SUMMARY

Food riots in Mexico City, environmental outrage from Osama bin Laden and Russian territorial claims in the Arctic: the past year has seen climate change emerge as a serious issue across the security agenda, from the abstraction of discussions in the UN Security Council to the brutal reality of drought-driven conflict in Africa. These are just the first signs of how climate change – and our responses to it – will fundamentally change the strategic security context in the coming decades.

Conflict over natural resources, whether driven by need or greed, has always been a part of human society. The past shows us that social tensions driven by past climatic change destroyed many advanced societies, such as the droughts which drove the collapse of early civilisations in Mesopotamia and Peru. The coming decades will see rising resource scarcity, greater environmental degradation and increasingly disruptive climatic change at levels never experienced before in human history. In an increasingly uncertain world these trends are disturbingly predictable.

Climate change is already creating hard security threats, but it has no hard security solutions. Climate change is like a ticking clock: every increase in greenhouse gases in the atmosphere permanently alters the climate, and we can never move the hands back to reclaim the past. Even if we stopped emitting pollution tomorrow, the world is already committed to levels of climate change unseen for hundreds of thousands of years. If we fail to stop polluting, we will be committed to catastrophic and irreversible changes over the next century, which will directly displace hundreds of millions of people and critically undermine the livelihoods of billions. There is some scientific uncertainty over these impacts, but it is over when they will occur not if they will occur – unless climate change is slowed. Preventing catastrophic and runaway climate change will require a global mobilisation of effort and co-operation seldom seen in peacetime.

In the next decades, climate change will drive as significant a change in the strategic security environment as the end of the Cold War. If uncontrolled, climate change will have security implications of similar magnitude to the World Wars, but which will last for centuries. The past will provide no guide to this coming future; a robust response will require clear assessments based on the best scientific projections.

Despite these threats, current responses to climate change are slow and inadequate. Even Europe, which leads global efforts to move to a low-carbon economy, is only spending the equivalent of around 0.5 per cent of its combined defence budget on tackling climate change, though this does not count the action achieved through direct regulation. There is a need for more direct and interventionist action to prevent climate risks. One reason for this is that economic analysis has systematically undervalued the potential extreme impacts of climate change, underplaying the implication of the most severe risks to policy makers. But a failure to acknowledge and prepare for the worst case scenario is as dangerous in the case of climate change as it is for managing the risks of terrorism or nuclear weapons proliferation.

Security sector actors must not just prepare to respond to the security challenges of climate change; they must also be part of the solution. Partly, this means reducing the climate impact of their operations and activities. Much more importantly, it means communicating the security implications and costs of uncontrolled and extreme climate change to political leaders and the public. Unless achieving climate security is seen as a vital and existential national interest, it will be too easy to delay action on the basis of avoiding immediate costs and perceived threats to economic competitiveness.

But climate change is also a security opportunity. A low-carbon global economy will be a far more energy-secure economy. Trillions of dollars otherwise invested in oil and gas production increasingly concentrated in unstable regions, will instead deliver new technology and local clean energy sources. This will lower geo-political tensions over fossil fuel reserves, and greatly reduce the security impact of 'peak oil' when it arrives.

The security sector has the vital – and expensively acquired – experience of how government can drive technological development

and infrastructure deployment at a similar scale to that needed to respond to climate change. Security actors should promote dramatically increased investment in the development and deployment of technologies critical for energy and climate security. This will be expensive, but is achievable. Recent estimates suggest this would require investment commensurate with current spending on the War on Terror, and if a crash response is needed in response to extreme climate change, investment at levels similar to the Apollo programme.

The reality of climate change will require fundamental changes in how international relations are conducted, and will alter much of the focus of international security policy. It will change strategic interests, alliances, borders, threats, economic relationships, comparative advantages and the nature of international co-operation, and will help determine the continued legitimacy of the UN in the eyes of much of the world. Climate change geo-politics will extend far outside the environmental sphere, and will link old problems in new ways. Managing the complexity of our collective climate security will become an ever more important part of foreign policy.

Climate change will require OECD countries to revisit their international industrial policies by sharing advanced energy technologies and funding large-scale investment in economic competitors such as China and India. OECD countries must recognise that achieving climate security is a more vital national interest than the narrow maximisation of domestic company profits.

Energy security interests will be increasingly delivered through co-operation with energy consuming countries on technology development and diffusion, rather than through relationships with producing countries on fossil fuel discoveries and delivery. Declining use of imported fossil fuels may cause tensions with many producer countries. Countries will not be able to achieve national energy security by undermining other countries' climate security by using coal without capturing the carbon. There will be no agreement on climate security without guaranteeing all countries' energy security.

Nuclear proliferation mechanisms will need to be greatly strengthened if nuclear power is to be deployed at a scale which would make a real difference to climate change. Climate change will be used as a political mask for some states to acquire nuclear technology for military purposes, and development and sharing of more benign energy alternatives is the best protection against this. A major climate change disaster in the next decade would also drive pressure for a 'crash programme' of rapid deployment of nuclear power worldwide; at rates which would compromise the ability of the current nuclear industry supply chain to preserve safety or security.

Rising sea levels and melting ice caps in the Arctic are already leading to territorial disputes between major powers. The disappearance of small islands could release valuable marine resources into the already contested waters of the Indian Ocean, Pacific and South China Sea. The rights of environmental refugees and migrants will become a source of national and international tensions, especially in delta regions such as Bangladesh, Nigeria and Egypt. Fisheries stocks will collapse or move, destroying millions of people's livelihoods and undermining delicately negotiated international management regimes. The EU Common Fisheries Policy will not survive in its present form.

Countries will respond to the forecasts of more erratic water flows in all major river basins by building new upstream dams and water storage. Such 'climate change adaptation' will drive cross-border tensions in the next decade, including the potential for armed inter-state conflict. Strengthened international rules and more activist preventative diplomacy from the international community will be needed to peacefully manage changes in shared water and fisheries resources, and to preserve the rights of displaced people and states.

Issues of justice and ethics lie at the heart of climate change; the rich have caused the problem but the poor are bearing the brunt of the impact. Global resentment against the current international order will rise if there is a failure to agree and deliver aggressive emission reduction goals, or adequately help the victims of climate change adapt and obtain compensation. Radical protest movements are building around the globe, and direct action against new airports and power stations is growing. Violent extremists will use these tensions to fuel existing causes and Osama bin Laden has spoken several times on the inequities of climate change: Muslim countries will be among the hardest hit by climate change. If frustrated by inaction to slow climate change, radical environmental movements may spawn eco-terrorist groups in a parallel with the evolution of extreme left-wing movements in the 1970s. Failure to act effectively will undermine the legitimacy of the international system, reducing its effectiveness in tackling other security threats.

In general, climate change could drive a more collaborative approach in inter-state relations or it could exacerbate tensions between and within countries, leading to a 'politics of insecurity' as countries focus on protecting themselves against the impact. The pattern of co-operation which arises will depend on how effectively climate change is incorporated into mainstream foreign policy, and is perceived as changing the balance of national interests in major countries across a wide range of security and geo-political issues.

Climate change is already increasing conflict risks in unstable regions – especially Africa – as fragile governance systems are overwhelmed by the social stresses released by drought, famine, flood, migration, extreme weather events and rising sea levels. At moderate levels of change, conflict is preventable and conflict causality is complex as climate change acts as a stress multiplier of existing tensions. But the growing information on present and future serious climate security impacts is as good, if not better, than other information routinely used in security planning and assessment. If climate change is not slowed and critical environmental thresholds are exceeded, then it will become a primary driver of conflicts between and within states.

Over the next decades, the determinant of whether climate change drives serious conflict lies in how political systems respond to the tensions it creates. Too often, analysis of climate change impacts assumes that all governments will act to maximise the common good in response to change. But resource management regimes in much of the world are already built upon communal divisions and conflict, and are highly unlikely to respond in a predictable, rational and inclusive manner to climate stresses. Experience of current instability in the Sahel – especially Darfur – shows how quickly disputes over access to resources in times of environmental stress can become politicised and exacerbate existing communal conflicts based on ethnic, religious or other lines. These conflicts develop their own internal dynamics, but will see no sustainable solutions unless the root causes of resource grievances are addressed.

Achieving security in a climate-stressed world will require a more pro-active and intensive approach to tackling instability in strategically important regions with high climate vulnerability and weak governance. This will require changes across the security sector, with a stronger incorporation of long-term and structural risk factors into planning and a willingness to engage effectively with tough governance challenges; bringing diplomatic, development, intelligence and law enforcement capabilities to bear. This does not just require implementation of some general 'conflict prevention' agenda, but direct focus on the strategic necessity of managing increased resource use tensions. There will be no long-term stability in Afghanistan unless rural livelihoods and water management are robust to climate change. Attempts to build a 'hearts and minds' coalition against Islamist extremism will be crucially undermined when many of the main sources of job creation for young men in North Africa are being undermined by warmer temperatures and declining rainfall.

The impact of climate change on instability will also require changes to how climate adaptation is handled in the international climate change regime. To date climate adaptation has mainly been framed as a technical development activity, but in reality it will involve complex political and diplomatic interventions in difficult and highly charged internal resource management issues. The political economy of resource management must lie at the heart of all adaptation measures as they deal with the resources of subsistence and identity: land, water and security. More controversially, access to international adaptation finance may need to be made conditional on countries implementing reforms to internal resource management policies to improve social resilience and prevent conflict and marginalisation of vulnerable groups.

All these impacts are already occurring as the earth gradually warms in the early stages of climate change. If climate change is not controlled before we meet critical 'tipping points' in natural systems the impact will become catastrophic, with large parts of the world becoming uninhabitable for their current populations by the middle of the century. Such an outcome would overwhelm current security and humanitarian capacity to respond, and would make a mockery of the international community's commitments to a 'Responsibility to Protect' and the achievement of the Millennium Development Goals.

The world has the financial resources and technological potential to deliver a secure and low-carbon economy. The question is whether we are capable of making the political choices to mobilise these resources in pursuit of our collective climate security. Security issues are fundamental for making the political case for urgent action. Security sector reform will be central to managing the consequences of

the changes we are already undergoing. Security actors have a strong interest in ensuring a bold and rapid transformation to a secure and low-carbon economy, as this will also reduce tensions over access to dwindling fossil fuel reserves.

The changing security context driven by climate change requires an imaginative and forthright response from security actors if we are to preserve our vital interests and values in this century. The first signs of this response are emerging, but the necessary changes will need to happen much faster than in the past if they are to match the remorseless ecological timetable of a changing climate driven by a dynamic global economy.

I. INTRODUCTION

> By tackling climate change we can help address the underlying securities that feed and exacerbate conflicts and instability. By ignoring it we resign ourselves to the same crises flaring up again and again, and new ones emerging. So climate change is not an alternative security agenda. It is a broadening and deepening of our understanding as to how we best tackle that existing agenda.

Rt Hon Margaret Beckett, UK Foreign Secretary, 2007

Climate Security Hits the Mainstream

Climate change will be one of the critical forces shaping the coming century. Along with globalisation, population growth and technological change, it will fundamentally alter the way we live, the risks we face and how we interact in an increasingly interdependent world. Many of these changes will be unpredictable, but what is clear is that they will extend far outside what has been traditionally seen as the environmental arena to impact fundamental issues of prosperity, security and interests for all countries.

Looking back, 2007 will be seen as the year when the security implications of climate change started to be taken seriously. Many people were surprised when the UK put forward energy and climate security for debate at the UN Security Council in April 2007. But against most expert predictions, it was a successful event, and one of the best attended debates of its type by non-Security Council members. There was strong support for the substantive links between climate change and security, and many powerful testimonies from poorer countries on the current security impact of a changing climate. However, this was coupled with some procedural resistance from countries like China and India who are traditionally resistant to expanding the Security Council's remit.[1]

The UK has played a key – if often controversial – role in the climate security debate. The much repeated statement from Sir David King – then UK Chief Science Adviser – that climate change was a greater threat than terrorism provoked fierce reactions at the time. Margaret Beckett when Foreign Secretary[2] and Jock Stirrup as Chief of the Defence Staff[3] were the first security leaders from a major country to make the strong case for incorporating climate change into mainstream security and diplomatic planning.

As often happens, what appears radical at first then quickly becomes seen as the norm. A plethora of reports have followed building on these issues; ranging from a blue-ribbon panel of retired US military leaders[4] to the chief advisory body on environmental change to the German government.[5] Internal assessments of climate change as a security risk are known to have been carried out in the US, UK, Germany, France and Australia. Other countries – including India and China – are rumoured to have undertaken similar work but have yet to publicly confirm this.

These one-off and ad hoc efforts are beginning to become institutionalised. The UK Ministry of Defence has highlighted climate change in its most recent regular survey of future security trends.[6] The US Congress has commissioned a National Intelligence Assessment on the national security impact of climate change, due to be delivered in

---

1 UN Security Council *SC/9000*, 5663 meeting (AM and PM), 17 April 2007.

2 Margaret Beckett, 'Foreign Policy and Climate Security', speech given at UK Embassy in Berlin, 24 October 2006.

3 Speech given at 'Climate Change: Politics versus Economics', Chatham House, 25–26 June 2007 <http://www.chathamhouse.org.uk/events/conferences/proceedings/climatechange/>.

4 Centre for Naval Analysis, 'National Security and the Threat of Climate Change' (Virginia, 2007) <http://securityandclimate.cna.org/report/>.

5 WGBU, 'World in Transition – Climate Change as a Security Risk' (Berlin, 2007) <http://www.wbgu.de/wbgu_jg2007_engl.html>.

6 DCDC, 'Global Strategic Trends 2007–2037' (London: MoD, 2007) <http://www.dcdc-strategictrends.org.uk/viewdoc.aspx?doc=1>.

early-2008;[7] a similar analysis for the European Union is being prepared for the European Council in March 2008[8]. The draft climate bill approved by the Senate Energy Committee in November 2007 includes a provision for regular updated assessments of the security impact of climate change, backed by significant additional funding raised from the carbon markets to address security concerns overseas.[9]

But perhaps the key event which drove climate change rapidly into the consciousness of the security sector was the sight of a Russian expeditionary mission planting a titanium flag at the bottom of the Arctic Ocean, in order to lay claim to potentially vast oil and mineral deposits. The rapid retreat of permanent Arctic sea ice has opened up a nineteenth century style series of border and mineral disputes: between Canada and the US over the legal status of the Northwest passage; between Greenland and Denmark over independence; and between all Arctic nations over mineral access rights. None of these disputes would have happened unless each nation believed that Arctic sea ice will rapidly retreat in the coming decades, in line with the predictions of climate change models. Governments which in climate change negotiations have been sceptical about the pace of climate change, have shown themselves true believers in the science when faced with the prospect of large economic benefits.

Developing a Strategic Security Response to Climate Change

We are just at the beginning of the age of climate change, and even with the toughest efforts to address its causes are already committed to significant global temperature increases over the coming fifty years of between 2–4°C. The flow of detailed information on the impact and consequences of climate change continue to grow at a rapid pace, often swamping decision-makers' ability to absorb and make sense of

---

[7] 'Intelligence Authorization Act for Fiscal Year 2008' (S. 1538) Section 321, US Congress, Washington, 2007 <http://www.govtrack.us/congress/billtext.xpd?bill=s110-1538>.

[8] Council of the European Union, 11177/1/07 REV 1, para. 41, Brussels, 20 July 2007 <http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/94932.pdf>.

[9] US Senate Press Release 'Warner–Lieberman Bill' (Washington, 2007) <http://lieberman.senate.gov/newsroom/release.cfm?id=286558>.

how it will affect their decisions and priorities. If experience – such as the end of the Cold War – is a reliable guide, then it will take at least a decade for the implications of this new security context to be understood and absorbed by mainstream institutions. The faster this mainstreaming happens, the better prepared we will be to respond and prevent the negative impacts of climate change, and the sooner we will be able to grasp the opportunities for enhancing security and stability through imaginative responses.

This pamphlet aims to help accelerate this security response. It does not attempt to provide a comprehensive guide to the science, economics and business of climate change. There are more authoritative and comprehensive reports which do that. Nor does it give a detailed examination of how climate change will impact particular countries and conflicts, which is a fast-growing – if young – field of analysis.[10]

Neither does it try to set out a definitive version of 'climate security' – a term subject to numerous interpretations – as the complexity of interactions between security interests and climate change are too wide to be captured in a single approach. Instead, this pamphlet aims to illuminate some critical aspects of how climate change will impact geo-political alignments, strategic priorities and changes in institutional capability.

As such, this pamphlet attempts to provide a framework for developing robust strategic responses to the international security and diplomatic challenges thrown up by climate change. It is aimed at a broadly defined 'security sector' audience, covering diplomatic, military, intelligence, policing, peacebuilding, development and humanitarian actors, all of whom will have to incorporate climate change into their already complex and challenging agendas. Though it is often said 'climate changes everything', it still has to take its place alongside

---

[10] For an overview see: WGBU (German Advisory Council on Global Change), 'World in Transition: Climate Change as a Security Risk', *Earthscan* (London, 2008). For some exemplary case study work in Darfur see: UNEP, 'Sudan Post-Conflict Environmental Assessment' (Nairobi, 2007); and Tearfund, 'Relief in a Fragile Environment' (London, 2007). For innovative blending of conflict and climatic data see Doug Bond and Patrick Meier, 'Environmental Influences on Pastoral Conflict in the Horn of Africa', mimeo, (Boston: Harvard University, June 2005).

other existing and future threats and challenges, and responses have to be proportionate and aligned with existing resources and capabilities.

This pamphlet argues that a much more explicit, long-term and risk-based approach to security analysis will be needed if climate change is to be successfully incorporated into a broad context of other risks to security and stability. This is consistent with the tradition of military security risk analysis and strategic trends, especially for capability planning, which is comfortable dealing with large ranges of uncertainty in developing responses to potential threats. However, this type of approach needs to be extended into 'softer' areas of conflict prevention, diplomacy, governance strengthening and resilience enhancement, which require the involvement of diplomatic, development, humanitarian and law enforcement actors.

Perhaps one of the most important attributes the security community can bring to the global debate on climate change is a willingness to seriously examine possible worst case scenarios and develop a proportionate response.[11] It is ironic that the economic and environmental literature on climate change often downplays the more catastrophic climate change scenarios, despite their scientific validity, for fear of being accused of scaremongering. There also seems to be a cultural reluctance among some environmental and development actors to discuss the potential social breakdown and conflict which climate change could engender, often for fear of 'securitising' the policy response.

In contrast, security analysts are used to rigorously categorising between existential threats and discretionary operations and making the case for radical action to protect a country's vital interests. In security-themed discussions of climate change, there is often a rather frustrated view, especially from the serving military, that the current political and financial response to climate change does not seem to reflect the seriousness of the threat. One reason is that many of the policy and political actors in charge of responding to climate change

---

[11] Indeed, one of the first and most well-known security studies on climate change looked at the catastrophic impact of the disruption of the Gulf Stream; concluding that this would lead Europe to descend into semi-anarchy and as a response the US should withdraw from the Atlantic Alliance. See Peter Schwartz and Doug Randall, 'An Abrupt Climate Change Scenario and Its Implications for United States National Security', October 2003.

are not used to dealing with large, existential threats to their nations' prosperity and stability. There is an inbuilt bias to avoiding radical movements from the status quo, especially in finance and economic ministries, which while perhaps sensible under usual circumstances becomes a liability in times of exceptional threat.

However, while climate change raises many hard security problems, it has no hard security solutions. Unless we stabilise concentrations of greenhouse gases in the atmosphere at safe levels, the catastrophic consequences will overwhelm most countries' capacity to adapt. Though the precise timing of these 'tipping points' is unclear, the geologic record sends a stark warning that they do exist and if greenhouse gases are not controlled we will definitely pass them in the next century.[12]

This pamphlet intends to lay out some approaches which will enable the security community to play its full part to help deliver climate security, and to effectively respond to the many day-to-day security and international policy challenges which will occur even under the most aggressive scenarios of climate mitigation.

The pamphlet starts with two brief overviews of future climate change impacts, with an emphasis on describing the ranges of critical uncertainties and possible worst-case scenarios. It then discusses how, based on the scientific data, climate change risks should be managed and the implications of different approaches for the urgency of political action to decarbonise the global energy system, management strategies, and how use of inadequate economic methods has systematically undervalued severe damage scenarios.

Two different approaches to climate security, both of which are current in the global policy debate, are then explored. Firstly, general use of 'climate security' to describe severe impacts which affect fundamental underpinnings of society (for example, disruptions in food supply) and from this to argue for stronger action to mitigate climate change. The potential role of security actors in this broad debate is explored; in particular their role in developing responses to 'worst case' climate change scenarios and more aggressive investment in development of clean energy technologies, which will also bring strong energy security benefits.

---

[12] Wally Broeker, *Fossil Fuel CO2 and the Angry Climate Beast* (Columbia University, 2003) <http://www.cfellows.org/wally/FossilFuelCO2-sm.pdf>.

Secondly, the more focused use of climate security to describe how climate change will impact the activities and priorities of the broadly defined security sector; for example, by increasing levels of intra-state conflict in some regions. This second area forms the focus of the remaining sections of the pamphlet. Key points are highlighted in bold throughout.

The next sections dig deeper into the security implications of climate change and how to develop robust and proportionate responses; and begin with a discussion of how climate change information can be integrated into decision support for security questions.

Using this general framework, the impact of climate change on national interests, alliances, threat prioritisation and policy responses is explored across a range of areas of geopolitical tension, covering; economic strategy; energy security; nuclear proliferation; border disputes; international resource management; and global extremism and the legitimacy of the international system.

The next section focuses on how climate change may increase conflict and instability in several regions, and looks closely at some of the fundamental dynamics underpinning climate changes role as a 'threat multiplier'.

The pamphlet ends with a discussion of a range of reforms needed in security systems – risk analysis, threat analysis, strategic planning, capability development – if they are to effectively maintain national and international interests in the face of the different patterns and levels of risks posed by a climate-changed world.

The climate security dimension is only one part of the climate change issue, and this pamphlet definitively does not ask for some naïve 'securitisation' of the issue where 'the generals' make policy. However, unless we begin to understand climate change as a fundamental threat to our security and prosperity it seems very unlikely we will be able to mobilise the political, economic and technical effort needed to successfully tackle it.

II. RAPID CLIMATE CHANGE IN A RESOURCE CONSTRAINED WORLD

> The ultimate objective of this Convention . . . is to achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
>
> ***Article 2, UN Framework Convention on Climate Change, 1992.***

Implicitly we tend to think of the future as being similar to our current world, albeit on a larger scale with a faster pace. However, future changes in the scale of resource use will bring about profound shifts in how we organise society and in relationships between countries.

Three key factors driving growing resource use are population, economic growth and urbanisation. In the 1940s, there were only 2.5 billion people on earth; currently the figure stands at 6 billion; but in the next twenty to thirty years, the figure could rise to between 8 and 10 billion. The next fifty years will see billions more people undertake the transition from agrarian to industrial societies, and from rural to urban living.

The size of the world economy has nearly doubled since the end of the Cold War, and it is on track to quadruple by the middle of this century. This implies that by 2050, global GDP will increase by eight times the cumulative growth seen between 1989 and 2006. The resource use of the world economy has already exceeded many critical environmental limits, while billions remain in absolute poverty.

A few facts serve to illustrate the coming dilemmas. If present consumption patterns continue, two out of every three people on earth will live in water-stressed conditions by the year 2025. More than two thirds of the world's fish stocks are currently being fished near to or beyond maximum sustainable levels. The Millennium Ecosystem Assessment predicts that in the next decades, the future rate of extinction will be ten times the current rate. An estimated 25 million refugees – sometimes described as 'environmental refugees' – have emerged as a result of weather-related disasters, and poor environmental quality contributes to 25 per cent of all preventable ill-health in the world.[13]

At the same time, the International Energy Agency predicts global energy use will increase 50 per cent by 2030, and continue to accelerate. The concentration of declining oil reserves in a smaller number of politically unstable countries has added an estimated $10-$20 political risk premium per barrel to global oil prices. The oil price rise between 2001 and 2005 increased the total cost of oil imports for Less Developed Countries (LDCs) by approximately $38bn, easily outweighing all official aid flows to them.

Even without climate change, the world would have experienced significant resource shortages and tensions. Our increasingly interdependent world faces new risks and opportunities where the pillars of prosperity – energy security, climate security, food security and water security – will come under increasing pressure from the very affluence they underpin. Without a fundamental change in the way we generate wealth, even the most basic aspirations of a growing global population will not be met.

At the same time, the impact of global climate change is already beginning to be felt. Current levels of greenhouse gases in the atmosphere are higher than at any time in the past 650,000 years. Average global temperatures have already risen by 0.7°C, and the world is committed to 1.2–1.7°C rise by mid-century just from past greenhouse gas emissions. Already the World Health Organisation estimates that global warming has caused millions of additional deaths, mainly in the tropical developing world through increased incidences of disease and heat impacts.[14] As Figure 1 shows, if emissions continue unabated, temperatures could rise by between 2.5–8°C by the end of the century even without contribution for natural feedback mechanisms[15].

---

[13] Millennium Ecosystem Assessment *Ecosystems and Human Well-Being: Synthesis* (Washington, DC: Island Press, 2005).

[14] WHO, 'Climate Change and Human Health: Risks and Responses' (Geneva, 2004).

[15] IPCC, 'International Panel on Climate Change Climate Change 2007: Synthesis Report—Summary for Policymakers' (Geneva: IPCC, 2007).

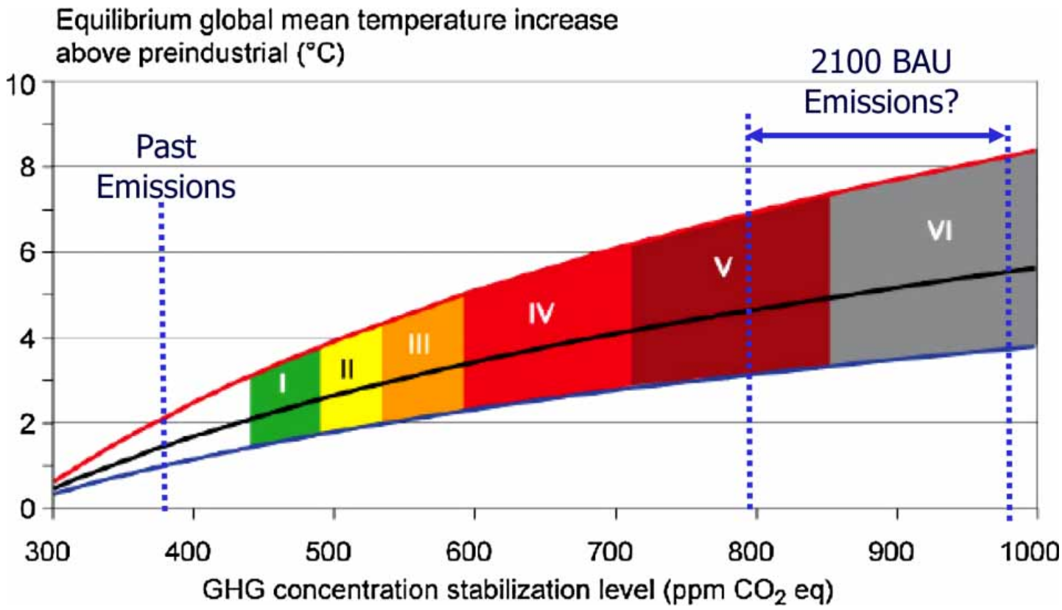

Figure 1 Global Average Temperature Projections
Source: IPCC (2007)

Twenty-three of the twenty-four hottest years since records began in 1850 have occurred since 1980. Ice sheets are melting at the poles and 99 per cent of all glaciers are net retreating. These factors combined gradually affect world-wide sea-levels. Over the period from 1993 to 2003, average sea-levels have risen by 3.1mm per year. This is nearly twice the historic average rate of increase and does not include the effects of melting ice sheets in Greenland and Antarctica. Extreme weather events are also on the increase. Incidents of major floods, wildfires, wind speeds and cyclone activities experienced a much stronger frequency over the last two decades even accounting for better measurement.

Sir Nick Stern's review of the economic implications of climate change estimated that the economic damage could amount to a permanent reduction in global GDP of 5–20 per cent by 2100;[16] equal to the cost of both World Wars and the Great Depression combined. However, this is likely to be an underestimate, as the Stern report was not able to estimate the costs of climate change from impacts on social stability or on reducing the supply of broad ecosystem services. For example, declining wetlands (which remove water pollution) and

[16] Stern Review, 'Stern Review: The Economics of Climate Change' (London: HMSO, 2006).

climate damage to coral reefs may reduce the productivity of ocean fisheries. Elsewhere, the value of these services has been estimated at $16-$54 trillion a year.[17]

These costs and negative trends will disproportionately affect the poorest people in the poorest countries. Not only are these populations most dependent on natural resources and most vulnerable to extreme natural events, but they have fewer resources with which to adapt to changing conditions. Low income countries have a much larger share of their wealth in natural capital (26 per cent) than high income countries (2 per cent).[18] There are many examples of current climate vulnerability leading to major macro-economic impact. In Mozambique, devastating floods in 2000 left 700 people dead and half a million homeless; economic growth fell from 8 per cent in 1999 to 2 per cent in 2000. Droughts in Kenya in the late 1990s reduced GDP by over 20 per cent as hydropower capacity was reduced and crops failed.

Figure 2 summarises some of the key impact of increased climate change on the risk of flooding, malaria, water shortages and food shortages. As can be seen there is a critical 'discontinuity' in the impact, with a sudden rise to 3.5 billion people at risk from water shortages which occurs after average temperatures exceed 2°C. This effect, coupled with some of the thresholds for catastrophic impact outlined below has led many scientists, and the EU, to adopt 2°C as a threshold on 'dangerous climate change' beyond which the world should not move.

Though supported by scientific analysis, this limit is yet to gain the political support of major emitting nations, with China, US, Canada and Japan supporting approaches consistent with a 3–4°C rise in temperature. As of February 2008 all the candidates for the US presidential elections have agreed to limits consistent with a 2°C scenario, but there is currently no majority in the US Senate for such radical action.

Figure 3 shows the projection of the distribution of increased drought risks across the globe 2041–70; a period when on business-as-

---

[17] Robert Costanza et al., 'The value of the World's ecosystem services and natural capital', *Nature* (Vol. 387, 1997), pp. 253–260.

[18] World Bank, *Where is the Wealth of Nations? Measuring Capital for the 21st Century* (Washington: World Bank Publications, 2005).

