some relevant tables and figures will be found in Annex III.
[40] Climate Change 2001: Impacts, Adaptation, and Vulnerability

one standard deviation of the mean, suggesting a reasonable level of consistency.

Drought, another key crisis agent, shows a more complex pattern. Numbers affected by drought in 2000-2005 exhibit high volatility, with a mean of 65 million on an annualised basis. (See: Annex III, Figure 25 and Figure 26) While it appears to show an increasing trend, the years in which there were no numbers of drought affected in the dataset bring the projection rapidly downwards. A more compelling projection from this data might be to assume that the numbers affected are not likely to be less than a base average of 65 million people in 2005.

While both numbers affected and frequency of events remained extremely consistent from 1971, the first half of the 1990s saw first a series of low then high frequency events, with the period 2001-2005 containing the largest number of drought events and equally highest numbers affected. The IPCC forecasts a variable result of global warming on water in the region. For example, the availability of water from the Himalayan snow-fed rivers is critical to the region, and may increase in the short term but decrease in the long run[41]. The scenario used here assumes that droughts have resumed their pre-1990s average, and forecasts this for 2010 and 2015 with some expansion for population growth.

[ii] demographic drivers. South Asia is becoming increasingly urbanised. By the year 2015, nearly 30% of Bangladesh's population will live in towns and cities, 32% in India and nearly 40% in Pakistan. One of the main crisis agents affecting Asia will be the growth of slums. Increase in urbanization equates to an average annual urban population rise of 4% between 2005 and 2015, and a regional urban population increase of 125 million. Of this increase, Indian towns and cities will account for 89 million. While the region's urban infrastructure will struggle to cope with underlying population growth, drivers associated with climactic change such as drought will further intensify the flow of peoples into urban areas, intensifying the humanitarian consequences of slum increases.

[iii] environmental degradation: combination of soil salinisation, deforestation and pollution will increase difficulty for agriculturalists and related commercial enterprises in the South Asian hinterland. On the coast natural protective barriers will be destroyed.

Throughout much of the region, increased flood propensity, as a crisis agent, will result in destruction of agriculture production and related activities. Environmental degradation, also, will lead to weakened infrastructure due to intensified erosion, affecting industrial structures and related storage sites, resulting in migration and also toxic waste poisoning.[42]

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[41] *Summary for Policymakers The Regional Impacts of Climate Change: An Assessment of Vulnerability* Edited by Robert T. Watson, Marufu C. Zinyowera, Richard H. Moss [A special Report of IPCC Working Group II]

[42] The issue of the inter-relationship between environmental degradation, pollution, toxic waste and effects upon local communities was central to UN discussions on the Basel Convention to monitor hazardous waste, held in Nairobi, 6 December 2006. Sachiko Kuwabara Yamamoto, head of the United Nations' Basel Convention unit, said the scores of delegates at five days of talks in Kenya had achieved a lot, principally on efforts to curb electronic waste, "But my concern is while this conference was very articulate in identifying the problems, the commitment of resources to help developing countries leaves a lot to be desired," she said.

India and Pakistan are one of the largest recipients of toxic waste, which is ransported through some of the countries largest urban conurbations, including Delhi, Karachi, Mumbai as well as

[iv] persistent health threats. In the South Asian region, emerging and re-emergent disease as well as persistent and new forms of hazards will be drivers of a wide array of crisis agents.

There have been two major outbreaks of cholera in the last decade, affecting 25,000 in 1998 and 34,000 in 2001. While this is a small proportion of the total population, an increase in flood frequency, temperatures, and population pressures on urban infrastructure increase the possibility of a major outbreak in the future. A significant increase of populations living below the poverty line and without good access to sustainable water supplies will lead to exposure to epidemics, as suggested in Annex III, Figure 29 - Figure 30. It is also possible that temperature changes from global warming will increase the prevalence of such non-vector-borne diseases as water- and flood-related diseases, and these will have particular impacts on the survival of the very young and older vulnerable groups.[43]

Currently, average physical exposure to floods in the South Asian area is 11.7% of the population[44]. Assuming an attack rate of cholera in flood affected populations at 1.1%, it is possible to construct a forecast of potential numbers affected[45]. In doing so, the increase in physical exposure is derived from the projected frequency in flood events to arrive at levels of 13.1% in 2010 and 16.6% in 2015 of the population.

While models project an outbreak of cholera on a major scale, the combined primary effect of climatic crises will be far greater than resultant cholera in terms of total numbers affected in 2010 and 2015 (see: Annex III Figure 31).

Potential Shocks

South Asian example is major pandemic shock:

[i] Avian Influenza-type epidemic

An epidemic of Avian Influenza could *inter alia* similarly affect populations living in extreme poverty. If infection rates are comparable to other major epidemics in the last century (around 25%), as many as 122 million in 2010 and 131 million in 2015 would be affected in populations surviving on less than $1 per day. With the inclusion of Avian Influenza, the total number of those affected by major hazard drivers could reach 219 million in the year 2010 and similarly could reach 236 million by 2015.

Bangalore, Meerot, Ferozabed abd Chennai – all prone to the effects of severe flooding and storm surges.

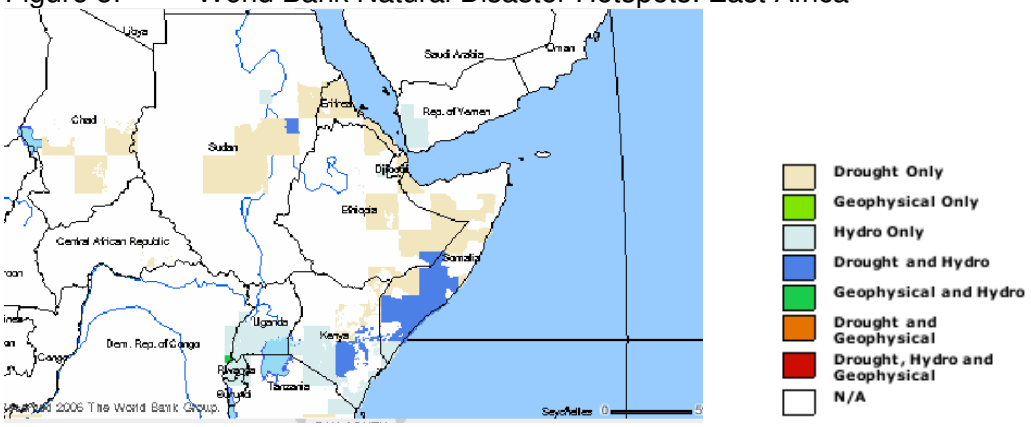
[43] *Summary for Policymakers: The Regional Impacts of Climate Change: An Assessment of Vulnerability* Edited by Robert T. Watson, Marufu C. Zinyowera, Richard H. Moss [A special Report of IPCC Working Group II]

[44] Physical exposure is calculated as the average number of people exposed to a hazard event in a given year.

[45] *Sur et al., 2000 (26) West Bengal, India, 1998.* Mortality and morbidity data collected from district hospital and four primary health centers In 3-month period after flood, 16,590 cases were reported, with 276 deaths (attack rate of 1.1**%** and case-fatality rate of 1.7%); laboratory results suggested that Vibrio cholerae was primary causative agent.

[29] **The East African Region in Perspective: Ethiopia, Eritrea, Kenya, Somalia and the Sudan**
-- 2005 to 2015 –

Figure 5: World Bank Natural Disaster Hotspots: East Africa



If one combines the potential impacts of major drivers in the East African region, one can project that at least 17.4 million people will be affected by one or more humanitarian crisis agents in 2010 and 26.1 million in 2015 (see: Annex III Figure 34). This compares with an annual average figure over the period 2000-2005 of 11.0 million.

[a] One of the most fundamental drivers in the recent history of the Horn of Africa, Kenya and the Sudan has been the transition from clanic and tribal communities to more conventional state structures. The transition has been inconsistent and often violent, burdened by poor governance and corruption. While other regions of the world have had higher flows of refugees and internally displaced persons at any one time, the countries identified in this regional perspective have had over the past four decades the largest long-term displaced populations in the world. ***Case Study #1*: *Cascading Displacement and its Consequences*** (Annex II) suggests a plausible outcome of this major driver by 2015.

[b] There appears little indication that the full gamut of crisis agents (including inter and intra-state resource wars, ethnic violence and intra-communal conflict) will not persist and probably intensify over the next decade. At the same time, environmental degradation continues to threaten livelihoods for millions in the region, and competition for water and the Nile's resources serve as an additional threat to human survival.

[c] In terms of overall numbers of peoples affected by different types of crisis agents, one can estimate that in totality there will be approximately 15.5 million by 2010 and 22.1 million by 2015.

Table 3: Numbers of crisis affected, East Africa

	2001-05	2010			2015		
(000s)		Low	Mid	High	Low	Mid	High
Drought (1)	9,718	7,666	12,273	15,773	8,568	17,367	24,769
Flood	274	591	763	772	660	1,039	1,214
Refugees	499	1,169	1,299	1,428	1,133	1,416	1,699
IDPs	491	1,027	1,141	1,256	2,014	2,237	2,461
Total [excl. major famine]	**10,981**	**10,453**	**15,476**	**19,228**	**12,374**	**22,059**	**30,144**
Major drought-induced famine (2)	n/a	27,072	30,081	33,089	28,142	33,108	38,074
Total [incl. Drought/famine (2), excl Drought (1)]	**10,981**	**29,859**	**33,283**	**36,544**	**31,948**	**37,800**	**43,449**

Drivers and humanitarian crisis agents

[d] According to the IPCC, there is high level of confidence that Global Climate Change will contribute to droughts, floods, and other extreme events, including conflict, across Africa that will add to stresses on water resources, food security, human health and infrastructures. There are four main drivers that underpin this regional scenario:

[i] inter and intra-state instability. In the five East African countries used for this analysis, each has to face intra-state and inter-state conflicts that will lead to destruction of livelihoods as well as large-scale internal displacement and flows of refugees.

This pattern will continue through 2015, resulting over that period in 1.4 million refugees and 4.7 million IDPs as well as 18.4 million populations in place that will continue to need assistance to survive from a regional total of 202 million people in 2015;

[ii] environmental degradation. Approximately 70% of the population in Eastern Africa is rural, practicing subsistence agriculture (WHO/UNICEF 2000).

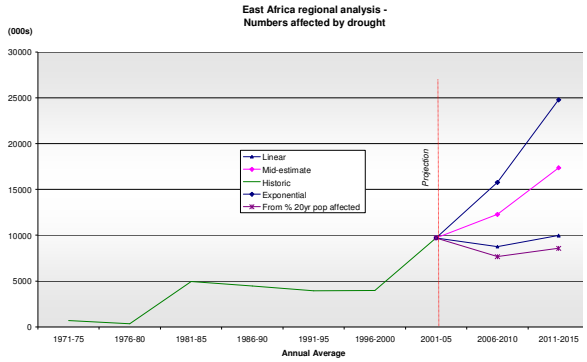
Rapid population growth and increasing demand for food, combined with high variability in rainfall and frequent drought are putting pressure on farmers to clear more natural vegetation, and to cultivate more and more marginal land. Shortening of fallow periods and high intensity of rainfall contribute to creating conditions which are conducive to land degradation, soil erosion and desertification (NEMA 2000). Thus, the main issues of concern are population growth, agricultural practices and food security.

[iii] water dimensions. Eastern Africa experiences high variability in rainfall over time and space, including frequent episodes of flooding or drought. IPCC-2001 predicts that rainfall will decrease in the already arid areas of the Horn of Africa, and that drought and desertification will become more widespread.

There is also competition for access to water resources between user groups between and within countries. This competition is not only for freshwater for domestic, agricultural and industrial purposes, but also for hydro-electric power generation. Hence, freshwater

availability and access are a priority issue for the sub-region. Concerns have been raised in recent years about declining water quality and, in particular, about the infestation of water hyacinth in various large water catchments in the region.

Figure 6: East Africa - Total Affected by Drought 1971-2015



EM-DAT

From the data for 2000-2005, an average of 11 million people were affected by drought in East Africa (See: Annex III Figure 40). While projecting forwards from this data produces results that tend rapidly towards zero, it is assumed that this is due to the short span and high volatility of the dataset, and that a more compelling low end forecast is provided by the projections of the average proportion affected historically of a growing population (see Figure 6 above.

[iv] <u>epidemics and diseases</u>. Global climate change is increasing the rate and dimensions of diseases in Africa and around the world (CCF). Global warming – with an accompanying rise in floods and droughts – is fuelling the spread of epidemics in areas unprepared for the diseases, say many health experts worldwide.

The World Health Organization has identified more than 30 new or resurgent diseases over the past three decades, suggesting the sort of epidemic explosion some experts say has not happened since the Industrial Revolution in Europe and North America brought masses of people together in cities.

Though the data does not indicate consistent trends in people affected by epidemics, it is clear that any incidents will put increasing strain on already limited health services. That said, there have been significant epidemics in the past as evidenced in Kenya and Ethiopia during the period 1991-95.

Potential Shocks

Potential Shocks: What are shocks for some regions seem to be regular occurrences for others. In this instance drought-induced famine will nevertheless be used as a *shock* factor.[46]

[i] <u>drought-induced famine:</u> The forecasts presented in the analysis of crisis agents reflects the shock of famine on a scale not seen across the Horn of Africa, Kenya and Sudan since 1984.

The effects of population increases bring the forecast number affected to 33.1 million in 2010 and 36 million in 2015.

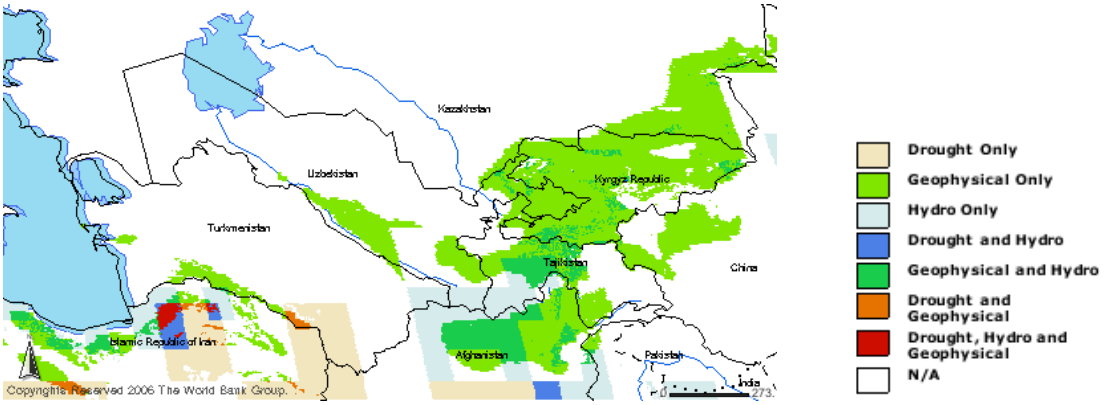
Population growth alone would not be the cause of such famine. Crisis agents would include population densities, political, economic and climatic factors.[47]

[46] In the "cascading case study" pertaining to East Africa (See: p.61 ff), the shock that is used is avian influenza.

[47] For example: Hendrix and Glaser (2005), *Trends and Triggers: Climate Change and Civil Conflict in Sub-Saharan Africa*

[30] **Central Asian Perspectives:**
A Region at the Crossroads of Crisis
– 2005 to 2015 –

Figure 7: World Bank Natural Disaster Hotspots: Central Asia



Central Asia has an estimated combined population of 59 million.[48] Since the end of the cold war, Central Asia has more and more become an ethnic cauldron, prone to instability and conflicts.[49] The region is an amalgam of historical, religious and cultural influences, and dominated by tribal and clan loyalties. While Russia was the major geo-political factor in the region since the 19th century, the area is now increasingly influenced by Turkey, Iran, China, Pakistan, India and the United States.

[a] Central Asian economies fell into sharp decline after independence with subsequent falls in living conditions (UNEP-GRID,2005). Poverty remains widespread, especially in rural areas.[50] Communal services have broken down in many areas, straining relations between local authorities and the population. Only recently have some of the economies shown signs of

[48] Since the collapse of the Soviet Union, Central Asia consists of five independent states – Kazakhstan 15.233 million, Kyrgyzstan 5.213 million, Tajikistan 7.230 million, Turkmenistan 5.042 million and Uzbekistan 26.6 million. .

[49] The cauldron analogue relates to repressed but active religious extremism, consistent clanic and tribal rivalries, an aggressive black market economy, etc.. See, for example, Collins, Kathleen, "Clans, Pacts, and Politics in Central Asia," Journal of Democracy - Volume 13, Number 3, July 2002, pp. 137-152. "Viewed in this larger strategic context, the problem of Central Asia is sobering indeed. The lapse of a decade since the break up of the USSR finds the former Soviet Central Asian republics not more but actually *less* stable, politically consolidated, prosperous, and free than they were in 1991. Some or all could follow the disastrous path taken by Afghanistan in the 1990s. Any effort to avert this frightening prospect must begin by asking why it is such a plausible scenario in the first place."

[50] More than forty percent of Central Asians live below the poverty line and in Tajikistan it is above eighty percent. UNDP ***Aral Sea Basin Capacity Development Project for Central Asia***, Tashkent, 2001/2002

improving, but GDP growth rates have not been sufficient for sustained poverty reduction and for reducing social inequalities.[51] Unemployment rates are high generally speaking throughout most of Central Asia.[52]

[b] Central Asia has been described as a disaster-prone area, exposed to various natural hazards such as floods, droughts, avalanches, rockslide and earthquakes (UNEP-Arendal,2005). It is also vulnerable to man-made disasters related to industrial activity (eg, oil and coal production) and the radioactive and chemical dumps inherited from the Soviet period.[53] Several factors - population density in disaster-prone areas, high overall population growth, poverty, land and water use, failure to comply with building codes and global climate change and persistent political uncertainties – make the region particularly vulnerable to natural as well as man made disasters.

[51] Considerable growth in terms of oil and oil related revenues are evident in countries such as Kazakhstan and Turkmenistan, ie, 6 ½%-GDP. External remittances, too, are increasing. See, for example, IMF, World Economic & Financial Survey: Regional Economic Outlook – Middle East and Central Asia, September 2006

[52] Official unemployment figures are well below what is called "disguised unemployment." More importantly, according to the World Bank's ***Poverty Net Analysis***, 2004, there is little evidence that increased GDP in countries such as oil-producing Kazakhstan where wealth has not kept pace with rural poverty.

[53] UNEP-GRID, 2005. Radioactive, chemical and biological hazards in Central Asia. The Soviet development model for Central Asia was based on building large-scale irrigation schemes enabling the region to become a major cotton producer and expanding the mining and processing industry. Industrial operations in the region paid little attention to the environment and public health, resulting in the accumulation of pollutants in the local environment. Today, not only active industrial facilities constitute a threat to environment, and often to security as well, so does the legacy of past operators. To date in the five countries under focus there are at least 8 uranium mining and milling facilities, 8 poorly maintained radio active waste storage facilities, 4 areas contaminated from nuclear trials and 5 non-nuclear [eg, mercury] storage sites. Many of these in Turkistan, Tajikistan and Kyrgyzstan are in areas of high seismic risk.

Table 4: Numbers of crisis affected, Central Asia

	2001-05	2010			2015		
(000s)		Low	Mid	High	Low	Mid	High
Drought	13	39	44	48	37	46	56
Flood	9	6	10	14	6	14	22
Refugees	67	44	49	53	27	33	40
Conflict-related IDPs	n/a	77	85	94	116	145	174
Total (excl. Radiation & industrial)	**89**	**166**	**187**	**209**	**186**	**239**	**291**
Radiation & industrial-related hazards	n/a	203	469	2,519	368	472	2,696
Total (incl. Radiation and industrial)	**89**	**369**	**657**	**2,727**	**554**	**711**	**2,987**

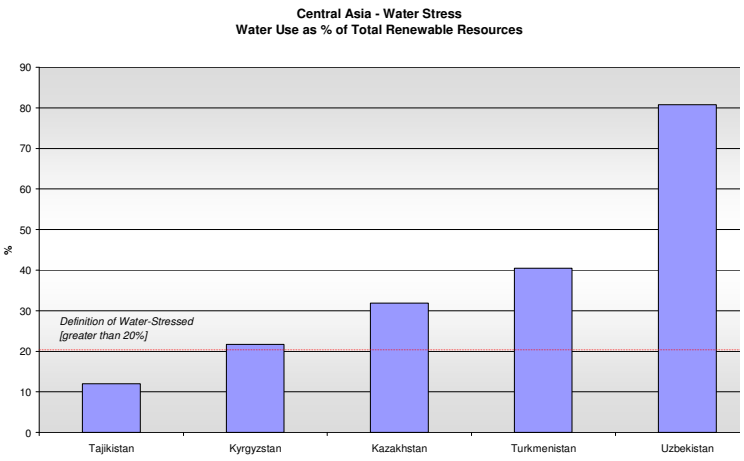
Drivers and humanitarian crisis agents

[c] **Crisis drivers:** There are five major drivers that will trigger a series of crisis agents that will affect the region.

[i] water management. The most important problem facing the Central Asian region is water (See Figure 8 below). Furthermore, the IPCC forecasts a decrease in water resources in the region through decreases in stream flow and groundwater recharge.[54]

As of 2005 surface water draw-down from the Amudarya and Syrdara Rivers (which are the main river sources of the rapidly reducing Aral Sea) are 150% and 110% over replenishment levels, and due to global warming, it is estimated that the region's main watershed basins may be reduced between 20-40% (UNESCO). Water, according to experts, will precipitate regional security crises as well as crises in economic and social spheres (GIWA-Sub-regional, 2005/UNEP,2005);

Figure 8: Central Asia – Water Stress, Water Use as Percentage of Total Renewable Resources



[ii] environmental degradation. Environmental degradation is reflected in a wide range of forms, including extensive deforestation, trans-boundary flows of radioactive waste entering the air, water and food chain, salinisation, chemical spillages into rivers and water catchments and soil contamination.

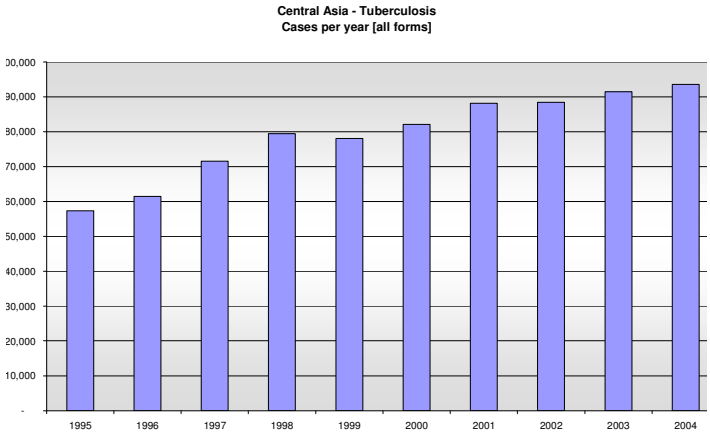
[54] Climate Change 2001: Impacts, Adaptation, and Vulnerability, p9

However, the effects and implications of environmental degradation in the region remain uncertain due to the lack of reliable and accurate data. One analyst attributes this data gap to the corruption of the local authorities, political and language barriers, and often political instability.

[iii] epidemics and diseases. Statistics on the overall health situation in Central Asia are inadequate, but it is generally recognised that the quality of health services – consistent with public services in general – is regarded as poor. Nevertheless one can point to at least three important areas of health issues that will continue to define the health profile of the region. The first two -- [i] effects of gamma-radiation on large segments of the population, particularly on unborn children and infants and [ii] the possibility of Avian Influenza -- will create the need for episodic periods of intense life-saving interventions.[55] The third, ie, increased incidents of HIV/AIDS, will require actions to deal with the inability of the young and the old to care for themselves in the absence of those who otherwise could ensure livelihoods.

In addition to these, there, too, are high incidents of Tuberculosis (TB) (See: Annex III Figure 9) and malaria. Prevalence of TB could reach 135,000 and 176,000 in 2010 and 2015 respectively, and is probably indicative of the pattern of disease throughout the region more generally (See: Annex III Figure 46).

Figure 9: Central Asia – Tuberculosis Cases per Year (all forms) 1995-2004



WHO Report 2005

[iv] demographic shifts. Central Asian demography is characterised by [i] high incidents of emigration and internal migration,[56] [ii] high percentages of youth and adolescents (estimated at 36%) and [iii] significant levels of poverty across the five countries, with extreme poverty around 13% of the combined states.

[v] fragile states. Intra and inter-state conflict in Central Asia is regarded as highly probable, and well substantiated predictions suggest that between 2015 and 2018 separatists and insurgency

[55] As noted by the Royal Society in the RS response to the House of Lords Science and Technical Committee inquiry into Pandemic Influenza, Central Asia is a "direct flight path" for migrating birds from South East Asia into Europe. RS Policy Document #24/05, October 2005

[56] The massive flow of migration in Central Asia greatly affects the economic, political and social aspects of the region. Labour migration through both legal and illegal channels is commonly practiced, and the remittances sent by migrants from abroad to their families are of significant importance to their families and also governments in Central Asia. Migration is also often associated with drug and human trafficking in the region. Given the multi-ethnic nature of the region, migration also greatly impacts the ethnic composition in the region. [Statement from UNESCO International Conference on Migration, Almaty, May 11-12 2005]

forces could take power in Uzbekistan, Kyrgyzstan and Turkmenistan.[57]

There could be a contagion that will soon after lead to violent regime replacement and inter-state conflict involving Tajikistan and Kazakhstan (RAND, 2003). These conclusions are underpinned by the foreseeable consequences of [i] unintegrated and alienated minorities, [ii] political repression, [iii] absence of effective political institutions and presence of "extra-legal forms" of governance, [iv] wealth disparities within and between countries of the region, and [v] intense water competition.