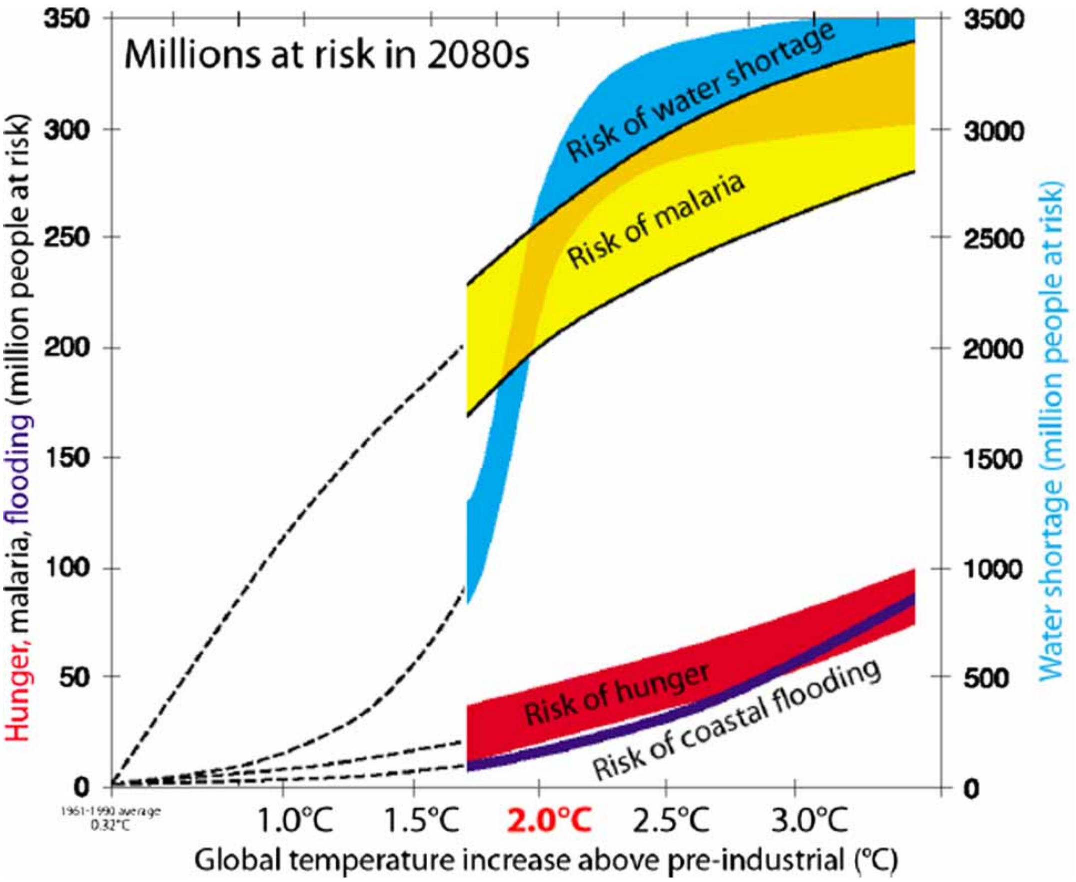

Figure 2 Climate Impact at Different Temperatures (Millions at Risk in 2080)
Source: Parry et al, 2001, 'Millions at Risk' Global Environmental Change

usual projections the 2°C limit will have been breached. As well as strong pattern of rainfall reduction across much of the US and Europe, very large reductions are seen in Central America and Brazil, the Sahel and Horn of Africa, parts of Central Asia, India and much of populous South East Asia. Only Northern Canada and Russia see sustained increases in rainfall.

These projections understate impact because they only look at changes in the average figures, not the propensity for extreme drought periods which may happen earlier.

Under these moderate warming scenarios, a combination of stronger national environmental management and international co-ordination could mitigate many problems. The technology and knowledge exists, but it needs to be applied. In many cases, better ecosystem management makes direct economic sense; for example, estimates are that the benefits of policies to radically slow desertification outweigh

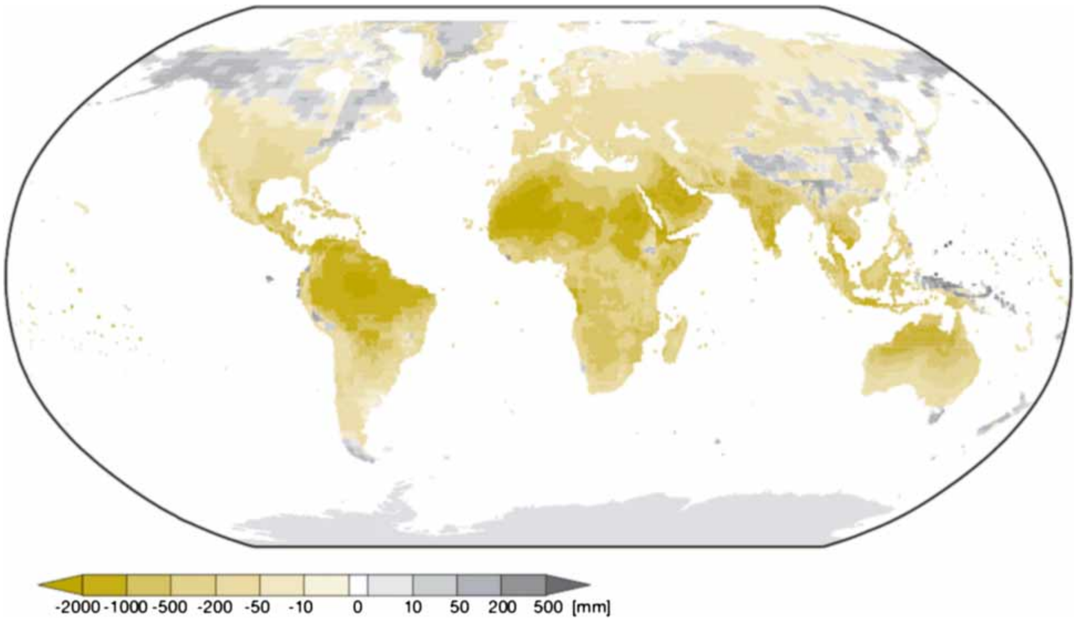

Figure 3 Projected Impact of Increased Drought Risk (mm of rainfall annual difference 2042–70 compared to 1961–90)
Source: WGBU (2008)

the costs by up to three times in many countries.[19] However, in many poorly governed countries flawed political systems will actually amplify the impact of climate change by encouraging unsustainable short-term behaviour to appropriate available resources, such as the invasion of agricultural lands by nomadic herders in the Sahel.

[19] Poverty Environment Partnership, *Environment and the MDGs: Investing in Environmental Wealth for Poverty Reduction* (New York: UNDP, 2005).

III. TIPPING POINTS AND HIGH IMPACT SCENARIOS

The climate is an angry beast and we are poking it with sticks.

Wally Broecker, Professor of Earth Sciences, Columbia University

Though economic forecasts of environmental damage costs are useful in showing the general scale of the problem, they can also be deceptive as they assume smooth transitions and predictably uncertain futures. Far less is known about our dependence on environmental systems – especially on a stable climate – than is often assumed. In particular, the potential for many large, irreversible effects – such as the collapse of whole fisheries and related ecosystems – is not included in these estimates. Or to use the currently popular Rumsfeldian terminology, they fail to account for both 'known unknowns' and 'unknown unknowns'.

The paleoclimate record in Figure 4 shows that rapid and extreme swings of temperature of over 10°C have been the norm in the climate system over the last four ice ages, stretching back 500,000 years. Human civilisation emerged in a relatively stable period in the climate, but this stability can obviously change over quite rapid timescales.

However, from a security perspective these extreme impacts are potentially more important than some of the more predictable impacts. There are three main categories of extreme impact:[20]

---

[20] Hans Schellnhuber (ed.), *Avoiding Dangerous Climate Change* (Cambridge: University of Cambridge Press, 2005) <http://www.defra.gov.uk/environment/climatechange/research/dangerous-cc/pdf/avoid-dangercc.pdf>.

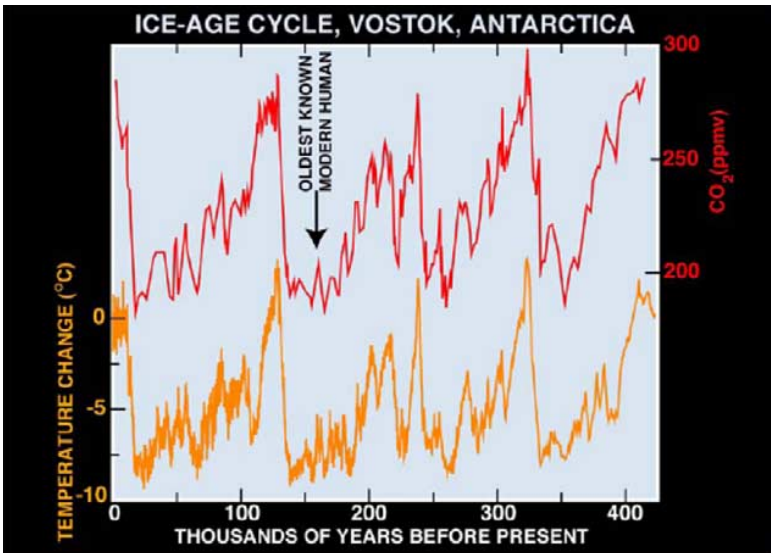

Figure 4 Global Temperature Variations over the last 500,000 Years

High impact reversible events: low probability and non-linear impact of climate change producing potentially large impacts, but which can potentially be reversed if the climate is stabilised over 50–100 years, for example: shift of Asian monsoons; dramatic weakening of the Atlantic conveyor; large increases in hurricane and typhoon activity; increased drought and flooding cycles; and shifting and productivity reduction in major commercial fisheries.

Irreversible Impact: where climate change causes changes which are effectively irreversible over human time scales (i.e., more than 10,000 years) even if temperatures were stabilised, for example: species extinction; alpine glacial melting; and melting of the Greenland and Antarctica ice sheets.

Runaway Climate Change: where climate change passes a tipping point where positive feedback loops release more greenhouse gases into the atmosphere from natural sources. At this point humans will lose complete control of climate change and final equilibrium will depend on the interaction of natural systems, for example: release of sub-sea methane hydrates; release of methane from frozen tundra; large scale forest die-back; slowing of ocean CO_2 absorption.

Current scientific knowledge is not precise enough to say when we have passed each tipping point and inertia in natural systems means it will be decades before some of these effects will become definitely observable. By then, we will be committed to potentially irreversible impact. Even notionally reversible impact will require radical efforts to reduce atmospheric concentrations of greenhouse gases below the threshold concentration, and will take decades before producing positive benefits.

A brief overview of some of the critical effects will give some useful texture to the risks we face in the future.

High Impact Scenarios

Many of the highest impact scenarios are the hardest to model as they depend on complex dynamic events at sub-regional levels, such as monsoon patterns and storm formation. Though it is to be expected that storm intensity would increase as more energy is retained in the atmosphere, the evidence to date has not shown a definitive global increase, although there has been a 50 per cent increase in Atlantic hurricane activity in the second half of this century.[21] As Hurricane Katrina reminded us, the human impact of storms critically depends on the management of flood defences and coastal areas – and tropical storms are most frequent in some of the fastest areas of growing population and poorer urban areas. As the expected strengthening of storms occurs, we would expect sharply increased impact on cities and fertile deltas in Asia and the Americas.

The stability of the Indian monsoon is hotly debated and again no clear trends have yet been observed: on aggregate less rainfall is expected, but the monsoon itself may intensify. More predictable is the impact of climate change in shifting and disrupting already depleted marine fisheries, which a primary source of protein for 800 million people. Fisheries are highly temperature and nutrient sensitive.[22]

---

[21] Greg J. Holland and Peter J. Webster, 'Heightened Tropical Cyclone Activity in the North Atlantic: Natural Variability or Climate Trend?', *Philosophical Transactions of the Royal Society of London*, 30 July 2007.

[22] Boris Worm et al, 'Impact of Biodiversity Loss on Ocean Ecosystems Services', *Science 3*, November 2006.

The complete collapse of the North Atlantic Conveyor – which brings warn water from the tropics across to Northern Europe – would lower summer European temperatures by several degrees and completely disrupt current patterns of agriculture. This effect was last seen 12,000 years ago. Melting glaciers caused a sudden flow of freshwater into the North Atlantic, shutting off the conveyor and causing a 1,200 year cold period in Northern Europe. Some modelling places the likelihood of this re-occurring if emissions continue as present at around 50 per cent in this century.[23] This scenario was citied in the famous US security study as precipitating wide-spread societal breakdown in Western Europe driven by economic collapse and mass migration.[24]

Irreversible Impact

Much climate impact is irreversible, the most obvious being species extinction, with a wide range of estimates for plant and animal extinction as the world warms faster than they can adapt to the new environment. The ability of ecosystems and species to adapt is also hindered by human barriers to species migration; for example, cultivated land around forests.

Climate change will have serious consequences for parts of the world that depend heavily on glacier meltwater to maintain supplies during the dry season. There are 1 billion people in snowmelt regions today, and potentially 1.5 billion by 2050. In a warmer world, runoff from snowmelt will occur earlier in the spring or winter, leading to reduced flows in the summer and autumn when additional supplies will be most needed. In the long run, flows will dry up permanently once a glacier has melted completely. In the short term, increased spring water flows will raise flood risks unless downstream water storage infrastructure is expanded in the next decades, including in North America and Europe.

In the Himalaya-Hindu Kush region, meltwater from glaciers provides 70 per cent of the summer flow in the Ganges and

[23] Joel B. Smith, Hans-Joachim Schellnhuber and M. Monirul Qader Mirza 'Vulnerability to Climate Change and Reasons for Concern: A Synthesis', synthesis of IPCC TAR Working Group II, 2005.

[24] See Peter Schwartz and Doug Randall, 'An Abrupt Climate Change Scenario and Its Implications for United States National Security', October 2003.

50–60 per cent for other major rivers. In China, 23 per cent of the population (250 million people) lives in the western region that depends principally on glacier meltwater, and where virtually all glaciers are showing substantial melting. In the tropical Andes in South America, the area covered by glaciers has been reduced by nearly one-quarter in the past thirty years. Many large cities such as La Paz, Lima and Quito rely on these water supplies and up to 40 per cent of agriculture in Andean valleys uses glacier meltwater. Up to 50 million people in this region could be affected by loss of dry-season water. These glaciers cannot reform once they have melted as they are the result of thousands of years of snowfall, and in some cases represent 'fossil water' which, once gone, will not be replaced.

The melting of alpine glaciers directly affects freshwater supply in inland areas, but the fate of the massive ice sheets of Greenland and the Antarctic will determine the sea level. The last time the Earth was 2–3°C warmer than today, about 3 million years ago, the sea level was about 25 metres higher. The last time the planet was 5°C warmer, just prior to the glaciation of Antarctica about 35 million years ago, there were no large ice sheets on the planet. Given today's ocean basins, if the ice sheets were to melt entirely, sea level would rise about 70 metres (about 230 feet). About 1 billion people live within a 25 metre elevation of sea level. Most East Coast cities in the United States would be under water with a sea level rise that large, as would almost the entire nation of Bangladesh, the state of Florida and an area of China that presently inhabited by 300 million people. A sea level rise of 5–7 metres, which could be provided by melting ice in west Antarctica, would displace a few hundred million people.

The Intergovernmental Panel on Climate Change's (IPCC) modelling estimates of sea level rise range from 18–59cm by 2100, but are mainly driven by thermal expansion in the oceans. Uncertainty over the rate of melting of the major icecaps means that the IPCC has declined to provide either a 'best estimate' or 'upper bound' on any additional sea level rise from this source. The rate of melting in parts of Greenland has far outstripped previous predictions and is driven by unexpected mechanisms, such as surface lubrication of glacier movement by meltwater. The rate of melting and the tipping point of after which the icesheets will all melt are still strongly disputed between scientists. James Hansen, chief climate scientist at NASA, takes a pessimistic view that only keeping future temperature rises below 1°C

(1.5–1.7°C total) will prevent the complete melting of the ice shelves. Global warming of an additional 2–3°C would lead to an eventual sea level rise measured in the tens of metres, and he estimates this would cause multi-metre sea level rise this century, initiation of ice sheet disintegration out of our control and a continually rising sea level.[25]

Runaway Climate Change

The most worrying outcome is runaway climate change, where humans lose control of changes to the climate system as massive amounts of natural greenhouse gasses are released. Again, these natural shifts in the climate system are not theoretical concerns; and they have all been observed in the geological record, though not in recent times.

Rapid warming could lead to droughts which start significant forest die back (death of standing trees as climate conditions change), changing major portions of the world's forests from absorbing to emitting carbon dioxide. The widespread drought that hit the western Amazon in 2005 has been linked to warming of sea surface temperatures in the tropical North Atlantic compared to the South Atlantic. With current levels of emissions, the chances of such a drought will rise from 5 per cent now, to 50 per cent by 2030, and 90 per cent by 2100. This effect can be accelerated by forest fires, which in 1998 released 400 million tonnes of carbon in the Amazon basin, equivalent to 5 per cent of annual human emissions from fossil fuels. With warming around 3°C the carbon cycle could be effectively reversed. As vegetation and soils release millions of tonnes more CO_2 into the atmosphere, the planet is locked into faster warming with rises of around 5.5°C possible by 2100. If some predictions are correct, and the Amazon forest dies and becomes impoverished grassland in 50–100 years, there would be massive disruption to global and regional ecosystems as it is home to half the world's biodiversity and the Amazon river contains 20 per cent of all the water discharged into the world's oceans. The Amazon rainforest also contains about 10 per cent of all carbon stored in land ecosystems.[26]

---

[25] James Hansen, 'Testimony to Iowa Utilities Board' *GCU-07-01*, 2007 <http://www.columbia.edu/~jeh1/IowaCoal_071105.pdf>.

[26] WGBU 2007.

Methane is a greenhouse gas twenty-three times more potent than carbon dioxide and is the other potential cause of runaway climate change. Recent Arctic warming is causing the release of methane from permafrost, but not to a major degree. However, once over the 2°C rise mark, the threshold for irreversible melting of permafrost is much more likely to have been passed, and large areas of Siberia, Alaska, Canada and even southern Greenland will be affected. Around 500 billion tonnes of carbon are currently locked up in frozen soils, representing over fifty years of fossil fuel emissions at current rates.

Most worrying is the potential for large releases of methane hydrates from undersea deposits in the Arctic. Estimates show that there are 2,500–4,500 billion tonnes of methane in these deposits, which is equivalent to nearly half the total amount of carbon that could be released by burning all fossil fuels. With rising sea temperature these deposits can become unstable and become released into the atmosphere, an effect which is more likely at the poles as they warm at around four times the average global rate.[27]

Paleoclimate records suggest that the positive feedbacks that occur for all major long-lived greenhouse gases (carbon dioxide, methane and nitrous oxide) are moderate for global warming less than 1°C. However, no such constraints exist for more major global warming, because there are no recent interglacial periods with global warming greater than about 1°C.

The science of extreme and abrupt climate change raises the spectre of profound risks to fundamental human security and prosperity. It is not a question of whether these changes will occur, but at what threshold of increased warming they will happen. Past certain thresholds, little can be done to reverse the impact and 'adaptation' will involve large-scale migration and abandonment of vulnerable urban centres. The usual approach when dealing with fundamental threats to security requires robust response planning to include the worst case scenario, not just working to the best-guess approach. But this has not been the case to date in the climate change debate.

---

[27] Christian Berndt et al, 'Dynamics of Gas Hydrates in Polar Environments', *Research Proposal*, University of Southampton, 2007. Research page <http://www.nerc.ac.uk/research/areas/polar/hydrates.asp>.

IV. CLIMATE CHANGE RISK MANAGEMENT

> [The results of economic analysis] do not as yet permit an unambiguous determination of an emissions pathway or stabilization level where benefits exceed costs.

International Panel on Climate Change Working Group III Report, 2007

Box 1 gives thumbnail sketches of three possible future scenarios of climate change in the next century taken from a recent report by the US foreign policy think-tank the Centre for Strategic and International Studies (CSIS). The critical observation from such scenarios, and the scientific evidence they are based on, is the rapid increase in impacts and damages as scenarios become more extreme. The more extreme scenarios could be driven by a failure to control greenhouse gas emissions or because the climate system is more sensitive than expected; or indeed a combination of both effects. What is clear is that the majority of potential climate change costs and security impacts would come from such potential extreme, irreversible impacts and the risks of uncontrollable climate change.

The critical test of effective climate change risk management is how these extreme scenarios and risks are handled in decision-making processes, and translate into the political will to set clear targets and policies for stabilising global temperatures and cutting greenhouse gas emissions. However, as the introductory quote above from the 2007 International Panel on Climate Change report makes clear, there is no established economic consensus on what level to stabilise global temperatures — 1°C, 2°C or 5°C above normal. The damage costs

Box 1: Three Climate Change Scenarios (CSIS, 2007)

Climate Scenario 1: Expected Climate Change

The average change obtained in IPCC projections based on the standard emission scenario is realised without abrupt changes or other great surprises. By 2040 average global temperature rises 1.3°C above the 1990 average. Warming is greater over land masses, and increases from low to high latitudes. Generally, the most damaging local impact occurs at low latitudes because of ecosystem sensitivity to altered climate and high human vulnerability in developing countries, and in the Arctic because of particularly large temperature changes at high northern latitudes. Global mean sea-level increases by 0.23 metres, causing damage to the most vulnerable coastal wetlands with associated negative impact on local fisheries, seawater intrusion into groundwater supplies in low-lying coastal areas and small islands, and elevated storm surge and tsunami heights, damaging unprotected coastlines. Many of the affected areas have large, vulnerable populations requiring international assistance to cope with or escape the effects of sea level rise. Marine fisheries and agricultural zones shift polewards in response to warming, in some cases moving across international boundaries.

The North Atlantic ocean conveyor is not affected significantly. Regionally, the most significant climate impact occurs in the southwestern United States, Central America, sub-Saharan Africa, the Mediterranean region, the mega-deltas of South and East Asia, the tropical Andes and small tropical islands of the Pacific and Indian Oceans. The largest and most widespread impact relates to reductions in water availability and increases in the intensity and frequency of extreme weather events.

The Mediterranean region, sub-Saharan Africa, northern Mexico, and the south-western United States experience more frequent and longer-lasting droughts and associated extreme heat events, in addition to forest loss from increased insect damage and wildfires. Overall, northern mid-latitudes see a mix of benefits and damages. Benefits include reduced cost of winter heating, decreased mortality and injury from exposure to cold, and increased agricultural and forest productivity in wetter regions because of longer growing seasons, CO_2 fertilisation, and fewer freezes. Negative consequences include the higher cost of summer cooling, more heavy rainfall events, more heat-related death and illness, and more intense storms with associated flooding, wind damage, and loss of life, property, and infrastructure.

Climate Scenario 2: Severe Climate Change

Average global surface temperature rises at an unexpectedly rapid rate to 2.6°C above 1990 levels by 2040, with larger warming over land masses and at high latitudes. Dynamic changes in polar ice sheets (i.e., changes in the rate of ice flow into the sea) accelerate rapidly, resulting in a global mean sea-level rise of 0.52 metres. Based on these observations and an improved understanding of ice sheet dynamics, climate scientists by this time express high confidence that the Greenland and West Antarctic ice sheets have become unstable and that four to six metres of sea-level rise are now inevitable over the next few centuries.

Water availability decreases strongly in the most affected regions at lower latitudes (dry tropics and subtropics), affecting about two billion people worldwide. The North Atlantic ocean conveyor slows significantly, with consequences for marine ecosystem productivity and fisheries. Crop yields decline significantly in the fertile river deltas because of the sea-level rise and damage from increased storm surges.

Agriculture becomes unviable in the dry subtropics. Irrigation becomes exceptionally difficult because of low water availability and increased soil salinity resulting from more rapid evaporation of water from irrigated fields. Arid regions at low latitudes expand, taking previously marginally productive croplands out of production.

North Atlantic fisheries are affected by significant slowing of the North Atlantic ocean conveyor. Globally, there is widespread coral bleaching, ocean acidification, substantial loss of coastal nursery wetlands and warming and drying of tributaries that serve as breeding grounds for anadromous fish (ocean-dwelling fish that breed in freshwater, e.g., salmon). Because of a dramatic decrease in the extent of Arctic sea ice, the Arctic marine ecosystem is dramatically altered and the Arctic Ocean is navigable for much of the year. Developing nations at lower latitudes are affected most severely because of climate sensitivity and low adaptive capacity.

Industrialised nations in the north experience clear net harm and must divert greater proportions of their wealth to adapting to climate change at home.

Climate Scenario 3: Catastrophic Climate Change

Between 2040 and 2100, the impact associated with climate scenario two progresses and large-scale singular events of abrupt climate change occur. The average global temperature rises to 5.6°C above 1990 levels with larger warming over land masses and at higher latitudes. Because of continued acceleration of dynamic polar ice sheet changes global mean sea-level rises by two metres relative to 1990, rendering low-lying coastal regions uninhabitable, including many large coastal cities. The large fertile deltas of the world become largely uncultivable because of inundation, and more frequent and higher storm surges that reach farther inland.

The North Atlantic ocean conveyor stops at mid-century, generating large-scale collapse of North Atlantic marine ecosystems and associated fisheries. Northwestern Europe experiences colder winters, shorter growing seasons, and reduced crop yields relative to the twentieth century. Outside of northwestern Europe and the northern North Atlantic Ocean, the ocean conveyor collapse increases average temperatures in most regions and reorganises precipitation patterns in unpredictable ways, hampering water resource planning around the world and drying out existing grain-exporting regions. Southern Europe and the Mediterranean region remain warmer than the twentieth century average and continue to experience hotter, drier summers with more heat waves, more frequent and larger wildfires, and lower crop yields. Agriculture in the traditional breadbaskets is severely compromised by alternating persistent drought and extreme storm events that bring irregular severe flooding. Crops are physiologically stressed by temperatures and grow more slowly even when conditions are otherwise favourable. Even in many regions with increased precipitation, summertime soil moisture is reduced by increased evaporation.

Breadbasket-like climates shift strongly northward into formerly sub-arctic regions with traditionally small human populations and little infrastructure, including roads and utilities, but extreme year-to-year climate variability in these regions makes sustainable agricultural difficult on the scale needed to feed the world population. Mountain glaciers are virtually gone and the annual snow pack is dramatically reduced in regions where large human populations traditionally relied on glaciers and annual snowfall for water supply and storage, including Central Asia, the Andes, Europe, and western North America. Arid regions expand rapidly, overtaking regions that traditionally received sufficient annual rainfall to support dense populations.

The dry subtropics, including the Mediterranean region, much of Central Asia, northern Mexico, much of South America, and the southwestern United States are no longer inhabitable. Not only do these areas require remote water sources for habitability dramatically larger than in 1990, but such remote sources are much less available because mountain glaciers and snowlines have retreated dramatically as well. Half of the world's human population experiences persistent water scarcity.

Locally devastating weather events are the norm for coastal and mid-latitude continental locations, where tropical and mid-latitude storm associated wind and flood damage becomes much more intense and occurs annually, leading to frequent losses of life, property and infrastructure in many countries. Whereas water availability and loss of food security disproportionately affect poor countries at lower latitudes, extreme weather events are more or less evenly distributed, with perhaps greater frequency at mid-latitudes because of stronger extratropical storm systems, including severe winter storms.

conventionally calculated by economists do not take into account extreme climate impacts or possible security and stability impacts from uncontrolled climate change. At the extreme, commentators such as Bjorn Lomborg have used these economic results to argue that we should just adapt to a changing climate and not attempt control emissions at all.[28]

---

[28] <http://www.copenhagenconsensus.com/Default.aspx?ID=788>

These are far from academic and long-term issues. Following the recommendations from climate scientists to keep temperature rise below 2°C, would require stabilising greenhouse gas levels in the atmosphere at around 450 parts per million of CO_2 equivalent (ppm CO_2eq). Current modelling estimates that this would give a 50 per cent chance of remaining below a 2°C increase, not accounting for any climate change feedback.

Stabilising emissions at 450 ppm would require radical shifts in global energy systems over the next twenty-five years. Global emissions of greenhouse gases would need to peak in ten to fifteen years, and then start reducing; currently they are rising at a rate consistent with the most damaging scenario modelled by the Intergovernmental Panel on Climate Change. Assuming that richer countries will have to act first to reduce their emissions, this requires a 25–40 per cent cut in their emissions by 2020, and 70–90 per cent reductions by 2050. Developing countries such as China would need to start delivering absolute emission reduction by 2020–2030, when their per capita emission levels will still be a fraction of developed country levels. In 2006, Chinese per capita CO_2 emissions were around a third of European ones; American per capita emissions are double European levels.

These numbers lead to a simple conclusion. An even chance of staying below the 2°C threshold requires the developed world to have moved to a zero-carbon energy system by the middle of the century. Any remaining carbon 'allowances' will be used in agriculture, defence and probably some international air travel.

This will require much faster investment in low-carbon energy sources in the next twenty-five years than is currently underway, and a far more aggressive and interventionist approach by policy-makers to the research, development and deployment of new technologies over the next five to fifteen years.

In contrast, adopting a less ambitious greenhouse gas stabilisation target would remove any need for serious action in the next fifteen years (conveniently over any election horizons). As Box 2 shows, stabilisation at 550 ppm only requires global CO_2 emissions to peak by 2040 and stabilisation at 650 ppm by 2060. But delaying the peak of emissions also locks us in to another generation of high-carbon infrastructure, making the eventual shift to a low-carbon economy more difficult and expensive, and hence less likely.

Box 2: Possible Pathways to Stabilisation

The table below gives a typical example of potential pathways for emission reductions used in the UN Climate negotiations; where the developed countries are termed Annex 1 countries and developing countries non-Annex 1 countries.[29]

		2020	2050
450 ppmv CO_2eq.	Global	+10%	−40%
	Annex I	−45% to −25%	−95% to −70%
	Non-Annex I	Substantial deviation from reference in all regions	Substantial deviation from reference in all regions
550 ppmv CO_2eq.	Global	+30%	−10%
	Annex I	−30% to −15%	−90% to −55%
	Non-Annex I	Substantial deviation from reference in Latin America, Middle East, Centrally Planned Asia and East Asia	Substantial deviation from reference in all regions
650 ppmv CO_2eq.	Global	+50%	+45%
	Annex I	−15% to 0%	−75% to −25%
	Non-Annex I	Deviation from reference in Latin America and Middle East, East Asia	Deviation from reference in most regions, especially in Latin America and Middle East and Centrally Planned Asia

Reaching a 450 ppm target may be up to five times more expensive than stabilising between 550–600 ppm, but there has been only scant modelling of more aggressive abatement scenarios. The

[29] Taken from a presentation by Niklas Höhne Ecofys, 'Was ist gerecht? Vorschläge für eine faire Lastenteilung', at Heinrich Böll Stiftung, Fachgespräch Internationale Klimapolitik vor Bali, Berlin, 25 October 2007.

costs would amount to around 1–2 per cent of global GDP over a period where global output is expected to grow by 400 per cent, not including any economic co-benefits from reduced air pollution and increased energy security. Some economists even expect the move to a low-carbon economy to provide a net increase in GDP – without counting the benefits of preventing climate change – because it will stimulate high rates of investment and technological innovation.[30]

But though tackling climate change may not be on balance hugely expensive, it will be not be easy. Over the next twenty-five years, it will require shifting over $20 trillion in energy investment from high- to low-carbon technologies. This will result in much less investment in oil, gas and power infrastructure and increased investment in efficiency, buildings and clean power. Much of this shift must happen in fast-industrialising economies such as China and India, who will be responsible for 60 per cent of this investment from now to 2030, but have yet to take binding commitments to control their emissions. Despite slower demand growth, the aging fleet of power stations in the EU, US and Japan will require a huge amount of replacement investment over this period; the EU will build nearly as many power stations as China.[31]

China alone plans to build 500 major coal power stations over the next ten years. If all the planned fossil power stations in the US, India, China, and the EU are built by 2030 then their lifetime emissions will exceed all previous emissions from the use of coal. Given replacement of old plants, seven out of ten coal plants planned for operation in 2030 have yet to be built.[32] This gives the opportunity to replace them with cleaner alternatives, or shift to carbon capture and storage (CCS) technology which takes carbon from the fuel and buries it in geological deposits. Already, there is movement for a moratorium against building any new coal power plants without CCS technology in the US and Europe.

---

[30] See IPCC, Working Group III Report, 2007. For discussion of modelling scenarios see E3G Commentary 'Investing in the Economics of Climate Security', November 2007 <http://www.e3g.org>.

[31] International Energy Agency, 'World Energy Outlook' (Paris, 2006).

[32] Natural Resource Defence Council, 'No Time Like the Present' (Washington D.C., March 2007) <http://www.nrdc.org/globalWarming/coal/mit.pdf>.

Effective action to tackle climate change will create winners and losers. It will build new industries and rapidly reduce markets for some existing ones, and will force citizens to change their behaviour and consumption choices. The difficult political economy of climate change lies in these shifts, not in the overall additional costs of shifting to a low-carbon economy. These tensions will reverberate internationally, whether through the vested interests of oil producing countries, the impact of expanded biofuel production or the changes in terms of trade from imposing higher efficiency standards on products.

Delay also results in other risks. Since oil prices rose rapidly from 2002, countries have moved towards coal power and coal-to-liquids technology, increasing the rate of global CO_2 emissions growth. This reality has not been reflected in most long-term climate modelling, which has tended to overestimate the impact of high oil prices on demand, and underestimate the shift to coal.

There is a real choice as to how much 'climate insurance' we should buy. Limiting increases in average temperate to 2°C requires radical action in the next decade to shift private sector investment patterns, and substantial public investment in the acceleration of large-scale zero-carbon technologies and in helping industrialising countries decarbonise.

This is not just an economic choice but a security choice as well. If the transformation does not happen quickly enough the mistake cannot be reversed. High-carbon infrastructure cannot be dismantled overnight without prohibitive cost, and carbon cannot be just sucked out of the atmosphere at scale.

There are also signs that climate risks may be rising faster than previously estimated. For the last five years, less carbon has been absorbed by natural systems leading to a doubling in the annual increase in global concentrations. Measured rates of ice melting in parts of Greenland are far higher than previously estimated, and glacier retreat elsewhere is similarly accelerated compared to predictions.

Managing the risks of climate change requires an assessment of the costs of catastrophic climatic and social disruption against the costs of shifting decisively to a low-carbon economy over the coming decades. Uncertainty abounds over any choice. But this is a risk management decision – not an abstract quest for truth. The critical point to remember is that while choices to invest in a low-carbon future could potentially be reversed if climate change is more benign than expected, once critical climate change tipping points have been passed climate security can never be regained.

The science of climate change is as certain as any other information used to drive major political decisions on economic, social and security issues. There can be no excuse of uncertainty to delay the core political choices over the scale and ambition of action to slow emissions of greenhouse gases. The natural instinct of any decision-maker is to delay difficult decisions, but the irreversible nature of climate change makes time an expensive commodity. When balancing the costs and benefits of action, it is vital that the security implications of the problem are fully understood and incorporated into critical decisions, as only then will wise choices be made.

V. THE TWO FACES OF CLIMATE SECURITY

> In the post-9/11 world, threats are defined more by the fault lines within societies than by the territorial boundaries between them. From terrorism to global disease or environmental degradation, the challenges have become transnational rather than international. That is the defining quality of world politics in the twenty-first century . . . In this sense, 9/11 has taught us that terrorism against American interests 'over there' should be regarded just as we regard terrorism against America 'over here.' In this same sense, the American homeland is the planet.
>
> ***9-11 Commission, 2004***

It is one thing to present the evidence that climate change will be a serious challenge to international peace and security, but another to decide how the security community should respond. As the 'climate security' debate has expanded, even those who recognise the dangers have questioned whether they require any specific security response beyond implementation of current policies and programmes to prevent and respond to crisis and conflict.

This is a perfectly reasonable position. Many different global issues undermine global security but are currently not considered to require a major and specific security response, for example: global financial instability; global pandemics (including HIV/AIDS); global organised crime; and corruption. There are good arguments for why the security community – and government security policy more widely – should indeed focus more on these areas,[33] but even in the absence of such a broader change in the security paradigm, climate change deserves particular attention because it represents a much more significant and pressing security challenge.

One of the sources of confusion in the climate security debate has been caused by the fact it has two distinct faces, each with its own focus, community, audience and source of authority. One face involves a general discussion about the fundamental threats climate change poses to prosperity and security. The other face involves the specific challenges this poses to the interests and objectives of the broadly defined 'security' community, and outlines how they must change to respond to them. Both are equally valid reflections of the challenges of climate change, but are clearly distinct.

In many ways, they mirror the confusion engendered by the post-9/11 rhetoric of the War on Terror. This was primarily used to define a public political debate, but also had early consequences in helping define the overall strategic thrust of the security response, in ways which are now generally considered as unhelpful. It is unsurprising that this blurring of political focus has happened. Such threats merge the traditional distinctions between domestic and international issues, and require a range of security and non-security responses, including significant domestic civilian engagement.

The Public Climate Security Debate

The general debate on climate security focuses on understanding climate change as a serious collective security challenge to all countries. The audience is composed of the public, politicians, climate experts and, to a lesser extent, security actors. The debate is focused on how the foundations of broadly defined human security are threatened by climate change, as it undermines the 'pillars of prosperity': water security, energy security, food security and climate security.[34] This debate also addresses the threats to both international

---

[33] For example see Nick Mabey, 'Security Threat and Misperceptions', in Paul Cornish (ed.), *Britain and Security* (London: The Smith Institute, 2007).

[34] See Tom Burke and Nick Mabey, E3G, 'Europe in the World: Political Choices for Security and Prosperity' (London, 2006).

peace and security and national stability from climate change, but in a relatively non-specific manner and by presenting broad scenarios rather than specific country case studies.

Good examples of the type of analysis underpinning this debate are the CSIS report, 'Age of Consequences', which laid out three scenarios for future security challenges and the comprehensive report from the German WBGU Committee on 'World in Transition: Climate Change as a Security Risk'. The most major incidence of the general climate security debate was the discussion in the UN Security Council in April 2007, where most countries speaking accepted the general link between climate change and security. However, there was deliberately no attempt to arrive at consensus language on either specific threats or conflicts.

The main aim of the public climate security debate is to motivate greater urgency in mitigating the drivers of climate change and, to a lesser extent, to increase action to adapt to climate change. The role of security actors in this debate has mainly been to provide analytic authority for the projections of the security impacts of climate change. This is an important role, as there have been significant (and mostly unproductive) disputes in the past between analysts over the role environmental factors have played in driving conflict.

However, there is a more profound role which security actors could play in the general climate change debate by applying their understanding of how to assess and manage significant societal risks. There are currently three main professional communities addressing the pace and scale of action on climate change: scientists, environmentalists and economists. Each of these communities has its own biases when dealing with risks and threats, none of which correctly define a risk management framework which fits the reality of climate change.

Scientists are in the business of supplying proof, and therefore typically work to a 95 per cent certainty for defining robust evidence; this tends to bias them away from highlighting less well understood – but still likely – phenomena such as positive climate feedback mechanisms. Recognising the different needs of policy makers, the IPCC process has gradually evolved better mechanisms for handling risk using more probabilistic assessment measures, with specific and well-defined language (e.g. high probability) for distinguishing ranges of uncertainty over particular results (and which has strong similarities to best-practice intelligence analysis methods). Environmentalists tend to build their assessments on the science, but, to make up for the reluctance of scientists to highlight significant risks, have developed the 'precautionary principle' which prescribes action to reduce uncertain risks when impact may be high and irreversible. However, there has been reluctance among environmentalists to highlight the potentially high cost of social breakdown from climate change, and perhaps an unrealistically high level of optimism over the potential for international co-operation.

On the other hand, the standard analytical frameworks used by economists implicitly assume impact from climate change will be marginal and reversible, or can be compensated by financial transfers, and by discounting the future heavily, reduce the importance of potentially catastrophic outcomes.[35] There has also been an over-emphasis on the costs of moving first to tackle climate change, especially on competitiveness, even though most serious analysis shows these costs to be negligible.[36] The Stern Report was the most advanced attempt by the economics community to overcome some of these biases, and resulted in far larger estimates of climate damages than previous studies; with a range of 5–20 per cent of global GDP compared to 2–5 per cent in the existing literature.[37] These increases were mainly driven by the explicit ethical choice made by Stern to use a low discount rate which results in a higher present valuation of future damage costs. The Stern Review also acknowledged that their estimates were biased downwards because they could not calculate the costs of social conflict and disruption. More recent work by Weitzman which explicitly considers how to correctly address high impact climate change events suggests that costs estimates should be increased even further, perhaps

[35] For a discussion of precautionary principle and climate change see Nick Mabey, Stephen Hall, Clare Smith and Sujata Gupta *Argument in the Greenhouse: The International Economics of Controlling Global Warming* (London: Routledge, 1997).

[36] See Climate Strategies, 'Climate Change and European Competitiveness' (London, 2007).

[37] For an example of the critical reaction raised by Stern's analysis from parts of the economics community see Richard Tol's response at <http://www.fnu.zmaw.de/fileadmin/fnu-files/reports/sternreview.pdf>.

by up to ten times.[38] Given recent changes it seems likely that economists will begin to move away from the ambiguous positions outlined in the 2007 IPCC report and back more aggressive climate change action.

The security community – though not without its own biases – potentially brings a set of complementary skills to the climate change debate. Firstly, it complements environmental and economic analysis of the impact of climate change by bringing an authoritative analysis of its potential security and stability effects,[39] though there is much more that could be done to deepen this analysis, which is covered below. Secondly, it brings a willingness to consider the consequences of more catastrophic scenarios and the degree of societal mobilisation needed to address them.

Despite the public attention given to climate change, the current amount of public spending and cost of climate regulation is relatively small. For example, it is far outweighed by military and security budgets. Europe, the leading region currently tackling climate change, spends €202 billion on its (combined national and EU) annual military budget, while its climate change targets are estimated to cost under €7 billion per annum to reach and perhaps €3 billion is spent on purchasing carbon credits outside the EU.[40] In contrast, the Stern Review estimates that the total cost of achieving aggressive greenhouse gas stabilisation would be around 1–2 per cent of global GDP (though most of this is unlikely to be public spending), which is comparable to global military expenditure of 2.5 per cent of GDP in 2006. An estimate of the share of these costs to be covered by developed countries, which takes into account historical responsibilities for emissions, suggests that the EU would pay around €100 billion per annum (around 80 per cent of the current EU budget) and the

---

[38] Martin L. Weitzman, Structural Uncertainty and the Value of Statistical Life in the Economics of Catastrophic Climate Change, mimeo, Harvard University, 30 July 2007.

[39] It is interesting that the majority of studies done in this area have been by initiated by mainstream security analysts, not environmental or environmental security analysts who led much of the previous 'environmental security' debate.

[40] European Emission trading figures and costs can be found at <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/05/84&format=HTML&aged=1&language=EN&guiLanguage=en>.

US $212 billion.[41] These are large absolute costs, but a manageable price to pay for climate change compared to spending on other public goods such as health, welfare, education and traditional security.

The security community has unique experience to contribute to the global process of constructing a political and policy response that is adequate to tackle the risks of climate change. However, it will need to operate outside its traditional policy sphere and comfort zone if it is play its full role in the global climate change debate.

The Security Case for Investing in a Disruptive Transition to a Low-carbon Economy

Security actors should grasp the security opportunity of the transition to a low-carbon economy, as it will significantly reduce threats to international peace and security, from both climate change and competition over energy. A low-carbon future will be a more energy-secure future. Countries will consume far less energy, and the energy they do use will derive from domestic sources such as renewable energy, nuclear power, coal with carbon capture and storage. Transportation will be steered onto a mixture of biofuels, sourced from a wide range of countries, and locally produced electricity.

The energy security benefits of a low-carbon economy are large and tangible. Instability in oil-exporting countries was estimated to add a $10–$15 per barrel premium to oil prices in 2006, costing the UK between $6 billion and $9 billion a year; far more than estimates of the cost of any future conventional terrorist attack. The recent rise in oil prices have cost low-income countries $270 billion, compared with net aid flows of $85 billion, reducing the pace of economic growth and poverty reduction. Large opportunities exist to save energy cost-effectively in these countries, which could be supplemented by international carbon finance under a global climate agreement. For producer countries, the distorting and corrupting effects of oil dependency are one of the main causes of civil wars and foreign interference, and generally bring little economic prosperity for the

---

41 Christian Aid, 'Truly Inconvenient: Tackling Poverty and Climate Change at Once' (London, 2007).

majority of the population (itself a source of conflict). Developing countries with few natural resources grew two to three times faster than countries with resource-dependent economies over the last forty years.[42]

As oil and gas reserves become ever more concentrated in unstable areas of the world, the benefits of diversification into new sources of energy will increase. However, there remains some clear tensions between achieving climate security, and the energy security imperative of utilising local (but high-carbon) energy sources such as coal, lignite (brown coal) and tar sands. These sources exist in all the major energy consumers of Europe, North America, India, South Africa and China. In the future, countries will no longer be able to buy their own national energy security at the expense of increasing *global* climate insecurity. Only the successful development of carbon capture and storage or radical breakthroughs in renewable energy (e.g. cheap solar power) will allow this tension to be resolved, but this is a highly capital-intensive process and major public funds for commercial scale CCS plants have yet to be delivered, despite political declarations of intent in Europe, the US and Middle East.

The powerful confluence of urgent energy and climate security interests could generate enough political will to overturn the interests of existing energy producers in the status quo. To an extent, the current ethanol boom in the US – driven by cumulative subsidies of $90 billion – shows how quickly sectors can be changed; though this has been to the detriment of the climate as corn ethanol generates more emissions in production than it saves by displacing oil. However, the pace of change generally has not been fast enough to meet the urgent challenges. Current approaches to climate change mitigation assume rather linear and steady change, as carbon budgets are progressively tightened, with few fundamental surprises in technologies or lifestyles. However, this does not reflect the history of technological change which has tended to be punctuated, disruptive and lumpy in its impact, leaving large amounts of redundant infrastructure from the previous technological generation: for example, the replacement of canals by railways in the nineteenth century, or the dotcom and telecoms boom in the 1990s.

---

[42] World Bank, 'Extractive Industries Review' (Washington DC, 2004).

There is little emphasis on preventing economies being locked into high-carbon infrastructure, which would last for 40–100 years. For example, China will build the equivalent of the total housing stock of Western Europe in the next ten years which will leave a legacy of inefficiency for the next hundred years. Policies to tackle lock-in must emphasise aggressive development of technology and the rapid deployment of current energy efficiency measures to delay the need for new supply-side investments, until low-carbon technologies are available at commercial scale.[43]

If some of the critical climate change tipping points occur sooner than expected, there will also be huge political pressure – and indeed raw panic – to move abruptly to a low-carbon economy, even if this is highly expensive. At the moment, there are no available options to deploy in such a 'crash' climate change programme; for example, a lack of nuclear qualified engineers and manufacturers would make a massive global expansion of fission reactors unsustainable on safety grounds.

Despite the current political focus on energy and climate security, public R&D spending is currently much lower than in the early 1980s. Europe, which leads the world in deployment of low-carbon technologies, only spends a quarter of what it did in the 1980s (€2.5 billion in 2006) and is increasing the Community energy research budget by only 50 per cent for the next 7 years, to €886 million.[44] A similar pattern is repeated elsewhere, with public R&D in the US declining by 50 per cent and Japan's being static.[45] The difference has not been made up by private sector R&D which has been static or falling in real terms in most regions. Current estimates of carbon prices between €20–30 per tonne of CO_2 over the next 20 years are not high enough to make major R&D investments profitable, especially in the

---

43 For an extensive discussion of lock-issues focused on China and the EU see Chatham House and E3G, 'Changing Climates' (London, 2007) <http://www.chathamhouse.org.uk/publications/papers/view/-/id/580/>.

44 European Commission, 'A European Strategic Energy Technology Plan 'Towards a low carbon Future'' *SEC (2007) 1508-11* (Brussels, 2007).

45 General Accounting Office, 'Department of Energy: Key Challenges remain for the developing and deploying advanced energy technologies to meet our future needs', *GAO-07-106*, US Congress (Washington DC, 2006).

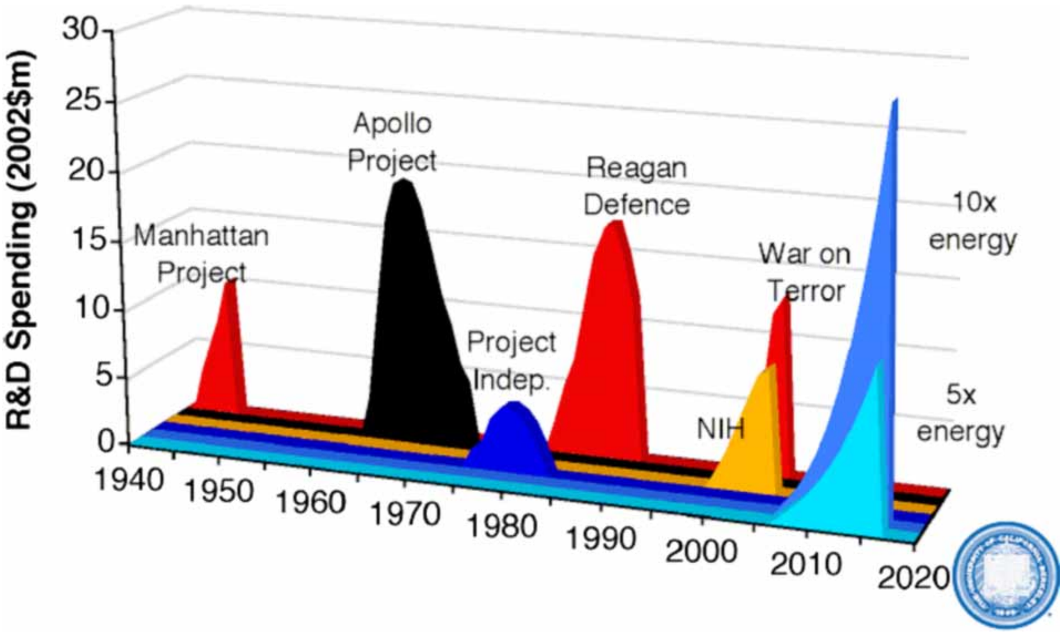

Figure 5 Past US Public R&D Programmes Compared to Radically Increased Energy Research[46]

power sector, and areas such as renewables are currently driven by regulation, not carbon prices.

Despite difficulties in estimating R&D demands, a number of researchers, including the Stern Review, have suggested that global energy R&D should be expanded by two to five times to meet the climate change challenge. Though this sounds an ambitious increase, it has been achieved before, even in peacetime. Figure 5 shows that a five-fold expansion of the US federal R&D budget would be comparable to the Manhattan Project or the War on Terror; a ten-fold increase would be analogous to the Apollo programme or the defence research spending of the Reagan era.

The security community is used to motivating public investment and action at significant scale to deliver long term and often uncertain ends. The security community also has vast experience – earned at a very high price and through multiple failures – of how to aggressively drive the development and deployment of new technology to tight timescales, and the unavoidable economic risks this involves. This has required the continuation of a relatively interventionist economic

[46] Gregory Nemet and Daniel Kammen, 'Energy R&D: Declining Investment, Increasing Need, and the Feasibility of Expansion', Energy and Resources Group, University of California, Berkeley, 26 September 2006.

approach at odds with the current policy fashion in many developed countries. Without the application of such ambition and focus, and incorporating the knowledge of past security policy failures and successes, it is unlikely that sufficient resources and technology will be mobilised in time to tackle the climate change threat.

There is a strong security rationale to accelerate the deployment of technologies which deliver critical disruptive technologies for energy and climate security. Key areas would include:

- Large scale carbon capture and storage technologies which remove the trade-off in coal use between energy and climate security
- Second (cellulosic) and third (modified bacterial) generation biofuels which directly tackles oil dependence when combined with
- Ultra-high efficiency hybrid 'hypercars'[47] which would allow alternative low-carbon fuels to displace a high proportion of transport demand without requiring massive (and slow) scale-up of low-carbon power plants
- Thin film solar energy and concentrated solar thermal are both potentially fast-scaling technologies with global application which could be deployed in response to a crash climate programme.

All of these technologies can feasibly be developed to a deployable stage in the next five to ten years given sufficient investment, though there are some fundamental material and scientific challenges on thin film solar and advanced biofuels. There is also a need to invest in basic science in biotechnology, materials and nanotechnology, which will underpin the next generation of low-carbon solutions.

Security actors should promote a dramatic scaling up of research and development into technologies critical for delivering large scale energy and climate security transformation. This will require programmes commensurable with current investment in the War on Terror and if a crash response to extreme climate change is needed, then levels similar to the Apollo programme are necessary.

---

[47] See <http://www.hypercar.com/> for the design concept.

Security and Foreign Policy Responses to Climate Change

Beyond the general climate security debate, a more specialised set of discussions have emerged which look at climate change as a serious challenge to existing security postures and objectives. The key audiences for these discussions are foreign ministries, the military, and development and peacebuilding communities. Their primary aim is to understand the necessary re-orientation of existing strategic, operational and organisational approaches in a climate-changed future.

These discussions are understandably less mature than the general climate security debate, as they require more detailed understanding of the impact of climate change. Probably the leading example of this type of work is the CNA Corporation National Security and the Threat of Climate Change Report, written by a group of retired senior US military officers. This type of work more explicitly focuses on how national interests are affected by climate change and looks across a broad range of security and foreign policy issues.[48]

This work has begun to establish a clear framework for understanding these issues in detail, and significantly has moved the framing of debate on climate security away from the rather sterile discussions over whether environmental factors cause specific conflicts. Climate change is characterised as a threat multiplier, interacting with numerous other sources of risk and fragility to increase the likelihood of crisis and conflict. This is consistent with a broader move in the understanding of conflict drivers away from simple 'causality' models towards the use of risk-based approaches which recognise the inherent complexity of conflict dynamics.[49]

Discussion focuses on responding to climate change over the next thirty years, which is typically the maximum security planning horizon and often before the most extreme impact of climate change

---

[48] Other analysis has looked more directly at foreign policy, such as IISD, 'Climate Change and Foreign Policy' (Geneva, 2007) <http://www.iisd.org/pdf/2007/climate_foreign_policy.pdf>.

[49] For a review and discussion of applied conflict risk assessment approaches see Nick Mabey and Chris Yiu, Prime Ministers Strategy Unit, Background Paper, 'Practical Risk Assessment, Early Warning and Knowledge Management' (London, 2005) <http://www.cabinetoffice.gov.uk/upload/assets/www.cabinetoffice.gov.uk/strategy/2technical.pdf>.

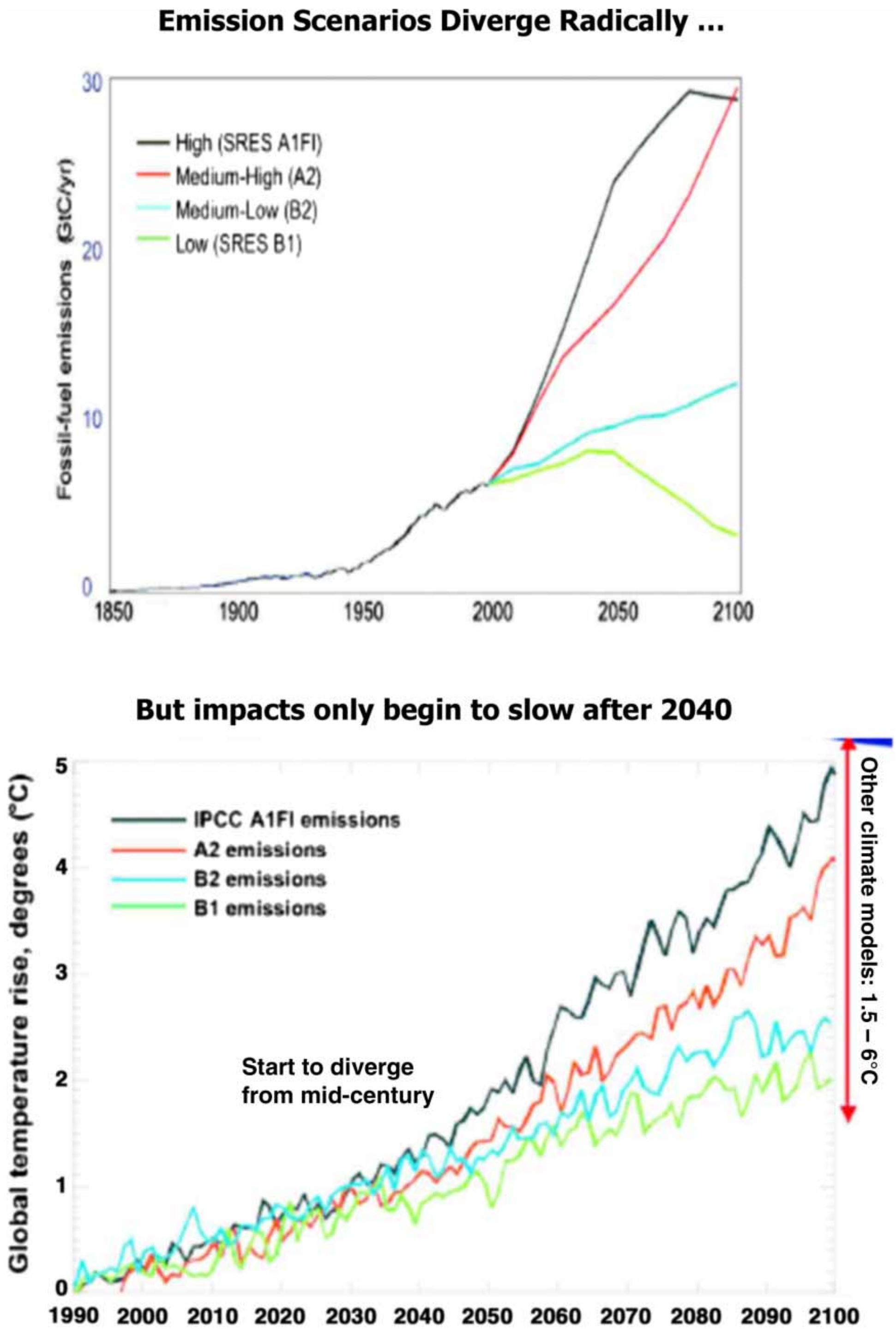

Figure 6 Mitigation Scenarios and Temperature Rise to 2100

may occur. We can do little to affect the magnitude of climate change on this time scale. As Figure 6 shows, even the most aggressive mitigation scenario is still likely to result in 0.5–0.7°C temperature rise this century.

Over this period, the critical variable shaping the future is the capacity of countries to adapt to climate change in a peaceful and stable manner. There is no absolute link to security and stability. All impact is mediated by governance and institutional capacity, whether at international, regional, national or sub-national levels. This makes the scale of security analysis critical, as broad generalisations will fail if they do not take into account the specific factors which will make adaptation to similar levels of climate change differ in, for example, Botswana, Namibia and Angola. In the past, climate change projections have not provided fine-grained enough results to allow detailed integration with social and political data, but this is changing as computing power increases and the number of detailed regional and country impact studies grows.

With this important caveat, some general points can be outlined. Peaceful adaptation to climate change will be fundamentally challenged by borders, existing property rights (e.g. for water) and vested interests in maintaining control over resources at all levels; local, sub-national, national and regional. Poor governance systems, and especially communally controlled resource management systems, will *amplify* the impact of climate change and not dampen it, as climate change disrupts the existing the political economy of resource allocation and management.

In an increasingly interconnected world a wide range of interests will be challenged by both the internal and trans-boundary security impact of climate change; some of these shocks as seen by the UK Ministry of Defence's Defence Academy are given in Box 3. Developed country investment in China is vulnerable to climate change driven social instability; drugs control policy will be undermined by drought driven poverty in Afghanistan and the impact of increased hurricane activity in the Caribbean. Islamic extremism would be fuelled by economic failure in North Africa, if the impact of climate change on the agricultural and tourism industries is not compensated. Oil prices are vulnerable to extreme weather events in the Niger Delta and Mexican Gulf.

The impact of climate mitigation policies (or policy failures) will drive political tension nationally and internationally, whether through the impact of changing demand on oil producers or through rising food prices as the use of biofuels expands. In all cases, climate change will produce unique political reactions because of its trans-boundary nature. At a moral level, climate change driven deaths from malaria in

Box 3: UK Ministry of Defence Views on Some Strategic Shocks linked to Climate Change[50]

Revolution in the Supply of Energy

Investment in alternative sources of energy, particularly hydrogen power, offers the possibility of an affordable, miniaturised, autonomous power source, especially as advanced fuel cells could enable power to be stored for transport systems and other remote platforms. A sudden and early breakthrough would reduce global dependence on increasingly scarce fossil fuels and the unstable regions from which they are obtained, significantly altering the geo-political context of the early twenty-first century. Similar shocks might arise from early breakthroughs in nuclear fusion and the exploitation of methanol and ethanol.

Collapse of Fish Stocks

The largest single source of protein for human beings is fish. Most of the world's major fisheries are being exploited beyond their sustainable yield and, with climate change, the sea is becoming more acidic. A global collapse in fish stocks, resulting from overfishing or climate change would result in the economic collapse of coastal populations, social instability and widespread hunger, as well as the loss of a significant source of carbon capture. South and East Asia, with higher than global average dependence on fish protein, would be especially severely affected.

Africa Becomes a Failed Continent

Challenges, including climate change and HIV/AIDS, scarcity of food and water and regional conflict could lead to Africa becoming a failed continent, where even large, currently self-sustaining states become chaotic. Outside engagement and intervention would effectively be limited to a small number of well-defended entry points and corridors, which would provide access to raw materials essential to the global economy. Nations or corporations wishing to trade with Africa would increasingly be required to provide security for their nationals and the necessary support to sustain critical areas of access and security.

---

[50] This is an extract from a UK Ministry of Defence document, which provides further evidence of the mainstreaming of climate security issues by conventional defence analysis. DCDC (Development, Concepts and Doctrine centre), 'Strategic Trends 2030' (London: UK Ministry of Defence – Defence Academy, 2007).