In addition to refugees and IDPs, this scenario includes a low level violence component. It uses base figures drawn from the Ferghana valley, which is the intersection for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan states, and has a total population of around 10.5 million people. The construct assumes around 10% of overall population of the identified area as directly affected by conflict in terms of humanitarian needs.[58]

Also included in this scenario is a calculation for IDPs caused by industrial-related conflict. Such conflict is the result of violent reactions of local communities to the impact on water and land due to the effects of industrial waste flows and seepages from neighbouring countries.[59] This factor is reflected in a mid-range estimate of 60,000 IDPs in industrial-related conflict in 2015.

Potential Shocks

Potential shocks: The fragility of the states in the region, the lack of social support systems and the region's overall environmental vulnerability leave it exposed to a host of potential shocks. One likely shock is a "resource war". Another shock for the region could also be a "Chernobyl"-type nuclear accident.

[i] the resource war. Water security is deemed to be one of the key challenges that face Central Asia. It is quite likely that water competition will lead to conflict between the oil rich "downstream" countries of Kazakhstan, Uzbekistan and Turkmenistan and those "upstream", oil poor countries of Kyrgyzstan and Tajikistan who use major waterways for hydro-electrical purposes (RAND, 2003). This conflict will be intense, but could combine insurgency movements with the potential for a more conventional inter-state conflict.

Previous conflicts in the area have triggered the movement of peoples internally and across borders, leading to severe impoverishment.

Water management issues from the Toktogul reservoir have strained relations between Uzbekistan, Kazakhstan and Kyrgyzstan. In the summer of 2000 and 2001, drought years that affected 3.5 million and 685,000 people respectively (See: Annex III Figure 45) Kyrgyzstan deployed troops to protect the reservoir

[57] Tanya Charlick-Paley with Phil Williams and Olga Oliker, "The Political Evolution of Central Asia and South Caucasus: Implications for Regional Security", in ***Faultlines of Conflict in Central Asia and the South Caucasus***, RAND, California.

[58] The figure of 10% is extrapolated from "refugee" figures, as noted in Annex III Figure 39. While not a precise indicator, it provides a sense of numerical range.

[59] Eric W. Seivers, "Water, Conflict, and Regional Security in Central Asia", NYU Environmental Law Journal, Vol #10, 2002, p. 364

and its main operation. To-date multilateral bodies have helped to ensure that these strains have not developed into a crisis, but this scenario assumes that international intervention has not succeeded.

[ii] radio-active seepage. The scenario examines the consequence of radioactive seepage on Central Asia, using the effects of the 1986 Chernobyl nuclear accident as a basis for assessing potentially affected peoples. The calculation assumes that – as with the Chernobyl incident – numbers immediately and most dramatically affected will be within a 30km radius. This calculation includes a comparison of numbers requiring assistance to relocate in the Chernobyl area, and an event taking place in a highly urbanised area – in this example, a facility located near Tashkent.

The projection estimates a mid-range estimate of around 470,000 people affected by such a scenario. Projecting from the population affected by the Chernobyl accident would lead to an increase of attributable cancer mortality of around 3,000 people, not including those such as emergency workers exposed in extreme proximity to the event. A major effect of the Chernobyl disaster was the psychological consequence of anxiety through exposure to radiation, leading to a culture of despair and dependency, particularly among the population of youths.[60]

According to WHO, "The mental health impact of Chernobyl is the largest public health problem caused by the accident to date".[61] Studies have found that exposed populations around Chernobyl had anxiety symptom levels that were twice as high as control populations and were three to four times more likely to report multiple unexplained physical symptoms and subjective poor health.[62] Central Asia, with its high levels of unemployment and youth population would be particularly at risk from mental health consequences, and its impact on livelihoods, health systems and even conflict.[63]

[60] *Strategy of the psychological and social support among adolescents victims of the Chernobyl disaster for reproductive health promotion* Proceedings of the 4th International Conference "Chernobyl children – health consequences and psychological rehabilitation". June 2-6, 2003. Buzunov,V.A., Korol,N.A., et al Kyiv, Ukraine. 6-2-0030.

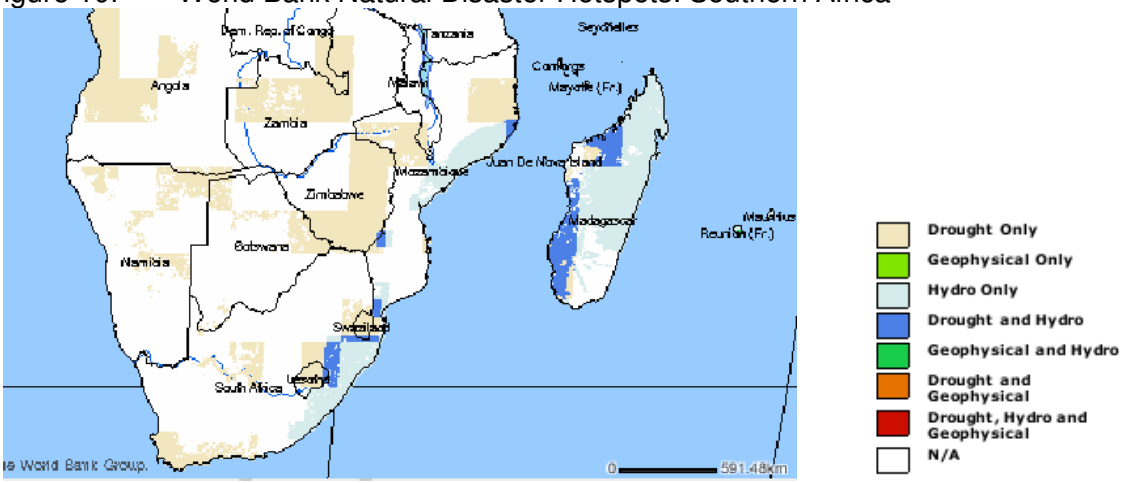
[61] *Health Effects of the Chernobyl Accident and Special Health Care Programmes: Report of the UN Chernobyl Forum Expert Group "Health".* (2006) Burton Bennett, Michael Repacholi, Zhanat Carr

[62] For example Havenaar,J.M., et al. (1997b) *Long-term mental health effects of the Chernobyl disaster: an epidemiologic survey in two former Soviet regions.* American Journal of Psychiatry 154, 1605-7.

[63] Since the 1994 post-genocide relief operation in Rwanda, trauma and post-traumatic psychological assistance has become increasingly an instrument in the armoury of humanitarian workers. Save the Children – USA , for example, is dealing with these sorts of issues in its humanitarian programme in Darfur, Sudan.

[31] **Southern African Regional Perspectives: Poverty, Coping Mechanisms and Climate Change**
– 2010 to 2015 –

Figure 10: World Bank Natural Disaster Hotspots: Southern Africa



About 60% of people in Southern African countries live below the poverty line.[64] Of these, around 30 percent live on less than one US dollar a day. Poverty has continued to deepen, exacerbated by droughts, disease, inadequate health and education facilities. The 1992 Southern African drought, the region's worst drought in living memory, is indicative of the very fundamental issues that increasingly face so much of the Southern African region.

[a] Out of SADC's twelve member-states in 1992, cereal production in nine of them fell to 38% of the previous five year mean. There were heavy losses of cattle, and reportedly in Zimbabwe alone more than one million died due to lack of water and grazing. Analyses of the drought note that drought relief, including international (eg, WFP) and regional (eg, SADC) and food-for-work programmes, at best met 15-25% of the needs. But there was no famine.[65]

[b] The reasons why this drought did not become a famine are clearly related to the wide range of coping mechanisms that were available to those large numbers of impoverished people who were directly affected. These coping mechanisms were not standard, but centred on activities that ultimately would intensify their poverty. In other words, conventional coping strategies such as wild foods, food gifts and labour on more prosperous farms were comparatively unavailable. Instead, the poorest drought-affected used a

[64] The countries include Malawi, Mozambique, South Africa, Zambia and Zimbabwe.

[65] This conclusion is born out by many analyses, for example, Christopher Eldridge's, "Why there was no famine following the 1992 Southern African drought?", IDS Bulletin, #33 [4], 2002, pp.79-87. That said, the 1991-92 drought in Southern Africa exposed more than 17 million people to the risk of starvation.

combination of means to purchase food that enabled them to survive, but left them in highly vulnerable condition. These means included cutting expenditure on education and agricultural inputs as well as on other less essential items, worked off their own land for longer than usual; and, in some cases, sold assets.[66]

[c] The reason for the unusually dry weather that was forecast for the region at the time had to do with a complex set of variables including rising sea surface temperatures and the impact of El Nino.[67] Now fifteen years later, Sub-Saharan Africa, including the Southern African region, will be subject to increasingly severe spates of drought and floods. Droughts will become more frequent and intense as will rain falls (UNEP/GEO-3). As the IPCC-1a has noted, while difficult to forecast frequency and intensity at this stage with any degree of accuracy, Africa is the most vulnerable region in terms of predicted decreases in dry and precipitation extremes.[68] Water and food security will become increasingly a problem and an overall economic inability to adapt to change with sufficient alacrity (IPCC 1998). The interaction between poverty, climate change and region's burgeoning population would seem to suggest that the lives as well as livelihoods of a growing number of people will be at risk.

[d] Continued poor governance, inter- and intra-state tensions and demographic flows to other parts of the continent or to Europe and the Americas will continue to undermine the types of capacities that will be required to overcome the consequences of drivers and humanitarian crisis agents noted, below.[69]

[66] Ibid #66, Christopher Eldridge

[67] New Scientist, [1823], 30 May 1992, p. 6

[68] This is a view confirmed by the Sterns Review, as per Chapter I of this study.

[69] Continuing poor governance continues as does corruption, and these will continue to drag down efforts to help the poor. A mixed trend, however, is in migration flows. As noted in the article that follows, migration has positive as well as negative implications. Its consequences for the future remain probably more negative than positive, and its impact on economic growth throughout most SADC states will at best be "mixed." According to Aderanti Adepoju in "Changing Configurations of Migration in Africa", Migration Policy Institute, Washington, DC, 2004, "Migration in Africa is dynamic and extremely complex. This is reflected in the feminization of migration, diversification of migration destinations, transformation of labor flows into commercial migration, and brain drain from the region. Completing this picture are trafficking in human beings, the changing map of refugee flows, and the increasing role of regional economic organizations in fostering free flows of labor."

Table 5: Numbers of crisis affected, Southern Africa

	2001-05	2010			2015		
(000s)		**Low**	**Mid**	**High**	**Low**	**Mid**	**High**
Drought	5,159	784	1,938	3,091	3,237	7,018	10,798
Flood	642	408	949	1,489	428	567	706
HIV Incapacitated	2,013	1,879	2,370	2,831	2,172	2,726	3,245
Malaria - Cases	8,087	7,652	8,927	13,174	4,491	5,941	7,392
Cholera - Cases	52	49	150	250	13	54	96
Total	**15,954**	**10,773**	**14,333**	**20,835**	**10,340**	**16,306**	**22,236**

Drivers and humanitarian crisis agents

[e] There are five drivers that will trigger a series of crisis agents over the next decade in the Southern African region:

[i] water management. The competition for freshwater is an increasingly acute problem in southern Africa. The region's population will have grown from approximately 105 million in 2005 to 115 million in 2015. There is considerable competition amongst the Southern African states for water from the seven principal basins of Southern Africa.

The potential for inter-regional conflict over scarce water is exacerbated by the lack of efficiency in irrigation schemes, and it has been noted that before reaching irrigated land, between 40 and 60% of water drawn from rivers is lost through seepage and evaporation. Rainfall patterns, too, exacerbate potential water crises. No area receives more than 1600 mm of rain per rainy season and many areas receive between 400-600 mm.[70] Similar to many other parts of the globe, Southern Africa, too, has to contend with high urban growth rates and the increasing demand for water for domestic consumption and industries. Urban population levels have risen from 35% of the region's population to 44% between 1985 and 2005; they are forecast to reach 49% by 2015 (See: Annex III Figure 49). Of these an estimated 55%, 25 million urban inhabitants were considered to be living in poverty.[71]

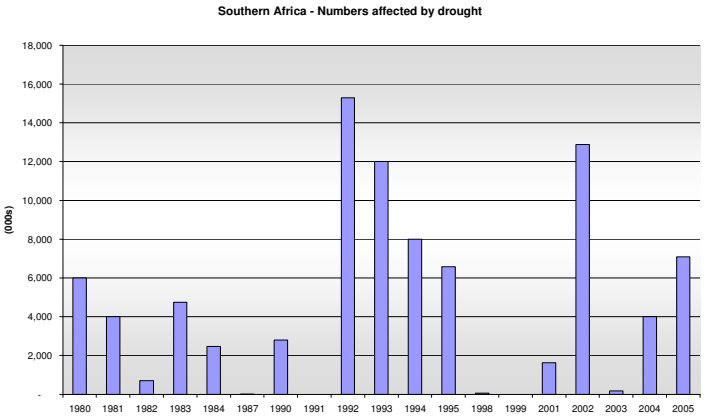
The number of people affected by drought in the region (See Figure 11 below) shows how numbers affected centre around decadal clusters, which reflect patterns of climatic activity such as the El Nino effect, as mentioned. The pattern of five-year annual average drought affected in the region clarifies the decadal pattern in drought incidents (See: Annex III Figure 50). Numbers of affected by drought are very much determined by peak years, such as 1992. The forecast of drought provides ranges that include the statistical mean of drought affected combined with population growth, and a repetition of an

[70] One essential factor is the pattern of precipitation, where rain deluges make water catchment difficult. As for areas with 400-600 mm of rainfall, they include southern Angola, most of Namibia, Botswana, southern and western Zimbabwe, southwestern Zambia and northern South Africa.

[71] Estimate based on World Bank data.

earlier cycle accounting for population growth (See: Annex III Figure 51).

Figure 11: Southern Africa – Numbers Affected by Drought 1980-2005



Source: EM-DAT

A similar pattern is evident for floods, though with peaks and troughs in symmetrically reflecting patterns of drought affected (Figure 52). Again, this pattern suggests both major decadal weather patterns, and a worsening effect on inhabitants of the region that goes beyond changes in other drivers such as demography.

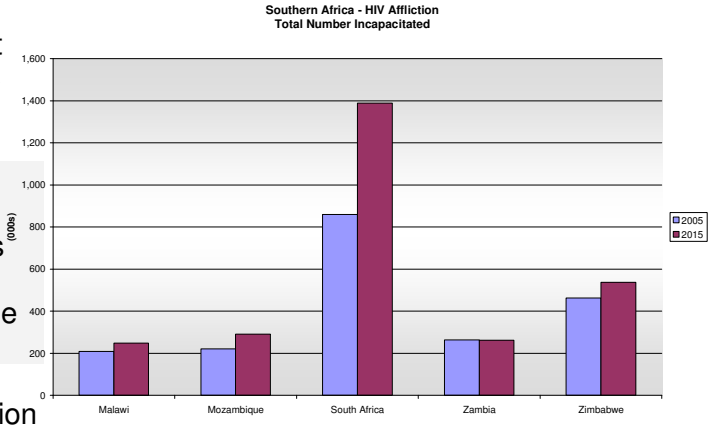
[ii] <u>environmental degradation.</u> In Southern Africa, escalating land degradation over the past decade has been caused by increased livestock. Overgrazing causes more than half the soil degradation in the sub-region.

Declining agricultural yields in the region are also attributed to water erosion which is responsible for about 15 per cent of land degradation. About 2 per cent of the soils in Southern Africa are also damaged by physical degradation such as the sealing and crusting of topsoil, leading to a reduction of available soil water, the compaction of topsoil and water-logging. Soil losses in South Africa alone are estimated to be as high as 400 million tonnes annually.

Soil erosion affects other economic sectors such as energy and water supply. In a continent where too many people are already malnourished, crop yields could be cut by half within 40 years if the degradation of cultivated lands were to continue at present rates (IUCN, UNEP).

[iii] <u>epidemics and disease</u>. The Southern African region is "at the epicentre of the global HIV/AIDS epidemic." The five countries under review together had around 11 million people living with HIV in 2005. The progression of the disease forces people to spend an increasing amount of time bed-ridden, unable to work, and a general drain on social development and growth. The incapacitated number of people affected by the disease is forecast to rise from 1.2 million in 2005 to 1.3 million in 2015 (See: Annex III Figure 12).[72]

Figure 12: Southern Africa – HIV Affliction, Total Number Incapacitated



Source: ILO HIV-AIDS Global Estimates 2004

Furthermore, the region is rife with diseases that directly link into interactive

[72] Figure #42, Annex III, includes South Africa and hence a regional total of 2 million and 2.7 million HIV/AIDS affected in 2010 and 2015. This number is significantly reduced, as can be seen, when South Africa is not included.

factors of poverty and environmental degradation. Cholera is a case in point in which worm infestation, due to inadequate sanitation, makes cholera epidemics far more prevalent.[73] Cholera outbreak peaks have more than doubled in the last twenty-five years, in line with increase in flood severity. A forecast is presented in which this trend continues, in cycle with forecast floods for 2010 and 2015 (See: Annex III Figure 54).

In less than one year – from October 2005 to March 2006 – 83,000 people in Southern Africa died of malaria, a figure that is seen as reflecting the interaction between the disease itself and the inability of authorities to deal with the growing number of breeding grounds created by floods and poor sanitation.[74]

While cases of Malaria in 2003 were at the lowest levels since 1997, a forecast based on the historic data suggests between 8 million and 13 million cases annually in the region by 2010. This forecast compares growth of the overall series to growth of cases at five-year minima, such as 1995 and 1997.

Despite considerable improvements in the provision of protection against Malaria in the region, variability in annual number of cases suggests a possible continuation of a trend of high prevalence. Kondo (2002) found in Mozambique that incidence of malaria reported increased by a factor of 1.5–2.0[75]. This is reflected in Annex III which sees a return to historical rates projected through the region as a result of flooding.

Potential Shocks

Potential shocks: The shock that will catalyse drivers in this Southern African regional scenario is severe drought.

[i] severe drought. Not since 1992 has drought impacted the region as it might do eighteen years later. While in 1999 and 2000, Southern Africa suffered devastating floods, it must be assumed that the pattern of droughts that one has seen in the region will also intensify and that 2010 will present a shock long overdue.[76] This particular shock will introduce the impact upon threatened populations of HIV/AIDS and persistent decline in income as a likely scenario for the region sometime during the next decade.

[73] South African Medical Research Council, MRC News, October 2001, Vol.32, #5

[74] http://allafrica.com/stories/200609130370.html

[75] Kondo H, Seo N, Yasuda T, et al. Post-flood—infectious diseases in Mozambique. Prehospital Disaster Med 2002;17:126–33

[76] S.J. Mason and A.M. Joubert, in "Simulated Changes in Extreme Rainfall over Southern Africa," suggest that greenhouse-related climate change may be most detectable through an increase in extreme flood events. © 1997 by the Royal Meteorological Society. However, as noted by Wachira Kigotho in "Decade of drought predictions for Southern Africa," Science and Development Network, June 2005, so-called drying models are increasing in magnitude.

[32] As discussed in ***Chapter III: Lessons-learned***, one of the challenges to be addressed in attempting to forecast numbers of potentially crisis-affected peoples is the way one handles multidimensional risk. One of the conclusions that one can draw from the regional studies in this chapter is that there will be few if any humanitarian crisis events that will not have synchronistic, multiple, cascading or global-local dimensions.[77] The single humanitarian crisis agent still reflected in much of the present public reportage and to some extent even in humanitarian organisations' preparedness and response activities is increasingly a characteristic of the past, if it ever really was an accurate reflection of reality.

[77] For descriptions of synchronous failures, multiple crisis agents, cascading crisis agents and global-local crisis agents, see, Chapter 1, p.24, para. 23

Chapter III -- Lessons-learned: Perspectives on the study's methodology

[33] This note briefly discusses the methodologies used in the study, ***Dimensions of Crisis Needs***, and to suggest improvements in futures research when applied to dealing with longer-term humanitarian strategies. Its intention is to highlight some important aspects of the approach used, based upon comparisons with other projects and additionally by identifying areas of interest for subsequent development. Methodologies discussed in this note include trending time series data, volatility and integrating subjective expertise into forecasts. It also raises methodological issues that pertain to the quality of data, itself, and the inter-relationship between science and humanitarian forecasting.

Project methodology

[34] The research methodology that underpinned the ***Dimensions of Crisis Needs*** study can in various instances be compared to the State of the Future Index (SOFI), produced by the Millennium Project's State of the Future report[78]. SOFI is a measure of the 10-year outlook for the future, constructed with key variables and forecasts that, essentially, depict whether the future promises to be better or worse. The SOFI methodology extrapolates from time series using one of seven basic equations, from simple straight-line relationships[79] to more complex linear equations[80].

[35] Of such basic functions, the ***Dimensions of Crisis*** study primarily utilised linear and exponential functions to establish base-line trends. The motivation for limiting the number of curves used was to avoid trying to "fit the model to the data." While a power function, for example, may provide a better fit to the historic data than an exponential function, the project at this level tried to avoid over-stating goodness of fit with pre-determined curve shapes, where there is no clear underlying reason for such a relationship.[81] The project highlights the provision of a "sense of scale" at this stage.

[36] In terms of incorporating meaningful models into the forecast, the ***Dimensions of Crisis*** study partially followed the approach of the Stern Review by utilising underlying physical properties[82]. In Stern, functional forms are used to assist forecasts. The underlying equations relate to physical and biological principles, such as exponential population growth or the cubic relationship

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[78] The Millennium Project's State of the Future is published annually by the American Council for the United Nations University.

[79] Such as $v = m*t + b$, where v is a variable's value and t represents time and b is the intercept

[80] For example, $\ln\{(v/L)/[1-(v/L)]\} = m*t + b$, as above, except where L becomes an upper limit providing an s-shaped trend.

[81] "Goodness of fit" refers to how well observations fit a model; R-squared tests are examples of measures of goodness of fit. A visual example would be how close data points are on average to a trend line. The closer they are, the better the data fits the model that the trend line describes.

[82] See Box 3.1, Stern Review: The Economics of Climate Change, page 60

between hurricane damage and wind speed. Using such relationships should improve the strength of the forecast by moving from correlation to causation, an approach that has been partially incorporated into this study.

[37] Another relationship with SOFI is the use of expertise to guide forecasting. Many of the advances in SOFI from launch in 2001 through to 2006 come from improving use of data from their Global Lookout Panel. A future direction of ***Dimensions of Crisis*** would similarly incorporate relevant expert opinion into the forecast. (This differs from the equally valid approach of using experts for 'set piece' or 'story line' scenario forecasting, also used by *State of the Future* contributors.) SOFI uses Trend Impact Analysis to modify the forecast according to normative [best case] and dystopic (worst case) responses on impact scale and probability judgements to add upper and lower boundaries to the baseline forecast.[83] A panel would be assembled from experts in the relevant areas of scientific (e.g. climate forecasting), the "relief community", private sector, etc. to address the chain of impacts from the most macro climatic events to the way people are affected. A Monte Carlo-type analysis, designed to deal with values that are broadly known but the specific effects of which are uncertain, would be used to process the impact and probability judgements being made.[84] Furthermore, respondents would be able to provide feedback online.

[38] A further critical input into the model is current projects being carried out by governments through recipient governments as well as aid agencies and NGOs that will bring positive future developments It is recommended that information relating to the numbers of people that will be assisted by aid agency projects is incorporated into projections only after Trend Impact Analysis has been calculated. In this way, a project to provide, for example, one million bed nets (insecticide-treated nets or ITNs) would be incorporated after best and worst case ranges had been worked out, subtracting the same one million (plus or minus any interactive effects) from the total affected in best case, through baseline and dystopic ranges. It would also be useful to incorporate any relationships between vulnerability and economic indicators into future models, which would utilise available economic growth forecasts.

[39] Much of the data used in the ***Dimensions of Risk*** report were provided by CRED's EM-DAT database. The project focussed on total numbers of affected.

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[83] In regard to this overall use of scenarios for such purposes, see: Kees van der Heijden, ***The Sixth Sense: Accelerating organisational learning with scenarios***, London, John Wiley & Son Ltd, 2006.

[84] Monte-Carlo type analyses were used in the aforementioned SOFI, and offers a methodology for dealing with variables that have a known range of values but an uncertain value for any particular time or event [e.g. interest rates, staffing needs, stock prices, inventory, phone calls per minute]. For each uncertain variable [one that has a range of possible values], one defines the possible values with a probability distribution. The type of distribution one selects is based on the conditions surrounding that variable.

This relies on interpretation at the data collection end, and this interpretation will originate from varied sources including press and relief agency reports. However, when it comes to projecting impacts, one cannot ignore the disconcerting conclusion of the Natural Disaster Hotspots report that available data are inadequate for understanding "absolute levels of risk" posed by any specific hazard or combination of hazards. Present data are "adequate for identifying areas that are at relatively higher single or multiple-hazard risk," but are not sufficiently reliable "to estimate, for example, the total mortality risk from flooding, earthquakes and drought over a specified period."[85]

Methodological perspectives for the future

[40] In situations such as the case study of the 2005 Maharashtra floods, use of numbers affected can lead to an information 'whiteout': certainly the entire city was affected, but what does this say about those truly in need or for relief agencies that seek to assist? Little information can be gleaned about the way in which they were affected. However, such a 'gross' number does provide important information on scale. Future developments of the ***Dimensions of Crisis*** project could look at gradations of 'affected' in order to differentiate between, say, livelihoods in Mumbai 2005 (disrupted) and New Orleans 2005 (devastated).

[41] In large part, the available data come through organisations such as the United Nations. The data have an inherent tendency towards national boundaries. National boundaries can on occasion hide the true nature of crisis causation, volatility and consequence, and therefore limit the ability to get accurate perspectives on risk exposure groups. This applies to trans-boarder issues such as glacial lake bursts in the Ferghana Valley or drought in the Horn of Africa. Certainly future development should look at the use of Geographic Information Systems (GIS). Accurate segmentation of risk groups is also likely to require more diverse, local data such as census bureau information.