Youth Reaction

Declining youth populations in Western societies could become increasingly dissatisfied with their economically burdensome 'baby-boomer' elders, among whom much of societies' wealth would be concentrated. Resentful at a generation whose values appear to be out of step with tightening resource constraints, the young might seek a return to an order provided by more conservative values and structures. This could lead to a civic renaissance, with strict penalties for those failing to fulfil their social obligations. It might also open the way to policies which permit euthanasia as a means to reduce the burden of care for the elderly.

Terrorist Coalition of the Willing

Islamist terrorism is likely to remain the most obvious manifestation of the international terrorist threat until at least 2020. However, changes in the strategic context could cause this threat to evolve in unusual ways. A generational change among leading Islamist terrorists could lead to a more broadly based coalition in opposition to globalisation and modernisation. A terrorist coalition, including a wide range of reactionary and revolutionary rejectionists, such as ultra-nationalists, religious groupings and even extreme environmentalists, might conduct a global campaign of greater intensity.

Chinese Collapse

China's economic growth will be accompanied by significant demographic changes, including the urbanisation of its population, which uniquely among developing countries, is ageing. These factors, together with changing patterns of land use, the failure to deliver per capita prosperity and environmental stresses caused by climate change and pollution, could reduce China's traditional resilience to natural disaster. A future large-scale disaster might therefore cause China's progress towards strategic power status to stall and might even result in it becoming a failed state, prone to civil conflict and separatism.

developing countries will be seen differently than existing malaria deaths, because they will be characterised as the result of wasteful over-consumption by a privileged group. The precise differentiation of causality around malaria deaths will not always be required to cause controversy, but as climate change allows malaria to move into new areas it will definitely become politicised. Falling demand for Russian gas (by up to 40% from business-as-usual in some scenarios by 2020) due to European climate change policy may be seen as a political move worthy of a political response, however symbolic, compared to a similar fall caused by market movements. Ironically given current European pre-occupation with dependence on Russian gas supplies, the largest security threat to Europe could be increased Russian instability if gas revenues slump as climate policies begin to bite. The best strategic response is likely to be the counter-intuitive policy of European encouragement to increase Russian gas exports to China, which will also reduce Chinese greenhouse emissions by displacing coal power with gas.

There is no way security policy can avoid incorporating these impacts if it is to remain effective in protecting vital national interests. The quicker security policy adapts to the realities of climate change, the more likely it will be to preserve its objectives. This is not a matter of commissioning more studies, or the occasional piece of futures work, though both are necessary. An effective response will require systematic integration of climate change in to everyday mainstream analysis, strategy and operations; these issues are too fundamental to be bolted onto existing institutions.

To achieve this, security policy will need to progressively move towards a more preventive, risk-based stance and away from a reactive approach. There is no time to learn by doing, as climate change will constantly produce new challenges. This will require greater investment in information systems, preventive capacity and governance building by diplomatic, military and development actors.

The process of adapting existing institutions to the new security context of a climate-changed world needs to be accelerated. The security voice must be present in discussion around the mitigation challenge, and in managing the security implications of climate change policy. While there is more time to prepare to respond to the worst impact of climate change, these pressures seem to be rising faster than expected. The first signs of the necessary reforms are emerging in some countries, but there is still a long way to go.

The next sections of this paper outline a framework for climate security analysis and some of its implications for security policy, practice and institutional change.

VI. DECISION SUPPORT FOR CLIMATE SECURITY

Climate change presents some new challenges to security decision-makers. Despite a history of commissioning long-range scenario and political analysis to guide strategic policy assessments and capability planning, never before has such a broad and diverse field of scientific endeavour had to be incorporated wholesale into security analysis; let alone one so based on highly complex modelling into the far future. Climate change has to be integrated into security decision-making, but this must be done in a structured manner that avoids massive information overload on security decision-makers, or ad hoc and inconsistent cherry-picking of scientific results by security analysts.

Though the broad connections can be drawn between climate change and future security challenges, this is only relevant if information is accurate and reliable enough to be able to drive real changes in strategy, policy and operations. Therefore the first critical step to constructing a security response to climate change must be to analyse the information needs of decision-makers around different security challenges.

To be useful to decision-makers, analysis of climate security issues should be structured to support the critical types of decisions which are needed in day-to-day security and foreign policy. This 'decision support' approach requires a carefully tailoring of information to decision needs, and critically in the case of climate change, defines the accuracy and detail of information necessary to make sensible choices between different courses of action. There is a vast range of climate change data available, but virtually none has been produced specifically to inform security decisions. It is critical that the security sector begins to carefully define its information needs so it can begin to support the necessary research, tools and analysis needed to underpin decisions.

Analysis of decision support requires three distinct stages. Firstly, analysis of the type of strategic decisions which may be involved and over what timescale they need to be made. Secondly, analysis of the range of information and analysis needed to support these decisions. Lastly, analysis of the type of data and tools needed to provide necessary information for decision support.[51]

Three levels of decision-making are critical for climate security:

> **Geo-strategic**: how the interests, intent and strategies of different countries and groups will be impacted by climate change and climate change policy; for example, EU-Russia relations or US-China relations. This mainly involves analysis of country intent and perception over the importance and impact of these factors. For example, China and India may change their energy security objectives towards greater reliance on gas and nuclear energy in light of climate change, with knock-on impact on proliferation and their strategic foreign policy and energy relations with Burma and Russia.
>
> **Strategic Impact**: analysis of how strategic objectives – anti-terrorism, conflict prevention, energy security, poverty reduction, etc. – will be impacted by climate change. This mainly requires analysis of how regional, country and/or sub-national stability, conflict and economic development are affected by these factors, and how contingency planning and medium-term preventive responses will be affected by future trends.

---

[51] This section draws heavily on work carried out in the UK Prime Minister's Strategy Unit (PMSU) on decision support for addressing Countries at Risk of Instability, involving a two year process working with the full range of cross-governmental and international actors; a public summary of this work can be found in PMSU, 'Investing in Prevention, Cabinet Office' (London, 2005) <http://www.cabinetoffice.gov.uk/strategy/work_areas/countries_at_risk.aspx>.

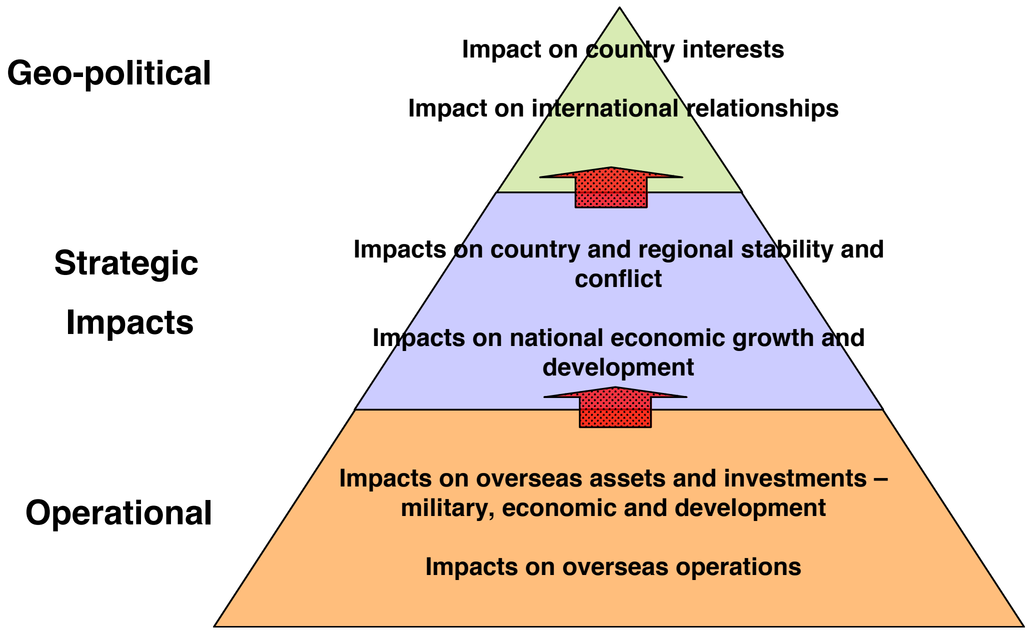

Figure 7 Pyramid of Climate Security Analysis

> **Operational and Capability Planning**: analysis of how climate change will affect specific military assets, economic investments or development projects, and impact on equipment and capability planning for future military, development and humanitarian operations. This requires detailed data on climate change impact at particular geographical locations.

These levels can be placed in a 'pyramid of analysis', as shown in Figure 7. The area of the pyramid is intended to roughly represent the volume of specific climate and security analysis needed at each level. For while relatively robust conclusions can be made at the geo-political level using very broad brush data, deciding on whether to refurbish a specific military base which is potentially vulnerable to climate change would require highly specific and detailed analysis looking forward thirty years.

For each level of decision making, a range of information is needed to generate robust strategic options, which will need to guide decisions over several timescales. Geo-political analysis depends on assessments of interests, perceptions and intent and will be one of the first to respond to the future power impact of climate change – as has been seen in the Arctic. Strategic and operational impact depends on more structured analysis of how specific changes in climate impact affect particular areas. The strategic level is perhaps the most difficult and complex, because it is here where the impact of climate change on the behaviour of societies and polities must be assessed, inside a complex web of political and resource economy.

Critically developing strategic responses at the geo-political and strategic levels requires a 'whole of government' approach linking diplomatic, military, development, humanitarian and security ministries. This will often have to be replicated at international level and with international organisations and agencies. This adds an additional level of complication to an already complex task. Detailed institutional analysis of security systems across major governments has repeatedly shown them to be poor at conducting structured medium- to long-term analysis, especially if it requires multi-disciplinary approaches and a significant level of quantification.[52]

In contrast, operational responses will generally be controlled by a single actor or ministry, and are therefore easier to undertake. This will produce an underlying bias towards reactive and defensive responses in many cases; for example, from a single development agency point of view it is easier to decide not to pursue development activity in a flood prone area of a developing country where investment may be destroyed, than to build a consortium of donors and governments at sufficient scale to deploy a long-term flood management plan which is resilient to climate change.

Further development of climate security analysis will require detailed analysis over differing timescales and levels of resolution. At each level, issues of uncertainty in scientific modelling will require different types of risk management to inform actual decisions. For example, if there is a 50 per cent chance by 2020 of rainfall in a region of Afghanistan falling below the levels necessary to sustain a growing population on the land, should a policy of urban resettlement replace the current one of agricultural alternatives as a drug eradication policy? How would this affect existing tribal structures and the immediate fight against the Taliban?

Currently a lack of detailed climate data and shortage of security analytical resources mean that in most cases it will be impossible to

---

[52] For a comparative review of reforms see Patrick and Brown, *Greater than the Sum of its Parts? Assessing whole of government approaches to fragile states* (New York: International Peace Academy, 2007) <http://www.ipacademy.org>.

answer these types of critical questions with rigorous analysis, and sensible judgements must be formed using the best available data. However, as climate change impact modelling and monitoring improves – as it will, given the considerable investment in analysis and technology underway – then security analysis will need to be able to absorb and use this type of detailed information. Detailed analysis of the steps needed to achieve this are examined later in Section IX.

The next two sections give an overview of the geo-political and strategic impact of climate change. The geo-politics section uses current knowledge of the high-level impact of climate change combined with political analysis of countries' positions on climate change, energy security and other policy to examine some of the critical geo-political issues surrounding climate security. The second section examines in more detail how to address the potential of increased country and regional instability and conflict due to climate change, and provides recommendations for improving response strategies to risks in specific regions and countries. The issues of operational impacts are not covered as this requires highly contextual information and the general approach to this has been well addressed elsewhere (for example, the CNA report on National Security and Climate Change).

Climate change poses a systemic challenge to security policy. It requires the type of joined-up, long-term and preventive approach to security which has long been advocated, but seldom implemented in real decisions. The urgency and scale of climate change may provide the catalyst for delivering some of the change agenda which has been outlined on general conflict prevention and 'soft power' over the last decade,[53] and going beyond this to develop the full range of capabilities needed for the rigours of a climate-changed world.

[53] For example, the complementary agendas described by the UN High Level Panel on Threats and Opportunities in 2004; the EU Security Strategy in 2003; and the Africa Commission in 2005.

VII. RESPONDING TO A CHANGING GEO-POLITICAL LANDSCAPE

> [T]he interdependent world, for all of its promise, is inevitably unsustainable because it's unstable. We cannot continue to live in a world where we grow more and more and more interdependent, and we have no over-arching system to have the positive elements of interdependence outweigh the negative ones.

Former US President Bill Clinton, 2003

> Climate change is an act of aggression by the rich against the poor.

Ugandan President Yoweri Museveni, 2007

Responding to climate change will require fundamental changes in the practice of international relations, and will alter much of the focus of international security policy. Climate change will immediately introduce a new set of interests into geo-political calculations: the costs of climate change and the costs of responding to climate change. As climate change impact continues growing, it will change de facto resource allocation by altering river flow patterns and fish stock locations. It will then begin to change borders, through rising sea-levels, shifting rivers and melting ice caps. Eventually, as populations move within and across borders, it will raise fundamental issues of sovereignty, citizenship and responsibility. If polluting countries fail to prevent the worst impact of climate change, then it will be seen as an act of international aggression against the victims.

These effects will alter perceptions of interest, and therefore the shape and focus of alliances across a wide range of policy areas. In many ways, the geo-political implications of climate change will change faster than much of the physical impact. Geo-politics is, at its heart, a discussion of interests, relationships, intent and long-term identity. Climate change will impact all of these areas and also affect the interpretation and validity of global norms such as basic human rights, nation-state sovereignty and the emerging norm of Responsibility to Protect.

In any changing geo-political context, there is a basic taxonomy of strategic responses which countries can adopt:

- **Isolation** – closing/restricting borders, pursuing self-sufficiency in energy, increasing adaptation expenditure;
- **Buffering** – reducing exposure to global shocks, by for instance building national oil reserves, diversifying export markets and reducing reliance on vulnerable countries;
- **Reaction** – rapid response to emergent threats, for instance through military intervention and international humanitarian activity; and
- **Prevention** – investing in global, regional and national governance networks to reduce instability and strengthen governance in areas of key threat.

There is no simple choice as to which mix of strategies is best at any one time; all responses are costly and have different probabilities of success. The effectiveness of each approach is heavily determined by the prevailing political context and willingness of others to co-operate.

Climate change could drive a more preventive and collaborative approach to international relations extending to areas such as energy security, conflict prevention and development. Alternatively, climate change could exacerbate tensions between and within countries, leading to a 'politics of insecurity' as countries focus on protecting themselves against its impact because co-operation is weak and fails to deliver collective climate security.

The next sections examine the geo-political impact of climate change in five critical areas: global economic relationships; energy security policy and politics; nuclear proliferation; managing borders and neighbours; and global resentment. This is by no means an exhaustive list of areas which will need to be re-evaluated, but gives a flavour of the range and complexity of issues involved.

Each area raises the need for a strategic adjustment of country interests, alliances and strategies in response to climate change, across the broad range of economic and security issues. Designing detailed responses in each area will require a comprehensive re-evaluation based on a systematic view of future trends and climate change impact.

Interdependent Interests: Tackling Climate Change in a Globalised Economy

> Europe's economic health increasingly depends on a thriving Chinese economy. Should China falter as we progress through this century, European pension funds would struggle to earn the returns necessary to pay our pensions. As Europe's population ages, the drag on our economies would be immense.
>
> *John Ashton, UK Special Representative on Climate Change, 2007*

Climate change will fundamentally alter how economic interests are perceived between countries in trade, investment and most crucially in technology. Only by harnessing the power of globalisation to the transformation to a low-carbon economy are we likely to achieve the rapid changes needed to ensure climate security, but this will require shifts in political positions which go against the current rise in protectionist sentiment in the OECD countries, particularly concerning China.

This changing pattern of interests, and the difficulty of resolving them, was perfectly illustrated earlier this year when EU trade officials voted informally to remove anti-dumping duties on energy-efficient compact fluorescent lamps from China. These duties add import taxes of up to 66 per cent on the Chinese imports. Cutting the duties appears logical, since the Union is moving towards phasing out less efficient lighting in 2009 and China today produces four fifths of the world's energy-saving light bulbs, with exports worth $1.5 billion last year. It is estimated that cutting these duties could save the EU up to 28 million tonnes of CO_2 every year. But the decision divided European actors into opposing camps. Osram, an arm of Germany's Siemens, an electronics company, pushed for the duties to be extended, citing risks to hundreds of jobs in the EU. Philips, a Dutch manufacturer, and other manufacturers, wanted the duties lifted, supporting an aggressive expansion in the European market for high-efficiency lighting. The eventual compromise was a temporary renewal of duties for a year, but a clear sign of intent towards liberal trade in energy efficient products.[54]

To effectively decarbonise the global economy, the world needs China to produce low-carbon goods. This will lower the cost of compliance in the OECD, as Chinese power equipment is typically 30–60 per cent cheaper to purchase, and would help China drive its own low-carbon transformation. However, encouraging greater exports from China is seen as political suicide in Europe, Japan and the US. In the same way, achieving a global agreement on climate security is likely to require large fiscal transfers to China through carbon markets and public investment. The Stern Review estimated additional Chinese investment needs to be in the order of $10-25 billion per annum by 2015.[55] Already, European companies have spent billions of euros buying carbon credits in China, and China has created a €2 billion Green Energy Fund just from the windfall profits of these transactions. However, the public support for expended transfers is very low – particularly in the US and Japan – with companies arguing that they should not have to pay their competitors to save energy.

An aggressive approach to climate mitigation would also require a concerted effort to develop new low-carbon technologies with fast industrialising economies such as China and India. Radical new solutions to meet energy security and climate challenges present genuine opportunities for new models of technological co-operation, which may also require changes to existing intellectual property right regimes to take account of the public good of these technologies.

---

[54] See Bernice Lee and Nick Mabey, 'Towards a Low Carbon Future: China and the European Union', in *The World Today* (London: Chatham House, November 2007).

[55] Estimates derived from Stern 2007, and World Bank, Clean Energy Investment Framework, 2007.

China has already called for a new Climate Technology Fund to buy patented technologies and make them freely available, and a redefinition of the international intellectual property rights regime for these technologies to make them more widely available; unsurprisingly, these proposals have not been supported by developed countries.

Developed countries will need to reconsider these positions, as the increased production of advanced low carbon technologies by Chinese and Indian firms is critical to delivering climate security for OECD countries. OECD manufacturers will not be the main builders of China or India's low-carbon infrastructure, so domestic firms must have access to the best technology developed in the West before they invest in old, dirty technologies. Facilitating the transition to a low-carbon future also requires removing tariff and non-tariff barriers to trade in low-carbon, energy-efficient and environmentally friendly goods and services. It would indeed be mad to continue to use systems under the Kyoto Protocol and its successors, which subsidise the use of low-carbon technology in industrialising countries, while simultaneously raising the cost of access to the best of these technologies and restricting trade in low-cost solutions. However, companies and governments in developing countries often object to such liberalising measures for industrial policy reasons; for example, India levies tariffs of up to 36 per cent on imports of electric motors, which account for a large proportion of industrial electricity use.

Luckily, the economic choices are less stark than perhaps they appear at first sight. As manufacturing supply chains integrate across borders, the gross value of exports is not necessarily indicative of economic benefits for the exporting country. Despite the headlines over the US-China trade deficit, a recent study suggested that for the year 2002, for every US$1,000 of Chinese exports to the United States, only US$386 of value accrued in China, with US companies usually gaining the lion's share of value added.[56] The majority of China's trade

[56] Lawrence J. Lau, Xikang Chen, Leonard K. Cheng, K. C. Fung, Jiansuo Pei, Yun-Wing Sung, Zhipeng Tang, Yanyan Xiong, Cuihong Yang and Kunfu Zhu, 'Estimates of US-China Trade Balances in Terms of Domestic Value-Added', Stanford Centre for International Development, *Working Paper No. 295*, September 2006.

in hi-tech products stems from processing operations, 80 per cent of which are carried out by foreign companies established in China.[57] Working with China and India to deliver climate security will benefit OECD firms, not just strengthen their competitors.

However, whatever the economic realities the political barriers to achieving a scale-up of low-carbon co-operation, investment or trade at this scale remain formidable. As long as China is seen as the enemy – and in the US and Japan increasingly as a military threat – it will be very hard to gain political support for the economic and technological linkages which will help drive global decarbonisation. This would require a fundamental change in attitudes in the policy-making elite, especially among security experts in the US and Japan, as well as sizeable change in public opinion.

The mirror-image of OECD discussions focused on China's strength – and the foreign exchange in its sovereign funds – are Chinese perceptions of its own weakness. Faced with the need to drive its economy at a high pace in order to prevent social instability, it is also aware that growing environmental impact and climate change will be a major threat in the coming decades.[58] China is uncertain it can decarbonise without destabilising itself, but fears being pressured to do this through trade sanctions from the OECD. Although, given economic interdependence these are unlikely to be effective, every climate change bill currently in the US Congress has some form of trade measure aimed at China, and similar measures are on the table in Europe (though with the US as an additional target!). These measures have not gone unnoticed in China, and strengthen the hands of those who downplay the risks of climate change and counsel that China should take no radical action in the coming decades that will risk its growth.

For China to wholeheartedly begin addressing climate change, it must see the feasibility of its future development in a carbon constrained world as the foundation of the stability for its political regime. This requires China to gain a sizeable piece of global low-carbon equipment markets: the global 'low-carbon pie'. But this will

---

[57] Guillaume Gaulier, Françoise Lemoine, Deniz Ünal-Kesenci 'China's Integration in East Asia: Production Sharing, FDI and High-Tech Trade', *CEPII Working Paper, No 2005-09*, June 2005.

[58] RAND Corporation, 'Fault Lines in China's Economic Terrain', RAND, 2003.

not happen under a business as usual approach, where entrenched interests will argue for national preferences and promote the politics of fear towards Chinese imports and investment.

Delivering the transformation to a global low-carbon economy will require a deepening of policy-driven economic and technological co-operation between developed and developing countries. Slowing the transfer of best-practice technology and restricting trade with developing countries because of fears over national competitiveness will undermine progress to a global climate deal, and slow global decarbonisation, damaging everyone's climate security. Developed and developing countries will need to re-evaluate the strategic balance between national industrial policy aims and the vital imperative of global energy and climate security. This will require decisions at the highest political level in order to balance the narrow concerns of domestic industry groups with the broader national security interest concerns.

Beyond Zero Sum Politics: Impact of Climate Change on Energy Security Geo-politics

> The stone age did not end for lack of stones, and the oil age will end before we run out of oil.
>
> ***Sheik Ahmed Yamani, Minister of Oil, Saudi Arabia, 1962–86***

The changing geo-politics of energy is threatening the international rules-based order. Oil and gas markets are moving away from rules-based systems, with direct state control and strategic involvement increasing across the world. The increase in political and financial support to repressive regimes in Africa and Central Asia has led to democratic retreat and fuelled the destabilisation of whole regions.

Geo-political tensions rooted in bilateral energy alliances between countries are preventing – or weakening – global collective action to reduce other security threats. Chinese and Russian energy relationships with Iran are weakening Security Council action on nuclear proliferation; China's oil sector involvement with Sudan delayed UN action on Darfur; India's energy investments in Myanmar have limited action against the military regime; and European and US energy interests in Russia and Central Asia weaken action on human rights and internal oppression.

The geo-politics of energy security is limiting the international community's freedom to act in many unstable parts of the world, notably Africa, Central Asia and the Middle East. In the long-term, this is likely to increase political instability and the risk of conflict as international mechanisms are not deployed to reduce tensions. State-to-state relationships on energy access are increasing instability in producer states by undermining the political and governance reforms needed to tackle the destabilising impact of high-value resources on the political economy of supply countries.

Strategic rivalry over access to energy resources decreases trust between consuming nations and makes co-operation to secure fundamental interests difficult. Part of the reason for aggressive energy security policies by China and India is their fear of the 'West' monopolising access to the major Middle East/Russian/Central Asian oil and gas due to their closer geographic proximity and larger purchasing power. Recent moves by the US to place military bases in West Africa near new oil fields, increases suspicions that in times of crisis, military control will be exerted over supplies. As a result, Chinese policy-makers argue they are forced to deal with countries where the US and Europe tend not to operate due to human rights or security concerns such as Sudan, Myanmar and Angola. In their turn, these moves are interpreted by US and European governments as strategic moves to deliberately undermine their influence in the region.

Reserves of oil and gas will become increasingly concentrated in the OPEC countries and Russia as overall supply reduces and prices rise in the long-term. This is already increasing the political influence of fossil fuel exporters at the regional level – for example, with Russia having an increasing influence in preventing democratic reforms and conflict resolution efforts in Europe's eastern neighbourhood.

The growing geo-political approach to energy security is undermining co-operation between large energy consuming countries in a range of areas, and increasing instability in many supplier countries. However, climate change adds a new political imperative to this equation which will drive new alliances and approaches.

Politically, global co-operation to tackle climate change cannot be achieved in an atmosphere of ever-increasing national competition for energy resources. Preventing catastrophic climate change will require international co-operation on a scale never seen before, and must rest on a basis of trust and mutual interest. The politics of energy security must be re-oriented in a similar way, with major consumers co-operating to ensure stable and reliable supplies.

Economically, the (mainly private) decisions to invest around $20 trillion in energy systems over the next twenty-five years need consistent signals from governments if they are to deliver the public goods of energy and climate security. In contrast, the recent rise in oil prices has lead to an explosion of interest in new coal-fired power stations and in coal-to-liquids technology to preserve energy security. There is a need for consistent incentives to ensure any future coal power stations are climate neutral (e.g. built with carbon capture and storage).

Institutionally, governments and regulators have separated the issues of energy, transport and environmental performance into different institutional silos. Achieving the size of investment shifts needed to tackle climate change makes this a self-defeating approach. For example, driving greater efficiency in the personal car fleet improves both climate and energy security, but requires unprecedented co-operation in investment, pricing, innovation and behavioural incentives between a range of ministries and constituencies. Climate and energy security challenges will only worsen over the coming decades; a major public sector reform process is needed in all countries to build the new institutions capable of tackling them.

Delivering energy and climate security, for all its complexity, is a question of global political alignment. Countries must feel that their national strategic interests are best advanced through co-operation, not competition, and through prevention, not reaction. This will require a focus of energy security politics away from supplying fossil fuels, to delivering secure energy services through reduction in demand, technological innovation and co-operation. The twin challenge of energy and climate security requires a convergent approach to policy that tackles these issues simultaneously. Maintaining the current political and policy silos will result in confusion and stasis.

A decisive shift of political focus is needed away from building alliances with fossil fuel producers, to forming alliances between major energy consumers. Energy and climate security interests will be increasingly delivered through co-operation on technological development and diffusion, not on fossil fuel discoveries and delivery.

The weakening of producer-consumer ties is perhaps already beginning. If Europe implements its climate policies in full to 2020, gas imports from Russia could drop by 20 per cent instead of rising, totally changing the political dynamic in the region and potentially causing severe economic disruption in Russia. If the US continues its current policies on ethanol and car efficiency it will cease to depend on Middle Eastern oil, which will have an obvious impact on its willingness to deploy militarily in the region. All US presidential candidates as of February 2008 intend to remove US dependence on foreign oil by 2030, and secure 80 per cent reductions in greenhouse gas emissions by 2050.

Once climate change policies begin to bite in the major developed countries in the next decade, major fossil fuel exporters are likely to retaliate as they feel their power diminishing. OPEC countries have already fought a destructive rearguard action in the UN climate talks for twenty years in partnership with some western oil firms. Though major reductions in revenue are unlikely in the next ten to fifteen years, OPEC has already signalled its concern. However, the development of carbon capture and storage technology would enable them preserve their markets for far longer. However, the perception of threat is more likely to drive hostile and destabilising responses unless managed carefully.

No international forum currently exists where these broad political realignments can be created between major energy consumers, and supplier tensions managed. Energy security discussions are too narrow, generally bilateral and too heavily focused on short-term solutions. Climate change discussions are based in environmental fora, fail to engage with economic interests and are often marginalised inside political debates. There is a need to create new spaces, with a new range of actors to drive agreement forward.

Energy security policies will need to be fully integrated with climate change policies to be successful, and re-oriented to focus on efficiency, technology and innovation. This implies a focus on

co-operation, not competition, between major energy consuming nations and a carefully managed decline in the importance of relationships with fossil fuel producers.

Nuclear Proliferation and Climate Change

Fear about nuclear weapons proliferation (including radiological 'dirty bombs') are a dominant priority in global security. Fears focus on proliferation into both 'rogue' and unstable states and of a terrorist group acquiring nuclear capability, especially through a state sponsor. It is known that some terrorist groups have been seeking nuclear and biological material. It is generally considered that no currently active terrorist group has come close to acquiring effective weapons of mass destruction (WMD) production capability.

A large number of countries have existing or recently discontinued WMD programmes which could have been be a source of material. However, in the context of a globalising world economy and the spread of high technology businesses, the capability to manufacture WMD is much wider. The AQ Khan nuclear network used Dutch designs, and a series of high technology suppliers and manufacturers in Pakistan, Malaysia and other industrialising nations to develop black market nuclear components and assemblies.

The worldwide use of civilian nuclear power is a potential driver of nuclear proliferation. Currently, the world's stock of civilian nuclear power stations is mainly in OECD countries and Russia, and use is expanding in China, Russia, Japan, India and Korea. In the absence of additional policy commitments, baseline growth in total civilian capacity is expected to be around 20 per cent to 2030 in the 2006 IEA baseline scenario. However, if nuclear power becomes even a modest part of a global response to climate change, then experts at the Massachusetts Institute of Technology and elsewhere expect to see a tripling of global installed nuclear capacity over the next forty years, half of which would be in developing countries.[59] This would only have a modest impact on reducing climate change (about 10 per cent of the total carbon reduction needed by 2050), but a major impact in the spread of nuclear technology and fuels. A programme going

[59] MIT, 'The Future of Nuclear Power', MIT, 2003 <http://web.mit.edu/nuclearpower/>.

Box 4: Global Nuclear Build Programmes

Committed/Under Construction

	Size	NPT?
China	15000 MW	Yes
India	5000 MW	No
Japan	14000 MW	Yes
Korea	11000 MW	Yes
Russia	30000 MW	Yes
Iran	2000 MW	Yes

Planning/Under Consideration

	Size	NPT?
Pakistan	600 MW	No
Indonesia	1300 MW	Yes
Vietnam	1000 MW?	Yes
Argentina	700 MW	Yes

Countries considering new nuclear facilities include US, France, Nigeria, Israel, Kazakhstan and Egypt.
(Source: World Nuclear Association)

beyond this level could probably be supplied from known resources of high-grade uranium (though there is dispute about the size of reserves).[60] However, a more aggressive programme which would make a real impact on climate change would exhaust high-grade resources and the energy needed to process fuel from low-grade ores makes nuclear power no longer attractive as a low-carbon energy source. Therefore, significant scale-up over a long period is likely to need reliance on Generation IV reactors based on fast breeder fuel cycles, which effectively recycle nuclear fuel reducing fuel demands by 60 per cent.

Box 4 shows current range of countries who have announced strong intentions to initiate or increase their civilian nuclear programmes. More recently, several other countries, especially in North Africa and the Middle East, have suggested that they too are considering developing civilian nuclear capacity, partly to manage the

[60] AEA Technology, 'Uranium Resource Availability', Paper for the UK Sustainable Development Commission, 2006.

impact of climate change and resource shortages by powering water desalination plants.

It is also likely that countries interested in acquiring nuclear weapons would use climate change climate change to legitimise their 'civilian' nuclear programme, even if other energy options are available to them; Iran has already used this line of argument extensively. The proliferation risks from expanded civilian use of nuclear energy are not automatic. They can occur through state-led programmes, as with Iran, and through non-state routes through the expansion of nuclear engineering capabilities and larger quantities of nuclear materials which would inevitably arise from an expanded programme. In particular this would increase the potential of non-state groups acquiring a radiological or 'dirty' bomb. Moves to increase nuclear reprocessing, which due to shortages in the supply of high quality uranium fuel would be necessary under a major expansion of nuclear energy production, would greatly increase the amount of plutonium and enriched uranium circulating in global markets.[61]

Most of the solutions to de-linking the spread of civilian nuclear energy from proliferation of state nuclear capability – including fuel banking, neutral nuclear fuel providers, and 'proliferation-proof' reactor designs (Generation IV) – have yet to find widespread political support among nations seeking nuclear power, or have yet to reach technological maturity. It is estimated that more proliferation-proof reactor designs will only be ready for wide-spread commercial use from 2025-2030, and even then it is likely that many developing countries would prefer to use more tried and tested designs, such as the indigenous designs which Indian nuclear companies have recently begun marketing to Indonesia and others.

Despite widespread talk of a nuclear renaissance driven by energy and climate security concerns, it is likely that the rate of new nuclear plants being built will rise slowly over the next decade – if only because of supply constraints – and be predominantly in developed and a few rapidly industrialising countries. Even one of the largest global programmes, China's aim to build 15GW of new nuclear power by 2020, seems rather slow given that it will construct

[61] Frank Barnaby and James Kemp, 'Too Hot to Handle' (Oxford: Oxford Research Group, 2007).

400-500GW of coal power and 125-250GW of large hydroelectric power in the same period. However, as the impact of climate change worsens, a major climatic disaster (for example, a major collapse in the West Antarctic Ice Sheet) would cause intense pressure to undertake a 'crash programme to limit climate change'. Given the paucity of current mature low carbon energy options such a scenario would result in political pressure to rapidly build new nuclear plants at a global scale, even if the proliferation issues have not been adequately resolved. Such a crash programme would also raise significant safety fears over construction quality given the global shortages of qualified nuclear engineers and manufacturers at current build rates.

Current proliferation controls are not adequate for a world where nuclear power is a widespread low-carbon energy option in all countries. Given likely pressures to rapidly increase nuclear capacity in the face of climate change, which would rapidly escalate in the face of a major climate disaster, increased effort is needed to put a robust political framework and new technological options in place in the next decade.

Borders and Barriers: Defining Rights and Responsibilities in a Shifting World

> Pacific island countries are likely to face massive dislocations of people, similar to population flows sparked by conflict. The impact on identity and social cohesion were likely to cause as much resentment, hatred and alienation as any refugee crisis. . . . The Security Council, charged with protecting human rights and the integrity and security of States, is the paramount international forum available to us . . . the Council should review sensitive issues, such as implications for sovereignty and international legal rights from the loss of land, resources and people.

Delegate of Papua New Guinea, UN Security Council Debate, April 2007

Climate change will drive increased tensions in traditional areas of regional security covering borders, shared and common resources, migration and mutual responsibilities. Eventually, as populations move to avoid extreme climate impact inside and between countries, it will raise fundamental issues of sovereignty, citizenship and responsibility.

Constructive management of the inevitable tensions raised by these changes will be critical to managing regional stability and security. This may just require more enlightened bilateral and regional dialogue, planning and informal arrangements, or could be achieved through a more systematic application of resource management agreements. In many areas, such as fisheries and river flows, changes in resource patterns may occur suddenly, precipitating local economic crisis and potential confrontation. Advanced planning around potential vulnerabilities, including contingency governance arrangements, will be critical to reduce conflict risks. This will need to include the 'climate proofing' of existing international resource management agreements.

Shifting Borders[62]

As discussed above, IPCC estimates a sea-level rise range from 0.18-0.59 metres by 2100, driven by thermal expansion in the oceans. There is potential for far larger increases, due to accelerated melting of the Greenland and Antarctic icecaps. These rises will alter maritime borders, which are normally determined by low water-mark baselines. The territorial sea, Exclusive Economic Zone (EEZ) and fishery limits of a state are drawn by reference to these baselines. The rising waters could affect these baselines and even cover major areas of a state's territory, potentially changing their borders.

Small island states and delta regions such as those in Bangladesh, Nigeria and Egypt are the most vulnerable to these changes, and could lose significant fisheries, mineral and marine rights when outlying islands are inundated. Where 200 mile EEZs overlap in large bays, even a small retreat can lead to large shifts in maritime borders if neighbouring countries assert their full rights.

---

[62] Much of the material in this section is taken from Cleo Paskal, 'Climate Change and Borders' (London: Chatham House, 2007) <http://www.chathamhouse.org.uk/research/eedp/papers/view/-/id/499/>.

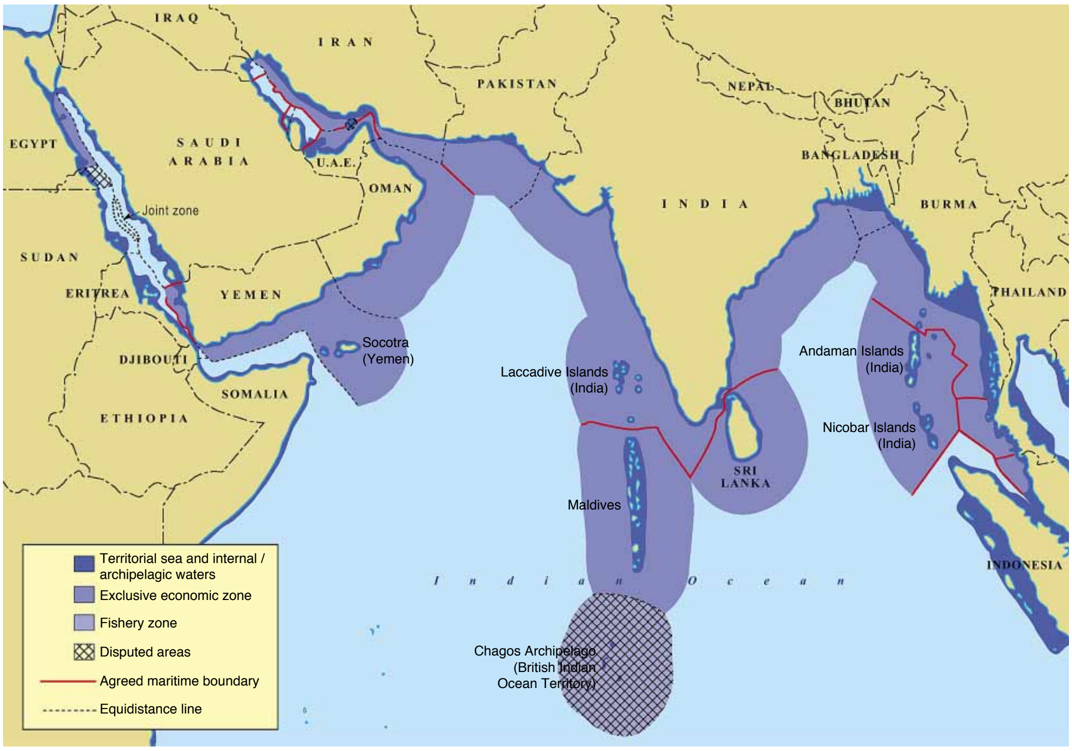

Figure 8 Maritime Borders in the Indian Ocean

Bangladesh is particularly vulnerable to these pressures. Without a well defined EEZ, its small area of maritime rights in the Bay of Bengal, sandwiched between India and Burma, (see Figure 8) rich in oil, gas and fisheries resources which could virtually disappear as the Sundarbans become inundated and deserted. The coastline is constantly shifting and prone to flooding, making it very hard to define a stable low water line. Several islands have already been depopulated in the last decade, effectively moving the coastline inland and with it, Bangladesh's maritime zone.

Further offshore, the borders between India and the Maldives, and the Maldives and British Indian Ocean Territory (BIOT), could be shifted as parts of the archipelago are inundated, releasing significant areas back into international waters. The UK and the US could lose the low-lying geo-strategic bases on Diego Garcia, Chagos Archipelago (part of BIOT), though given their strategic importance for the Persian Gulf it is likely to be cost effective to expand flood defences over the coming decades.

The majority of states affected by climate change and rising sea-levels will not disappear completely, but may experience changes to the baselines that might affect their borders. Only 180 maritime boundaries have been agreed upon world-wide. According to geographers, potentially, 400 such boundaries exist. Many of these agreements will need to take into account the fact the realities of climate change if they are to be sustainable in the future.

Rising oceans could also complicate the resolution of disputed sovereignty claims in the Spratly Islands, a group of low-lying atolls in the South China Sea which sit astride potentially rich deposits of oil and have already been the scene of military tensions between China, Vietnam and the Philippines. Some of these islands are already partially submerged and the highest (Southwest Cay) is only four metres above sea-level. Beijing has also challenged the island status of Okinotorishima, a small offshore islet claimed by Japan, at the southernmost part of the archipelago that is uninhabited and slowly sinking, but which could be significant in any future conflict over maritime resources. Under Article 121 of the United Nations Convention on Law of the Sea (UNCLOS), islands classified as 'rocks' are not entitled to a 200-nautical mile EEZ.[63] Other politically charged areas include the Florida Keys, which are highly vulnerable to climate change, and if permanently inundated would result in the shifting of the US-Cuba maritime border.

Late 2007 saw the emergence of inter-state territorial disputes driven by climate change, ironically driven by opportunity and not catastrophe. The retreat of Arctic sea ice has opened up a navigable (for specialised vessels) Northwest and Northeast Passage through the Arctic in the summer, potentially cutting days off transit time from Asia to Europe. However, control of the future Northwest Passage is already causing disputes between Canada and the USA. Canada maintains that the passage lies inside its territorial waters and thus it can exercise control on ship movements through it; the US wishes to see the passage classified as an international sea lane and thus outside any one nation's control. The Canadian government has started to invest in staking its claim to the Arctic waters by constructing new naval bases in the area and ordering a new fleet of Arctic patrol boats and establishing underwater listening posts to monitor for foreign submarines and ships.

---

[63] Lowy Institute, 'Heating Up the Planet: Climate Change and Security', *Lowy Institute Paper 12* (Sydney, 2006) <http://www.lowyinstitute.org/Publication.asp?pid=391>.

At the same time, the retreating sea ice has opened the potential for deepwater drilling for oil and gas deposits in the Arctic. This has stimulated the much publicised Russian scientific expedition to claim mineral rights over a large portion of the Arctic as its continuous geological territory, an act which looks to be repeated by Canada, the US and Greenland. The spectacle of a group of countries – many of which have previously denied the reality of climate change – scrambling over resources which will only be valuable if climate models are correct, tells a cautionary tale. Even the most sophisticated states remain far better at grasping short-term opportunities, than responding rationally to long-term threats.

The Arctic experience of territorial claims is being repeated in the Antarctic, driven by the May 2009 deadline to register mineral claims under the UN Convention on the Law of the Sea. Given the contribution any newly accessible oil and gas reserves may make to climate change, it would be interesting to explore whether a large windfall tax could be applied to these reserves, to be spent on helping poor countries adapt to climate change.

Climate change will add to the uncertainty and disputes surrounding maritime borders, many of which are already politically charged. It would make sense to forestall this through the UNCLOS treaty by freezing coastal baselines at their last recorded extent, and where possible, accelerating the definition of maritime borders in disputed areas.

Managing Resource Management Tensions

Climate change will affect the availability and distribution of resources which are managed between countries and in particular, rivers, lakes and fisheries. Rivers and lakes also often form boundaries between countries, and any changes due to climate change may affect these borders. The history of trans-boundary water management, especially in the last decade, has been very positive with major water agreements in highly sensitive areas such as the Nile Basin. Fisheries have had a more contentious management history, especially since the unilateral establishment of national EEZs – eventually reaching 200 miles offshore – which resulted in severe tensions in the 1970s,[64] including the Cod Wars between the UK and Iceland.

International Fisheries Management

Over 800 million people rely on fisheries as their main source of protein. The impact of climate change on global fish stocks is likely to be large, but hard to predict.[65] The breeding success of fish species is highly related to temperature, as is the location and incidence of their food sources and thus their range. Climate change is increasing ocean acidity, which has an immediate negative impact on coral reefs (major breeding grounds for many tropical species) and reduces plankton yields. As climate change affects ocean circulation it will have secondary effects on the location, intensity and timing of ocean nutrient upwellings on which many major commercial fish stocks depend.[66] The impact will be to change the composition of marine ecosystems and in the short term to favour highly adaptable 'weed' species (e.g. jellyfish) over more fish populations adapted to narrower ranges of environmental conditions which will tend to dominate relatively stable ecosystems.

Climate change itself will not alter the total levels of fish stocks to a great degree: its effect will be far outweighed by (current) unsustainable fishing practices. However, there will be large impact on the location and composition of fish stocks. In developing countries, this will have serious impact on traditional, subsistence fishers who cannot follow stocks as they move, and may not be able to survive off any replacement species. Shifting fish populations will also drive conflict between commercial and subsistence fishers in many parts of the developing world, as they will undermine the demarcated zones they have in under current agreements. These issues are already highly

[64] Barbara Kwiatowska, *The 200 Mile Exclusive Economic Zone in the New Law of the Sea* (Dordrecht: Springer, 1989).

[65] Julie M. Roessig, Christa M. Woodley, Joseph J. Cech, Jr. and Lara J. Hansen, 'Effects of global climate change on marine and estuarine fishes and fisheries', *Reviews in Fish Biology and Fisheries* (2004).

[66] IPCC 2007, also see summary of current literature and policy responses at <http://www.oceansatlas.org/servlet/CDSServlet?status=ND1maWdpczEzNzg5LmZpZ2lzVG9waWNzMTM5NTMmNj1lbiYzMz13ZWItc2l0ZXMmMzc9aW5mbw~~>.

charged in Asia and West Africa where Japanese, Russian and European long-distance commercial fleets are highly aggressive.

Stock movement will also undermine the basis of management in internationally shared fisheries, especially those which allocate catching quotas by percentage of species within a certain area; for example, the European Union. In Europe, where stock location is highly temperature sensitive, cold-water species such as cod have already moved north and warm water species like mullet and squid have begun to colonise areas such as the English Channel and North Sea. If a species declines or leaves the area, a country's quota share allocation then become worthless, and the international 'bargain' underlying the fishery management system collapses. This impact is compounded if, as occurs in the EU, any new species which have yet to be assigned a quota in an area are open for anyone to fish anywhere. This is already leading to a race for fish new stocks as they appear due to climate change, because past catch levels will be used as the basis for future quota settings. Without radical reform it seems unlikely that the EU Common Fisheries Policy and many other international fisheries agreements will be able to survive serious climate change.

Shifting patterns of fish stocks may cause the collapse of many already strained fisheries management agreements between countries, and increase conflict between long distance and subsistence fishers in many parts of the world. There will be a need to design much higher degrees of adaptability into agreements and a larger focus on risk management approaches to handle more extreme fluctuations in stocks.[67]

Trans-boundary Water Management

Recent successes in 'hydro-diplomacy' has suggested to many that water wars are unlikely to occur in the future, and that countries will find ways to manage resources peacefully. However, comprehensive statistical analysis suggests that countries sharing river basins are more likely to experience conflict than ones which do not, though the causality of this

[67] Prime Minister's Strategy Unit, 'Net Benefits: a sustainable and profitable future for UK fishing' (London: Cabinet Office, 2004).

effect is not clearly related to resource scarcity.[68] The future will see more pressure on shared water use management than in the past, from both rising consumption and climate change. This will occur in some of the most politically sensitive areas of the world. Sub-Saharan Africa (shared water basins cover most main African countries[69]) and the Middle East are both areas where shared rivers have been significantly associated with conflict.

Climate change will deliver a world of larger extremes in water availability, and much more difficult water management challenges. Scenarios show regions of strong wetting and drying, with a net overall global drying trend.[70] The high latitudes of North America and Eurasia can expect to see increases in river flow of 10 to 40 per cent, and runoff can be expected to increase in the wet tropics. Decreasing runoff by 10 to 30 per cent is expected in the Mediterranean, southern Africa, and western USA/northern Mexico. In general, between the late twentieth century and 2050, the areas of decreased runoff expand.

Increased precipitation and glacial melting will mean a large increase in flood risk. For fifteen out of sixteen large basins worldwide, the 100-year peak volumes are predicted to increase, and in some areas a once-a-century flood could occur every two to five years. Up to 20 per cent of the world's population live in river basins that are likely to be affected by increased flood hazard by 2080.

At the same time, the proportion of the global land surface in extreme drought is predicted to increase by a factor of ten to thirty; from 1-3 per cent for the present day to 30 per cent by the 2090s. The number of extreme drought events per 100 years and mean drought duration are likely to increase by factors of two and six respectively, by the 2090s.

Climate change is only one cause of water stress, which is predicted to rise globally due to higher water usage. Irrigation

---

[68] Nils Petter Gleditsch, Kathryn Furlong, Håvard Hegre, Bethany Ann Lacina and Taylor Owen, 'Conflicts over Shared Rivers: Resource Wars or Fuzzy Boundaries?', *Political Geography* (Vol. 25, No. 4: 2006), pp. 361–382.

[69] From Conway and Goulden, *Transboundary Rivers and Climate Change in Africa*, Tyndall Centre, University of East Anglia, 2006.

[70] Following draws heavily from IPCC Working Group II, 'Freshwater Resources and their Management', Contribution to, 2007 <http://www.gtp89.dial.pipex.com/03.pdf>.

Box 5: Climate Change and Water Sharing in the Nile Basin;[71]
About 100 km^3/yr of water flows into to Sudan, and about 84 km^3/yr flows into Egypt. Growth in population, mechanisation of agriculture and use of water for other applications will increase the demand for water in both Sudan and Egypt.

Table 1	Pop. 2005 (million)	Pop. 2050 (est.)[72]	Pop. Growth 2005-50 (%)	Water resources km^3/yr	Water use 2000 km^3	Current surplus (%)
Egypt	74	126	70	78.2	68.3	14
Sudan	36	67	84	64.5	37.3	73
Egypt & Sudan	110	193	75	142.7	105.6	35

dominates human water use, accounting for almost 70 per cent of global water withdrawals and for more than 90 per cent of global consumptive water use, i.e. the water volume that is not available for reuse downstream. Water stress is modelled to decrease by the 2050s for 20 to 29 per cent of the global land area and to increase for 62 to 76 per cent of the global land area. In all cases, the largest driver of water stress is increased consumption. Climate change, by increasing precipitation, is in fact a major cause of decreased water stress.

The main immediate impact of climate change on trans-boundary water management will be the increased need for intensive management to cope with extremes of flood and drought. This could take many forms, including greater upstream dam building which would charts have consequences for downstream water availability, especially in drought years. Greater water storage infrastructure will be necessary to balance higher inter-seasonal changes in flow, and this will put a strain on infrastructure budgets in poorer countries. With higher demands, more variability and intensive management, the potential for disputes and tensions over water management can only

[71] This analysis was kindly provided by Clive Bates, currently Head of UNEP in Sudan.
[72] United Nations Population Division, 'World Population 2004', 2004.

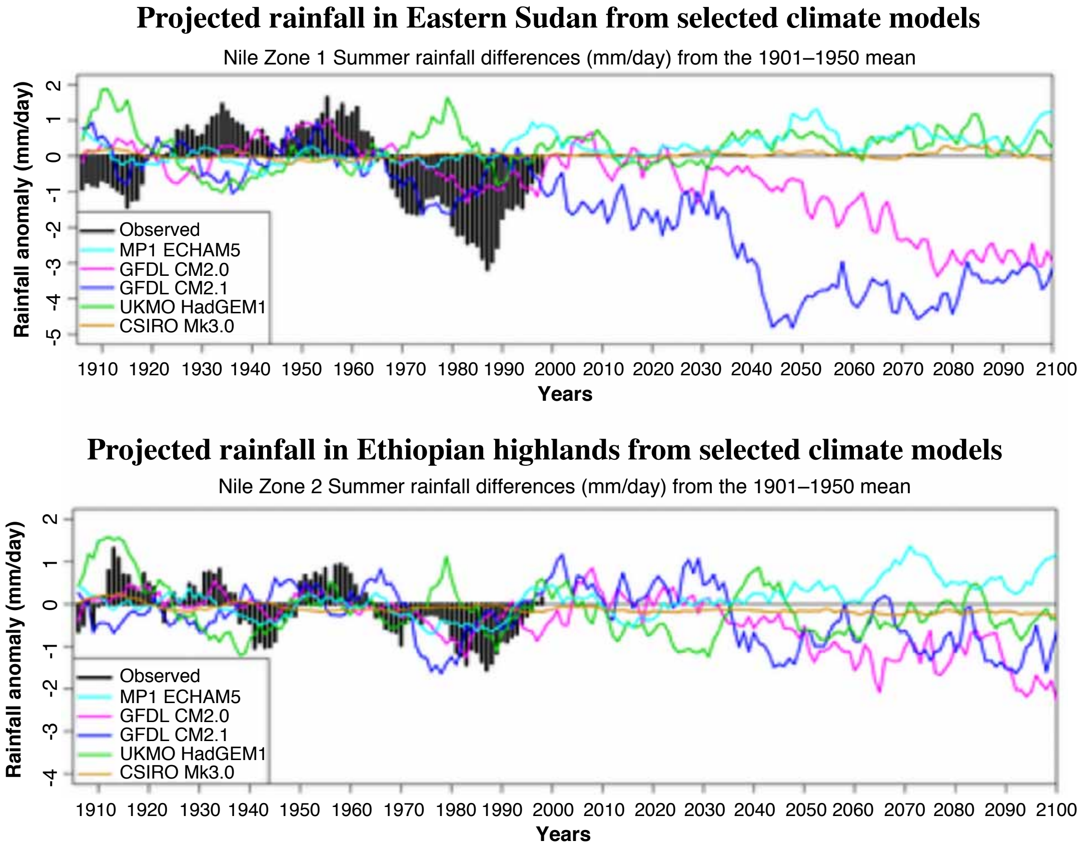

Figure 9 Projected Rainfalls from Selected Climate Models

rise. The potential power of the upstream state to control downstream exposure to both flood and drought will increase, and so will the impact of mismanagement.[73]

Box 5 illustrates one aspect of the underlying stress – Egypt is water-stressed and will become increasingly so with population growth. But Egypt is reliant on Nile waters from Sudan for most of its water and so meeting demand will require Egypt to take a larger share. However, the combined Sudan/Egypt system has a projected population growth of 75 per cent against a current water surplus of 35 per cent. Population pressure in upstream countries (for example, Ethiopia's population is expected to double) and possible impact of climate change and the falling level of Lake Victoria may reduce water flowing into Sudan.

[73] Margaret Palmer et al., 'Climate change and the world's river basins: anticipating management options.' *Frontiers in Ecology and the Environment* (In Press, 2007).

Figure 9[74] show the risk of lower precipitation in key areas of the Nile Basin. This is a good example of how climate change can destabilise highly stressed environmental systems. The charts also reflect uncertainty – some models show little change, some show dangerous declines.

The shortage of water in the Nile has led to efforts to develop more water resources and use more sustainable form of agriculture. There have been ambitious but failed projects to gather more water from the wetlands of the South such as the Jonglei canal, which would create a range of environmental impact and impact in the South. The situation may be further complicated if southern Sudan secedes after 2011.

The Nile Basin Initiative has been established to address these tensions and appears close to reaching agreement on a new Comprehensive Framework Agreement, which would trigger substantial investment, further capacity building and create a new permanent institution, the Nile River Basin Commission.

Box 5 illustrates these factors for the Nile Basin and water sharing between Egypt and Sudan. A critical aspect to note are the political consequences of scientific uncertainties over projections of future water flows, which are typical of most major rain fed river basins. Some models show mild increases in Nile river flow, others dangerous declines; the choice of which prediction upstream states use as a basis for planning and infrastructure build will have significant implications for the water security of downstream countries.

The potential for upstream countries to use climate change as a screen for renegotiating water sharing agreements onto more favourable terms is high, and the uncertainties around water availability are likely to increases levels of distrust in downstream countries. In times of heightened tension over other issues, water infrastructure will become an increasingly attractive weapon of diplomatic pressure, or target in military confrontation, and is already borne out by the history of recent water conflicts.[75] As with many

---

[74] KNMI (Royal Netherlands Meteorological Institute) – website 11 December 2006.

[75] Peter Gliek, 'Water Conflict Chronology', Pacific Institute for Studies in Development, Environment and Security, 2004 <http://www.worldwater.org/conflictchronologychart.PDF>.

issues related to climate change, perceptions and trust will be vital in creating a shared management regime which is resilient to the unpredictable extremes of climate change. Will upstream countries reduce water flows to their farmers during drought years to make up for a lack of water storage by downstream countries? As flood defences are breached and dams reach maximum capacity, will flood waters be sent downstream to vulnerable communities? The harsh politics of managing such extremes inside a country are delicate enough: when mixed with difficult trans-boundary relationships they could easily become incendiary. The case of Central Asia shows how a legacy of distrust between former Soviet states, coupled with geo-political interests of major powers, has undermined water management co-operation in an area of growing water stress.[76]

These scenarios point to the critical importance of 'climate proofing' existing water agreements by deepening co-operation in infrastructure and management schemes. This has already been recognised, through mechanisms such as the recently established UN Economic Commission for Europe (UNECE) Water Convention's Task Force on Water and Climate.[77] However, the success of these approaches in renegotiating agreements which have often taken decades to forge will require high levels of trust and joint working between the parties, and better co-ordination of infrastructure and management. This intrusive diplomacy may prove very hard to achieve in many areas of the world without strong international support.

If climate change is not stabilised at low levels, then even these measures will become inadequate for glacier-fed trans-boundary waterways. After the initial increasing volume of flow as glaciers begin to melt, flows will decrease to the point where existing water sharing agreements will become worthless. This will begin in areas such as Peru in the next two decades, and would affect the major

---

[76] Jeremy Allouche, 'The governance of Central Asian waters: national interests versus regional cooperation,' *Disarmament Forum (No.4, 2007)* (Geneva: UN Institute for Disarmament Research) <http://www.unidir.ch/pdf/articles/pdf-art2687.pdf>.

[77] UNECE Task Force on Water and Climate, 'Guidance Towards Climate-Proofing of Water Management', UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, *TFWC/2007/3* Bonn, 2007.

rivers in India and China by mid-century. At this point, it is likely that large-scale migration and conflict will overwhelm any agreement, with highly unpredictable consequences

Under moderate climate changes scenarios, technical and infrastructure solutions are available to manage the increased variability in water flows due to climate change. The challenge is in applying these in politically sensitive and developing regions without raising political tensions and driving conflict; this will require strong support and preventive intervention from the international community. It is likely that most agreements will fail under higher levels of climate change, especially in glacier-fed river systems, leading to conflict and large-scale migration.

Migration

Large-scale migration is often cited as one of the clearest geo-political threats from climate change, and its newsworthiness means that it often receives significant publicity.[78] However, good data and studies are very hard to find given the complexity of factors governing the sources and destination of migration, especially for moderate levels of climate change.

The world currently has around 163 million forcibly displaced people, of which 154.5 million have remained in their countries of origin: 25 million are people displaced by conflict and extreme human rights abuses; 25 million are displaced by disasters such as earthquakes, hurricanes and floods; and 105 million are displaced by 'development' projects such as dams, mines, roads, factories, plantations and wildlife reserves.

There are only 8.5 million people who are refugees who have fled their own countries and been accepted for asylum elsewhere, but there are many millions more of economic migrants, both legal and illegal. A typical example of the complexity of these issues is given by the experience of Bangladesh, where the disturbance of water flows in

[78] For example see Rear-Admiral Chris Parry's strategic trends work at the UK MoD's Development, Concepts and Doctrine Centre (DCDC) quoted in Peter Almond, 'Beware: the new goths are coming', *Sunday Times*, London, 11 June 2006.

the Ganges-Brahmaputra Delta has undermined the livelihoods of 35 million people over the last thirty years. This has been a critical motivation for the 11–15 million Bangladeshis who have illegally migrated into India, and the 600,000 internal migrants in the Chittagong district. In both cases, migration has resulted in political instability and often low-level armed conflict.[79] India has now built a 2,500 mile fence to slow down migration and the movements of extremists.

Current estimates of additional climate driven displacement include 200 million in the Stern Review and 250 million to 2050 by Christian Aid.[80] The World Development Report 2007 suggests that global temperature increases of 3–4°C could result in 330 million people being permanently or temporarily displaced through flooding. Over 70 million people in Bangladesh, 6 million in Lower Egypt and 22 million in Vietnam could be affected. It is unclear how many in these projections are expected to cross international boundaries and thus potentially be a cause of international political tensions and concern. Estimates of increasing droughts in the near term can lead to a much larger impact as illustrated in Figure 10, where the number of people displaced by drought increases by 60 per cent over less than a decade under even a moderate climate change scenario.

At moderate levels of climate change it seems likely that the increased frequency of extreme conditions in rural areas will accelerate the current rate of urbanisation and the flow of international economic migrants. This future is perhaps illustrated by the increasing flow of economic migrants from North and West Africa to the European Union, which has resulted in an increasing loss of life as unseaworthy and packed smuggler's boats founder in the Mediterranean and Atlantic. The EU has responded by increased joint border forces and internal co-operation, and targeted aid flows to key source countries. But it remains to be seen whether this will seriously affect short-term flows. Perhaps more importantly, the external image of the EU – and the EU's image of itself – as an active humanitarian power has been tarnished by these events.