[42] Further development would include examining patterns of volatility. The ***Dimensions of Crisis*** study showed that there was a large amount of volatility in terms of numbers affected on an annual basis. This tended to be smoothed out in longer periods, and five year averages were chosen. An important question to answer is how much volatility one can expect from year to year.

[43] It is clear that volatility is very much dependent on disaster type. With drought, for example, there are huge fluctuations, such as in South Asia, where 300 million may be affected one year with no significant drought the next.[86] On the other hand, disasters such as floods appear to be somewhat more predictable with more regular occurrences and numbers affected closer to the mean.

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[85] Op cit., Maxx Dilley, ***Natural Disasters Hotspots: A Global Risk Analysis***, p.1

[86] It may be interesting to explore relationships with the insurance industry to assess how they address budgeting for such variations.

[44] Future analysis would examine the extent to which volatility itself changes against time (and other factors). Given the large variance seen in the data, and combined with the large number of variables involved determining how many people are affected by disasters, a more in depth study of volatility would be valuable. Such heteroscedastic factors, in which volatility itself may be linked to trends, are highly likely in climatic and socio-economic instability.[87] It is worth noting that this would be relevant both to the concept of drivers, and the high volatility disaster events termed as 'shocks'.

[45] Further analysis of forecast numbers of affected should examine the extremely important area of correlation between disaster agents or "interactiveness" explored in ***Dimensions of Crisis***. A first step towards developing this approach would begin with a review of established correlations, and then move to build in such interdependence factors to the forecast model.

[46] Because of the number of permutations of outcomes in a multivariate model, depending on what the model was to be used for in each case, it is recommended that the results of future scenario development on a global or regional or sub-regional level could be provided in an interactive format, with a choice of either building a scenario to create a "what if" forecast, or setting probabilistic cut-offs to include the most likely crisis agents and their interactions for a single number or range of likely outcomes. This sort of dynamic systems analysis would enable users to answer such questions as "how many will be affected if we take into account x, y and z?" and "within a specified probability range, how many people are likely to be affected?" One report would not practically be able to provide all possible combinations.

[47] In addition to planning tools based on time series forecasts, other, more immediate models could be explored. For example, the number of people that are likely soon to be affected by a disaster agent could be based on a combination of "conditions precedent", to be assessed at regular intervals. Such a method would be required if the chaotic nature of climate systems, for example, or conflict, allowed only short-term forecasts to be made. In this case, a tool based on matrices, employing case study data, would highlight significant combinations.

[48] Incorporating the knowledge of field workers may be critical for relating interactivity of disaster agents to changes in aid required. Where no great change in assistance is required, a permutation may be discounted. One

[87] Heteroscedasticity often occurs when there is a large difference among the sizes of the observations. The classic example of heteroscedasticity is that of income versus food consumption. As one's income increases, the variability of food consumption will increase. A poorer person will spend a rather constant amount by always eating fast food; a wealthier person may occasionally buy fast food and other times eat an expensive meal. Those with higher incomes display a greater variability of food consumption.

example might be numbers affected by the potentially interrelated effects of flooding and cholera and the level of support required. If, for instance, the assistance to people affected by flood was primarily health check-ups, people already being treated for cholera should presumably be discounted. In addition, the duration of assistance to a disaster should be included. This too would be helped by looking at field data from assisting affected persons to understand how costs change in supporting the disaster-affected over time.

[49] In considering the methodological review to the IPCC, some of the next steps recommended above resonate with proposed areas of advancement in IPCC methodology. With regard to forecasting the effects of Global Climate Change, recommendations include better understanding of (natural and human) system dynamics and volatility, and interaction between those systems. Proposed areas include better understanding of variance in extreme weather event frequency and strength, and investigation of discontinuity points where previous time series forecasts would no longer be valid. But beyond attempting to improve forecast accuracy, the recommendations point emphatically to adapting the IPCC's approach to meet policymaking needs.

[50] In this context, there are two important features that are emerging when it comes to humanitarian forecasting from a methodological perspective. The first has to do with the concept of prediction from a technical point of view. There is a very real prospect that the traditional reluctance to be predictive about large social issues is less and less justified. New techniques – enabling one to bring together large numbers of variables – are emerging based in no small part upon ever more powerful computational methods, and some investigators suggest that predictive potential will advance well beyond forecasting about technical innovations.[88] Such complex multivariable forecasting should be reviewed and tested as part of a far more sophisticated prevention and preparedness approach – one which would also work to ensure the production of more robust statistics on crisis impacts.

[51] A second important feature in terms of forecasting is the relationship between the scientist and humanitarian organisations. It is increasingly clear that the acknowledged gulf between the policy-maker and scientist continues today, despite very positive steps to close the gap. For the humanitarian policy-maker, there are a growing number of opportunities to use the knowledge of science to begin to anticipate crises and their possible impacts more effectively.

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[88] Steven Popper, Robert Lempert, Steven Bankes, "Shaping the Future, Scientific American, vol. 292, No.4, p.52

[52] Much of the knowledge base that is needed to anticipate crises is already available. However, little effort has been made to show the humanitarian community how to use it. Cooperation amongst humanitarian organisations could be enhanced through identifying a shared vehicle to transfer scientific knowledge to the development/humanitarian sphere. A pooled source of expertise would reduce the need for each organisation to ensure in-house technical expertise and mitigate additional sectoral stove piping. In the UK context, the Tyndall Centre might be able to offer this support for climate change, the Benfield Hazard Research Centre on natural hazards. There, however, remains an additional gap to be filled, namely, that which applies to anticipating large social movements and trends.[89] Here, again, as noted in the paragraph immediately above, there might be eventual solutions to that, too.

[89] This conclusion is drawn from the ***Humanitarian Futures Programme's*** Futures Group meeting of 7 December 2006, where scientists and NGO policy-makers met to discuss dimensions of dialogue between the two.

Chapter IV – Observations and Conclusions

The changing nature of humanitarian crises and the humanitarian community

[53] Predicting the future is a hazardous undertaking. And yet, defying this very warning, there would appear to be seven factors that reflect changes in human vulnerability and its consequences when it comes to providing assistance to the affected. For humanitarian donors such as DFID, it will be important to consider these changes in the context of their own contributions to humanitarian response as well as in the context of how they might collaborate with the wider humanitarian community in the future:

Table 6: Changing nature of Humanitarian Crises

Key humanitarian changes	Possible consequences	Considerations for DFID
[1] changing nature of humanitarian crises. New sudden and slow-onset crisis agents, some directly related to climate change, such as water scarcity, mega-droughts, while others including technological systems failures, large-scale industrial and chemical collapse, nuclear seepage due to human intervention. Resource wars, particularly involving water (eg, Central Asia, South Asia) will trigger refugee flows and internal displacement affecting internal and inter-state stability.	International community not prepared to address new types of crisis agents. Little linkages made between IPCC findings, for example, and policies and programmes of major humanitarian agencies. In addition, certain types of disasters agents will involve issues of industrial and national security; some to require diversion of major overseas resources for donor domestic needs; some to require overall national emergency programme to respond effectively, eg, Avian Influenza.	[i] analysis of new types of threats and their potential implications; [ii] use fora such as ECHO, Good Humanitarian Donorship, special meetings to share analyses and look towards catastrophe coordination; [iii] support international organisations and INGOs with humanitarian responsibilities in developing better capacities; [iv] introduce related considerations through Commonwealth structure as well as through G-77, ACPs; [v] include log-term risk analysis support in UK government-funded governance and institution-building related programmes
[2] changing dynamics of humanitarian crises. Future crises more interactive, global and synchronous. Different disaster agents more prone to cascade into others, and individual agents, eg, pandemics, to become more global. "Synchronous failures," or the simultaneous collapse of survival systems including infrastructures and economic systems will severely threaten peoples, particularly in urban conurbations.	Related to #1, above, lack of incentives for international actors to assess impact of future drivers upon potentially vulnerable populations means inadequate preparation for addressing crisis dynamics. Persistent focus of many on rural needs means inadequate attention given to the sorts of highly complex interventions required for urban assistance.	[i] solutions reflected in #1/i, above. In addition, greater efforts to be made to promote – through scenario development, etc. – ways to help response agencies to prepare; [ii] consistent with above, greater attention made to establish collaboration arrangements with corporate sector and military, eg, NATO; [iii] promote integrated operational planning through IASC; [iv] in-depth analyses of climate change impacts upon human vulnerability and potentially affected

Key humanitarian changes	Possible consequences	Considerations for DFID
[3] changing nature of the affected. Nature of affected populations to include growing numbers of vulnerable people in developed world. Disaster affected to be increasingly urban, with approximately 54% of the world's population living in urban conurbations, 60% of whom will live in overcrowded, unsanitary and impoverished conditions. Thirdly, similar to HIV/AIDS, long-term afflictions (eg, chemical and nuclear exposure) to require sustained assistance over extensive time periods as well as up to 30 types of re-emergent diseases.	Impact of global climate change and related events to have increased impact upon "developed countries." Increased scale of impact and frequency to make adequate structural repairs and infrastructural improvements increasingly difficult. While affected principally to stem from lower-income communities, those vulnerable to pandemics, technological failures and other life-threatening systems failures will not be based on socio-economic status. Throughout the world, greater attention to urban poor, particularly in coastal areas, will be essential	[i] consistent with #1/i & ii, above, greater incentive required to anticipate and adapt to emerging threats; [ii] greater attention to hazards threat and alleviation in school curricula; [iii] refocus international development assistance on slum alleviation and more cost-effective urban development; [iv] similar to HIV-AIDS/Malaria/TB campaigns, establish resource and research coordination mechanisms to deal with re-emerging diseases and new types of afflictions (eg, nuclear exposure)
[4] changing assumptions about the response environment. Crisis response has normally been predicated upon at least four assumptions: [i] adequate global food surpluses; [ii] US dollar-led international currency stability; [iii] declaratory commitment to humanitarian principles; and [iv] adequate capacities to handle simultaneous emergencies both in developing and developed worlds. There is good reason to suggest that these assumptions cannot be assured over the next decade.	[i] Humanitarian response will lose the degree of automaticity that has marked large-scale interventions since the 1980s; [ii] periodic large-scale food crises in highly populated states, eg, China, India, will lead to external purchases that will significantly erode available food aid surpluses; [iii] major currency crisis and consequent adjustment over next decade will reduce percentage of available development and humanitarian aid; [iv] numbers of "forgotten emergencies" will increase, and future crises will be politicised as ethnic and insurgent interests stake out humanitarian assistance as extension of political instruments.	[i] Increased effort to promote local prevention and preparedness; [ii] strengthen regional organisations in prevention and preparedness; [iii] seek agreement with World Trade Organisation for emergency stockpiling provisions; [iv] strengthen advocacy programmes at international and bilateral levels to ensure adequate coverage for forgotten emergencies;

Key humanitarian changes	Possible consequences	Considerations for DFID
[5] changing instruments in the humanitarian toolkit. Preparedness and response will increasingly depend upon new forms of economic instruments rather than upon conventional relief interventions. The humanitarian toolkit of the future will include remittances from what today are called the Diaspora, and will increasingly depend upon insurance-based schemes, covering food and health security. Psycho-social issues will play a much larger response role.	[i] Dichotomy between new and conventional forms of assistance complicates coherence and coordination; [ii] Missed opportunities to engage new types of actors, and to link new instruments with prevention and preparedness measures; [iii] opportunities of new instruments should also feed into development opportunities.	[i] DFID to work more closely with Home Office to engage Diaspora groups in UK. This approach should be promoted in other countries, warranting consideration of this issue at a Good Humanitarian Donorship (GHD) forum; [ii] DFID should promote greater linkages between remittance-providing communities, insurance companies and counterparts in disaster-prone countries; [iii] DFID should explore linkages between new instruments and disaster prevention and preparedness arrangements; [iv] DFID should relate new instruments to institution-building and capacity-building programmes and projects
[6] changing types of humanitarian actors. The private sector as well as the military will play a growing role in the "humanitarian cycle." Private sector involvement will reflect the sector's need to protect existing assets in the absence of conventional safety nets, more sophisticated approaches to corporate social responsibility and the commercialisation of relief assistance. While the "civ-mil" debate continues to rage, future large-scale emergencies will require "martial law" type operations to ensure the necessary scale of support;	[i] similar to #5/i-iii, inability or unwillingness to relate conventional humanitarian actors to newly emerging actors will undermine coherence and fail to take advantage of economies of scale and new approaches to humanitarian prevention, preparedness and response; [ii] key for dealing with emerging actors will be reflected in different skills for humanitarian actors, eg, greater emphasis on socio-anthropological skills, as conventional response skills become increasingly dependent upon local relief workers and organisations	[i] DFID in collaboration with GHD should develop clear costing guidelines for military involvement in humanitarian operations; [ii] DFID, through UN global private-public partnership/compact, etc., promote active dialogue between NGOs, bilateral, military and corporate sector; [iii] DFID to promote World Economic Forum slot on humanitarian requirements and corporate, military linkages; [iv] related to i-iii, DFID should seek to put relevant item on G-8 discussion agenda

Key humanitarian changes	Possible consequences	Considerations for DFID
[7] new standards of accountability. The days of the well-intentioned but haphazard response to human suffering will become less and less tolerated as governments, authorities and even the affected demand that relief intervention be held to higher levels of accountability. In that sense, litigation is an aspect of globalisation which may strengthen accountability but not necessarily the commitment of humanitarian workers.	[i] greater attention to be given to IDRL-type commitments by governments of disaster-prone countries to enable clear understandings about operational requirements;[90] [ii] increasingly forms of contracting to be made explicit and/or be implicit in relief responses, adding to precarious situations for agencies and increased costs; [iii] greater attention required to have agreed international standards for assistance to the affected, including better assessment measures	[i] DFID to assess efforts to promote IDRL, and ways to capacitate relevant governments to implement agreed arrangements; [ii] DFID to provide increased support for studies and activities that will enhance assessment abilities to determine need; [iii] linked to 7/I, DFID to explore mechanisms to identify and promote agreed response standards

[54] This study accepts that, while the speculative details found in this report may prove to be wrong, the overall trends of growing human vulnerability in these four regions is not. There are no reasons to assume that present trends and, hence, this study's extrapolations are not compelling. This is not to deny the efforts that continue to be made through substantial development initiatives to offset such trends. This study, however, has not incorporated such factors into its analysis.

[55] While this study has not incorporated positive drivers into its analysis, one nevertheless needs to emphasise a very significant though still uncertain variable when it comes to vulnerability reduction, namely, the extent to which governments in crisis-prone states will actively promote good governance and tackle corruption. In terms of reducing vulnerability, establishing adequate safety-nets, and developing effective crisis-mitigation programmes, the issue of "the fragile state" – will be a key determinant.[91]

[90] [IDRL] International Disaster Response Laws, Rules and Principles is an initiative promoted by the International Federation of Red Cross and Red Crescent Societies to ensure that there is clarity about obligations of all parties involved in relief response, including governments of the affected.

[91] DFID has done a considerable amount of work in seeking ways to reduce poverty in states with "difficult environments," viz, fragile states. Such initiatives are essential if crisis prevention and preparedness as well as poverty reduction are to have an impact. [See, for example, DFID, PRDE Working Paper #6, Measuring Capacity and Willingness for Poverty Reduction in Fragile States, January 2005.

[56] This study also speculates that the changing dynamics and dimensions of humanitarian crises will lead to basic changes in the ways that humanitarian crises will be handled in the future. These changes will directly relate to issues of future operational costs, and include changes in the ways vulnerable people will be affected by future crises, in the types of organisations that provide assistance and the types of instruments and approaches needed to respond to future crises.

[57] In light of these transformations, it is all the more surprising that some of the most important organisations presently responsible for preventing, preparing for and responding to the sorts of humanitarian challenges that are anticipated in the future are failing to do so. Based upon a survey *inter alia* of seven major intergovernmental organisations, three non-governmental consortia and four main governmental aid providers between 30 October and 24 November 2006, it is evident that insufficient effort is being made by "humanitarian organisations" to prepare for the types of threats that are reflected in mainstream scientific and social scientific research.[92]

[58] There is considerable technical capacity among humanitarian organisations to address future threats, but there are two fundamental gaps. In general, most organisations that could begin to prepare to address future crises lack the strategic formulation capacity to plan for the future "from the future". Furthermore, the vast majority of organisations interviewed in this context accept that there are few incentives to do such forward planning. They acknowledge that the ethos of the present community is inherently reactive, technically proficient but neither particularly anticipatory nor strategic. This report indicates ways that this latter gap can be overcome by concerned governments.

[59] This study at the same time suggests that there are immediate steps that can be taken to engage the scientific and social scientific communities to help humanitarian organisations anticipate potential threats and their impacts far more effectively than is normally recognised.

[92] The survey included the Red Cross movement, ICVA, InterAction, the Standing Committee for Humanitarian Response, ISDR, UNDP, UNICEF, UNOCHA, Office of the UN's Special Envoy for Tsunami Recovery, WFP, WHO, WMO. USAID participated in the survey, and the governments of Denmark, Norway and Sweden gave their views on preparing for the future in separate discussions earlier in the year.

ANNEX I: A SURVEY OF KEY SOURCES

There has been a wide range of sources that have been useful for compiling this report. Most of these have been footnoted in the text. There are specific works, however, that have served to underpin the main conceptual findings of this report as well as proven to be major sources of data. It is these specific works that shall be noted in the brief reference survey that follows:

Arnold, M. et al, Natural Disaster Hotspots: Case Studies, The World Bank, Hazard Management Unit, Washington, DC, 2006. Companion volume to Dilley, below, and explores actual and potential crises as well as solutions for six geographically mixed case studies.

Dilley, Maxx *et al*, Natural Disaster Hotspots: A Global Risk Analysis, The World Bank, Hazard Management Unit, Washington, DC, 2005. Major work undertaken by scholars from six disaster research institutes identifies key "hotspots" where disaster risks are particularly high and methods for reducing risk.

Inter-governmental Panel on Climate Change [2001]. Working Groups I, II and III. The IPCC has established the agreed base-line to date for assessing the causes and potential impacts both globally and regionally of global climate change. This has been a major source of information for this report.

EM-DAT: The OFDA/CRED International Disaster Database www.em-dat.net - Université Catholique de Louvain, Belgium. This is regarded as very reliable source of information on natural disasters and their impacts.

> **Centre for Research on the Epidemiology of Disasters: Universite Catholique de Louvain [CRED]**
> **Thirty Years of Natural Disasters 1974-2003: The Numbers**
> **D Guha-Sapir; D Hargitt, P Hoyois [CRED]. Presses universitaires de Louvain 2004**
>
> **CRED Crunch, Disaster Data: A Balanced Perspective, June 2006**
> **Dr Debarati Guha-Sapir, [CRED] universite catholique de Louvain**
> **http://www.cred.be.cred-crunch@em-dat.net**

Glenn, J.C. and T.J. Gordon, 2004 State of the Future, United Nations University, Millennium Project, Washington, DC, 2004. Useful perspective on trends developed by a wide global network of scientists and social scientists.

Harvard Medical School - Center for Health and the Global Environment, Climate Change Futures: Health, Ecological and Economic Dimensions, November 2005, sponsored by Swiss Re and UNDP. Provides excellent

overview of health impacts arising from global climate change, and uses resources from the insurance sector to substantiate findings

Inter-Agency Secretariat of the International Strategy for Disaster Reduction: Living With Risk: A global review of disaster reduction initiatives, 2004 version. Good summary of available material in terms of threats and preparations for global climate change

Peter Hoppe & Roger Pielle, Jr. [Eds], Workshop on Climate Change and Disaster Loses: Understanding and Attributing Trends and Projections
http://sciencepolicy.colorado.edu/sparc/research/projects/extreme_events/munich_workshop/workshop_report.html

Stern Review: *The Economics of Climate Change*, November 2006

United Nations Department of Economic and Social Affairs: Population Division - The 2005 Revision Population Database. This UN document is a useful compilation of various UN data sources on population trends.

United Nations Development Programme, Bureau of Crisis Prevention and Recovery - Global Risk and Vulnerability Index, Trends per Year. An excellent source for determining increases and decreases in major vulnerability categories.

United Nations Economic Commission for Africa
Economic Report for Africa 2005 - Meeting the Challenges of Unemployment and Poverty in Africa. An interesting though perhaps over optimistic view of where the Continent is heading if there is adequate commitment.

United Nations Educational, Scientific and Cultural Organisation International Hydrological Programme, 2004-2005. This reference provides excellent support material regarding water development and trends.

United Nations Environment Programme - State of the Environment Country Reports, 2001 onwards. A guide to changes, both positive and negative, about environmental issues in member-states.

UNESCO -Africa Environment Outlook: Past, Present and Future, 2003. Useful reference for material on Southern Africa, though like many similar discussions, narrative about the present [2003] is depressing and hopes overly optimistic.

United Nations Environment Programme, Development Programme and Organisation for Security and Cooperation in Europe

Environment and Security Initiative: Transforming risks into cooperation: Central Asia: Ferghana-Osh-Khudjand Area, 2005. Excellent review of key socio-economic, environmental and conflict issues for states sharing the Farghana Valley.

United Nations Food and Agricultural Organisation
FAO Corporate Document Repository. General data base for range of food production and related environmental issues pertaining to agriculture.

United Nations High Commission of Refugees - Global Refugee Trends, June 2006 - Statistical Yearbook: Population Levels and Trends. Useful source, with references of migration patterns that are not solely refugees.

Joint United Nations programme on HIV/AIDS;
Report on the Global AIDS Epidemic, UNAIDS, 2006. Important up-date material on state of HIV/AIDS solutions as well as challenges.

United Nations-Human Settlements Programme [UN Habitat]
Challenge of Slums – Global Report on Human Settlements 2003. Very sound set of prescriptions about addressing an issue that HABITAT sees as a major and looming crisis.

United Nations Millennium Development Goals Report 2006
New York, 2005. Not a particularly happy picture about progress towards the major MDG objectives with ten years to go.

United Nations Population Fund - Annual Report, 2005
Country Profiles. Useful though very general source for recommendations about dealing populations as a development issue and as an issue in emergencies.

United Nations World Water Development Report
Joint undertaking by twenty three UN agencies, UNESCO, March 2003. Very good source for identifying the challenges that face global community on this issue of overarching concern.

World Bank – Independent Evaluation Group, Hazards of Nature, Risk to Development. An IEG evaluation of World Bank assistance for Natural Disaster, WB, Washington DC 2006. What the World Bank has done and intends to do in emergency and post-emergency situations, suggesting implicitly areas where it might have done better in the past.

World Health Organisation, WHO and the Millennium Development Goals, 2001. Useful review of the challenges that face the global community in terms of

major diseases. Though five years old, perspectives and conclusions appear relevant today.

World Meteorological Organisation
Horizon 2011, 6th WMO Long Term Plan 2004-2011

World Resources Institute, Ecosystems and Human Well-being: A Report of the Millennium Ecosystem, 2005

ANNEX II: REGIONAL CASE STUDIES

The case studies found in this annex are an attempt to show how the drivers and shocks discussed in the main body of this report will become increasingly inter-related and inter-active in the following ways:

[i] cascading hazards, like dominoes, views inter-active disaster agents in terms of one type of agent triggering another, as described in the *East African displacement case study*;
[ii] synchronous failures suggests the simultaneous collapse of systems, from technical and economic, to infrastructural and societal. This is suggested in the *Mumbai case study*;
[iii] global-local hazards looks at inter-relatedness in terms of the impact of a global event, eg, El Nino, upon a local event, eg, disaster in the Zambezi River basin as noted in the *Zambezi River basin case study*;
[iv] multi-hazard impacts reflects the interaction between several types of disaster agents on vulnerable populations, as described in the *Ferghana Valley case study*;

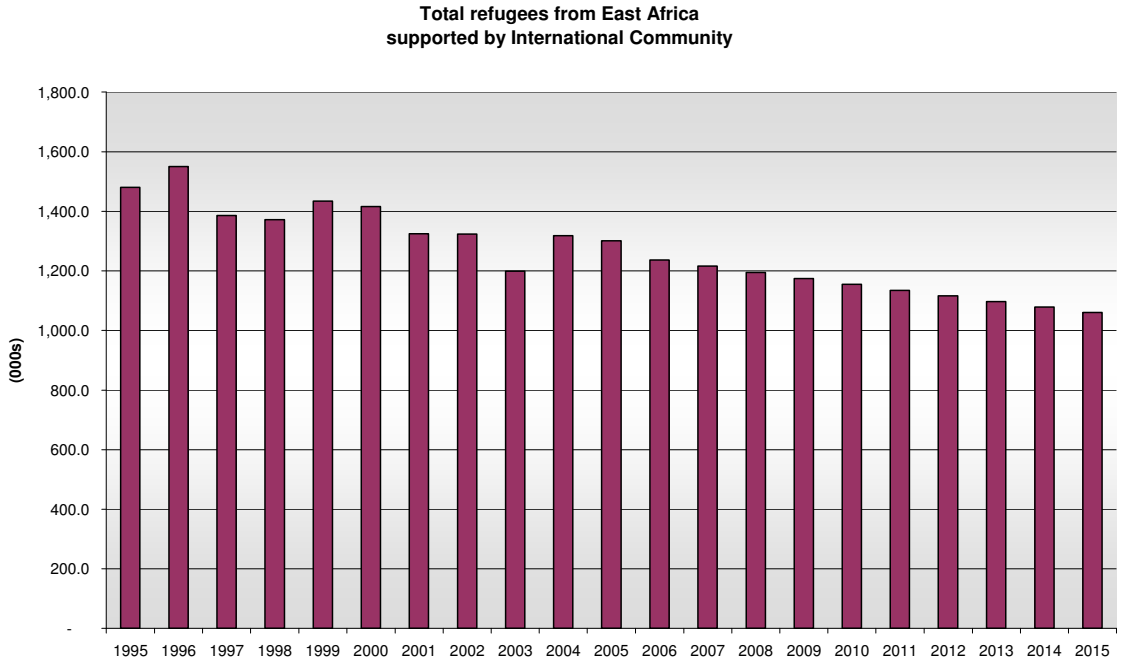
East Africa:

Case Study #1: Cascading Displacement and its Consequences

Inter and intra-state conflict will continue to persist over the next decade in various East African countries, principally Ethiopia, Eritrea, Kenya, Sudan and Somalia. The assumption underlining this case study is that there will be prolonged periods of massive displacement and refugee flows at various times over the next decade. The potential causes of these flows will be intermittent clashes between a re-emerging Somali state and Ethiopia, the consequences of the 2011 referendum in the Sudan and an emerging power vacuum on the northern borders between Kenya and the Sudan. Kenya will bear the brunt of the refugee flow, the sheer size of which will intensify environmental degradation that is already impacting upon the livelihoods of the country's rural populations. At the same time, the scale of these flows will increase the impact of potential epidemics.