---

79 International Alert, 'A Climate of Conflict', London, 2007 <http://www.international-alert.org/publications/322.php>.

80 Christian Aid, 'The Human Tide' (London, 2007) <http://www.christianaid.org.uk/Images/human_tide3__tcm15-23335.pdf>.

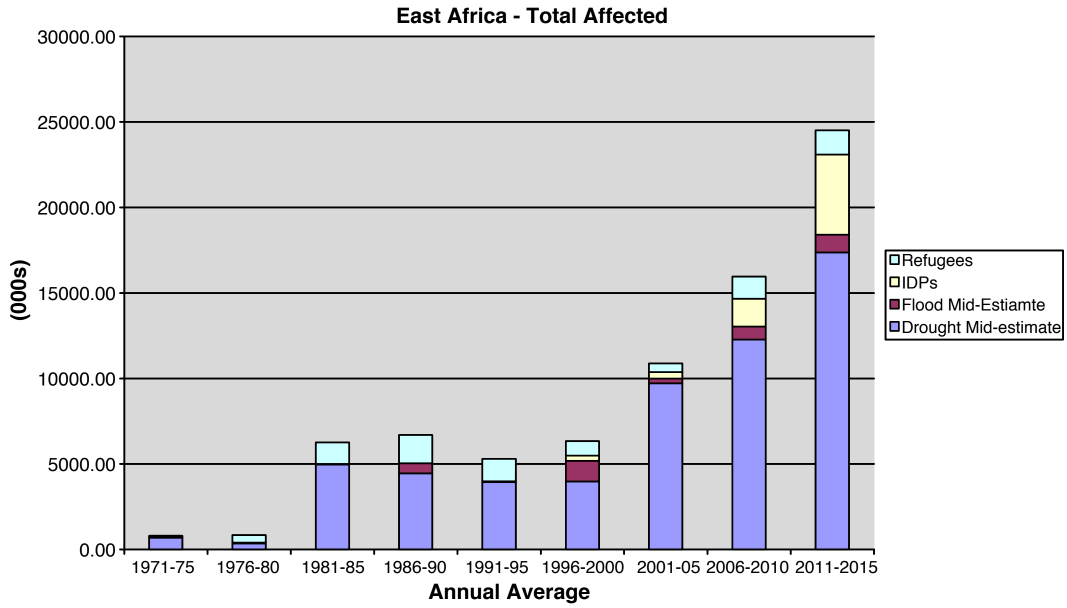

Figure 10 Projected Humanitarian Impact in East Africa to 2015 (Source: King's College, London, 2007)

Though most internationally displaced people will move between developing countries due to physical proximity, the potential for climate change to magnify economic differences between countries, especially in the face of a failure to adapt to climate change in the developing world, would increase these migratory pressures still further. This will be a strong motivation for developed countries to work with traditional source states of migrants to ensure livelihoods are maintained. Some developed countries, especially the UK, are particularly exposed with strong diaspora communities from highly climate-vulnerable countries such as Pakistan, Bangladesh, Jamaica and Nigeria. In the face of significant climate change, the pressures to accept large numbers of refugees from these countries could become intense, and will certainly divert resources from long-term development budgets into humanitarian aid and disaster preparedness.

Along with physical impact, there is also likely to be pressure to define a new category of 'environmental refugee' and place responsibility for housing and accepting these with the major emitting countries, rather than the current custom of proximity and country of first arrival.

Rapid and extreme climate change will cause significant international forced migration, but this seems less likely at lower levels of

climate change where displaced groups will remain inside country borders. Climate change is likely to increase the incidence of fortified borders, with consequent international tensions, and lead to calls for changes in international responsibility for refugees.

Sovereignty and Residual Rights

Beyond incremental impact on migration, in the most extreme cases countries such as the Maldives and Tuvalu could disappear if climate change proceeds unchecked. In international law, Article 1 of the Montevideo Convention on Rights and Duties of States sets out that the following qualifications are necessary for the existence of a state: (a) a permanent population; (b) a defined territory; (c) a government; and (d) capacity to enter into relations with other states. This seems to mean that a state will no longer exist if its entire territory has disappeared.

Rising sea-levels will have dire consequences for low-lying atoll countries in the Pacific such as Kiribati (population 78,000), the Marshall Islands (population 58,000), Tokelau (population 2000), and Tuvalu (population 9000). These small islands are highly vulnerable because of their topography, high ratio of coast to land area, relatively dense populations and subsistence economies. Periodic storm surges could inundate up to 80 per cent of the land area of North Tarawa and 54 per cent of South Tarawa (Kiribati) by 2050 under median climate change scenarios, with the economic costs expected to range between 10 per cent and 30 per cent of their GDP. By 2080, the flood risk for people living on small islands will be, on average, 200 times larger than if there had been no global warming. Ultimately, human habitation may not be possible even with moderate climate change. If temperature and sea-level rises are at the high end of those forecast, or the Greenland and Antarctic icecaps continue melting faster than predicted, then the sea will either eventually submerge the coral atolls or ground water will become so contaminated by salt water intrusion that agricultural activities will cease.[81]

These countries have relatively small populations and in most cases already have resettlement rights elsewhere. Tokelauans already

---

[81] Lowy Institute, 'Heating Up the Planet: Climate Change and Security', *Lowy Institute Paper 12* (Sydney, 2006) <http://www.lowyinstitute.org/Publication.asp?pid=391>

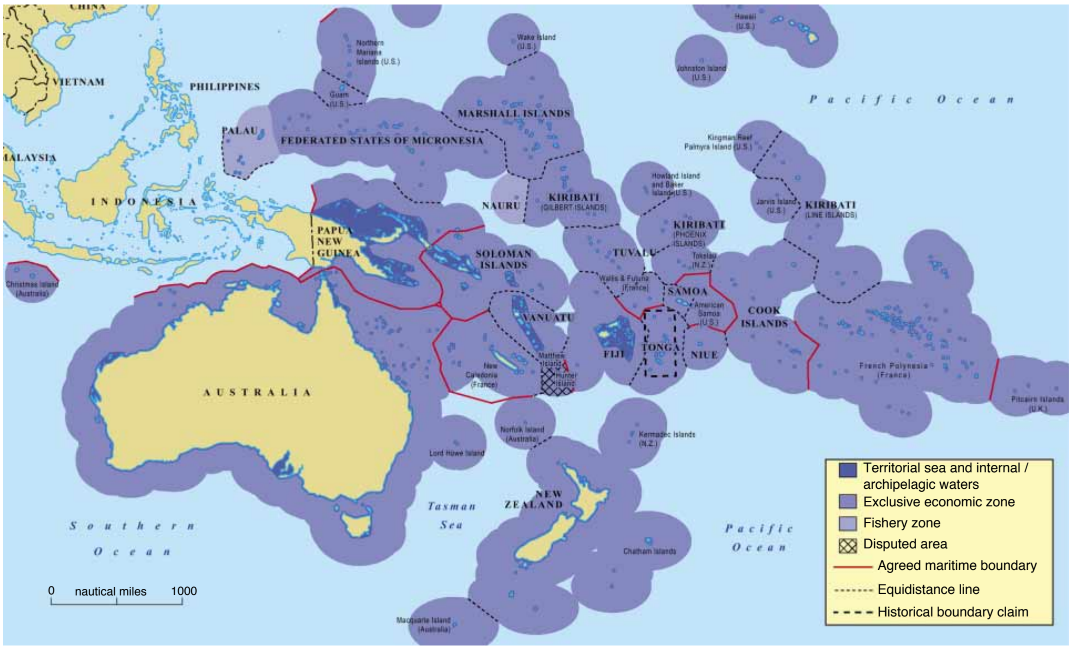

Figure 11 Maritime Borders in the Pacific

have access to New Zealand, the inhabitants of Tuvalu have negotiated migration rights for nearly all of its citizens, while the Marshallese can settle in the United States under the Compact of Free Association. Of the Pacific Island states most threatened by rising sea-levels, only the inhabitants of Kiribati have no real migration options. However, as Figure 11 shows, these islands have rights over very large areas of the Pacific Ocean and the question arises: to whom do these rights revert, if a state ceases to exist?

There are good reasons for affected countries to try to retain their status as independent states. These include the need to maintain a continued source of income for displaced communities through the sale of resource rights (fishing, undersea mining, off-shore oil and gas, etc.), a voice in international fora and the right to return if the seas eventually recede. It is possible that the ocean territory that once contained the islands of Tuvalu could be administered by a Tuvaluan population living in exile in Auckland. Given the potentially valuable nature of any residual rights, and existing tensions in many parts of the world over marine mineral and fisheries rights, it is likely that these issues will be raised in the UN in the next decade. However, defining rights for exiled populations could have more profound implications for other contentious sovereignty issues, and the rights of other types of displaced persons. Though the case of small island states may be straightforward, similar rights are likely to be claimed by distinct populations inside countries which are forced to migrate away from their homeland; for example, in the Sahel where pastoral groups are already moving south.

While granting residual sovereign rights to the citizens of states made uninhabitable by climate change has many humanitarian and equity advantages, it is also likely to raise many contentious issues over broader issues of sovereignty and lead to prolonged disputes over international legal principles.

Stoking Global Resentment: Climate Change as a Challenge to the International Order

> [A]ll of mankind is in danger because of the global warming resulting to a large degree from the emissions of the factories of the major corporations, yet despite that, the representative of these corporations in the White House insists on not observing the Kyoto accord, with the knowledge that the statistic speaks of the death and displacement of millions of human beings because of that, especially in Africa.

Osama bin Laden 'Letter to America' September 2007[82]

At its heart climate change is an issue of justice. Developed countries are responsible for around 70 per cent of greenhouse gases currently in the atmosphere. The vast majority of emissions are produced by the wealthiest billion people in the world, and the impact will be felt hardest by the poorest 2–3 billion people. These groups also have the fewest resources to adapt to climate change, weakest systems for managing natural disasters and live in the areas of the world most vulnerable to social conflict and crisis over scarce resources. The growing political visibility of this tension is exemplified by the 2007 Human Development Report, entitled 'Fighting Climate

[82] Full text available at <http://observer.guardian.co.uk/worldview/story/0,,845725,00.html>.

Change: Human Solidarity in a Divided World', which framed stabilisation at 2°C as the 'most pressing moral challenge of our time'.

Failure to control climate change will be seen as a moral failure, and not simply an economic or security problem. The chain of responsibility for climate damage is clear and is already generating a backlash. In the hands of more extreme groups, this could be used to drive violent conflict, similar to the international left-wing terrorism of the 1970s.

The Poisonous Geo-politics of Climate Change

The clear moral imperative of climate responsibility runs against the harsh power dynamics of carbon politics. Power in carbon diplomacy comes from the size of a country's emissions, and twenty-five counties (including the EU as one region) emit 83 per cent of greenhouse gas emissions. In the absence of any countervailing forces, these countries will together forge any global climate deal, and this is the logic behind the 'Major Economies Process' of the top-twenty emitting countries launched by the Bush administration in 2007. Most of these countries are developed or middle income, and therefore have greater capacity to adapt to climate change than the least developed. Even in countries with large populations of rural poor, perceptions of national interest seem to be dominated by the urban and middle classes. For example, China has expressed a preference for a 550 ppm global target which would lead to a 3-4°C temperature increase, devastating the livelihoods of much of its rural population.

Economic models of the climate change 'power game' weigh the negotiating power of countries as the balance of the cost of cutting emissions against their vulnerability to climate change. These suggest that in pure power game, it would be optimal for China and India to pay the developed world to reduce greenhouse gas emissions, as in the absence of such 'compensation' they would not abate enough.[83] This logic is hidden by the cost-benefit models used by Stern to generate global GDP losses of 5-20 per cent, which rely on the assumption that developed countries will value reducing deaths in developing countries

[83] For a review see Nick Mabey, Stephen Hall, Clare Smith and Sujata Gupta, *Argument in the Greenhouse: The International Economics of Controlling Global Warming* (London: Routledge, 1997).

in a similar way to damages at home. However, other economic studies show that in real situations people's willingness to pay to reduce harm to others decreases rapidly with distance and time; public opinion is unlikely to reflect the benign economic calculus of the Stern review.

A deal made between the climate 'villains' without the 'victims' at the table is therefore unlikely to be fair, and will obviously emphasise the domestic costs of mitigation over other countries' damage costs. In the absence of a sense of global justice, it is unlikely that a global climate target will be agreed which aims to stabilise temperatures at a 2°C increase. This may be unwise for major emitters, given the risks of extreme climate change to their economies, but unless the imperative of climate security is grasped, it remains a very likely negotiating scenario. This approach would have parallels to how World Trade Organisation (WTO) talks were conducted before the Seattle talks in 1999, where the major trade powers settled issues in the 'green room' and then presented the deal to the other countries. At Seattle this process was blocked by the African countries which felt excluded from the negotiations. A similar reaction to an agreement perceived as being unfair could derail climate change discussions on the UN Framework on Climate Change, which operates under consensus rules.

Even if a strong agreement is reached, many poorer countries will still need help in adapting to the changes already in train. The World Bank estimates that the cost of climate-proofing development aid programmes will be $4.5 billion per annum, and the additional costs of all adaptation are likely to be around $44 billion by 2015: around half the current global aid budget. However, currently the global climate adaptation fund has received pledges of $279 million from developed countries, and of these, only $160 million has actually been received by the UN. Unless these dedicated funds are increased, climate adaptation expenditure will fall on national budgets, will be diverted from existing aid funds, or adaptation measures will just not be implemented.

A global climate change agreement that is perceived as being unfair to the poor and highly vulnerable – either due to inadequate targets or a lack of assistance for adaptation – may become politically unsustainable.

Legal Challenges to Climate Insecurity

The UN Framework Convention on Climate Change (UNFCCC) is not the only avenue of international law which countries can use to address climate change. The UN Security Council has the jurisdiction to address climate change as a threat to 'international peace and security' in a similar way that it has dealt with terrorism. There is a precedent for the Security Council dealing with trans-boundary environmental issues from its statements on Iraq's responsibility for damage to Kuwait from oil fires and spills deliberately started in the First Gulf War (Resolution 687). Many of the most threatened small island states have explicitly reserved their right to take climate change to international bodies outside the UNFCCC.[84]

The Security Council could be brought into the climate change debate under two scenarios. If the UNFCCC fails to agree an overall target which would preserve the existence of many of the small island states, they could try and use the Security Council (most likely through allies in the EU and Africa) to challenge the agreement. Perhaps a more likely scenario will occur if some significant countries refuse to join an agreement under the UNFCCC, or fail to comply with their obligations. Neither the UNFCCC nor the Kyoto Protocol can currently apply compliance mechanisms outside the climate system (for example, using the threat of trade sanctions), and the UN Security Council could be used to apply binding sanctions against non-compliance. Though this mechanism is not a panacea for agreement, as it will be ineffective against permanent Security Council members (the P5) who could veto any resolution, it would be a credible threat against countries such as Brazil, India, Mexico, Pakistan or Saudi Arabia. The UN Security Council debate in April 2007 showed the sensitivities from the G77 and China over the expansion of Security Council activity into climate change. Partly, this is a general point of principle, but also a fear that the Security Council could be used to coerce smaller countries into an unfavourable agreement.

In either case, if UNFCCC negotiations do not successfully address mitigation and adaptation to the satisfaction of the broad

---

[84] Christopher K. Penny, 'Greening the security council: climate change as an emerging 'threat to international peace and security'', *International Environmental Agreements*, 2007.

majority of UN members, as opposed to the major emitters, then climate change will become a constant source of dispute across the international system. This will hurt the legitimacy and effectiveness of the UN far more than the recurrent failures to manage conflict and genocide, because the impact of failure will be felt in a large number of countries and across much of the global population.

Radical Mobilisation

Across the world, radical political responses are emerging to climate change; from airport blockades in the UK to a rising set of campaigns against new coal power plants in the US, UK and Germany. These campaigns combine local activists with relatively new campaign groups organised through the Internet.[85] These campaigns are sometimes fostered by established groups such as Greenpeace, but they also have their own dynamic which is more confrontational and less hierarchical than traditional groups. The broad anti-globalisation movement which has emerged since the Seattle WTO conference in 1999 has also begun to mobilise around the linked challenges of climate change and peak oil, seeing these as fundamentally undermining the current global economic order.[86]

The level of direct action and public protest in developed countries over climate change is likely to increase, but perhaps the more important movements will emerge from developing countries. The underlying injustice of climate change is beginning to stimulate new movements such as the straightforwardly named African group 'Stop Killing Us Now' (http://www.stopkillingus.org/). Mainstream politicians in Africa are increasingly highlighting the injustices of climate change, and linking it directly to a potential backlash against the developed world. To quote Desmond Tutu in May 2007: 'Our friends there should think about this the next time they reach for the thermostat switch. They should realize that while the problems of the Mozambican farmer might seem far away, it may not be long before their troubles wash up on their shores.'

Mobilisation in developing countries is being driven both by the projected impact of climate change, and also by the actual and

---

85 For example see <http://www.planestupid.com/>.

86 <http://www.ifg.org/pdf/manifesto.pdf>.

perceived impact of climate change polices. The worldwide increase in food prices over the past year has mainly been blamed on the increase in biofuel production in the USA (an energy security, not a climate change policy), though increased Chinese demand for foodstuffs and drought in Australia has also contributed. Whatever the reality of the situation, it is clear that many climate change policy responses will hurt some in the developing world, with increased use of tropical biofuels and large-scale purchasing of forest carbon sinks being the most high-profile examples. If badly managed, these policies will push subsistence farmers and forest users off their land, and commercial interests will move in driven by carbon markets, as just a few bad projects could be enough to tarnish the whole process. Even individual and private sector climate change efforts can cause resentment in developing countries. The recent decision by the Soil Association to ban organic certification for most goods delivered by air freight will harm farmers in countries like Kenya. It has also had an immediate political impact in moving the Kenyan government to align with Saudi Arabia in supporting compensation payments for the impact of climate change policies under the UNFCCC, which previously was seen as an OPEC-driven blocking tactic in the climate change negotiations.

Leading radical activists, such as Vandana Shiva in India, are developing a new narrative where not just climate impact but the response to climate change will be used as another weapon in accelerating globalisation to the detriment of poor people; for example, through emissions trading, transfer of polluting industries, commercial forestry projects and use of biofuels.[87] Though these arguments have been deployed before about the general process of globalisation, in the context of climate change they potentially have more resonance and power. Responsibility for harm is much clearer for climate change than for trade liberalisation; the link between the emissions of the wealthy and the impact on the poor is a scientific fact, not a contested argument in political economy.

Climate change will be used by extremist groups to bolster existing resentment against developed countries, beyond the type of references made by Osama bin Laden in the last few years. Climate change will hit Muslim countries very hard as many are in water

---

[87] <http://www.democracynow.org/2007/9/14/vandana_shiva_decries_the_outsourcing_of>.

stressed regions of the world, and this fact has not been lost on Muslim commentators.[88]

As the impact of climate change and climate politics intensify, their political profile will only get stronger. Whatever is agreed in the UNFCCC, the effectiveness and fairness of any agreement will continue to be a source of dispute and protest especially in the developing world. The potential for these movements to become violent, even mutating into eco-terrorism as suggested by security analysts such as the UK's Defence Academy, will rise if international institutions do not agree to undertake radical action against climate change.

Failure to adequately address the interests of the poorest countries and people in a global climate change agreement will seriously undermine the legitimacy and effectiveness of the international system. Protest and direct action movements will increase especially in developing countries and these could well result in violent attacks on developed country interests.

[88] Examples of mainstream Muslim commentary on climate change can be seen at <http://www.martininstitute.ox.ac.uk/NR/rdonlyres/321A5E52-32EF-4007-AFB6-549BC2A490AA/0/IslamandClimateChange.pdf> and <http://www.salaam.co.uk/themeofthemonth/september01_index.php>.

VIII. TACKLING CLIMATE-CHANGE-DRIVEN CONFLICT AND INSTABILITY

> The expanding Sahara desert had brought with it some cross-border problems – for example, there were credible reports of nomadic Fulani cattle herdsmen arming themselves with sophisticated assault rifles to confront local farming communities, who had become impatient with the roaming cattle. It was important that, from time to time, the Council evaluate the dangers of such confrontations. The deadly competition over resources in Africa could not be glossed over; be they over water, shrinking grazing land or the inequitable distribution of oil.
>
> ***L. K. Christian, Representative of Ghana, UN Security Council, 17th April 2007***

The role of climate change in increasing geo-political tensions is illustrated by episodes such as the current border disputes in the Arctic. It is also clear that extreme climate change scenarios would cause large levels of economic and social dislocation, which would trigger both internal and external conflicts, including armed violence. More controversial, however, is the assertion that climate change under more moderate scenarios, or if stabilisation is achieved at around 2°C, will lead to increased instability and violent conflict in the short to medium term.

This is an important dispute. The costs of social instability and conflict are not currently included in the costs of climate change, and if high, would increase the pressure for aggressive mitigation action. Climate change would also change projections of stability used in strategic planning assumptions, affecting a range of security issues including organised crime, energy security, migration, regional stability and investment risk. Country-specific analysis of the impact of climate change will need to become part of mainstream security analysis. Already, organisations such as International Alert are predicting higher tensions in forty-six more countries – home to 2.6 billion people – because of climate change.[89]

The impact on patterns of climate change policy responses is equally importantly. Current discussion of climate change adaptation tends to focus on technological and infrastructure solutions, framing this area as essentially an apolitical branch of standard development policy. As some commentators put it: 'climate change adaptation is just good development'.

This view is undermined by the fact – discussed at length in the previous sections – that both the impact of climate change and policies to address it will raise intense political conflicts over the allocation and control of resources and territory. If these political tensions are handled well inside countries, then adaptation may be a peaceful and managerial process, but in countries where governance is weak and resource management already politicised – especially on communal lines – this would seem to be unlikely outcome.

If there are widespread increases in resource related tensions from climate change, especially inside countries, then the process of adaptation will need to recognise this in both its structure and focus. This would require a much stronger focus on conflict prevention in areas of fragile and contested climate sensitive resource management, and away from a focus on protecting the most economically valuable areas from climate impact. As discussed above, it will also require different methods involving the full range of diplomatic, development, security and peacebuilding capabilities to be deployed to prevent rising tensions and strengthen governance at sub-national, national and trans-boundary levels.

The impact of climate change on instability will also require changes to how climate adaptation is handled in international climate change policy. To date climate adaptation has mainly been framed as a technical development activity, but in reality it will involve complex political and diplomatic interventions in difficult and highly charged

---

[89] International Alert, 'A Climate of Conflict', London, 2007 <http://www.international-alert.org/publications/322.php>.

internal resource management issues. More controversially, access to international adaptation finance could be made conditional on countries implementing reforms to internal resource management policies to improve social resilience and prevent conflict and marginalisation of certain groups.

Failing to recognise the conflict and instability implications of climate change and responding by investing in a range of preventive action could be very costly in terms of instability, human lives and retarded development. This section gives an overview of the issues and uncertainties surrounding climate change and conflict, and proposes some frameworks for managing these risks.

Understanding Climate, Resources and Conflict

Conflict over natural resources, whether driven by need or greed, has always been a part of human society. There is also strong evidence that social tensions driven by past climatic change destroyed many advanced societies, such as the long-wave droughts which drove the collapse of early civilisations in North Africa, Mesopotamia and Peru (see Box 6).[90] Long-range data on climate and warfare from Eastern Chinese shows a clear pattern of climate induced crop failure repeatedly driving conflict over a millennium (1000 to 1911) and through 899 recorded conflicts[91]. Though history gives us no absolute guidance for whether climate change will drive greater levels of conflict in modern societies over the coming decades, it does show the often ignored links that have existed between climatic change and conflict in the past. The fact that these links do not seem to form part of the broadly accepted 'narrative' of conflict among security analysts in the developed world, may become a cultural barrier to developing appropriate responses to climate change.

[90] See Nick Brooks, 'Cultural responses to aridity in the Middle Holocene and increased social complexity', *Quaternary International,* (2006).

[91] DD Zhang, J Zhang, HF Lee, Y He, 'Climate change and war frequency in eastern China over the last millennium', *Human Ecology* (Springer, 2007).

Box 6: Climate Change, Conflict and Civilisation

In the historical and archaeological record, climate change has been associated with both societal collapse and conflict, and the flowering of sophisticated urban societies.

From about 6000 BC, changes in the Earth's orbit caused the global monsoon system to weaken, resulting in the southward retreat of monsoon rains throughout the northern hemisphere sub-tropics from West Africa to China. However, this process was not smooth, and the environmental record indicates a number of abrupt shifts towards aridity, with particularly severe desiccation occurring in the fourth millennium BC.

In the Nile Valley, the unification of Egypt occurred soon before 3000 BC, and it has been widely suggested that the migration of populations displaced by the desiccation of the surrounding desert played a key role in this event.

In Mesopotamia, the Uruk culture collapsed around 3200 BC amid increased conflict and settlement fortification, and a huge increase in the population of the principal city of Uruk-Warka, suggesting widespread upheaval in the surrounding regions. Environmental records indicate widespread and severe desiccation in the wider region at this time.

In northern China, the transition from the Yangshao to the Longshan culture around 2800 BC was associated with increasing social stratification, and followed a shift to more arid conditions commencing just before 3000 BC.

Attempting to understand the impact of climate change on conflict requires a general understanding of the underlying drivers and dynamics of instability, in different places and at different times. The historical record and statistical evidence can then be used to give some guidance as how climatic events affect these drivers and how they have been associated in the recent past with instability and conflict. These models of how climate has affected conflict risk could then be combined with climate change projections would give some guidance as to the size and location of future risks.

Though a logical approach to analysis, it is undermined by the lack of analytical consensus over the main drivers of conflict. Any review of the conflict literature shows there is little agreement between analysts over the causes of conflict, or indeed even what to measure as a conflict. While some assess a full range from non-violent disputes to full-scale war, others only consider violent conflicts where a certain number of combatants die. Only recently have detailed statistics relating to non-combatant deaths been estimated, showing that they usually outnumber direct battlefield deaths by a factor of four to ten times and would affect current classifications of conflict fundamentally.

Statistical results are complex and often non-comparable, and only a few factors seem to emerge consistently as materially raising the overall risk of countries experiencing internal conflict: low levels of GDP; previous conflict; high dependence on natural resources; and immature political regimes poised between autocracy and democracy. A larger range of other factors have been associated with some conflicts and perhaps the two most powerful are the presence of horizontal inequalities – between communal groups based on ethnic, political, religious or caste lines – and economic crisis. Even the most ambitious analysts consider that such structural factors can only account for around 50-60 per cent of the risks of conflict.[92]

There is even more dispute about the actual importance of the different factors, and different models and measures used to arrive at different conclusions. For example, the World Bank which highlights the association of previous conflict and natural resource dependence with the likelihood of civil war, above more 'common sense' explanations such as ethnic dominance.[93]

On the other hand, many political analysts consider the search for common factors underlying conflict to be at best useless and at worst a dangerous simplification of unique events which will distract from sophisticated and specific analysis. They point to apparent inconsistencies, such as if natural resources somehow drive conflict why are Norway, Saudi Arabia and Namibia stable, but Angola, Nigeria and Indonesia are not?

---

[92] Nick Donovan, Malcolm Smart, Magui Moreno-Torres, Jan Ole Kiso and George Zachariah, Prime Minister's Strategy Unit, Cabinet Office 'Countries at Risk of Instability: Risk Factors and Dynamics of Instability', *Background Paper* (London, February 2005).

[93] Paul Collier and Anke Hoeffler, 'Breaking the Conflict Trap: Civil War and Development Policy', World Bank Report, 2003.

Even if the existence of general patterns is assumed, then there are still good methodological reasons for doubting the applicability of standard statistical techniques, which assume consistent underlying causal model, to events which exhibit complex causality and interactions. It is likely that no matter how much we try and measure these phenomena there will always be much that cannot be incorporated into statistical modelling of conflict[94]. This general limitation to all conflict risk projections therefore limits the conclusions that can be drawn from the impact of future climate change, which adds an extra layer of uncertainty to the process of developing preventive response strategies.

The evidence from the general conflict literature shows us that it is usually a mistake to ask whether any single factor 'causes' a conflict, as all periods of conflict and instability are the result of a complex of factors and human responses. The historical literature on the origins of the First World War has been examining its 'causes' for nine decades, without coming to any uncontested conclusion, and certainly not a statistical understanding. History will never record the hundreds of conflicts which were prevented by acts of statecraft, leadership and wisdom on the part of individuals.

This approach puts into context some of the critiques of 'climate security' which urge caution on the grounds that there is no good empirical evidence that climate change has caused a specific conflict. To quote Barnett: 'on the basis of existing environment-conflict research there is simply insufficient evidence and too much uncertainty to make anything other than highly speculative claims about the effect of climate change on violent conflict'.[95]

However, as discussed above, the issue of what constitutes proof for academics is a different issue to whether information is robust enough to be useful in medium- to long-term security analysis. Many highly uncertain and often speculative pieces of information are used as the basis for key strategic decisions, especially when the stakes are high and response times very long. For example, the US National Intelligence Council regularly makes projections of the size of the Chinese military budget in 2030 though this is based on no verifiable

[94] Mabey and Yiu, op. cit.

[95] Joe Barnett, 'Security and Climate Change', *Global Environmental Change'*, (Vol. 13, 2003).

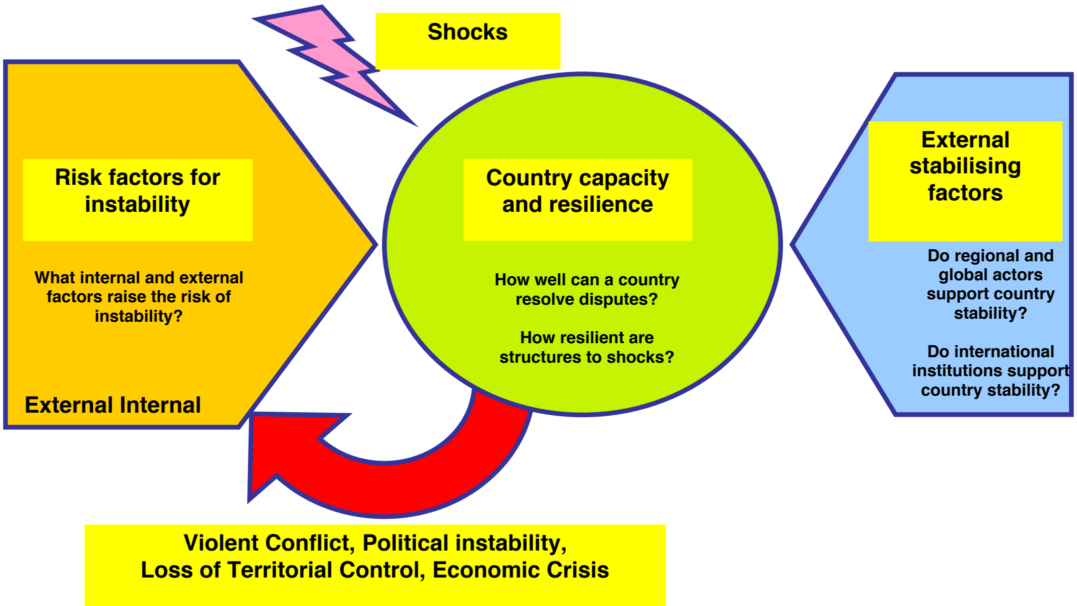

Figure 12 The Basic Instability Framework

scientific or intelligence base, as the Chinese have yet to decide how large their military budget will be that far into the future.

The impact of climate change and resource scarcity on security must therefore be understood inside the broader dynamics of country stability, and the weight given to results assessed relative to the uncertainty surrounding other factors related to conflict and security. Uncertainty must not be used as an excuse not to address these impacts, given the potentially large costs of climate driven instability.

Incorporating Climate Change in a General Instability Analysis Framework

Stability is not stasis, but emerges from the peaceful management of the changes and internal tensions all countries experience. Outwardly change-resistant countries should not be considered stable, if such stasis comes from the suppression, rather than active management, of risk factors of instability. Their risk of instability is rising over time, giving a high likelihood of rapid and violent change erupting. Instability may manifest in a number of ways: civil unrest; economic crisis; armed conflict; regime change; and lack of territorial control. Figure 12 shows a basic schematic of the dynamics of conflict in the Instability Framework developed in the UK Prime Minister's Strategy Unit. This

Framework can be used to map the interaction of the various factors associated with instability and conflict in a country or region.[96]

- **Country capacity and resilience** lies at the centre of country stability and determines the extent to which countries can successfully manage the risk factors and shocks which are present in all countries. Country capacity depends on both state and non-state institutions. Where country capacity and resilience are low, then destabilising factors can give rise to instability.
- **Risk factors for instability.** These can arise from internal processes and factors within the country, or be consequences of the actions or inaction of other countries and the international community. Risk factors are generally 'structural' and must be addressed through long-term policy measures.
- **Shocks** comprise more proximate and unpredictable risk factors which can trigger unstable situations at any moment in time e.g. assassinations and natural disasters.
- **External stabilising factors** are regional and global in nature and support and strengthen country capacity and resilience. External stabilising factors can also set incentive frameworks which can foster stability in a country.
- **The feedback of instability into the risk factors.** Once crisis or conflict emerges, a feedback loop of weak country capacity and resilience can drive a vicious cycle of instability by increasing risk factors further.

The risk of countries falling into crisis depends on the relative balance of these factors in the framework. Countries at risk of instability have limited internal capacity and resilience, many drivers of instability, and few external stabilisers. A country with weak capacity and resilience can be destabilised by even moderate risks, which a stronger country would be able to manage peacefully. While the risks of conflict and crisis can be assessed along with balancing forces for stabilisation, there is a limit to the predictive ability of any analytical

[96] The detailed research underpinning this model and a manual for how to use this approach in country or theme specific analysis can be found in the Countries at Risk of Instability Section (the 'Investing in Prevention' report) of the UK Prime Minister's Strategy Unit <http://www.strategy.gov.uk>.

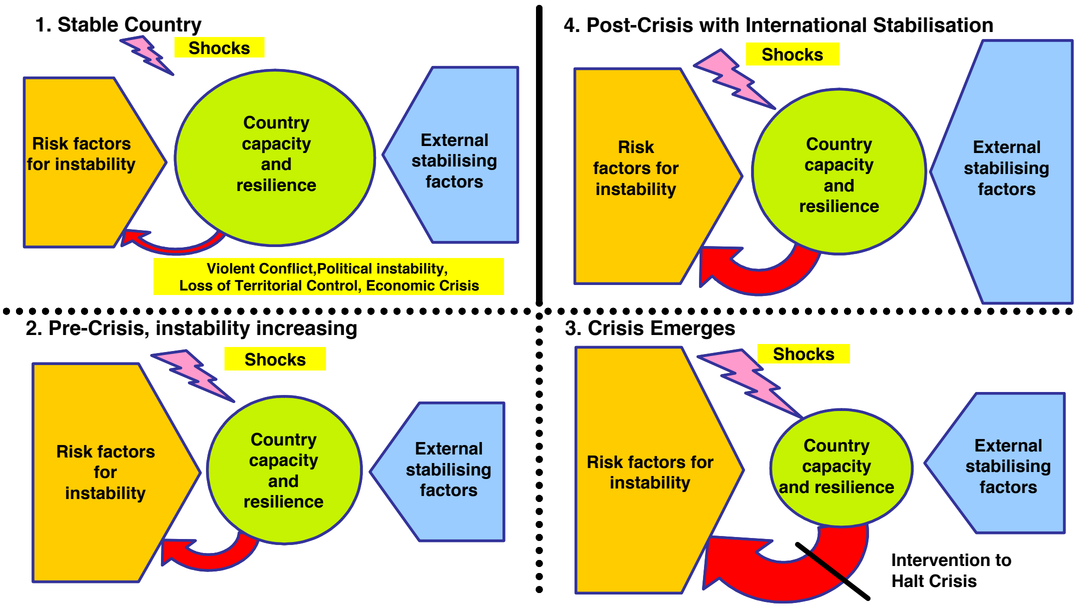

Figure 13 Dynamics of the Crisis Cycle

method. Conflict and crisis feeds off itself – as indicated by the large feedback arrow – and creates its own dynamic where the precise form and extent of crisis cannot be predicted with any certainty.

A risk mapping of this type makes explicit the fact that instability is a dynamic process involving many elements. While all countries face some risk factors, there is a wide range in the magnitude of risks faced, from slight to severe. The presence of risk, while increasing a country's chances of crisis, is not sufficient to result in widespread, persistent instability. Rather, the force of these pressures can usually be withstood by countries with strong capacity and resilience or where there are timely and appropriate external stabilising factors. As all political analyst know the role of individuals in positions of power – either those governing or opposing government – will be central to whether a country becomes more or less stable.

The dynamics of the crisis cycle are shown in Figure 13. The initial stable country (box 1) internal situation becomes increasingly unbalanced (box 2) until risks cannot be effectively managed and conflict breaks out (box 3). This feeds on itself, generating new risk factors and spiralling out of control until interrupted by internal or external interventions (boxes 3 to 4). International stabilisation pressures then help the country through the fragile post-conflict process, while it rebuilds its ability to manage its own internal tensions (box 4).

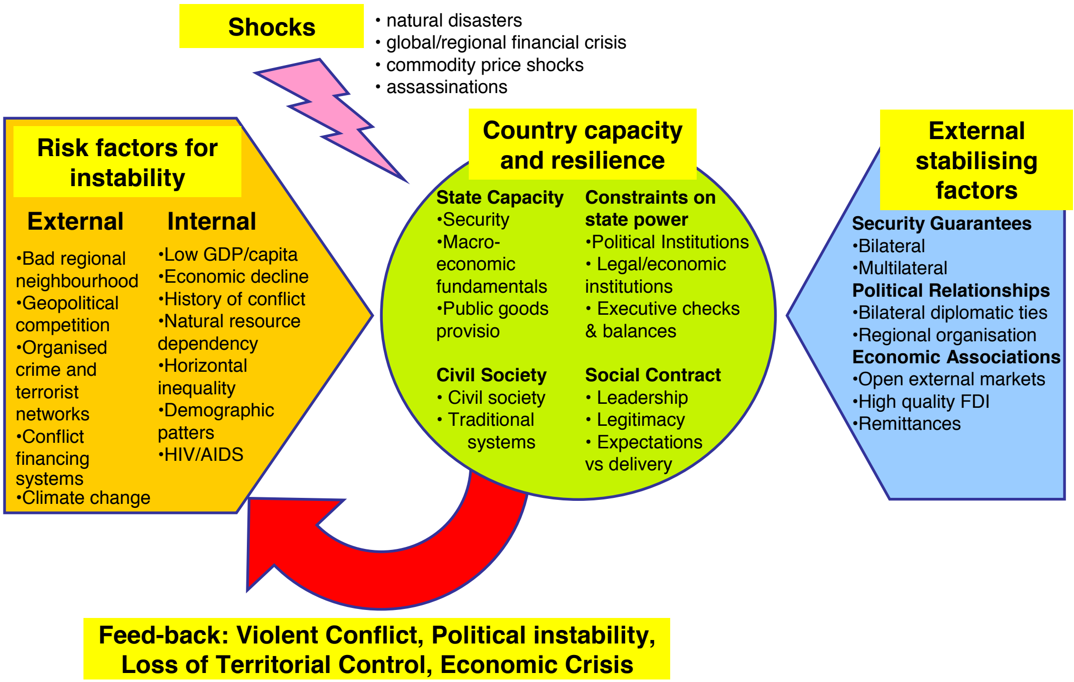

Figure 14 The Annotated Instability Framework

This simple framework can be used to structure country- and region-specific analysis of the overall balance of stability. Nevertheless, each country and region is unique, and requires in-depth and specific analysis. From the research literature on instability, combining case study and statistical material, the key generic factors which need to be included in specific country level analysis can be summarised in the annotated Instability Framework in Figure 14. A detailed discussion of the evidence base behind these factors and how they interact can be found in the background documents on the Instability Framework.

From the annotated framework, some of the critical factors associated with climate change can be derived. Climate change can be expected to contribute to risk factors for instability through: depressing overall growth levels; causing absolute economic decline over a two to five year period; increasing natural resource scarcity and increasing horizontal and communal inequality. Migration is probably the key risk factor which links internal and external tensions. As well as increasing these risk factors, climate change is also likely to reduce a society's ability to peacefully manage them through a reduction in public good provision (e.g. in time of drought) which will weaken central government authority and legitimacy and thus the social contract, and also disrupt traditional patterns of life which form part of the informal conflict resolution capacity of a country. For example, traditional pastoralist group structures are unsettled by migration and the undermining of the authority of elders, as traditional agricultural knowledge becomes redundant as local precipitation and climates change. The weakening of formal and informal governance systems may leave space for new political actors to emerge in response, which may be destabilising especially if organised on a communal basis.

As well as these structural factors, the impact of climate driven shocks to the economic and political system through extreme weather events, price fluctuations of traded crops and mass migration due to natural disasters will also put unpredictable periodic pressure on country stability. The Instability Framework also allows international interventions – beyond those focused on general development and adaptation efforts – to be included in the overall analysis; effective disaster relief and robust support for resource governance agreements are likely to be critical areas where enhanced international assistance can make a difference.

The Instability Framework gives a guide as to how to fit climate change issues into a broader holistic assessment of instability and conflict risk. In many countries, moderate climate change will not be a key factor in stability, due to either benign climatic conditions or strong governance. In others, it may be swamped by other factors such as demographic shifts and extremist politics. However, it will be a material factor in many countries, but more granular analysis of the key issues is needed to understand precisely how important it will be relative to other factors. Unfortunately, there are very few baseline assessments of future conflict trends, beyond the general strategic trend documents produced by governments. Where conflict assessment is carried out, it generally only extends six months to two years into the future.[97] An exception to this is the US Army College ACTOR

[97] For example, the US State Failure Task Force uses statistical modelling to look up to two years ahead and most public risk indices are essentially monitoring the current situation. For a review of existing systems see Mabey and Yiu, Background Paper, Prime Ministers Strategy Unit, 'Practical Risk Assessment, Early Warning and Knowledge Management' (London, 2005).

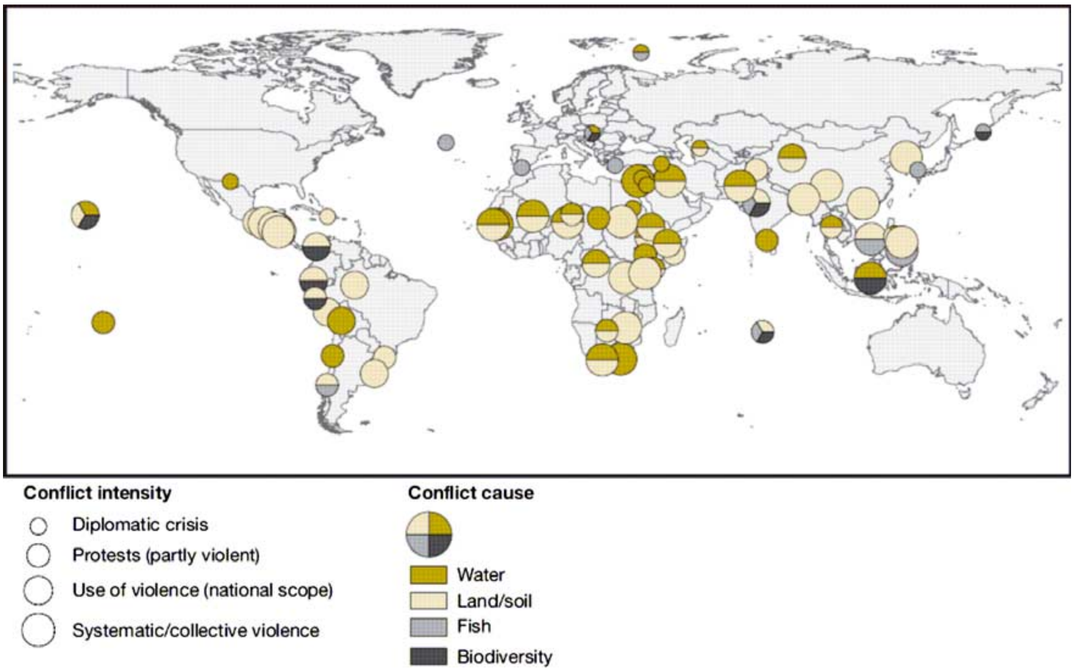

Figure 15 World Map of Environmental Conflicts 1980–2005

model which gives five, ten and thirty year risk forecasts based on some of the structural variables cited above.

Climate change issues need to be integrated into holistic instability and conflict analysis to give an assessment of their importance and main areas for preventive intervention. The main barrier to this is not uncertainty around climate change projections, but the lack of robust medium to long-term structural analysis of instability and conflict trends with which climate data can be integrated.

Evidence of Critical Climate and Conflict Linkages

The systematic study of environmental links to conflict has been an on-going field for several decades, if often far from the mainstream of conflict analysis. Several lists of 'environmental conflicts' exist, though this terminology is less helpful when viewed through the more complex approach to causality discussed above. Figure 15 shows one such conflict map for the last twenty-five years, showing a predominance of water and water/land based conflicts which are, unsurprisingly, clustered in the most water-stressed areas of the world.[98]

To date, average global temperatures may only have risen by 0.7°C owing to climate change, but the impact on marginal areas has been large. The IPCC has ascribed high likelihood that major droughts in the Sahel are linked to climate change and El Niño events. These abnormal conditions have pushed traditional resource management regimes beyond breaking point, resulting in migration and low-intensity conflict across the region. The roots of the Darfur conflict, in part, lie with the communalisation of conflicts between pastoral and agricultural groups over access to scarce resources. These effects of climate change give some guidance as to how future changes will impact conflict.

Based on past analysis of environmental links to conflict and the general conflict analysis outlined above, there seem to be three particularly strong climate change risk factors to consider in security analysis:

- Water stress and vulnerability
- Land fertility and ownership
- Economic decline

Countries will be particularly vulnerable to these stresses where central governance is weak and politically conflicted, resource management is linked to high levels of horizontal inequality between groups, and disaster management systems are weak in buffering the impact of extreme events. In all areas, migration within and between countries will increase the likelihood of tensions and the politicisation of resource-based disputes into violent conflict.

Water Stress

Even without climate change, increased populations and demand means that by 2025, over 60 per cent of the global population will be living in countries with significant water stress. Among those areas

[98] Alexander Carius, Dennis Tänzler, and Judith Winterstein, Expertise for the WBGU Report 'World in Transition: Climate Change as a Security Risk', 2006 <http://www.wbgu.de/wbgu_jg2007_ex02.pdf>.

where water supply is vulnerable to early climate change, where the natural resource base is weak, where governance is poor and where communal tensions already exist over resources, several stand out as highly at risk, including North and Sahelian Africa, the Middle East, Central Asia and several small island states.

The impact of water stress on internal conflict will differ markedly in urban and rural areas. In urban areas, where a growing majority of the world's population live, climate change will affect the existing power struggles over the availability, reliability and cost of water supplies. Increased variability in precipitation and river flows will require greater investment in water infrastructure, at a time when many in urban areas in the developing world have yet to connect major parts of their populations to the water mains. Disputes over investment priorities between fast-growing informal areas in cities (e.g. *favelas*) and the established communities will increase. If increased investment raises the price of water, this could place severe pressures on the poor who pay proportionately much more for their supplies. For example, in Tanzania the average percentage of income spent on water is over 5 per cent, whereas in the UK it is 0.013 per cent. Growing water demand in cities is already leading to disputes with agricultural interests, which take the majority of water flows. However, this also gives opportunities for urban areas to purchase this water and environmental services, such as watershed protection, from upstream users.

The example of Peru (see Box 7) typifies this type of issue where an existing situation of low-level conflict over the privatisation and control of water resources will be greatly exacerbated by the melting of glaciers which supply the majority of Peru's water.

In rural areas, water stress has traditionally caused significant tensions between pastoralists and agriculturalists, and between different groups of pastoralists competing for water and fodder. In sub-Saharan Africa, there are 50 million livestock-dependent pastoralists living in dry areas. Detailed and groundbreaking analysis by Bond and Meier brought together detailed records of rainfall and fodder availability and systematic community-level reporting of conflict and peacemaking activity in parts Kenya and Uganda to examine how variations in rainfall affect low-level conflict.[99] This study was only possible because of the

[99] Bond and Meier, op. cit.

Box 7: Peru and Water Risks (taken from International Alert, *A Climate of Conflict*)

The main climate change concern for Peru is that its glaciers are melting. Glacial coverage has been reduced by 25 per cent in the last three decades and it seems likely that all the Peruvian glaciers below 5,500 metres – the majority – will disappear by 2015. Glaciers are a vital source of Peru's water supply: two-thirds of Peru's 27 million people live on the coast, but natural springs in the area offer only 1.8 per cent of the nation's water supply.

The first effect as the glaciers continue to melt will be a surfeit of water. This seeming bonanza is unlikely to last long and in any case will only be exploitable with efficient water management and enough capacity in the reservoirs. With mounting population pressure, the demand for water is increasing. Local shortages are largely the result of political decisions governed by unequal power relations. Vulnerable groups, with a weak political voice, lose out. In the face of the predicted effects of climate change, resource management needs to be extremely careful not to provoke or exacerbate local tensions.

Peru, like much of Latin America, is moving towards privatisation of basic services such as water and energy. Recent efforts to privatise the water sector have already created significant disputes. In March 2004, large numbers of the urban poor mobilised in protest against the privatisation of water in three cities in the state of La Libertad. Almost half of the residents of La Libertad had no running water, and under the newly privatised management, the services had deteriorated even further. The problems included increased contamination as raw sewage overflowed into irrigation ditches, while the average household only received water service three to five hours per day.

These are the sorts of conditions that will jeopardise the social contract between citizens and the state established by Peru's nascent democracy. The peaceful acceptance of such fetid conditions by citizens cannot long be taken for granted. Local media and NGOs convey a strong feeling of local-level resentment over such conditions. Even where private water supplies have improved water access, lack of sensitivity to local context and dynamics have seen conflicts arise between new water managers and those who previously supplied water, such as travelling water vendors. To ease these disputes and thus reduce the risk of political instability and violent conflict, water management has to recognise the possibly explosive nature of the issue. Decisions about how to manage water supplies need to include an assessment of the potential conflict impact, a mapping out of stakeholders, a heavy emphasis on community consultations and transparency about the issues and decisions, tighter regulation of the water supply business, and compensation for communities whose water supply is affected.

local monitoring of conflict under the Conflict Early Warning and Response Mechanism (CEWARN) established by the Intergovernmental Authority on Development (IGAD) in East Africa in 2003.

The results of this work are complex, but show distinct patterns. Firstly, the level of conflict was far higher than estimated by media reports or in capitals, with deaths in cattle raids and other clashes reaching over 120 a month in some regions, a rate high enough to constitute warfare on some scales. Secondly, moderate levels of scarcity during the dry season tended to lead to increased peace-building activity between communities, including visits by women and other exchanges, and an actual decline in conflict activity. This shows the resilience of traditional systems when faced with normal levels of stress. However, at critical points, notably the end of the dry season when fodder is very scarce and the beginning of the wet season when prime watering sites were being competed for, these systems would break down leading to large spikes in conflict, as shown in Figure 16.

Bottom-up reporting of conflict using local monitors provides a much better tool for systematically analysing the conflict vulnerability of areas to climate variability. The establishment of an African Union Early Warning system based on the approach, and the use of public systems such as Swisspeace's FAST system, which covers twenty-five unstable countries,[100] will provide a much richer source of data to combine with detailed sub-national climate change projections.

[100] See <http://www.swisspeace.ch/typo3/en/peace-conflict-research/early-warning/index.html>.

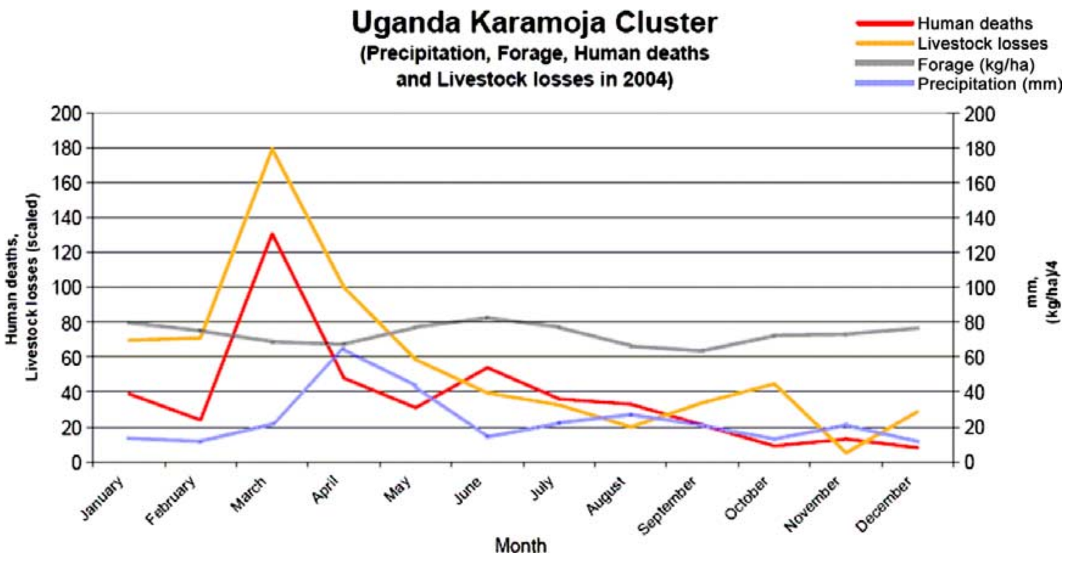

Figure 16 Conflict Impact and Precipitation Levels in Ugandan Karamoja 2004

Localised water stress is likely to be a source of conflict in many regions in both urban and rural areas. Traditional management systems are likely to be overwhelmed by significant changes will need to be supported by more formal methods and rights allocations.

Land Disputes

For a range of reasons, climate change is likely to lower agricultural productivity in many areas of the world. Reductions in rainfall, changes in growing seasons and greater extremes are all likely to have negative impact. In some areas, these will be offset by the positive impact of extra CO_2 in the atmosphere and by increased water availability. One scenario for changes in global cereal production in 2020 and 2050, showing the very dramatic fall in production across a large part of the developing world as climate change accelerates after 2020.[101] The IPCC predicts that net around 600,000 km^2 of cultivable land may become unsuitable for agricultural activities. They forecast, for example, that wheat could all but disappear from the African continent by 2080. Soya bean harvest is expected to drop close to 30 per cent by 2050. This could

[101] Martin Parry et al., 'Effects of climate change on global food production under SRES emissions and socio-economic scenarios', *Global Environmental Change 14,* (Elsevier, 2004), pp. 53–67 <http://www.undp.org/gef/adaptation/docs/foodproduction.pdf>.

translate into annual losses of $25 billion in crop failure due to rising temperatures and another $4 billion from less rain.

At a more granular level, climate change will reduce the growing seasons for many crops along climatic and soil boundaries. In Africa, the growing seasons for many staple crops is expected to shorten dramatically along an arc stretching along the Sahel and down the eastern seaboard and southern edge of the Congo forest.[102] These micro-level changes are far harder to predict with accuracy than larger aggregate changes because they affect marginal and border regions. However, it is precisely these types of areas that will experience the highest stresses and risks of conflict in the near term.

Figure 17 shows how the percentage of failed growing seasons will increase towards 2050 (depicted as the lightest shades), at the shifting borders of these areas significant local migration and competition for resources will occur.

In principle, many of these negative changes can be managed by effective adaptation to shift to different crop varieties and change agricultural patterns. In practice, it is more likely that groups will carry

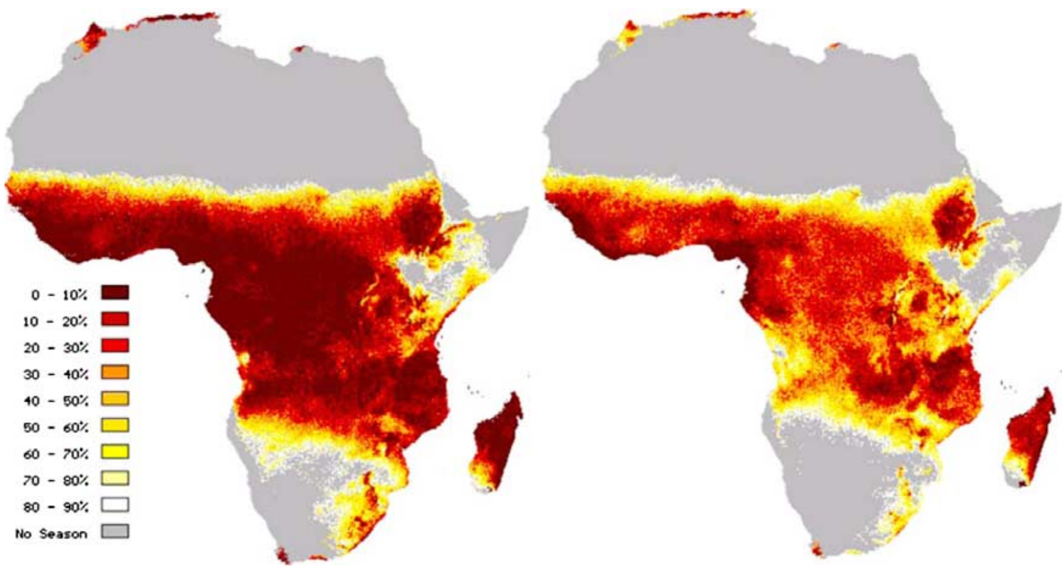

Figure 17 Percentage of Failed Growing Seasons 2000 and 2050

---

[102] Philip Thornton et al., 'Mapping Climate Vulnerability and Poverty in Africa'. Report to the Department of International Development, ILRI, Kenya, 2006 <http://www.napa-pana.org/extranapa/UserFiles/File/Mapping_Vuln_Africa.pdf>.

on using traditional crops and practices – often, they will have no choice – until they become economically untenable. At this point, there will no choice but to migrate and/or compete for more fertile and better managed land with other groups.

The case where groups which have degraded their own lands migrate and come into conflict with communities with more sustainable practices is well documented, especially where international investment creates 'conservation magnets' in forested regions. Examples include the Chiapas region in Mexico and Dry Forest in Madagascar.[103] In this way, adaptation policies themselves can be a cause of conflict unless they are managed in a way which minimises existing tensions and does not simply focus just on preserving the most economically productive areas.

Shifting patterns of cultivable land and increased pressure on land have both been seen as strong drivers of conflict in the past when combined with badly managed or opportunistic politics.[104] As with other resources issues, the dynamics of conflict are complex with a mixture of resource competition, and dynamics over land tenure and shift from subsistence to commercially based agriculture all playing their part. The case of the Rwandan Genocide is the most noted example of a situation where political tension over access to land has been seen to play a significant role in generating large scale conflict (see Box 8).

These issues do not just affect poor developing countries in Africa, Asia and Latin America. Land tensions are particularly high in many areas of China, and the source of most of the 70,000 annual environmental protests which occur, many of which are violent. India has the largest number of on-going violent insurgencies, many of which are linked to rural Maoist movements fuelled by local inequalities in land and water distribution and control. These large-scale – if relatively low-level – conflicts do not get the attention of many security analysts because they are not seen as threatening to overall country-wide stability. Central government power is considered adequate to defeat the military threat, if it were to escalate above a certain level. While this may be true in strictly military terms, the

---

103 WWF-UK, 'Poverty and the Environment: Facing the Real Issues' (Godalming, 1997).

104 For a review see OECD Development Centre Working Paper 233, 'Land, Violent Conflict and Development' (Paris, 2004).

Box 8: Land-related Tensions and the Rwandan Genocide (adapted from *Land, Violent Conflict and Development, OECD 2004*)

The case of Rwanda is a particularly stark illustration of the link between inequality in the distribution of land assets and the outbreak of conflict. Rwanda was characterised, before the civil strife of 1994 that eventually led to the genocide, by an ethnic division of labour in *urban* areas inherited from the colonial regime: Tutsis were allegedly over-represented in the private sector because of their difficulties in accessing public jobs. This phenomenon was actually rather less marked in reality, although Hutu control over the state apparatus was undeniable. A structural adjustment programme which explicitly sought to tilt the balance of the economy away from the state and towards the private sector was very likely to be interpreted in ethnic terms.

This urban-based rivalry, sharpened by the effects of structural adjustment, is the main reason for the outbreak of civil strife in 1994. However, the situation in rural areas, characterised by fierce competition for land but no ethnic-based inequality, played a key role in turning a low-level conflict into genocide. Interestingly, one of the cases documented by in Northern Rwanda confirms the link between prior land disputes and mass killings, and contradicts the ethnic argument – both the killers and their victims were Hutus. One lesson here is that land inequality is not necessarily a source of conflict, but that it can be an aggravating factor when associated with extreme poverty and vanishing opportunities.

economic impact of major sub-national civil unrest in these now-globalised economies would be immense, with a flight of international capital and impact on financial centres. These secondary effects would probably be more destabilising than the initial conflicts; in comparison, the IMF estimates the knock-on impact of a mild outbreak of Avian Flu in the Asia region would total between $99 and $238 billion.

Climate change will increase all these types of tensions in many parts of the world. Climate policy will also increase global demands for biofuels, much of which will be grown commercially in developing countries and will increase investment in tropical forestry as carbon sinks. But these trends could also provide ways of reducing land conflicts as biofuels based on plants such as Jatropha can be grown on marginal lands, and may provide a commercial alternative to food crops under climate change.

Access to fertile land will be a major engine of climate driven conflict, and is linked to complex issues of land tenure, privatisation and traditional management regimes. Adaptation strategies must focus on marginal areas and shifting patterns of cultivation if they are not to add to tensions by benefiting the productive areas.

Economic Recession and Decline

Economic recession and decline is highly correlated with internal conflict, as it reduces the legitimacy of the ruling elite and opens them to competition from new leaders and to direct protest from the population. It is also suggested that low levels of employment increase the number of young men available and willing to be recruited into rebel forces.

Many developing countries already face significant macroeconomic challenges in coping with existing climate variability; for example, the World Bank estimates that floods and drought in Kenya in the late-1990s resulted in direct economic costs of $4.8 billion, or 22 per cent of GDP per annum. It is not necessary for economic recession to last more than a few years for it to trigger internal instability; therefore, these effects may occur even in the early stages of climate change when increased climatic variation is the dominant impact on societies.