Background: Political upheavals and consequent violence have marked the internal and inter-state histories of Eritrea, Ethiopia, Somalia and the Sudan since the end of the 1980's. In one way or another these have led to flows of refugees into other countries, eg, Kenya, and to massive internal displacement, eg, Somalia, Sudan. In total, between 1995 and 2006, the international community has supported on an annual basis 1.2 million to 1.6 million refugees stemming from this region and on average 342,000 internally displaced persons (IDPs), with an annual maximum of 1.2 million IDPs during this period.

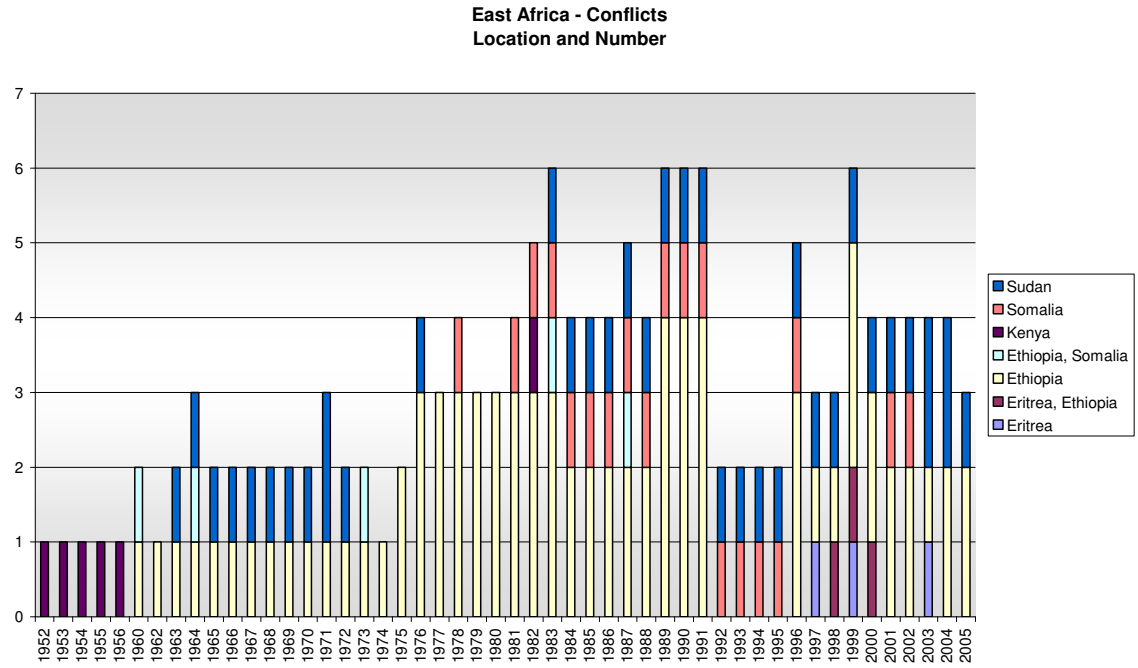
Figure 13: East Africa -Total Refugees supported by International Community 1995-2015



Crisis drivers: There are two plausible and interactive drivers that will affect these identified countries and the region which they comprise:

[i] <u>persistent conflict</u>. Inter-state conflict will take place within the foreseeable future, involving Somalia, Ethiopia and Eritrea, and at a lower level of conflict the porous border between northern Kenya and Ethiopia – an eventual "no man's land." Conflict has been persistent within the East African region (Figure 14). The sheer dimensions of refugee movements from Somalia, Sudan and Ethiopia will intensify conflict between rural Kenyan populations, as the former pushes further into the country's hinterland;

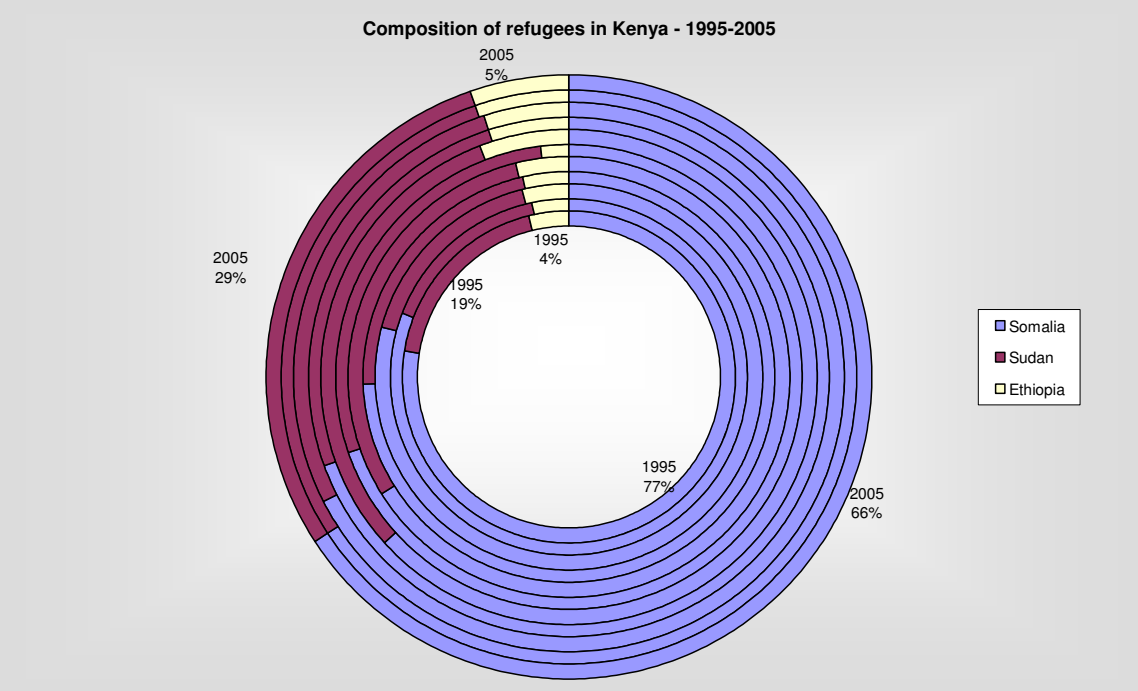
Figure 14: East Africa – Conflicts, Location and Number of Incidents 1952-2005



Conflict may escalate within the region as described in the introduction. A key result of this conflict will be an increase in refugee numbers. From 1991 to 1993, approximately 300,000 Somalis fled across the 800-mile Kenyan-Somali border.[93] This influx resulted in a refugee population comprising 77% Somalis in 1995 (Figure 15).

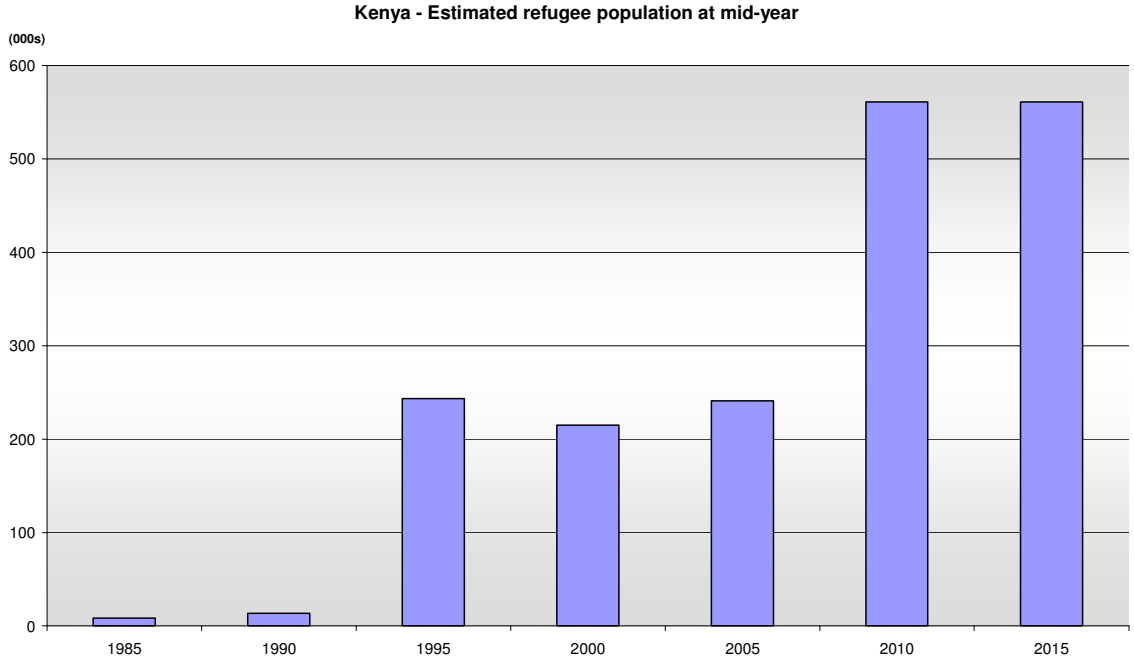
[93] 27 United Nations High Commissioner for Refugees (UNHCR), *Information Bulletin*, (June 1993) p. 4.

Figure 15: Kenya - Composition of Refugees 1995-2005



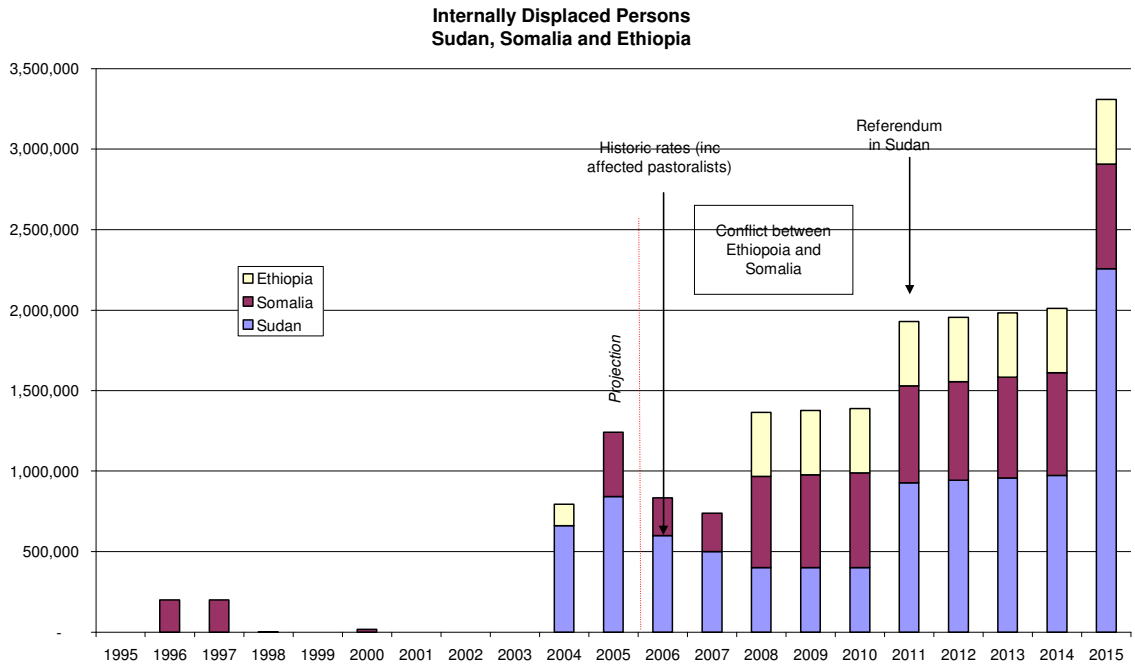
Future conflicts in the region are likely to cause a repeat of this movement of people, with Ethiopian and Sudanese refugees adding to the number. A projection based on a scenario of conflict that similarly effects populations across the region – Sudan, Somalia and Ethiopia – is presented in Figure 16.

Figure 16: Kenya – Estimated Refugee Population at Mid-Year 1985-2015



Conflict in the region similarly precipitates an increase in IDPs. While sources for IDP are limited, Figure 17 presents a projection based on current estimates against possible and likely events, including a referendum in Sudan.

Figure 17: Sudan, Somalia, and Ethiopia – IDP's 1995-2015



[ii] <u>environmental degradation</u>. As an estimated 560,000 people seek refuge in Kenya (see Figure 16), greater demands for fuels, eg, firewood, and for livestock grazing intensify environmental degradation, including the destruction of traditional agricultural lands.

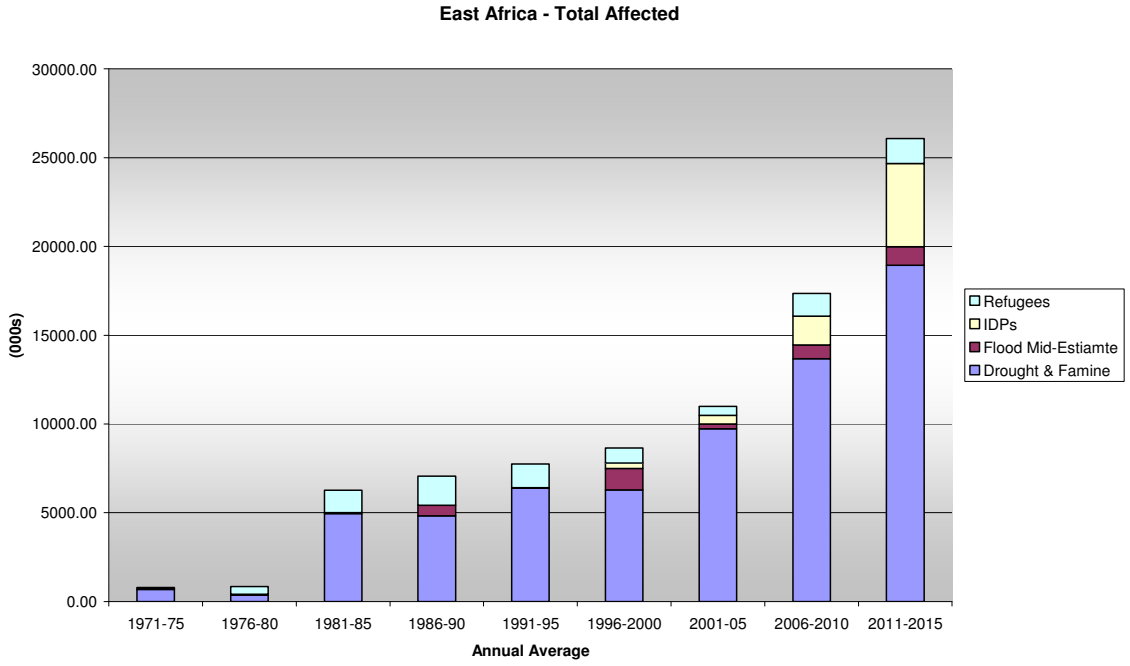
Between 2010 and 2015, the impact of such degradation increases the movement of rural populations into urban areas, eg, Mombassa and Nairobi, leaving remaining rural populations destitute. The extent of the effect of refugee arrival on local population movement would be dependent largely on the support of governments and aid agencies. There is evidence to suggest that rural population density is negatively related to calorific intake in sub-Saharan Africa as a general rule.[94]

[94] Hendrix and Glaser (2005)

Potential Shocks: The crisis drivers will leave refugees and IDPs in particular exposed to a number of shocks, but – as opposed to the more general East Africa projections found in para. #29, where the shock was drought-induced famine – this case study suggests that another interesting shock would be disease. Here, in this case study, the effect of the conflict, physical stress, and relocation of groups of people is to create more vulnerability to communicable diseases. In this case, one is projecting a variant of Avian Influenza, for which there will be no generic remedy. Attack rates for populations can vary from 20-40%; this case study envisages an outbreak that affects 25% of the exposed population.

The effect of conflict on human health manifests itself in the most vulnerable populations.

Figure 18: East Africa – Total Affected by Flood, Drought, Famine 1971-2015



Numbers of affected: The numbers of affected, based upon this case study, include:

[i] internally displaced persons in Ethiopia (400,000), Kenya (50,000), Somalia (650,000) and the Sudan (2.26 million) in 2015;
[ii] an epidemic with an attack rate of 25% amongst internally displaced persons, affecting up to 285,000 in 2010 and 559,000 people in 2015
[iii] an increase in refugees numbers from Sudan (162,000), Somalia (369,000) and Ethiopia (30,000)

[iv] an epidemic with an attack rate of 25% in the refugee population affecting 140,000 in the refugee population, projected to be 2010 and 2015
[v] Kenyan rural populations in need of survival assistance

South Asia:

Case Study #2: Synchronous Failure in Mumbai

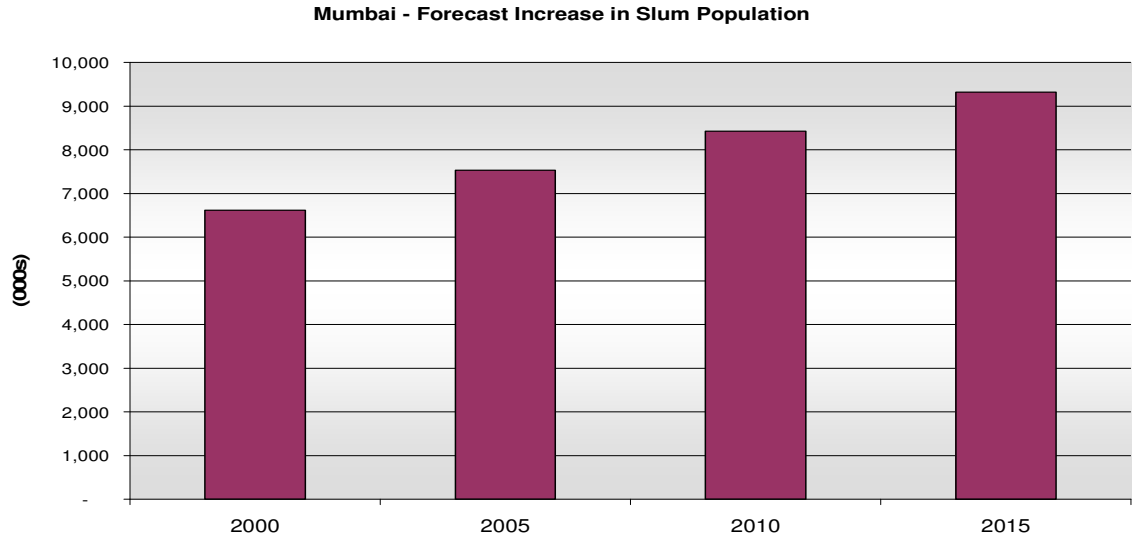
This "synchronous failure" case study suggests the impact that three key drivers and one potential shock could have on a densely populated and highly complex urban area in South Asia. As evidenced in the July 2005 Maharashtra floods, the links between the flood's impact upon the economy and the increased impoverishment of a significant portion of Mumbai's population is difficult to calculate. Nevertheless, the drivers – ie, demographic transitions, epidemics, and water management failures along side a shock of consecutive extreme precipitation – offer a plausible projection of affected peoples in 2015.

Background: The Maharashtra floods of July 2005 affected large areas of the metropolis of Mumbai, located on the western coast, in which at least 1,000 people died, 20 million people were affected in the region, and around $3.3bn of damage was casued. The floods were caused by the eighth heaviest ever recorded 24-hour rainfall figure of 944 mm (37.2 inches), peaking on 26 July 2005.

Crisis drivers: There are three plausible and interactive drivers that contribute to an estimate of the numbers that would be affected in the years 2010 and 2015 by similar weather events:

[i] demography: while India's main industrial centre in relative terms is not a poor region overall, extremely large numbers are living in slums around the capital. There is every indication to suggest that these figures will grow (Figure 19).

Figure 19: Case Study #2; Mumbai – Forecast Increase in Slum Population 2000-2015

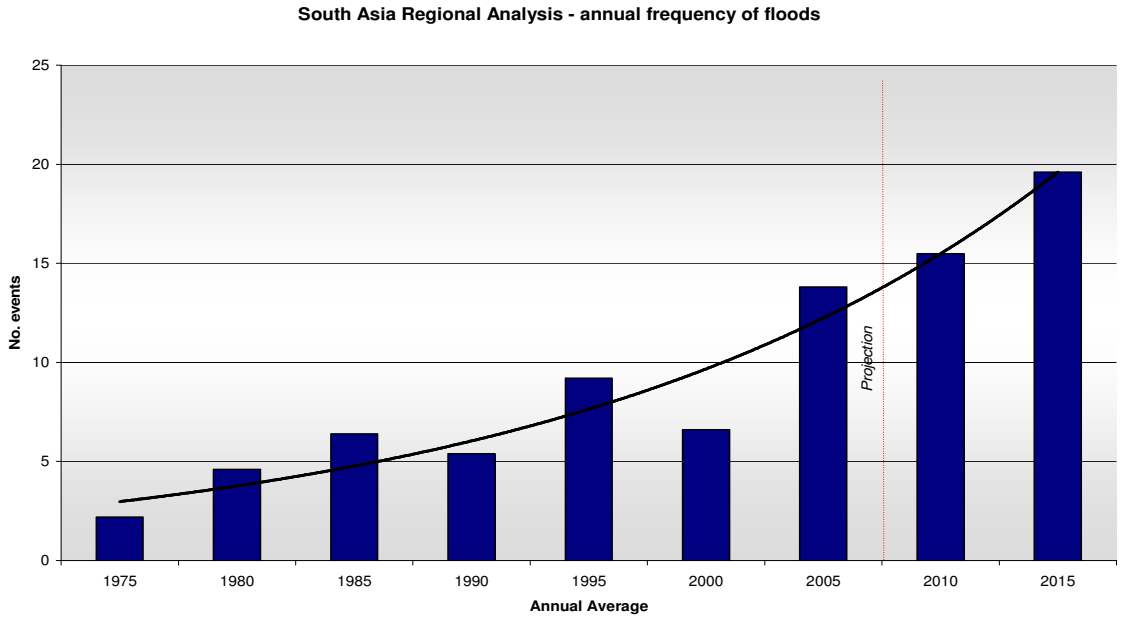


By population increase alone, Mumbai will incorporate an extra 3.7 million people by 2015. Insofar as the July 2005 floods affected the entire city's population; such an event in 2015 would affect, and therefore require assistance for, a population 20% larger. Population growth has caused haphazard urban development, with no overall urban plan for many of the new suburban developments.

[ii] water management: Projected frequency of extreme weather events will have a growing impact on water management failures as reflected in increased flooding. The assumption attached to this forecast is that efforts to maintain the urban infrastructures, in this case principally sewage and water systems, will not be able to keep pace with the flood events themselves and the continued growth of the city's population.

Flooding as indicated in Figure 20, below, is also becoming more frequent, putting severe strains on natural (eg, mangrove barriers) and manmade (eg, seawalls and drainage systems) forms of flood protection. In 2015 it is likely that flood-prone areas of South Asia will see an increase in flood frequency by up to half as many flood events again annually (Figure 20). An increase of both extreme precipitation events and Monsoon rain variability is anticipated by the IPCC.

Figure 20: South Asia Regional Analysis – Annual Frequency of Floods 1975-2015



Source EM-Dat

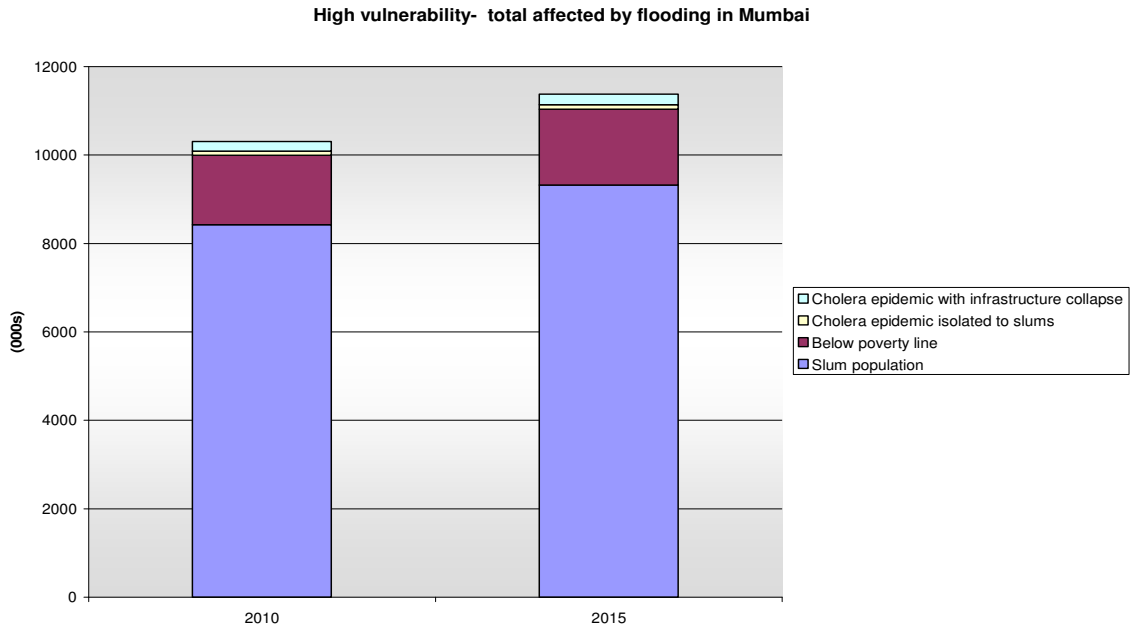
[iii] Epidemics Rain water from the 2005 floods caused sewage systems to overflow and contaminated water lines. The storm-water drainage system in Mumbai was capable of carrying a daily maximum runoff equivalent to 600mm rainfall, clearly inadequate for the 944mm seen on that day. Where the population of slums is exposed to open sewage, a cholera outbreak as seen in West Bengal in 1998 would be associated with an incidence of 93,000 cases in 2010 and almost 103,000 cases in 2015 in slum populations.

However, in looking at the total highly vulnerable population affected by a similar flood in the future, such an outbreak would be only a small part of the potential assistance required to slum populations and those living in extreme poverty.

Potential Shocks:

[i] This case study assumes a local shock on the Mumbai area whereby two consecutive extreme precipitation events occur. Where the first results in mass disruption as seen in July 2005, the second is sufficient to completely overwhelm infrastructure. Were a synchronous failure to cause the complete breakdown of the megalopolis's existing water management systems, the incidence of cholera would rise to around 220,000 and 241,000 for 2010 and 2015 respectively, with most of the city exposed to some degree of cholera risk through mains supply contamination.

Figure 21: Mumbai – High Vulnerability, Total Affected By Flooding 2010-2015



Numbers of affected: The numbers of affected, based upon this case study, include:

[i] population of Mumbai living in slums in 2010 and 2015 (8.4 million and 9.3 million) and below poverty line affected by floods (1.6 million and 1.7 million);

[ii] the population of Mumbai in 2010 (20 million) and in 2015 (21.9 million) will be exposed to a number of simultaneous effects of severe flooding

[iii] total affected by epidemics linked to floods and infrastructure collapse (220,000 to 241,000)

Southern Africa:

Case Study #1: Emerging Competition for Water in the Zambezi River Basin

Continuing human population growth and the consequent demands for freshwater are leading to what many have foresee as a world water crisis. The dynamics of this sort of global crisis can be seen in microcosm in the SADC region of Southern Africa's Zambezi River Basin (ZRB). The Zambezi River Basin is shared by Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe. Each of these countries are experiencing significant population growth and considerable increases in urban populations. Droughts have become more frequent as has land degradation, and, hence, the demands on irrigation become ever greater. Industrial development consumes increasing amounts of water. For this case study, the ZRB – not dissimilar to other river networks in Southern Africa and around the world – is experiencing tremendous demands on its resources. And like similar situations, there are growing concerns that a decline in water resources will be reflected in serious increases in disease, poverty and violent conflict.

Background: This scenario focuses on the main populations of the ZRB, namely Malawi, Zambia and Zimbabwe. The Zambezi River Basin is home to about 38.4 million people, mainly concentrated in Malawi, Zambia and Zimbabwe. Poverty among the people of the basin states is principally due to rapid population growth, slow economic development and a fragile natural resource base. Uneven distribution of resources is an additional cause for persistent poverty, and some also point to structural adjustment programmes as a further cause of increased job losses, ensuing poverty and environmental pressures.[95]

Crisis Drivers: According the IPCC, major rivers of Africa are particularly sensitive to climate change, with the Southern African region particularly sensitive in terms of decreases in average runoff and water availability. Further to this, the IPCC believes it is likely that the El Nino effect will affect this region severely, causing drought- and flood-induced agricultural productivity.[96]

[i] demographic patterns. The basin's population is growing rapidly. The average population growth rate for the basin is about 2.9 percent annually, although rates for individual countries vary. In most of the countries, over 40 percent of the population is under 14 years of age, implying a high dependency ratio. Population growth rates are particularly high for Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe. If the present growth rates of

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[95] Herbert Jauch, ***Structural Adjustment Programme: Their origin and international experiences***, Labour Resource and Research Institute (LaRRI),Namibia, March 1999

[96] IPCC: Climate Change 2001: Impacts, Adaptation and Vulnerability

population are sustained, the population will double within the next generation, or in less than 25 years. The demographic structures of these countries will place a great burden on national economies, in no small part due to the youthful population. While some of the main cities in the ZRB area are growing rapidly,[97] the greatest urban growth is taking place in small urban centres where people are dependent on agriculture and agro-based industries;

[ii] water management failure. The majority of the people in the basin states have no access to safe water, sanitation and health services. For example, between 1990-96, only 27 percent of Zambia's population had access to safe water. In Malawi, only 16 percent of the population had access to sanitation in the same period. While Angola and Zambia have adequate water supplies for the future, the rest of the basin states are either facing problems or will be, in less than three decades. Namibia has no perennial inland rivers and has great difficulties in mobilising available water to meet its current demand. Botswana is a dry country surviving on groundwater, which is insufficient to meet the demand of the growing population. While Zimbabwe has reasonable water resources at present, the country will suffer water stress by the year 2025 along with Mozambique and Tanzania. Malawi currently faces water problems and by the year 2025 the country will be beyond its ability to replenish the levels of water that it uses.

[iii] environmental degradation. Drought is the single most crucial natural disaster that affects the Zambezi Basin. Research shows that droughts occur every 10-15 years in the basin countries. Since the turn of the 20th century, these periods of serious drought followed by ever intensifying periods of rainfall are occurring at shorter intervals. It has been assumed that these shorter and more extreme patterns are directly attributable to global climate change.[98]

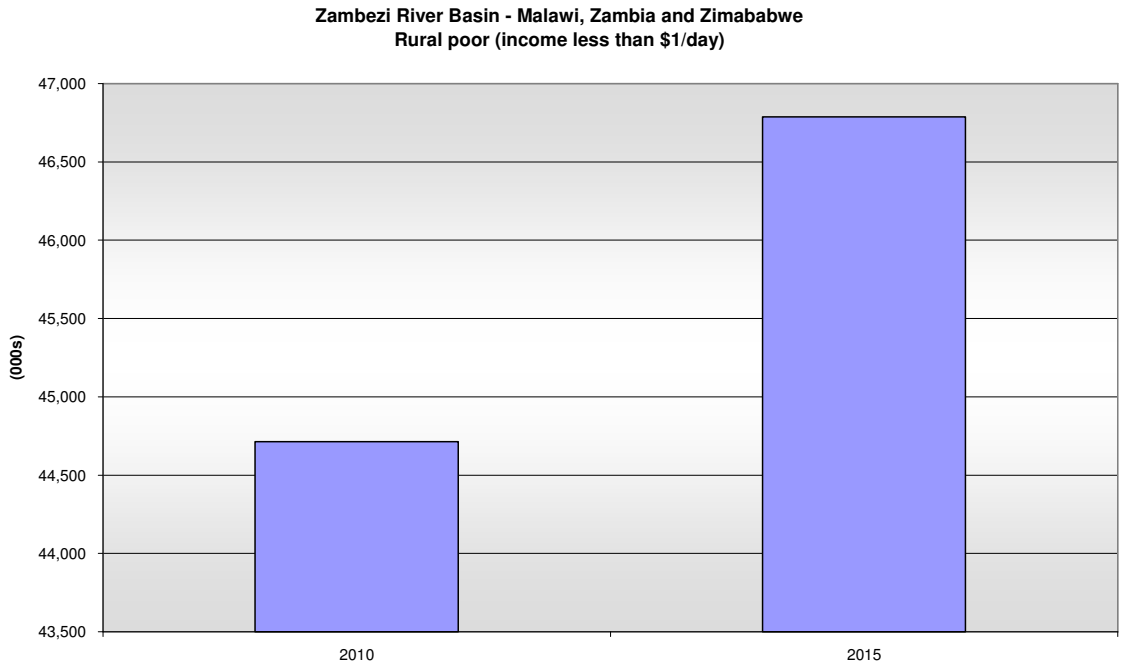
The droughts of the 1980s and 1990s have had a marked negative impact on the Zambezi Basin states. For example, the lake level at Kariba on the Zambezi River dropped by11.6 metres of water within a decade. With regard to water availability and hydroelectric power generation, the severe droughts of 1991-92 and 1994-95 had near-disaster consequences in some of the basin countries. The period between 1985-95 was disastrous for many rural communities, especially in Mozambique, southern Zambia and Zimbabwe. Boreholes dried up, making it impossible to grow crops or maintain livestock, and urban dwellers were also affected. Water supplies in Zimbabwe's capital, Harare, sank to alarmingly low levels towards the end of the 1990s and power shortages

[97] Annual growth rates: Luanda, Angola [3.6%], Maputo, Mozambique [3.8%], Lusaka, Zambia [3.2%]

[98] It is interesting to compare earlier studies on the impact of climate change [eg,, Mike Hulme, ***Climate Change and Southern Africa: An exploration of some potential impacts and implications for the SADC Region***, Climatic Research Unit, School of Environmental Sciences University of East Anglia, 1996] with more recent studies [eg, Oxfam et al., ***Up in Smoke***, Oxford, October 2006] to see that severe prognoses expressed in the former now appear to be relatively underestimated.

became commonplace. By October 1995, the Kariba Dam, which produces most of the country's electricity, was running at only 14 percent capacity".

Figure 22: Zambezi River Basin – Malawi, Zambia, Mozambique Rural Poor (income less than $1/day) 2010-2015



Source: WHO 1994, UN Population division, UNHCR

[iv] disease and epidemics. Southern Africa is the region worst hit by HIV/AIDS. HIV/AIDS will continue to wreak havoc in the basin with many of the countries experiencing a decline in life expectancy. Despite the recognition that AIDS is a pandemic, regional responses to date have not been very effective. In fact, some countries tried to ignore the problem in order not to jeopardize investment and tourism. HIV/AIDS has also placed heavy demands on the health sector, sending service costs spiraling and increasing the costs of importing drugs. Many thousands of people have no ready access to essential drugs and where such drugs are available, the costs are prohibitive. HIV/AIDS is killing many of the basin people still in their productive years, contributing to low human capacity in many areas. The true cost of this pandemic, if consistent with the disease's impact in other parts of Africa, will be a sharp increase in orphans and elderly who will not be able to maintain livelihoods, a significant number of affected who will not be able to care for themselves and a general deterioration in community support systems.

Numbers affected:
[i] a major drought occurring between 2010 and 2015 within the ZRB, compounding water stress, would affect between 45 million and 47 million people living in poverty in rural areas across Malawi, Zambia and Zimbabwe

MULTIHAZARD RISKS IN THE FERGHANA VALLEY: A CENTRAL ASIAN CASE STUDY

The Ferghana valley is the most fertile, densely populated region in the whole of Central Asia. The valley, straddled by three countries -- Kyrgyzstan, Tajikistan and Uzbekistan -- is home for 10.5 million people. 60% of the combined populations of all three countries is defined as poor, living on or below $500 per year. As with all five states in the region, the boundaries that join the three at the Ferghana Valley are former administrative boundaries. Only since post-Soviet independence have these boundaries become state borders. As border demarcation between Uzbekistan and Kyrgyzstan remains uncertain, those borders that might intersect waterways (eg, Kirki Dong and Koprovadskoe reservoirs) remain sources of contention. Such tensions are further compounded by the increased militarisation of the borders in the Ferghana area following the 1999 and 2000 military incursions of the Islamic movement of Uzbekistan.

Background: The richness of the Ferghana Valley is only equaled by its range of vulnerabilities. Poor water management, lack of any substantive attention to environmental degradation and conventional as well as industrial related health epidemics plague the valley. In the past, natural resources caused tensions and insecurity, with water depletion, deterioration and related issues causing cross-border disputes which intensify already strained ethnic tensions. High demographic pressures on limited land resources coincide with a lack of jobs and economic prospects, furthering public discontent, as witnessed recently in Osh and Jalal-Abad, two major Kyrgyz cities in the valley.[99]

Industrial activities present a challenge, in particular where pollution crosses borders such as between Kyrgyzstan and Uzbekistan. Active mines and smelters are important sources of national and local revenue. Many of them are, however, located near state borders and present a continuous source of discontent. Closed industrial sites are badly managed, schools and houses sprawl into former industrial areas such as the closed uranium mine in Taboshar, Tajikistan. The legacy of Soviet-era uranium mining is a region-wide source of public anxiety.

All these factors are further compounded by natural disasters and climate change which increasingly affects the environmental and thus security situation. As noted by UNEP, a land-slide in April 2005 at Mailuu-Suu in Kyrgyzstan passing just next to a major area of Uranium waste storage is a fresh reminder of the interaction between environmental degradation and the residue of outmoded means of industrial production.

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[99] UNEP, ENVES Initiative. ***Environment and Security Initiative: Transforming Risks into Cooperation – Ferghana, Osh, Khudgard***, 2004, p.19

Crisis drivers:

[i] demographic shifts. The Ferghana Valley is the most populous area in Central Asia, representing about 20% of Central Asia's population -- including 50% of Kyrgyzstan's population, 31% of Tajikistan's population and 27% of Uzbekistan's. Between 1959 and 1989 the population of the basin states increased by 140% and is expected to increase by 33% again by 2020. Population density is extremely high in the Uzbek part of the Ferghana Valley as compared to those of Tajikistan and Kyrgyzstan.[100] High population densities increase the risk of natural resource depletion, and are seen as a key factor in growing tensions in the region.

Population density is further exacerbated by the numbers of different ethnic groupings and clashes between ostensibly secular and Islamic authorities in the area.[101] As opposed, however, to other regions considered for this study, the Ferghana Valley is witnessing a return to rural areas and a decline in urbanisation;

[ii] water management failures. There are three main issues that point to water management failures in the Ferghana Valley. The first has to do with access to water, the second concerns water quality and the third revolves around the issue of raising groundwater. The problem of water access has several dimensions, but two of particular importance concern: [a] rivalries between petroleum rich downstream states who need water for large commercial farms and those less well-endowed upstream states that need to control water for hydro-electrical power; and [b] tensions between large-scale commercial farms and the rapid emergence of small farming plots. Both generate considerable ethnic animosities. Water quality, a second issue of major concern, involves the seepage of contaminated soil (linked to irrigated agriculture, pesticides, nitrates and strontium) and a wide variety of industrial toxins along with unregulated sewage. Thirdly, the lack of capacity on all sides of the valley to control water means that water-logging and groundwater problems destroy agricultural fields and housing;

[iii] environmental degradation. In the Ferghana Valley water and agricultural sectors are likely to be the most sensitive to climate change-induced impacts. Even though regional climate change scenarios are still uncertain, the likely consequence will be a significant shortage of water resources associated with significant increases in surface air temperature (IPCC,2001/ENVSEC, 2004).

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[100] Uzbekistan [277 people/km2], Tajikistan [69 people/km2] and Kyrgyzstan [18 people km2]

[101] Tanya Charlick-Paley with Phil Williams and Olga Oliker, "The political evolution of Central Asia and South Caucasus: Implications for Regional Security, in ***Faultlines of Conflict in Central Asia and the South Caucasus***, RAND, California, p.11

Rapidly rising populations and return movements to rural areas explain the persistent destruction underway of forests on the hillsides and lowland pasturelands that both border the valley.[102] Inhabitants of those areas depend to a large extent upon the resources put under pressure by the increasing numbers of new settlers. In this context, environmental disputes can be easily instrumentalised using ethnic identities as a marker and a divider. Limited land availability has another impact: because of population pressure and scarce resources all available lands are utilized for agricultural purposes also those areas rich in endemic and endangered species. Moreover, pipelines, roads, electricity lines, mining and processing industries are all factors contributing to the loss of biodiversity in the region.

Rising temperatures could have a devastating effect on the area in terms of flooding in the form of very large mudslides and floods caused by outbreak of mountain lakes. As has happened in the past (e.g. Shakhimardan River, 1998) warm weather melts snow and glaciers causing a flood wave that breaks open successive mountain lakes. There are an estimated 238 mountain lakes in the Kyrgyz Republic that threaten Uzbekistan.[103] Ikhnach Lake in the basin of the Pskem, which retains 5.8million cubic meters of water, is seen as a risk not only because it could flood the Pskem valley but because its strike wave would endanger Charvak dam.

In addition, there is a major risk that toxic wastes will be swept up in certain areas. In May 2002, a landslide slid across the path of the Maili-Suu River. Had the river been entirely barricaded, the over-spilling water would have inundated radioactive dumps located alongside the river. The resulting radioactive mudslide would have travelled through the Ferghana Valley to the Aral Sea. Directly at risk was the 96,560 kilometre square Ferghana irrigation network between the Tian Shan and Pamir-Alai mountain ranges.[104]

[iv] epidemics and disease. Compared to the rest of Central Asia, the Ferghana Valley is relatively positive in most overall health statistics. In terms of overall mortality, death from infectious diseases, infant mortality and mortality from all forms of cancers, the valley is significantly better than most other parts of the region (UNEP-GRID Arendal). That said, typhoid, malaria and hepatitis trends are increasing as living conditions in the valley decline (ENVSEC, 2004). The health situation is clearly threatened by industrial operations in the region which are carried out with limited environmental or public health concerns, and the results have been an accumulation of pollutants in the local environment. The

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[102] The growth in the rural populations has been explained as a move from small towns sustained until independence by Soviet enterprises. Rural populations now have gone beyond 65% of total Central Asian populations. There are some exceptions to this de-urbanisation process, eg, Batken, Osh and Bishkek. UNEP, ENVES Initiative, 2004, p.28

[103] The World Bank Group: Natural Resources Management, Kyrgyz Republic

[104] *Ferghana News Agency, 23rd May 2005*

Soviet Union had used the Ferghana Valley as one of the main sources of uranium ores, and it is well documented that "there were protection dams were washed away and radio-nuclides entered several of the valley's rivers and reservoirs. Only recently Tajikistan started to approach international organisations on the issue of radioactive waste deposits. Uzbekistan has so far adopted a lower profile in raising international attention to this issue. Uzbekistan has a joint commission with Kyrgyzstan that primarily deals with Mayluu Suu, and the Uzbek state of the environment report from 2001[105] confirms the concern over the question of nuclear waste (UNEP/GRID-ARENDAL, 2003).

[v] conflict. Conflict is endemic to the valley. In light of intense ethnic divides and the increasingly fierce competition for resources, the potential for explosions are clearly evident. The fact that except for one series of incidents in 1999 and 2000 there has been no serious violence in the valley has been the result, according to the ENVSEC,2004 report, of the ability of ruling elites to find accommodation and also – perhaps paradoxically – upon the calming influence of Islam to provide stability and restraint.

Nevertheless, a study on causes of conflict, though focused on Sub-Saharan Africa, indicates a relationship between rural population density, negative changes in rainfall, and increasing likelihood of conflict that is relevant to the Ferghana Valley.[106] The Ferghana Valley is facing a multiplicity of challenges that will inevitably increase the competition for ever scarce resources. At the same time, there is little sign that the ethnic tensions that pervade so many of the communities in the Valley are abating, and these tensions when combined with resource competition could prove to be an explosive mix.

Potential shocks: Direct military action or terrorist acts directed against strategic objects such as dams (eg, Papan in the Osh region, Toktogul reservoir, Lake Sarez in Tajikistan) could have disastrous consequences for the Ferghana Valley and Central Asia. The flood of water, for example, from the Papan dam that was breeched would not only saturate agricultural areas and intensify salinisation, but would also expose the industrial/nuclear wastage sites that have been developed so close to the valley's main rivers. A similar situation could be brought about by the natural bursting of a glacial lake, bringing about a similar range of hazard effects. The trans-boundary nature of such an event could equally exacerbate ethnic tensions.

Numbers affected:

[i] A glacial lake outbreak would affect around 20,000 people directly
[ii] A mudslide/flood triggered by the same event leading to radioactive waste reaching irrigation systems could affect up to 24 million people in the Ferghana Valley

[105] Republic of Uzbekistan, State of the Environment report, 2001, pp 106-107
[106] Hendrix and Glaser (2005) Ibid. p11

ANNEX III: FIGURES, CHARTS AND TABLES

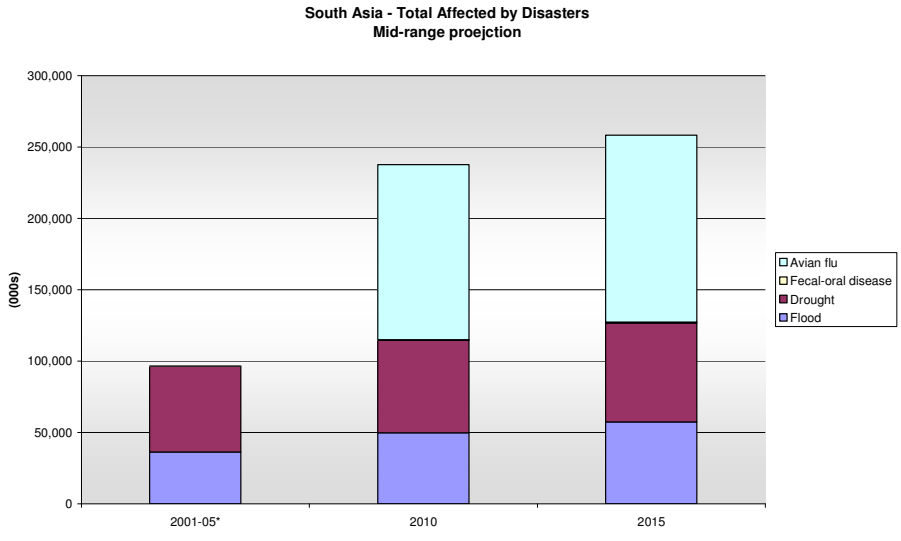
This section presents data relevant to ***Chapter II: Regional Projections***. A considerable amount of data have been collected to arrive at the analyses found in ***Chapter II***, but to include them all in that chapter would have made it cumbersome. Hence, following the same sequence as in ***Chapter II***, the reader will find charts and tables upon which the projections were based.

South Asia Regional Perspective

Projected numbers of crisis affected peoples

	2001-05*	2010			2015		
(000s)		Low	Mid trend	High	Low	Mid trend	High
Drought & Famine	60,014	33,835	49,283	64,732	32,876	51,125	69,373
Flood	36,328	39,184	47,358	49,766	41,993	53,044	57,350
Fecal-oral epidemics	38	285	320	383	306	434	521
Total excl Av. Influenza	**96,379**	**73,304**	**96,961**	**114,881**	**75,175**	**104,603**	**127,244**
Avian Influenza	n/a	48,986	122,466	146,959	52,380	130,951	157,141
Total incl Av. Influenza	**96,379**	**122,290**	**219,426**	**261,840**	**127,555**	**235,553**	**284,385**

Figure 23: Overall Numbers of Crisis Affected in Bangladesh, India, Pakistan 2010-2015



**2001-05: Annual average from 2001 to 2005 inclusive*

Figure 24: South Asia – Total Affected by Flood 2000-2005 with Trend To 2010-2015

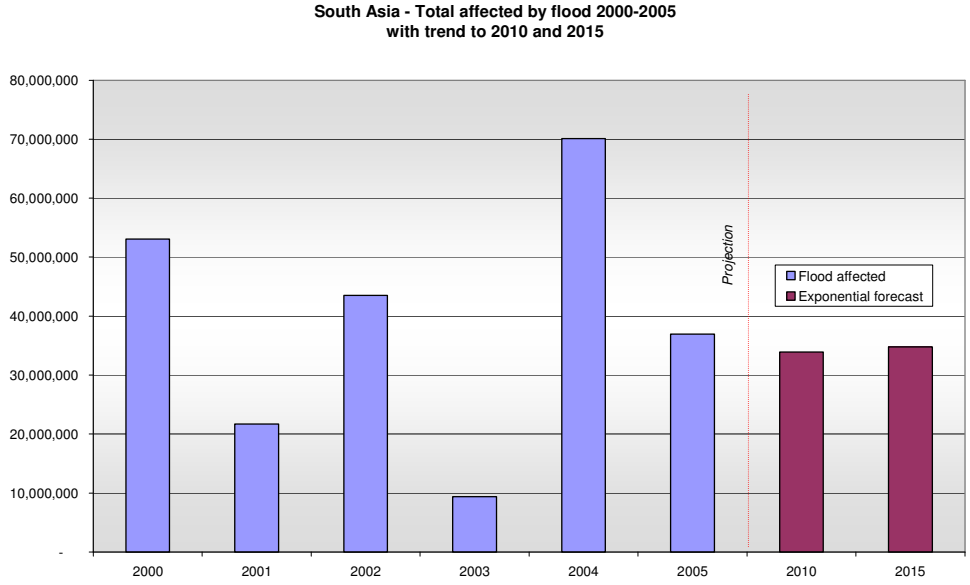


Figure 25: South Asia – Numbers Affected by Drought 2000-2005

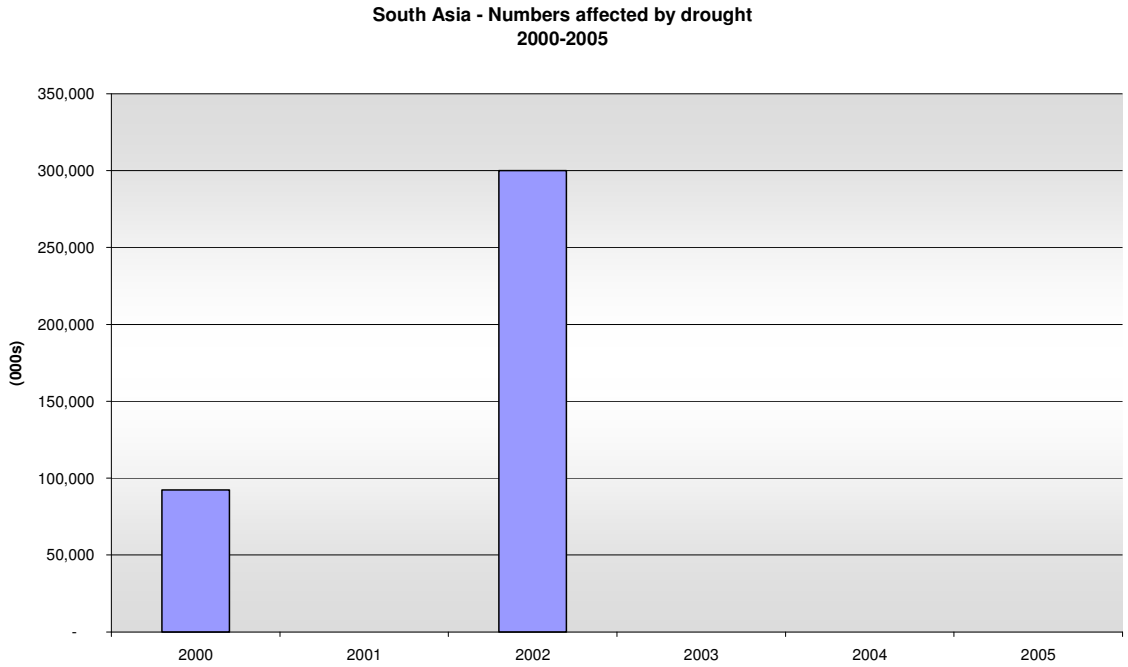
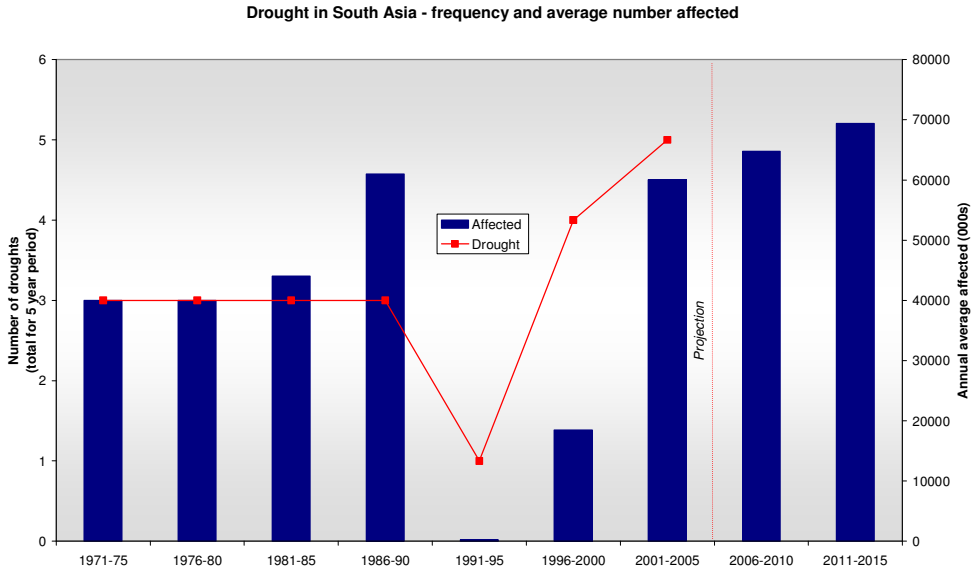
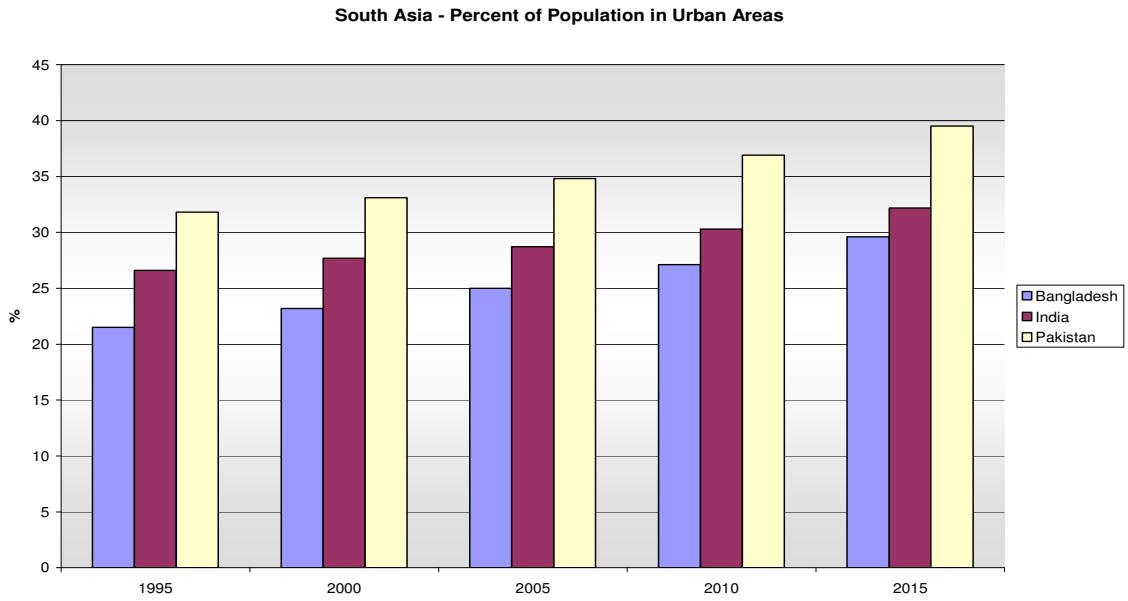


Figure 26: South Asia – Frequency and Average Number Affected by Drought 1971-2015



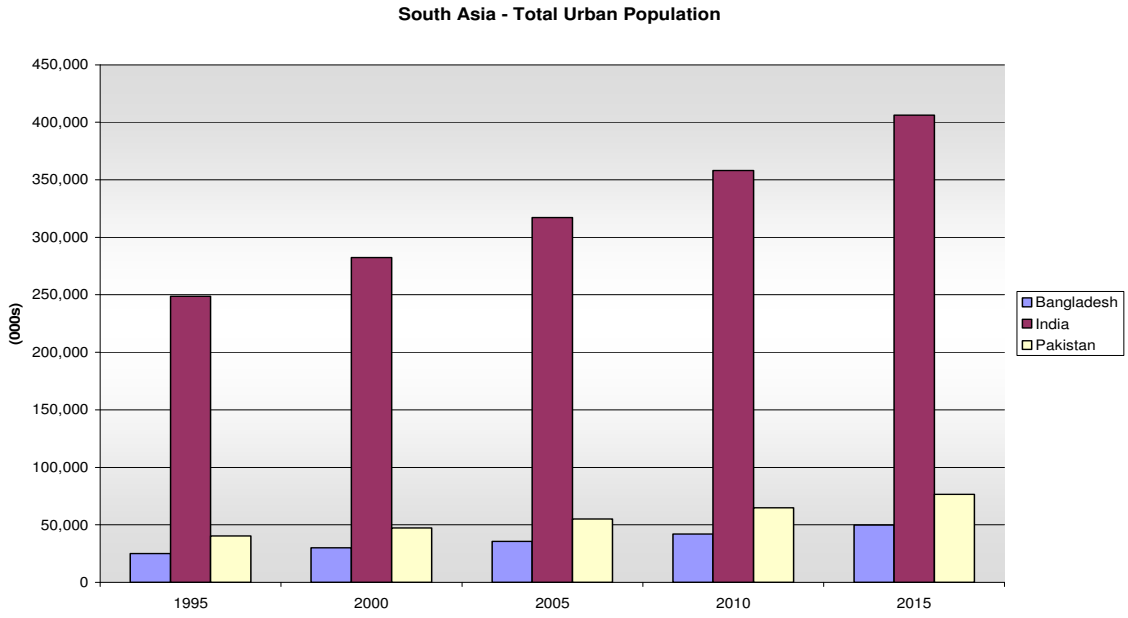
Source EM-Dat

Figure 27: South Asia – Percent of Population in Urban Areas 1995-2015



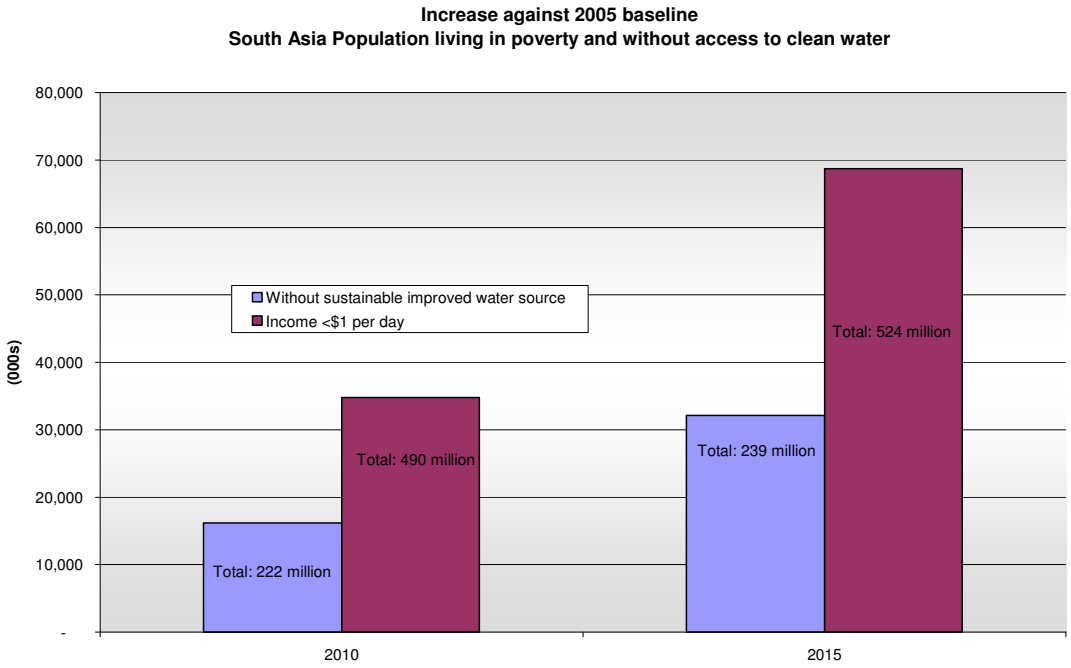
Source UN population division

Figure 28: South Asia – Total Urban Population 1995-2015



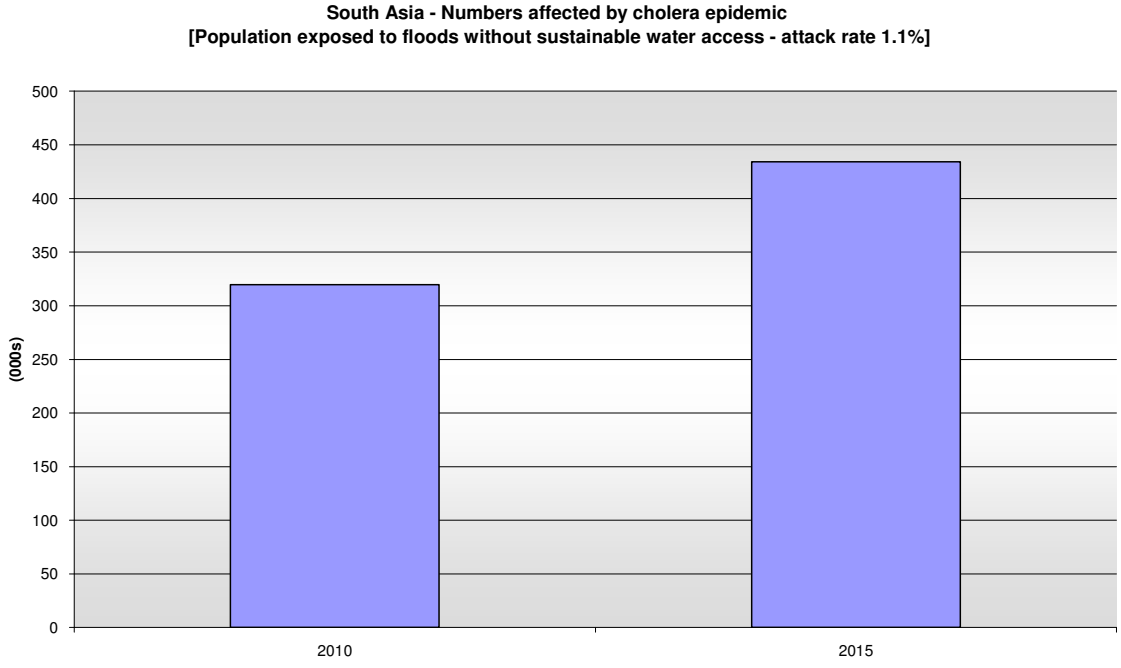
Source UN population division

Figure 29: South Asia – Increase against 2005 Baseline, Population Living in Poverty and Without Access to Clean Water 2010-2015



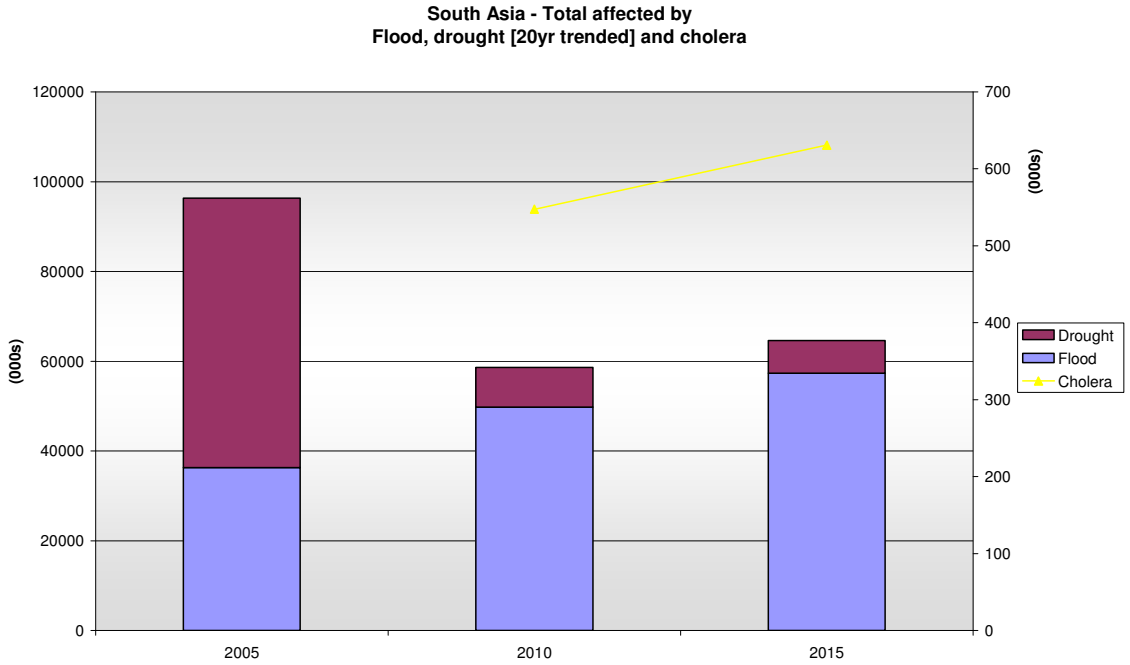
UNDP Human Development Report 2005

Figure 30: South Asia- Numbers Affected by Cholera Epidemic (Population Exposed to Floods Without Sustainable Water Access) 2010-2015



Sources: UNDP Human Development Report 2005, Global Health Impacts of Floods: Epidemiologic Evidence[107]

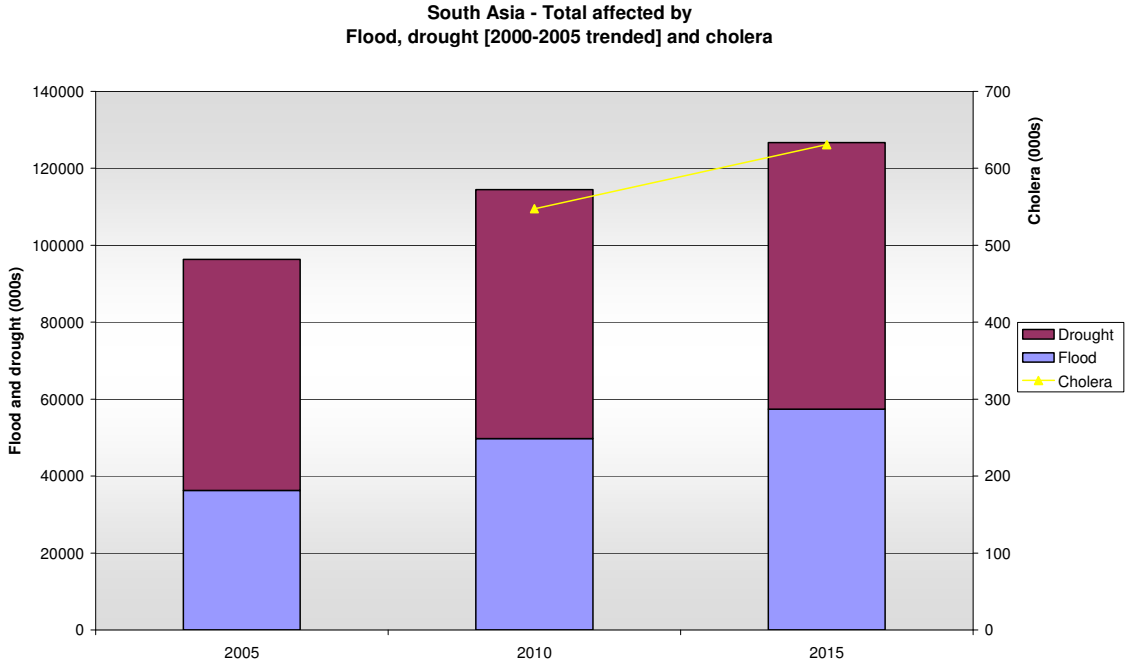
Figure 31: South Asia – Total Affected by Flood, Drought (20yr trended) and Cholera 2005-2015



Various sources

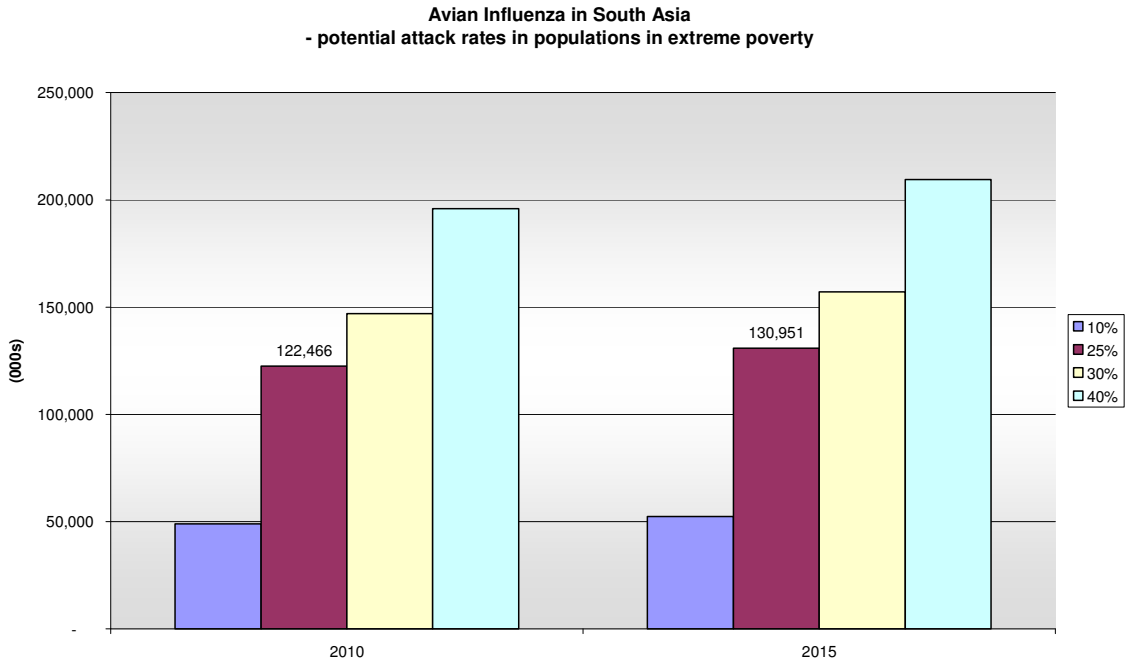
[107] Global Health Impacts of Floods: Epidemiologic Evidence, *Epidemiological Reviews.* Mike Ahern, R. Sari Kovats, Paul Wilkinson, Roger Few and Franziska Matthies

Figure 32: South Asia – Total Affected by Flood, Drought (2000-2005 trended) and Cholera 2005-2015



Various sources

Figure 33: South Asia – Avian Influenza – Potential Attack Rates in Population in Extreme Poverty 2010-2015



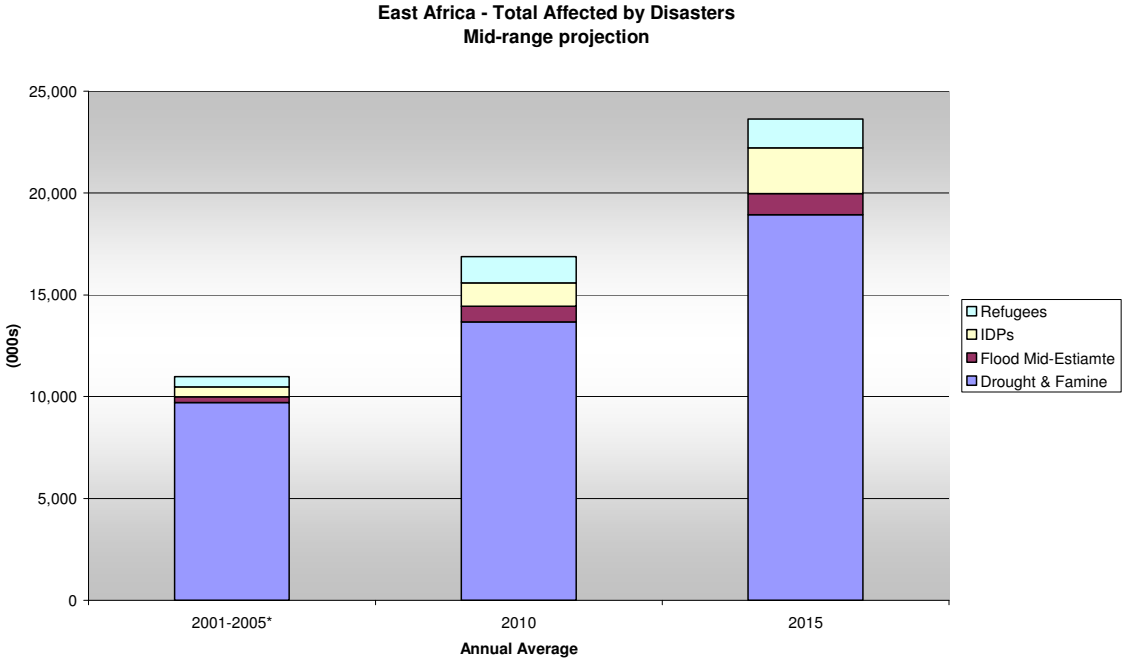
Source: WHO Epidemic and Pandemic Alert and Response

East Africa Regional Perspective

Projected numbers of crisis-affected, East Africa

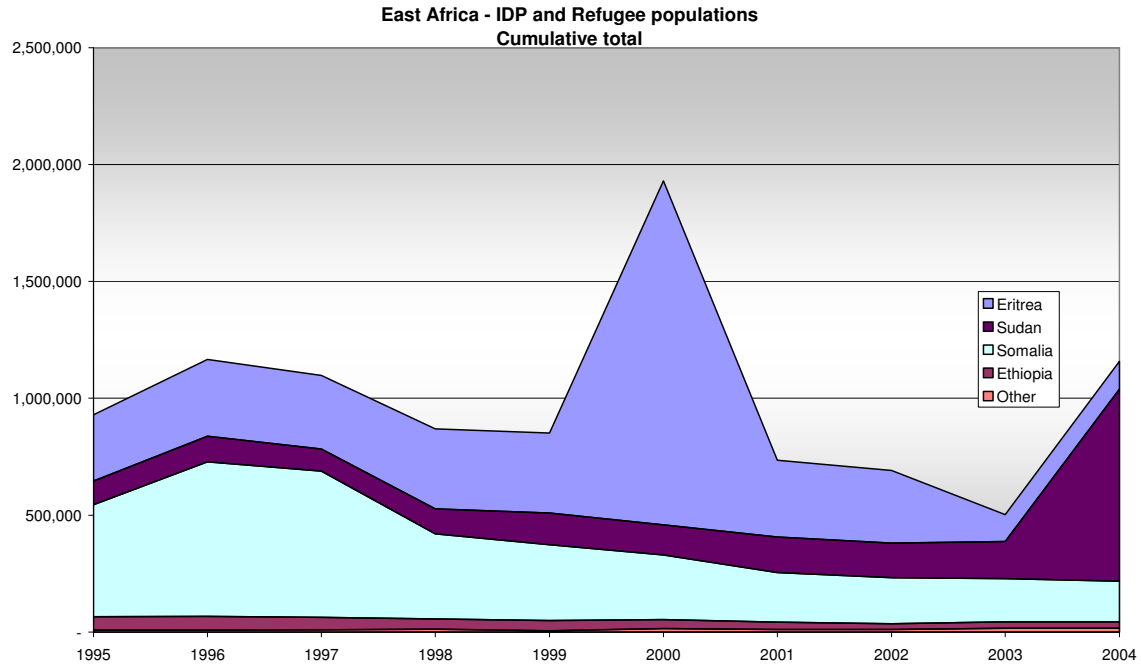
	2001-05	2010			2015		
(000s)		**Low**	**Mid**	**High**	**Low**	**Mid**	**High**
Drought (1)	9,718	7,666	12,273	15,773	8,568	17,367	24,769
Flood	274	591	763	772	660	1,039	1,214
Refugees	499	1,169	1,299	1,428	1,133	1,416	1,699
IDPs	491	1,027	1,141	1,256	2,014	2,237	2,461
Total (excl. major famine)	**10,981**	**10,453**	**15,476**	**19,228**	**12,374**	**22,059**	**30,144**
Major drought-induced famine (2)	n/a	27,072	30,081	33,089	28,142	33,108	38,074
Total (incl. Drought/famine (2), excl Drought (1))	**10,981**	**29,859**	**33,283**	**36,544**	**31,948**	**37,800**	**43,449**

Figure 34: Overall Numbers of Crisis Affected in Ethiopia, Eritrea, Kenya, Somalia and the Sudan 2010-2015



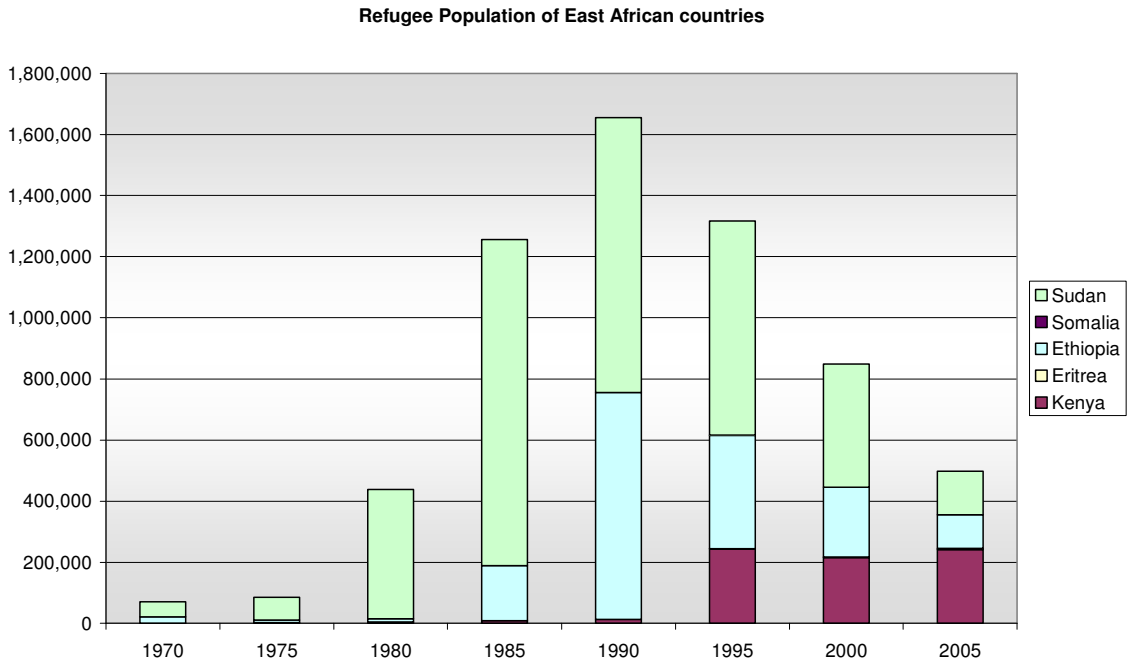
**2001-05: Annual average from 2001 to 2005 inclusive*

Figure 35: East Africa – IDP and Refugee Populations, Cumulative Total 1995-2004



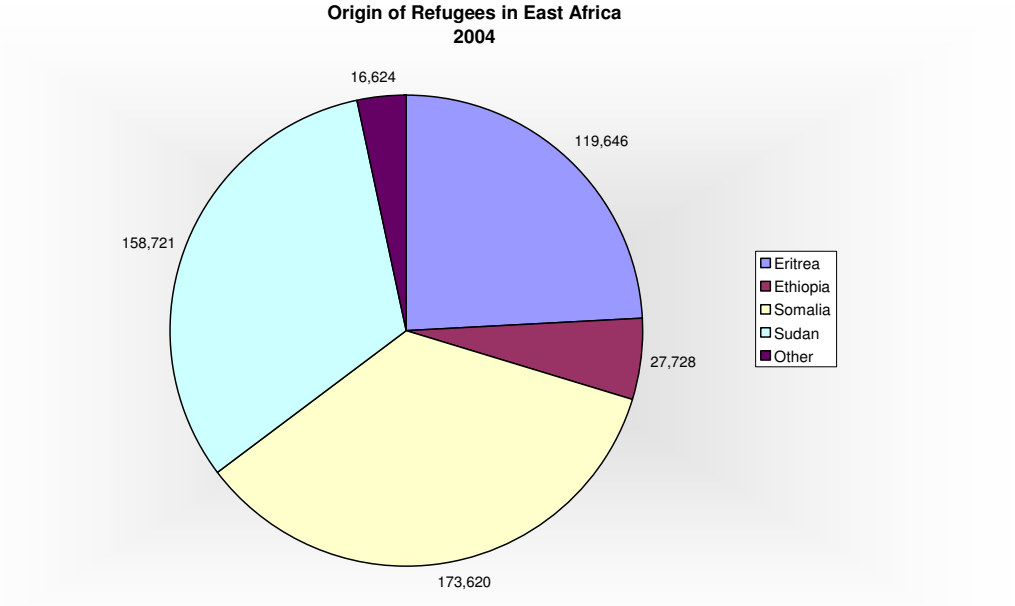
UNHCR 2004 report; UNHCR Provisional 2005 data

Figure 36: East Africa – Refugee Population 1970-2005



UNHCR 2004 report; UNHCR Provisional 2005 data

Figure 37: East Africa – Origin of Refugees 2004



UNHCR 2004 report; UNHCR Provisional 2005 data

Figure 38: East Africa – Regional Analysis of Numbers Affected by Flood 1971-2015

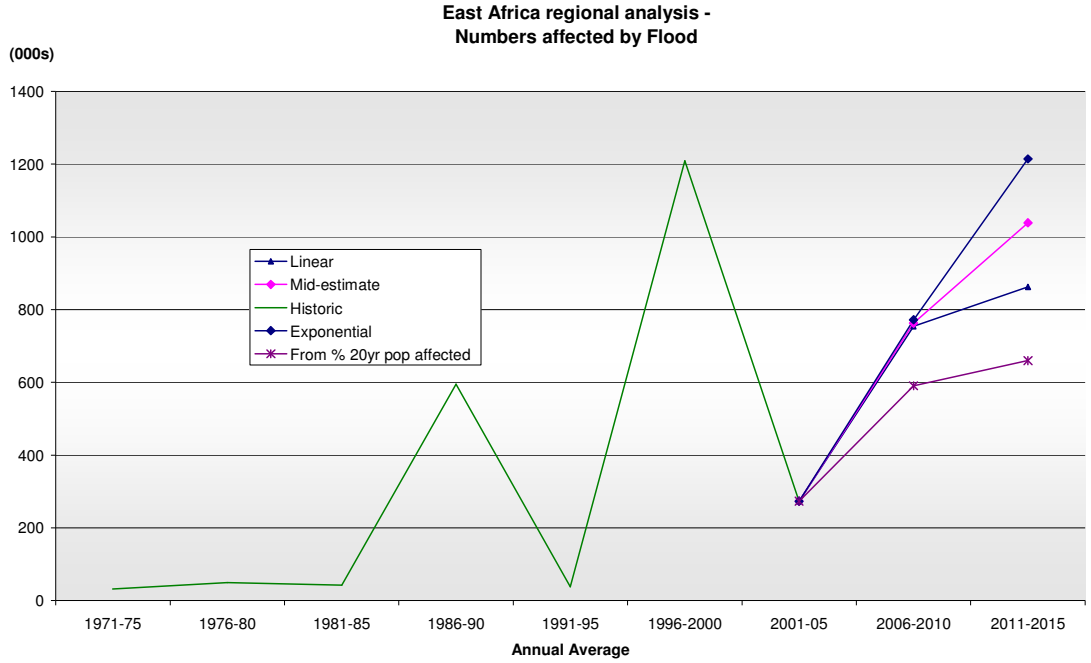


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Figure 39: East Africa – Total Affected by Flood 2000-2005

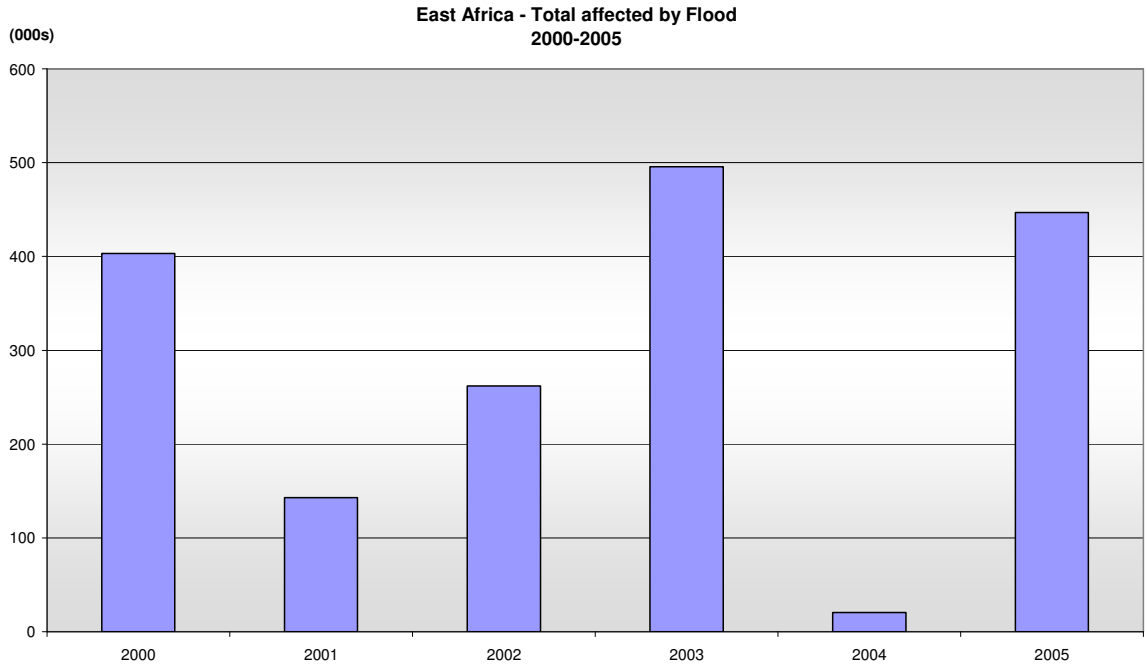

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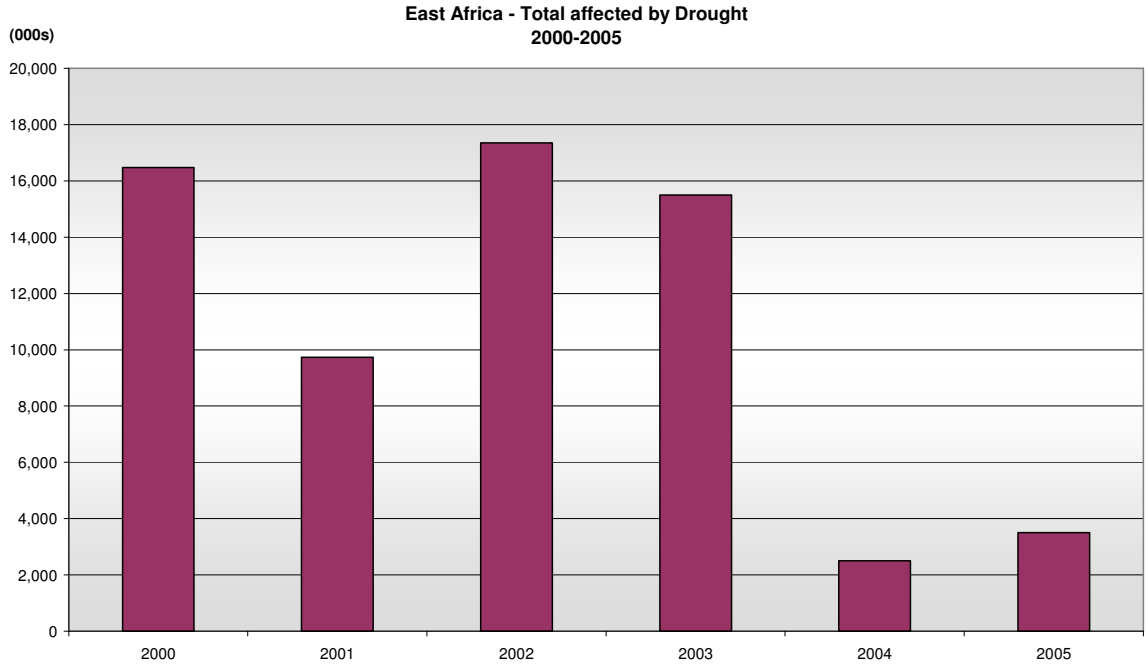
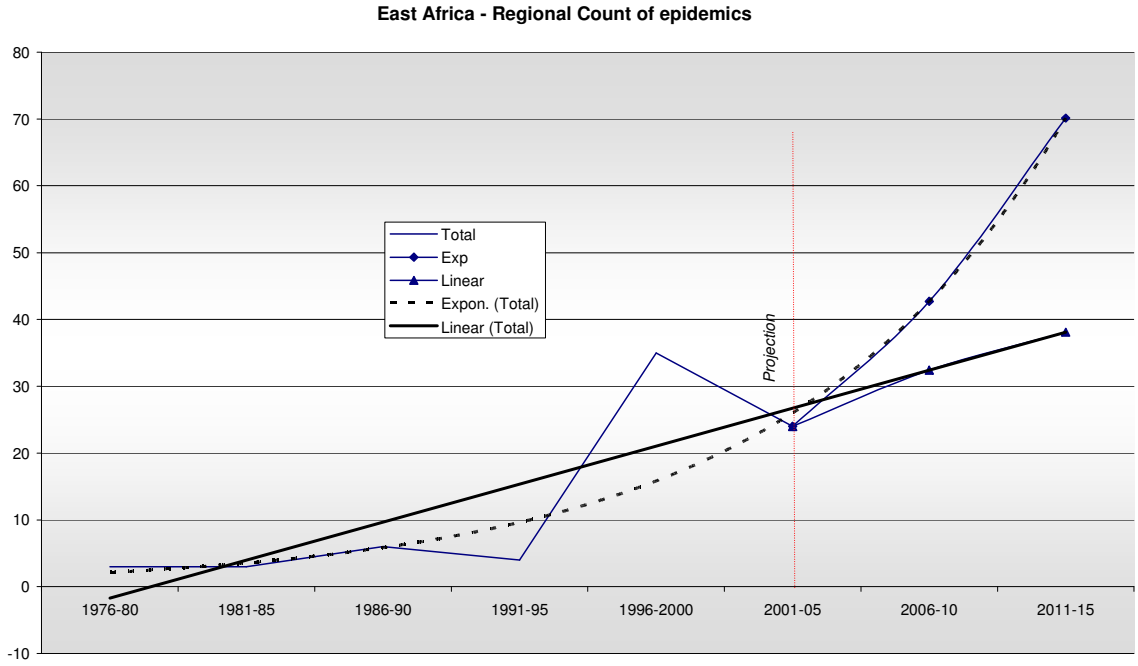
Figure 40: East Africa – Total Affected by Drought 2000-2005



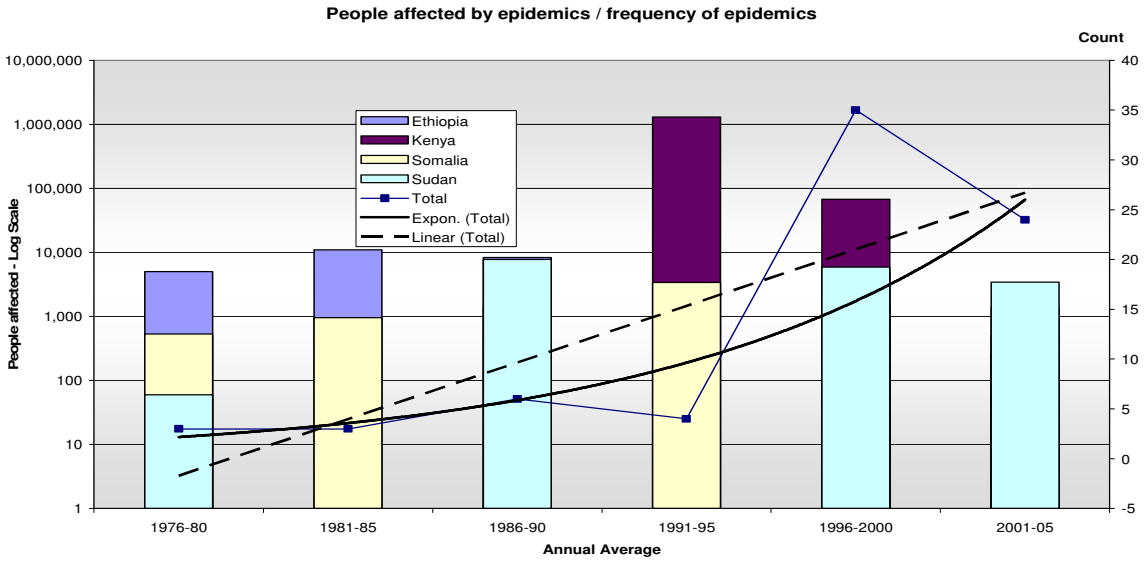
EM-DAT

Figure 41: East Africa - Regional Count of Epidemics 1976-2015



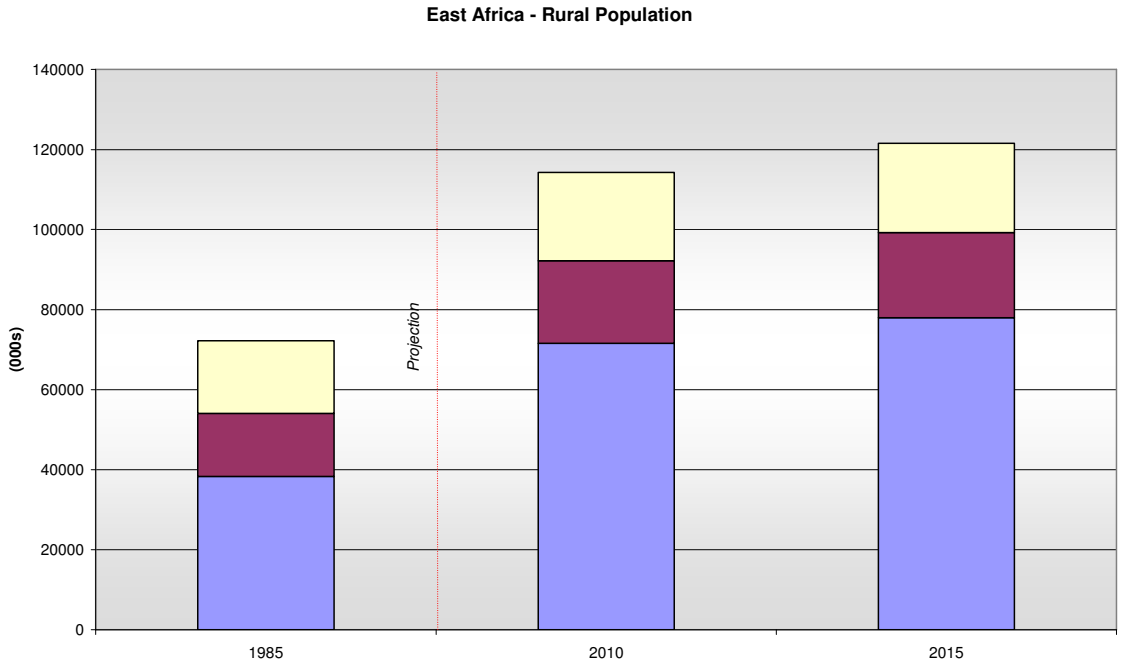
EM-DAT

Figure 42: East Africa – Numbers Affected by Epidemics/Frequency of Epidemics 1976-2005



EM-DAT

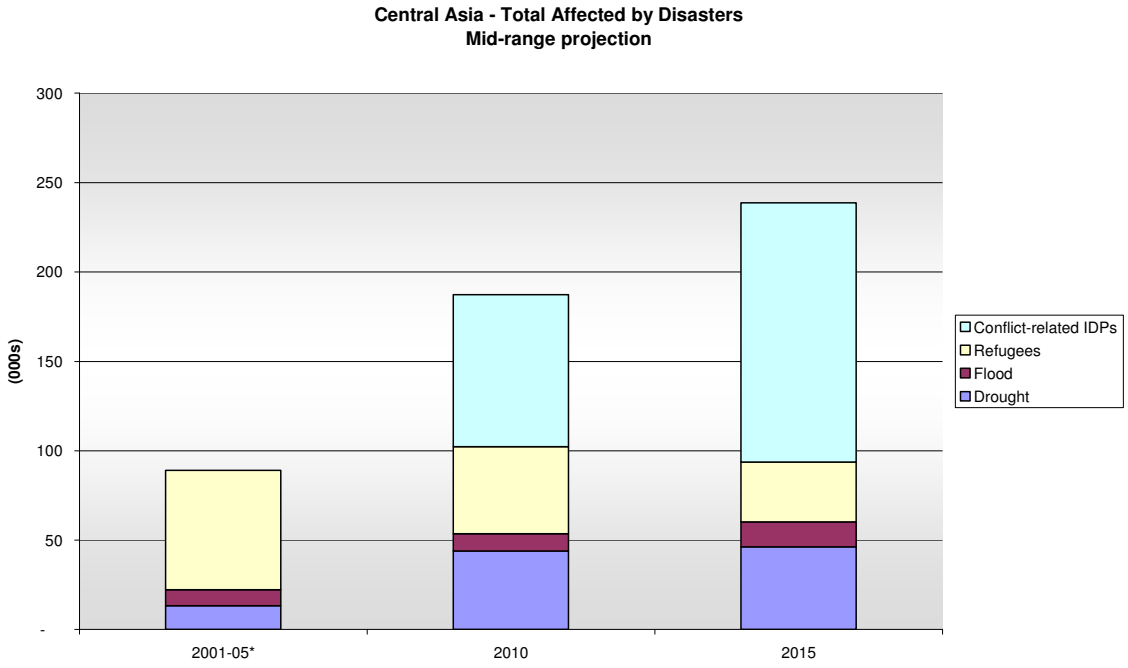
Figure 43: East Africa – Rural Population 1985-2015



Central Asia Regional Perspective

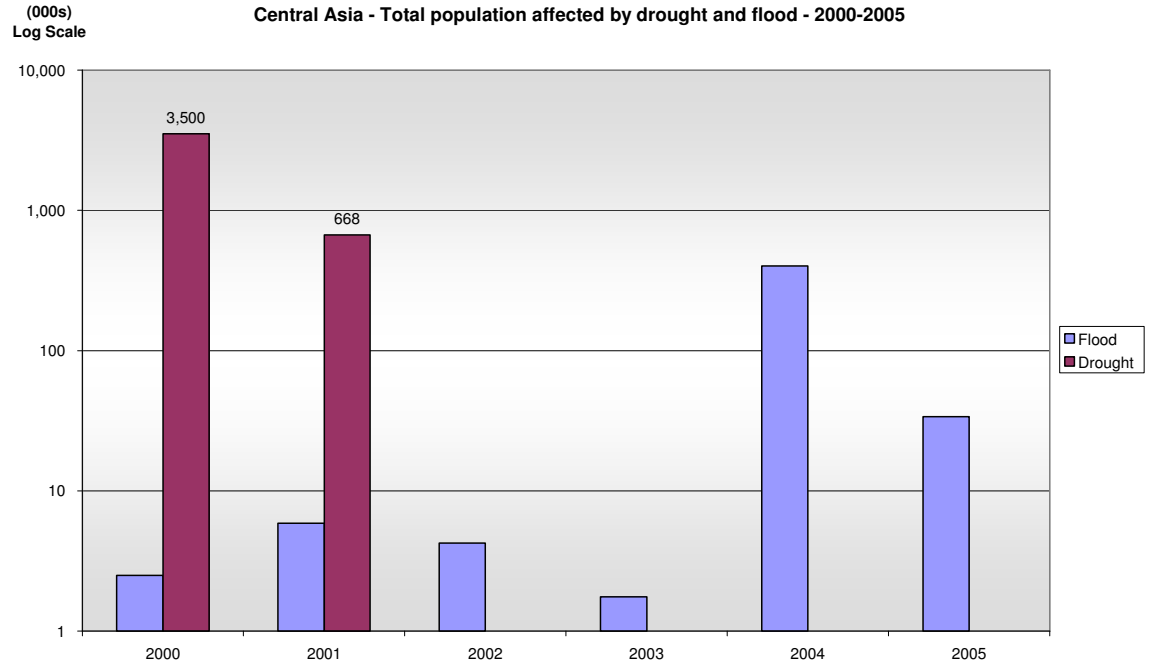
	2001-05	2010			2015		
(000s)		Low	Mid	High	Low	Mid	High
Drought	13	39	44	48	37	46	56
Flood	9	6	10	14	6	14	22
Refugees	67	44	49	53	27	33	40
Conflict-related IDPs	n/a	77	85	94	116	145	174
Total (excl. Radiation & industrial)	**89**	**166**	**187**	**209**	**186**	**239**	**291**
Radiation & industrial-related hazards	n/a	203	469	2,519	368	472	2,696
Total (incl. Radiation and industrial)	**89**	**369**	**657**	**2,727**	**554**	**711**	**2,987**

Figure 44: Overall Numbers of Crisis Affected in Kazakhstan, Krygyzstan, Tajikistan, Turkmenistan, Uzbekistan 2010-2015



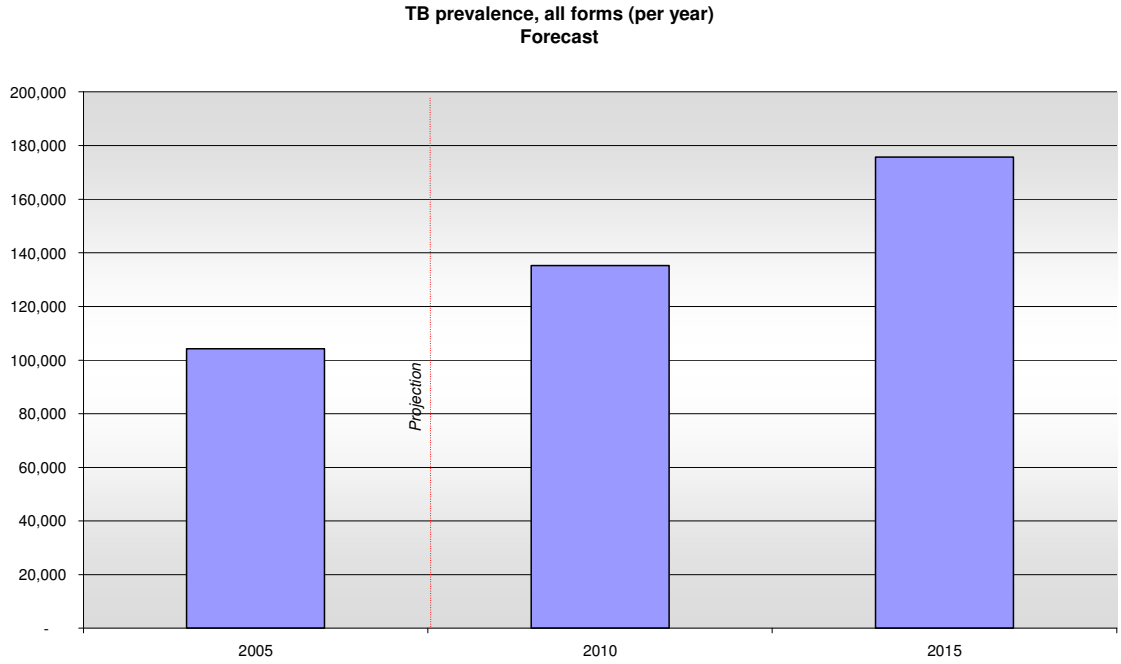
**2001-05: Annual average from 2001 to 2005 inclusive*

Figure 45: Central Asia – Total Population Affected by Drought and Flood 2000-2005



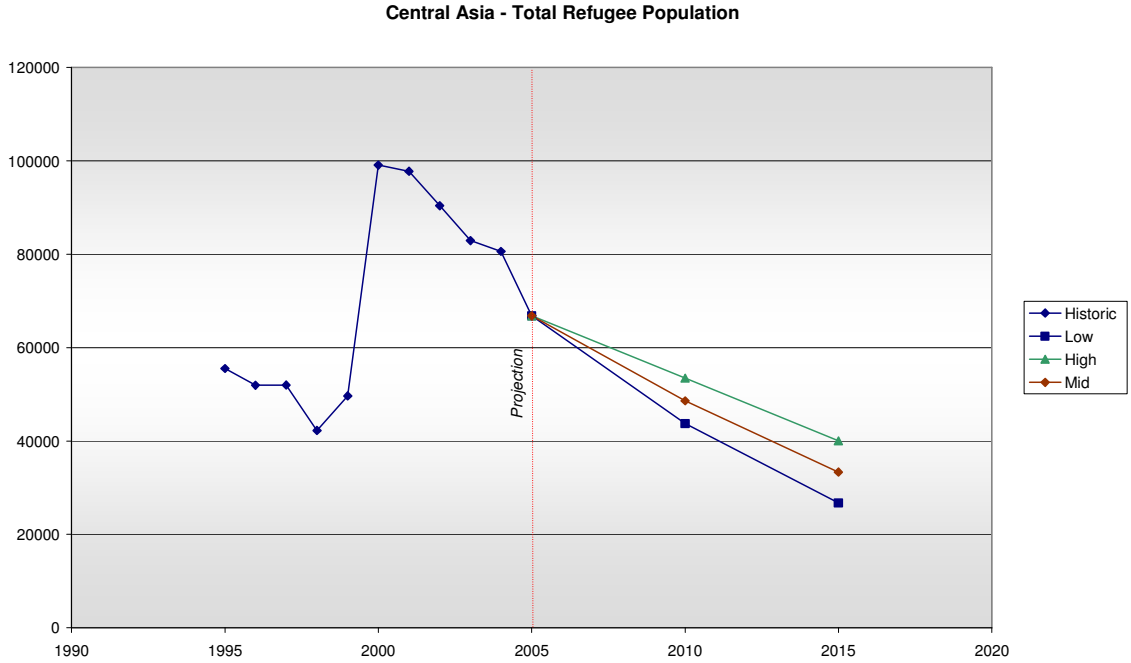
EM-DAT

Figure 46: Central Asia – Tuberculosis Prevalence (all forms) per Year 2005-2015



WHO Report 2005

Figure 47: Central Asia – Total Refugee Population 1990-2015

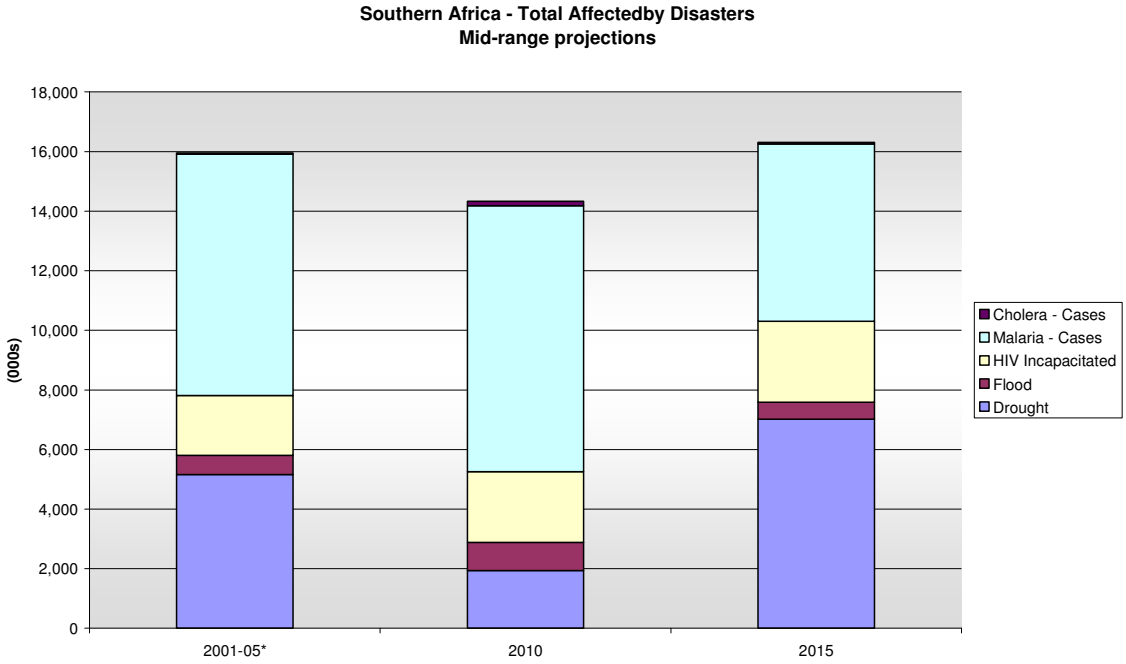


UNHCR Report 2004, UNHCR Report 2005 Provisional Data

Southern Africa Regional Perspective

	2001-05	2010			2015		
(000s)		**Low**	**Mid**	**High**	**Low**	**Mid**	**High**
Drought	5,159	784	1,938	3,091	3,237	7,018	10,798
Flood	642	408	949	1,489	428	567	706
HIV Incapacitated	2,013	1,879	2,370	2,831	2,172	2,726	3,245
Malaria - Cases	8,087	7,652	8,927	13,174	4,491	5,941	7,392
Cholera - Cases	52	49	150	250	13	54	96
Total	**15,954**	**10,773**	**14,333**	**20,835**	**10,340**	**16,306**	**22,236**

Figure 48: Overall Numbers of Crisis Affected in Malawi, Mozambique, South Africa, Zambia and Zimbabwe 2010-2015



**2001-05: Annual average from 2001 to 2005 inclusive*

Figure 49: Southern Africa – Regional Urbanization 1985-2015

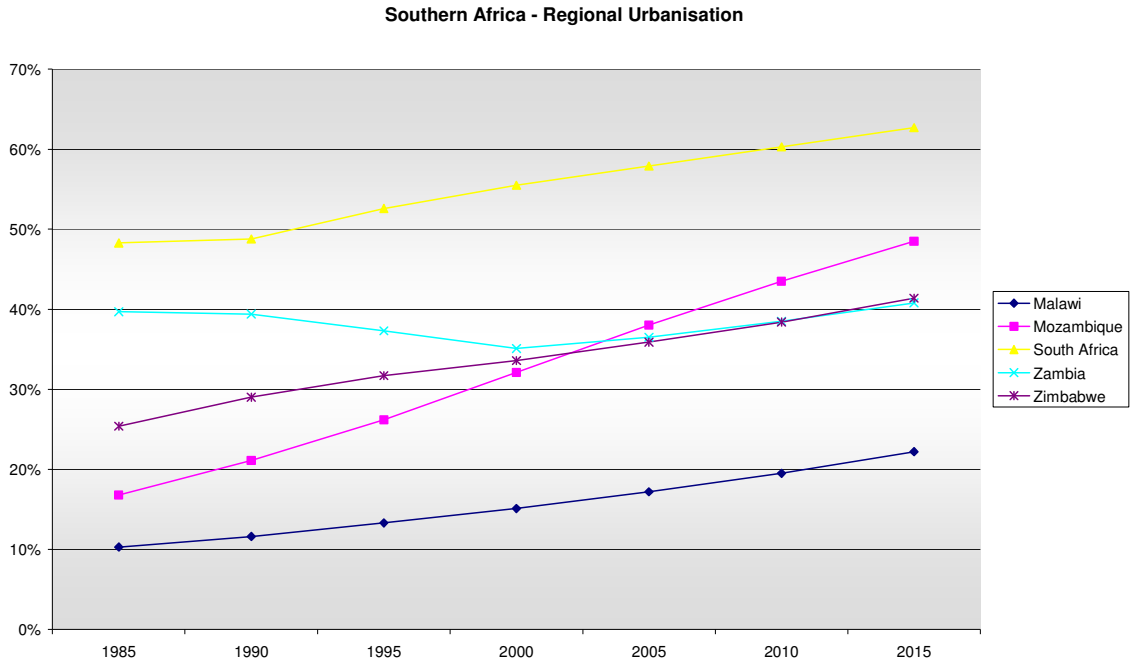
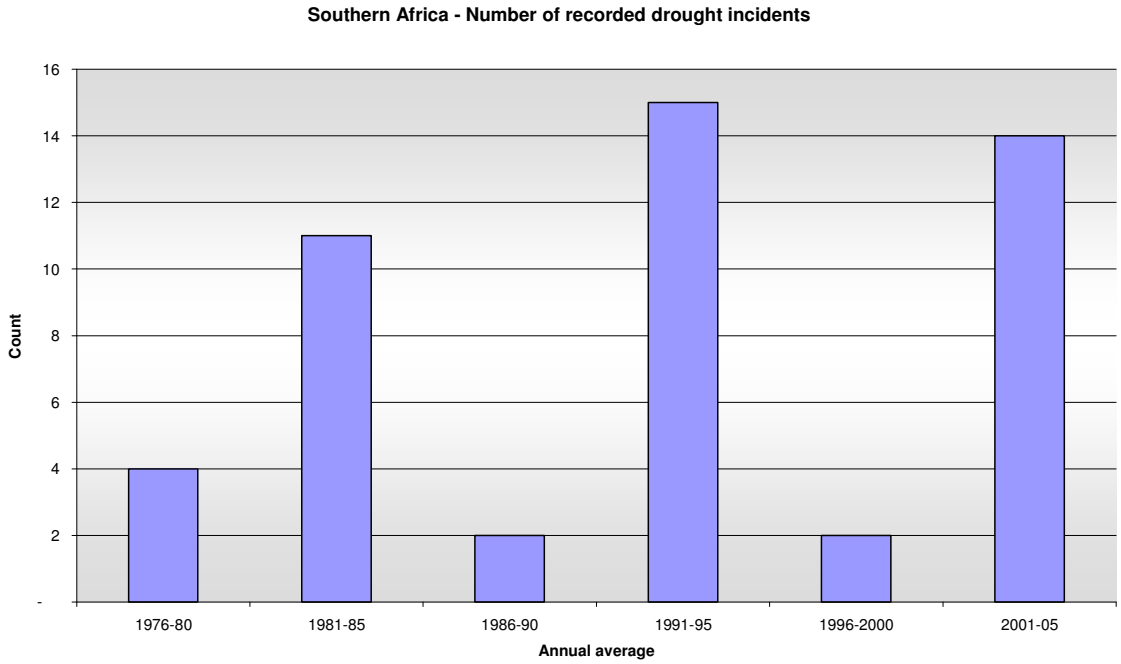
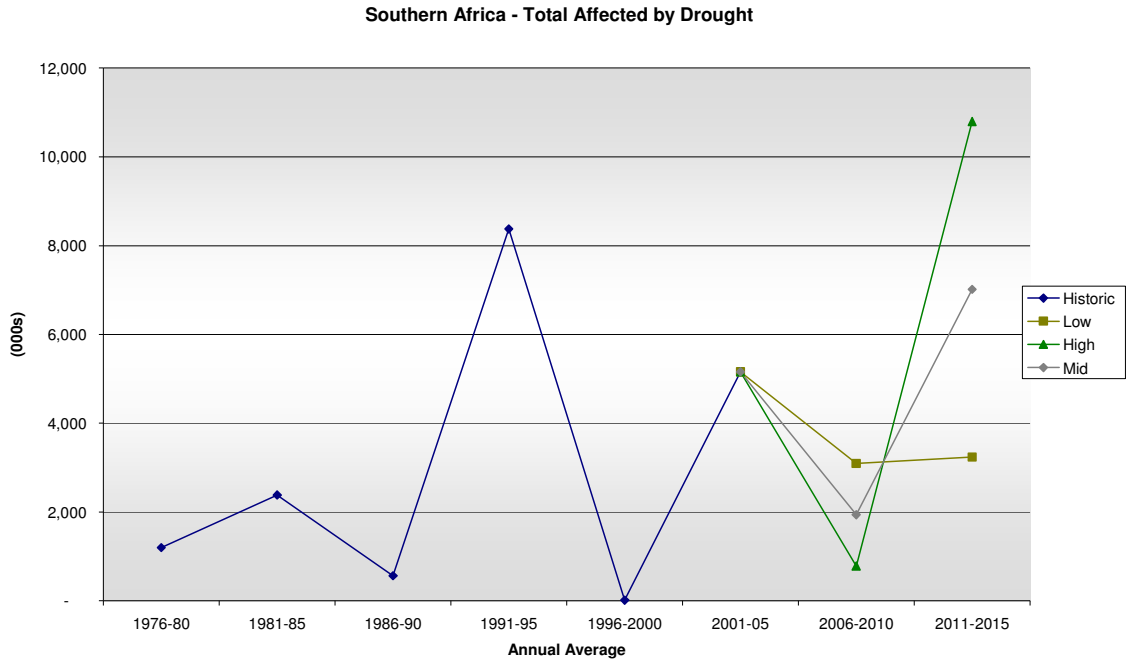


Figure 50: Southern Africa – Number of Recorded Drought Incidents 1976-2005



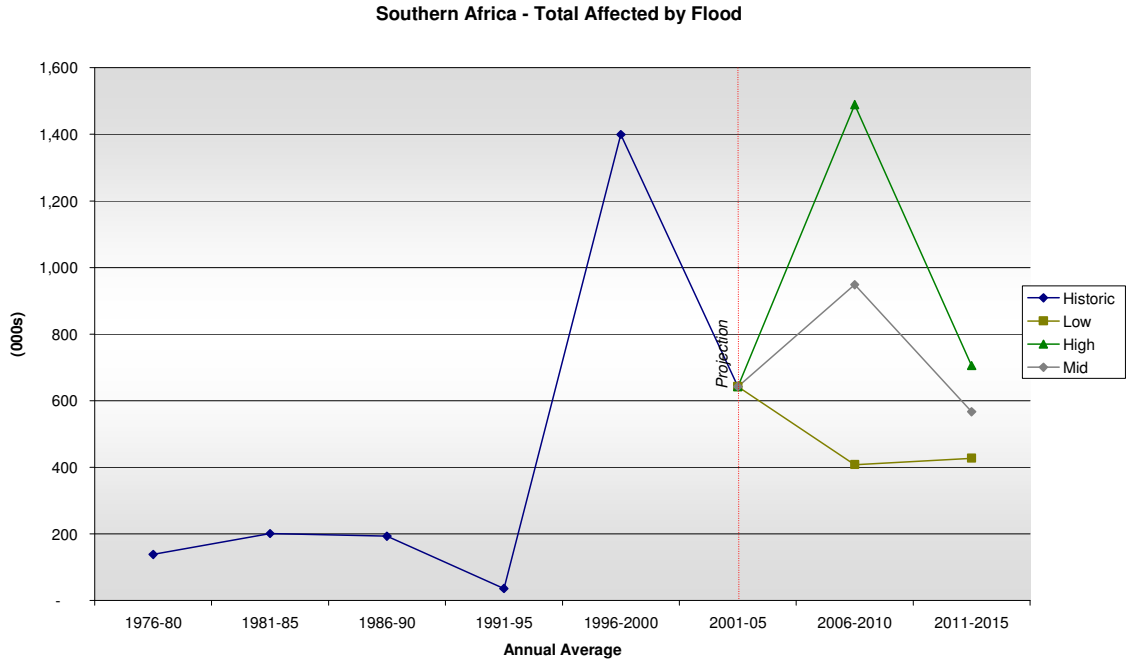
Source: EM-DAT

Figure 51: Southern Africa – Total Affected by Drought 1976-2015



Source: EM-DAT

Figure 52: Southern Africa - Total Affected by Flood 1976-2015



Source: EM-DAT

Figure 53: Southern Africa – Land Degradation as Percentage of Total

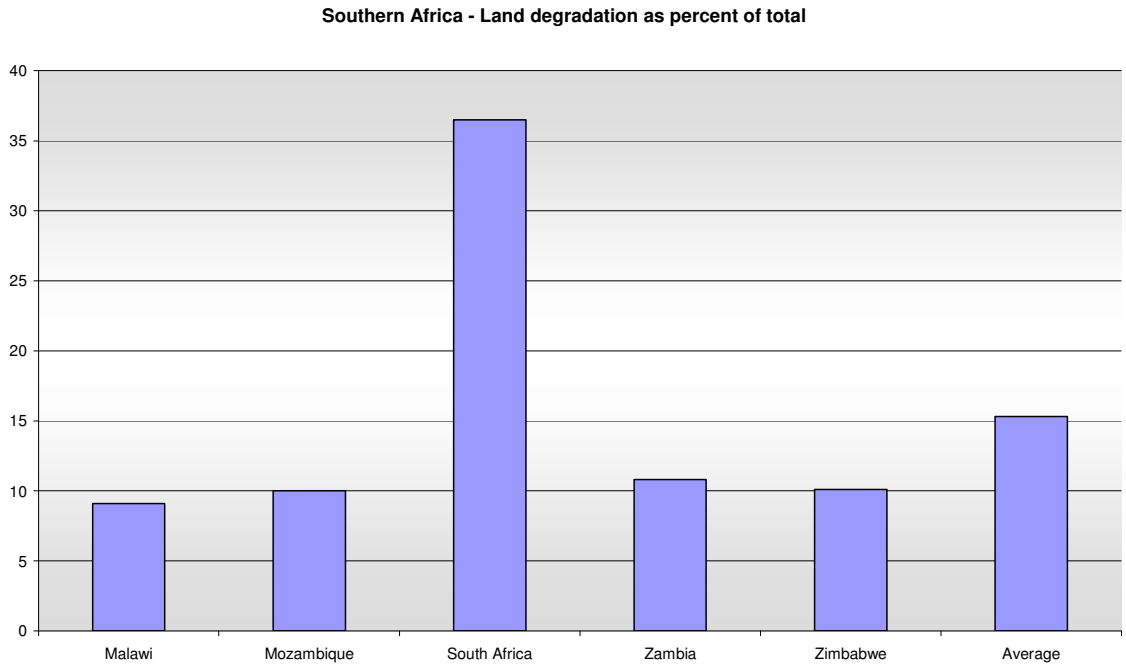
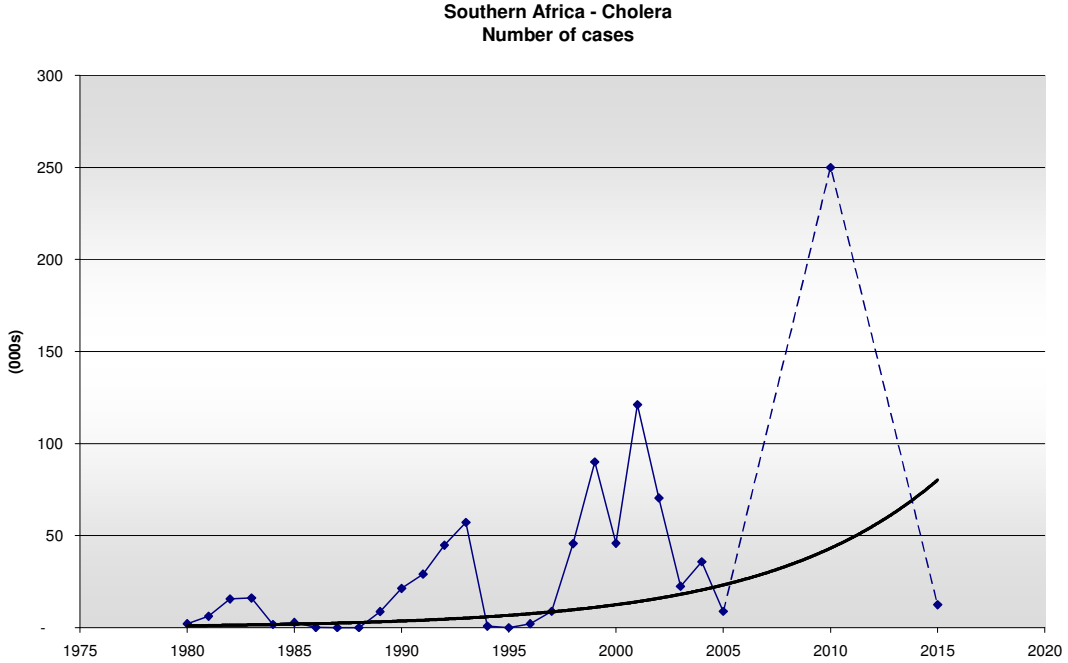


Figure 54: Southern Africa – Number of Cholera Cases 1975-2015



Source: WHO 2005

Figure 55 Southern Africa – Number of Annual Reported Cases of Malaria 1988-2006

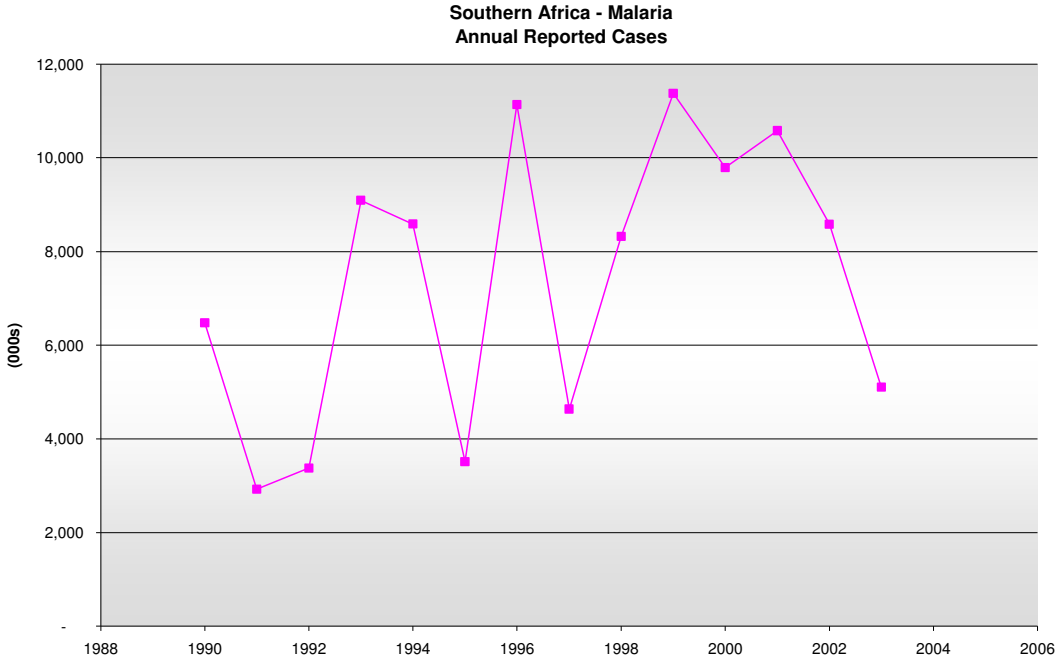


Figure 56: Southern Africa – Projected Cases of Malaria 2010-2015