The economic impact of increased extreme weather events, lower commercial crop outputs and reduced hydroelectric output could be highly significant in driving conflict. Analysis of civil wars in Africa shows a very strong correlation between rainfall, economic fluctuations and civil conflict during the period 1981–99.[105] In this study, the relationship between GDP growth and the incidence of civil wars is extremely strong: a 5 percentage point drop in annual economic growth increases the likelihood of a civil conflict (at least

---

[105] Edward Miguel, Shanker Satyanath and Ernest Sergenti, 'Economic Shocks and Civil Conflict: An Instrumental Variables Approach', *Journal of Political Economy* (Vol. 112, No. 4, 2004).

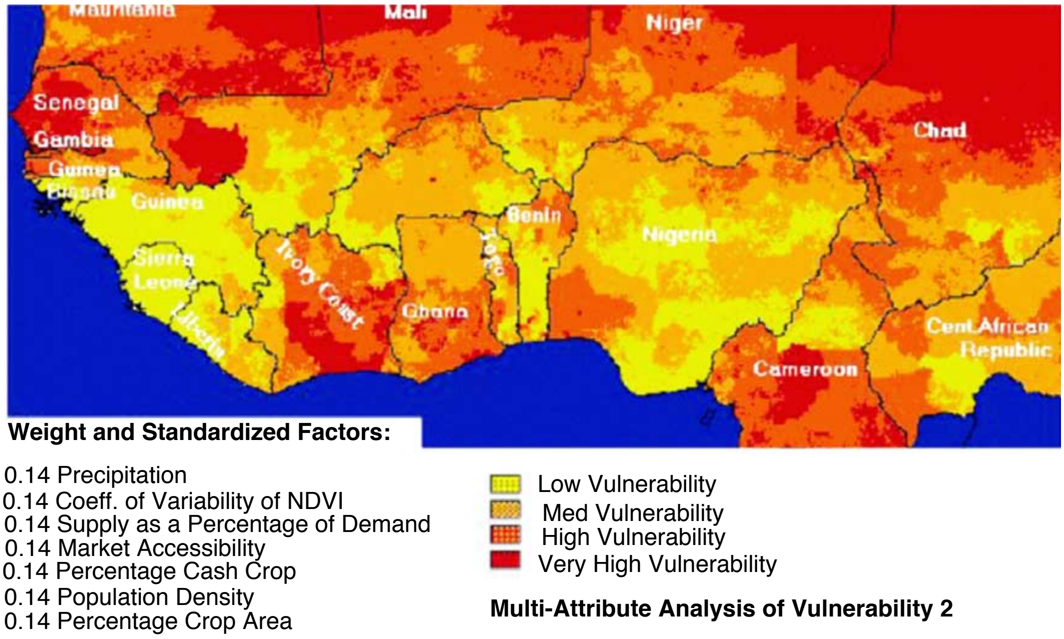

Figure 18 Economic Vulnerability to Climate Change in Northwest Africa

twenty-five deaths per year) in the following year by over 12 percentage points, which amounts to an increase of more than one-half of the likelihood of civil war.

Climate change will have a severe economic impact on richer countries in many ways: by raising the price of agricultural commodities as crops fail; reducing tourism revenues as extreme weather events multiply and climates warm; and by reducing the ability to produce cash crops and support tourism because of more frequent droughts. Small island states dependent on cash crops and tourism are particularly vulnerable to these economic effects, and have few opportunities to diversify their economies.

Extensive – though still initial – mapping has been done to examine the economic vulnerability of areas to climate change; much of this has focused on how dependence on income from cash crops will be affected by increased precipitation variability. Figure 18 shows one such mapping for Northwest Africa, showing the highly variable distribution of these risks among and inside countries, and the need for detailed analysis of country conditions which will need to drive attempts to reduce vulnerability to climate change.

Though this link has been most convincingly demonstrated in Africa, due to its high vulnerability and large incidence of civil wars, the same mechanisms will be present in other parts of the world.

Despite the recent increase in growth rates in the developing world, mainly driven by commodity prices, the history contains many economic reversals and decline is possible in all parts of the world and this is unlikely to change in the future.

One positive impact of climate change policy is that it may reduce the macroeconomic vulnerability of developing countries to oil price shocks by reducing future oil prices levels, increasing availability of more efficient vehicles and driving the development of efficient biofuels as a local oil replacement which does not require hard currency to purchase.

The impact of climate change on periodic economic shocks and depressions is very likely to increase conflict risks. However, current economic studies of climate change focus more on long term impact on trend GDP growth, and have not modelled the dynamic impact of droughts, foods and other extreme events which are likely to be much more important in the next two decades.

Bringing the Issues Together: The Example of African Inter-Communal Conflict

Conflict is a complex, dynamic and interlinked process, and separating different factors out for scrutiny – while often useful – always abstracts away from the full picture. The following sections outline the overall impact climate change may currently be having on a selection of countries in Africa.[106]

Traditional tensions over land-use exist throughout Africa, and have certainly provoked low-level clashes between pastoralists, or between pastoralists and farmers. The ability to fight for grazing, water or livestock is characteristic of the way pastoral communities cope with a harsh environment. Pastoralists often have a warrior tradition – and the weapons to back it up – in a way that sedentary and easily-policed farmers do not. These tensions are mostly endemic. Climate change intensifies them, or shifts their location, but it is rarely the only cause. Politics and other factors (race or religion, for example)

[106] This section is based on discussions with several analysts and particularly those in the UK Foreign and Commonwealth Office; however all conclusions are the author's own.

can have an important influence too. Although such conflicts can be low key (as in northern Kenya until recently) this is not always so. When other factors come to bear, as in Darfur, their effects can be severe. Some examples are given below.

In Côte d'Ivoire, migrants from Mali and Burkina Faso – most escaping the effects of desertification – make up a quarter of the population. Although originally welcoming, government policy changed in the 1990s, when a policy of 'ivoirite' was initiated. Resulting tension between *indigènes* and immigrants led to civil war. Over one million Burkinabes and Malians have been forced to return to their countries of origin, imposing serious pressure on already fragile economies.

Darfur is on the edge of the Sahara, and 60 per cent of its estimated population of 6 million are subsistence farmers. Desertification has exacerbated traditional tensions between such farmers and their pastoralist neighbours. But it is political (Khartoum's policies) and ethnic (Arab vs. black African) factors which have given the conflict its particular intensity. Millions have fled, thousands have died, and hundreds of villages have been razed. Addressing environmental degradation will not end the conflict. But it is a vital component in securing any lasting political settlement.

Nigeria suffers from perennial tension between pastoralists and sedentary farmers. Creeping desertification has forced the former southward – into the so-called Middle Belt – in search of fresh pasture, intensifying conflict. In 2005, 3,000 people were killed in Plateau State alone, and the government declared a state of emergency. The conflict also straddles the line between Muslim north and Christian south, adding a complicating and potentially inflammatory factor.

The Senegal River Basin suffered a decade of drought in the 1970s and 80s. This led to the creation of the Senegal River Basin Development Authority providing for its joint management, with Mauritania and Mali, including the construction of dams. In 1988/89, the recession of the river from the adjacent floodplains led to conflict between Mauritanian camel herders and Senegalese farmers. Hundreds of Senegalese were killed in Mauritania, and Mauritanian shops and property inside Senegal damaged. The conflict was so intense that Senegal and Mauritania broke off diplomatic relations for three years.

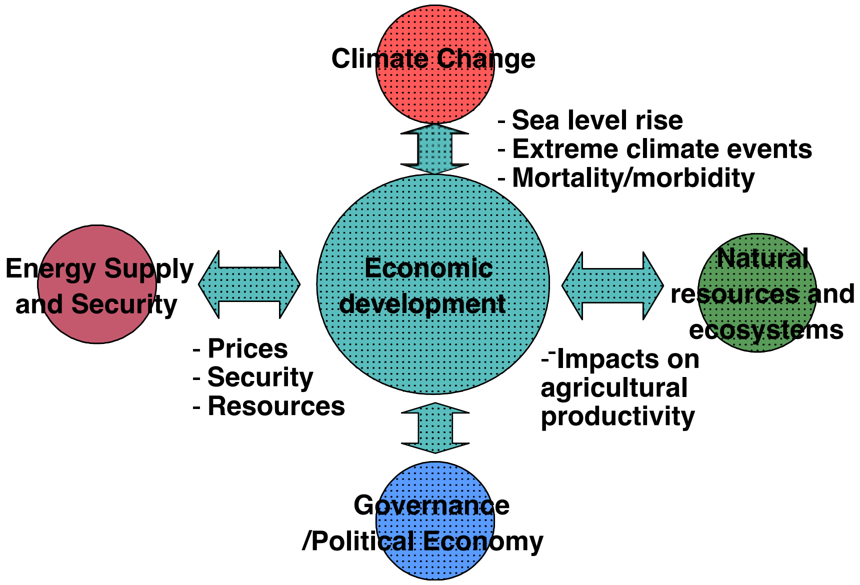

Figure 19 Links between Climate Change, Energy Security, Resource Use and Development

In the past, most conflicts associated with climate change in Africa have been localised. Although they may draw in the neighbours, they do not encompass a state's entire territory. But in the medium- to long-term, climate change could help provoke or intensify civil conflict country-wide.

Improving Analysis of Climate Change, Instability and Conflict

Analyses of the precise impact of climate change on conflict are still at an early stage, and will need development if they are to be applied systematically in security analysis. However, much of the problem lies on the security analysis side which cannot absorb the – often overpowering – range of data on climate change projections produced by the far better funded climate science community.

The general Instability Framework gives an overall framework for trying to incorporate different factors into an overall analysis, but more specific 'sub-models' are needed to explore specific effects. A range of these have been produced by analysts, perhaps the most developed being the 'conflict clusters' approach outlined in the WBGU report 'Climate Change as a Security Risk'.

Figure 19 outlines the current framework of analysis, where climate change, energy security and resource use are considered to

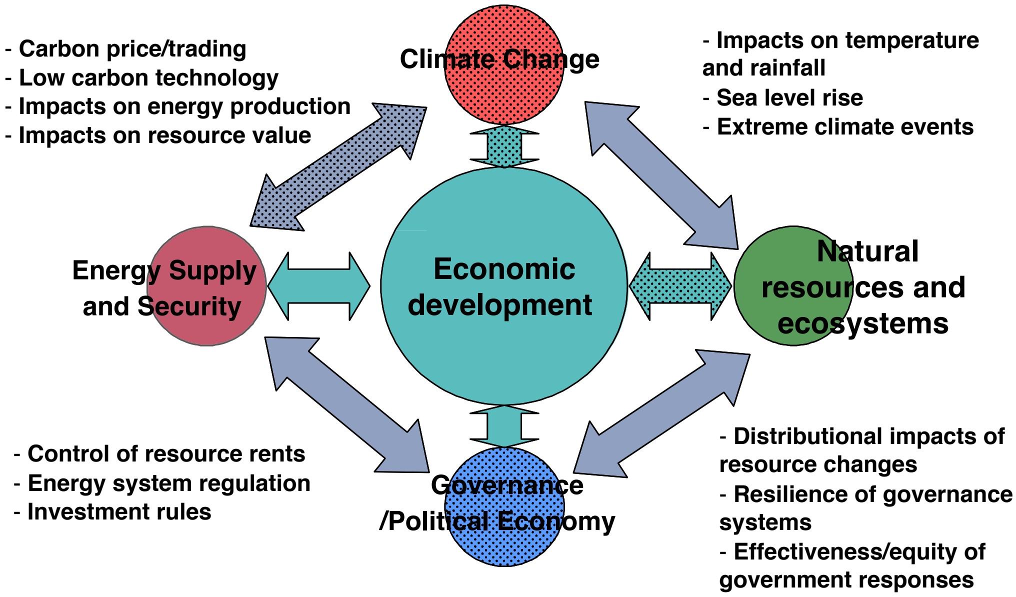

Figure 20 Interdependencies between Climate Change, Energy Security, Resource Use and Development

separately impact economic development and, via the balance between economic development and governance, the general stability of a country is determined. The critical links in this model are the impact of energy security, resource management and climate change on prices and sectoral productivity, and the direct economic impact of severe climate change – for example, through storm and flood damage.

Currently, these separate factors are generally only considered individually in their impact on economic growth; for example, through the World Bank governance indicators, World Bank economic and agricultural impact analysis and IMF analysis of energy price impact. There is no combined modelling of how the different factors combine together to impact economic growth and stability.

Based on the more holistic analysis above, Figure 20 then expands the analysis framework to include the linkages and cross-dependencies between the different areas. The linkages between the different areas present a more complex set of issues and bring more aspects of political economy and security directly, including:

- **Climate and energy security**: dynamic links between climate change and energy security policy. The evolution of the climate change regime will have a strong impact on energy prices and energy technologies, increasing energy security in many countries and potentially lowering revenues in some oil and gas exporters.

- **Energy security and governance/stability**: dynamic links between energy and resource use in countries and overall governance are strongest in energy exporting and transit countries, where research shows the negative impact of point-resource revenues on measures of conflict, corruption, good governance and pro-development policies. These countries also become embroiled in destabilising geo-political rivalry between consuming countries. Changes in energy security politics and policy linked to climate change will have knock-on impact on governance and stability; for example, by reducing the impact of the resource curse.
- **Resource use and governance/stability**: scarcity of water, land and forestry have always been linked to risks of instability, but are mediated through the dynamic links between local and national political economy and the ability to peacefully resolve resource based disputes. In many regions, resource disputes become aligned along communal lines (such as ethnic, religious or caste) and overwhelm traditional resource governance systems with the increased stresses of climate change, resulting in conflict and crisis over resource access.

To capture the main elements of climate change, this framework would need to be analysed in a fully linked and dynamic manner, where the joint impact of energy prices, carbon markets, extreme weather events and agricultural markets on national economies can be assessed to see how these stresses may combine to undermine governance and stability, both directly and indirectly.

Current methods and models are far away from capturing these levels of sophistication. While climate science models are run on supercomputers, conflict models are still being developed on spreadsheets. While the amount of data analysed should not be seen as a simple guide to an approaches accuracy or usefulness – a quick glance at economic modelling would dispel that illusion – there is vast room for improvement in approaches to economic and conflict risk modelling.

The strong interconnections between climate change, energy security, resource management and economic performance make stability analysis based on individual 'silos' highly misleading,

especially in the medium term when the impact of climate change and climate change policy will have grown far more acute globally. There is a need to build new approaches which fully capture the dynamics of these processes and how they impact stability and security.

Responding to Climate-Change-Driven Instability

There are many gaps and weaknesses in current understanding of how climate change will impact security and instability globally. But given current projections of expected impact, it will be a salient factor in many parts of the world over the coming decades even if the most optimistic mitigation scenarios are achieved, and we stabilise temperature rises around 2°C. However, even with these uncertainties and complexities, the combination of climate science and conflict analysis practice gives us some guidance as to how the future will not resemble the past and how this may impact security responses.

Technical adaptation is not enough to preserve development or stability: climate change creates winners and losers, and so will adaptation measures. Approaching adaptation as a technical exercise will undermine its effectiveness in both protecting livelihoods and preventing social tension and violence. The political economy of resource management must lie at the heart of all adaptation measures as they deal with the resources of subsistence and identity: land, water and security.

Marginal countries and areas will be the source of major tension: economically marginal areas will be some of the first places to exhibit climate-driven conflict, especially in dry regions such as the Sahel. Economic marginalisation is both a consequence of climate vulnerability and a reason for weak and ineffective governance. A failure to invest away from the economic heartland could see manageable disputes turn into to full-scale conflicts at a far greater frequency than now. The cost of managing the impact of these conflicts will involve far more political, military and financial capital than was devoted to stabilising these regions in the first place.

Traditional management systems will need to be replaced: informal and traditional resource management systems maintain the peace in much of the world, but have limited resources to respond to conditions completely outside the historical precedents on which they are based. As traditional knowledge is made redundant by a changing climate, these systems will lose authority with the population, opening political space for dispute and conflict. Even so-called modern systems of management will feel this pressure if they cannot adapt due to political or institutional inertia. A concerted programme to modernise and recast these systems will be needed if large-scale migration and conflict is to be averted.

Improving economic resilience is critical: climate change will increase economic volatility in many developing countries, and even in vulnerable middle income and developed economies – especially tourism dependent small island states. Economic decline is one of the strongest drivers of instability, but is very poorly understood in economic modelling and planning. In a world of tighter global markets for many commodities, the impact of price rises and shortages is transmitted far faster than in the past. The impact of combined shocks on country economies – from decline in hydroelectricity to higher food prices – will need to be taken into account when planning economic development paths and buffering systems.

International support is vital for resilience in shared resource management: international norms, treaties, diplomatic and technical support are all relatively low-cost ways to help improve the resilience to climate change of resource sharing agreements within and between countries. All critical resource management frameworks should be assessed for their robustness under different climate change scenarios and adaptation plans introduced, including political involvement to renegotiate terms before the crisis hits.

Climate policies will drive instability: if efforts to build a global climate regime are effective, it will release strong forces to slow down deforestation and promote the use of biofuels globally. While if well managed these could be benefit many poor countries and poor people, there will also be alternative cases where local communities are marginalised and excluded from their land to make way for these more lucrative activities, resulting in tension and conflict.

There are limits to adaptation which will often emerge as conflict: while it is important to maximise the potential to adapt to climate change, its limits must also be acknowledged. Even at moderate levels of climate change, it will not be technically possible, or cost effective, for many communities in areas affected by drought, floods and sea level rise to remain where they are. Those affected will be forced to migrate, and the management of this displacement will be critical in preventing rising tensions.

International funding for adaptation must recognise security issues: funding for adaptation under the UNFCCC is likely to increase rapidly over the next decade, amounting to tens of billions of dollars. However, as with all outside assistance these resources will only produce effective and positive outcomes in the right policy environment. Where climate related instability risks are high it is vital that assistance flows to support internal policy reforms designed to increase social resilience. This will often require governments to take on vested interests and tackle deep seated internal problems. Though controversial, some international funding for adaptation may need to be made conditional on resource management policy reforms in areas where dysfunctional management systems are critical drivers of instability risks and the marginalisation of vulnerable at risk populations.

Climate change may be only one driver of increased conflict, at least over the next two decades, but it is likely to be a vital one which requires specific remedies and approaches. Even with current levels of understanding, a range of approaches and priorities can be identified which should change development, diplomatic and security engagement in many parts of the world to improve stability, not least through supporting governments understanding of their internal vulnerability to instability and conflict driven by climate change.

IX. CLIMATE CHANGE CHALLENGES TO SECURITY SYSTEMS

> The biggest source of inefficiency in our collective security institutions has simply been an unwillingness to get serious about preventing deadly violence. The failure to invest time and resources early in order to prevent the outbreak and escalation of conflicts leads to much larger and deadlier conflagrations that are much costlier to handle later.
>
> ***UN High Level Panel, December 2004***

The analysis in the previous chapters aims to show that climate change has real security implications, and that the unique features of these problems require security actors to change both what they do and how they do it.

You cannot run a modern office software suite on a computer dating from the 1990s; the computer's operating system is out of date. In a similar way, you cannot expect current security systems to be able to understand, assess and respond to the challenges of climate change without significant change to underlying organisational systems and approaches.

This final section lays out ways in which changes will be needed in overall strategic approaches, strategic planning and risk and threat assessment, in order to better respond to climate change.

Investing in Prevention

Achieving practical climate security will require a far stronger ability to develop and deploy preventative strategies, both in potentially unstable countries and regions, and through critical bilateral relationships and international institutions.

The reality of security policy in all countries is that choices between preventive and reactive approaches are often made implicitly, and are heavily determined by existing institutional structures. Most current security architectures are designed essentially to deliver reactive strategies, and under-invest in resilience and preventive strategies. For example, except for high-profile missions such as Iraq and Afghanistan, the UK security machinery finds it difficult to maintain a long-term strategic focus on delivering reform and stability in any region.

The result is an unbalanced portfolio of action and funding which does not reflect the relative size of different security threats. The UK spends only £200 million on preventing crisis and conflict (including UN and EU contributions, but excluding peacekeeping missions and general development aid), compared with an annual armed forces budget of £35 billion. The UK is one of the largest investors in preventive responses globally, but still has a large imbalance between its capability to project force and its capability to promote stability, enforcement and good governance.

This approach does not mean cutting capability to project hard power, but complementing it with new capabilities to deliver stability and security. It is vital that the security benefits of such investment are clearly prioritised, in order to strengthen the political impetus behind such interventions. Following the spate of civil wars in the 1990s, there was political pressure in the USA, the UK, Germany and others to invest in new forms of preventive security capability. However, this political push has disappeared since 9/11 and many of the reform processes have stalled despite the efforts of the UN in moving forward the Peacebuilding Commission. The failure to produce sustainable stability in Iraq and Afghanistan and potentially the Democratic Republic of Congo is also leading to a louder call from 'neo-realists' to retreat to a mainly reactive approach, avoiding 'nation-building' and merely intervening on a short-term basis to attack perceived threats.

It is unsurprising that there have been failures, given current weak levels of capacity and short experience of stabilising countries and building governance systems. But this has been a failure of implementation, not strategy. The slowly emerging successful examples in the Balkans, Aceh, East Timor and Sierra Leone, among others, show that with concerted long-term effort by the international community, security and stability can be achieved in these areas.

One opportunity for this is the upcoming discussion of a strengthened EU security architecture, including a new EU external action service. As enlargement has shown, if deployed imaginatively, the political and economic scale of the EU provides a unique ability to promote stability and good governance, particularly in climate-vulnerable areas of North Africa, the Caucasus and Central Asia, and through partnership with the African Union in Sub-Saharan Africa.

Many of the difficulties in responding to the security challenges of climate change lie in broader problems in driving effective preventative action to tackle all threats to stability and security. The political imperative of climate change may give fresh impetus to some of the efforts to build more effective preventive security architecture globally.

Developing Response Strategies for Climate Security

Understanding a particular security risk from climate change does not mean action will be taken to address it, given the range of competing issues and limitations on resources. A strategic decision to respond to any risk depends on assessing four critical elements shown in Figure 21: risk analysis – what might happen over what timescale; threat analysis – how will these risks impact objectives and interests; effectiveness analysis – what are the options for action and how likely are they are to succeed; and political context – how will broader political and diplomatic concerns impact the strategic response.

All these pieces of analysis must then be brought together into an overall strategic framework, which lays out the decisions which need to be made to effectively address risks. Different decisions will also have varying timescales for delivery, as shown in Figure 22; for example, in the face of enhanced drought risk, it will take far longer for a decision to build more regional water governance to produce effects on the ground, than it would to prepare greater disaster response capacity to deal with higher humanitarian demands.

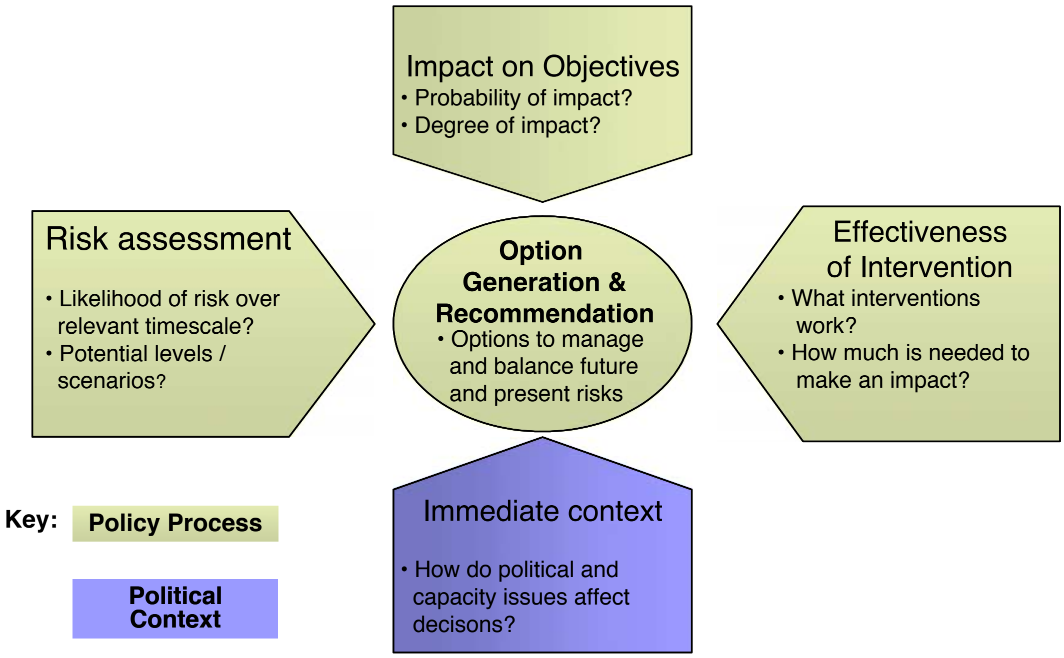

Figure 21 Elements of Strategic Analysis

Effective decision support has to be tailored to the specific type and timescale of decision involved. Providing generic information rarely results in effective action, and in the broad intelligence and analysis community this is generally expressed as defining the **customer** for the **risk or analytical product.**

Figure 22 Timescales of Critical Security Response Decisions

Based on the types of decisions outlined above, the different types of information needed for risk and threat assessment in each of three areas of climate security can be assessed:

- **Geo-political:** long term perceptions of costs, benefits and responsibilities for climate change; forward energy security strategy; resource use interests and intensity. This requires medium- to long-term information on country interests, perceptions and intent with assessment at global and regional levels.
- **Strategic:** impact on security and development of: resource conflicts and tensions – water, soils, forests, minerals; resource curse oil and gas; vulnerability to energy prices; and social vulnerability to climate change and natural disasters. This requires mainly medium- to long-term instability assessment at national and regional level, with some sub-national assessment in larger countries.
- **Operational**: Sub-national climate change impact on development and investment; combined impact on infrastructure projects; climate change impact on military assets and operations; and climate change and resource degradation humanitarian impact. This requires detailed national and sub-national assessment over a

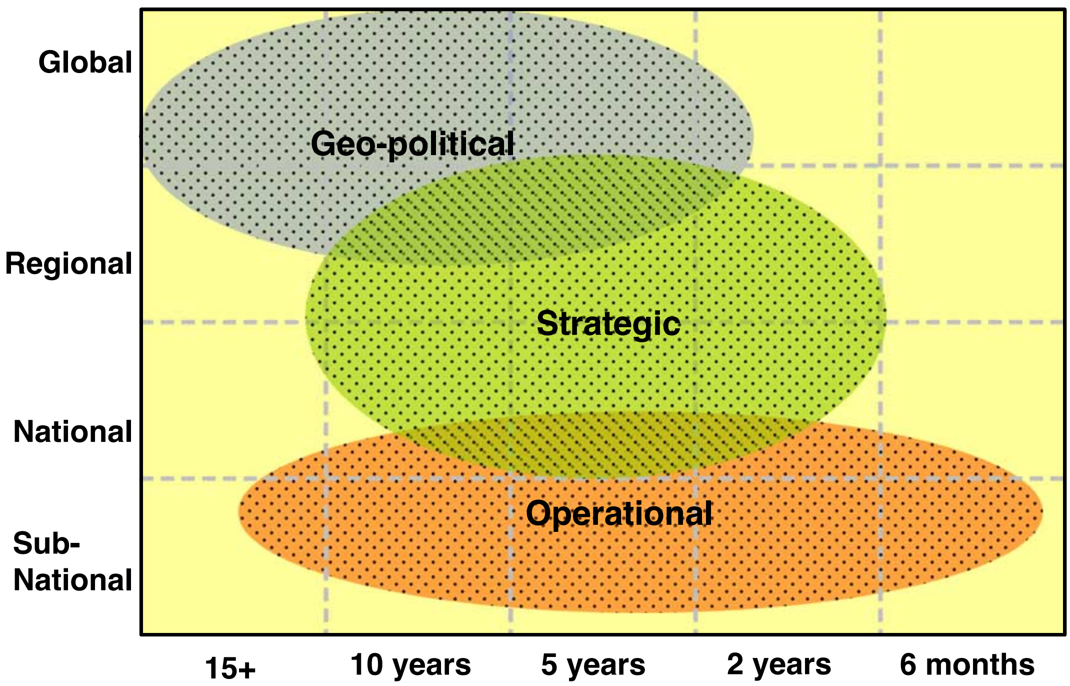

Figure 23 Range of Risk and Threat Assessment for Different Decisions

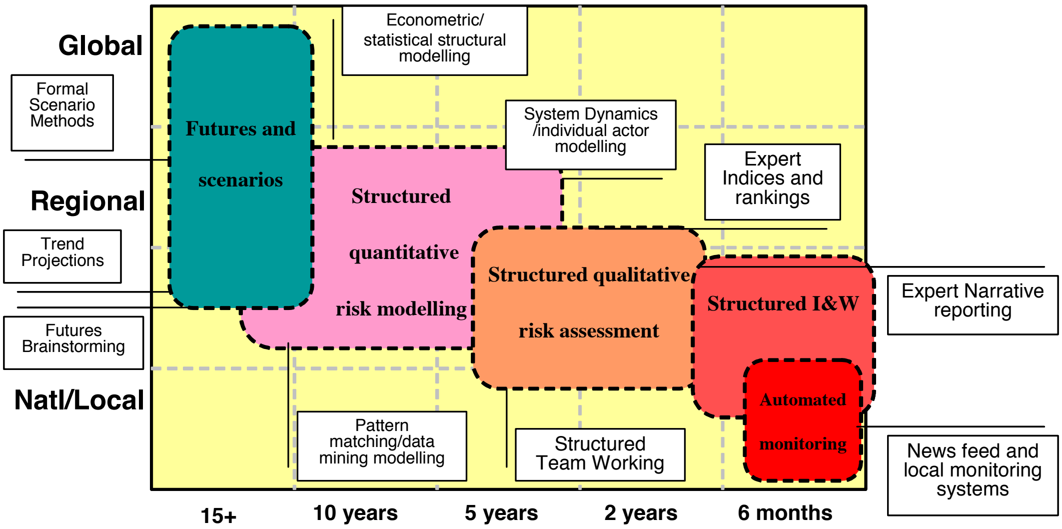

Figure 24 Landscape of Risk and Threat Assessment and Analysis Tools

broad range from short to long term, and is the most data demanding area of analysis.

The range and timescale of analysis needed to underpin decision making is illustrated in Figure 23, by plotting against the timescales for action and the scope of data, analysis and assessment needed – global, regional, national or sub-national.

There is no 'magic bullet' form of analysis and assessment, which can cover all of these areas. Figure 24 outlines the type of analytical, modelling and monitoring methods which can be used appropriately in each situation. This shows the general move from monitoring situations in the short term, to a more analytical and modelling approach in the medium term and a use of broader scenario and future techniques in the longer term – especially at the global and regional level. Examples of specific analysis tools used for each region are given in the call-out boxes, and there are obviously a range of different methods ranging from narrative reporting (e.g. diplomatic telegrams or ICG reports) to quantitative modelling (e.g. the US State Failure Task Force) all of which have different merits depending on the decision being made.

Combining the information from the two figures gives the following matching of decisions and tools/products:

- Geo-political: mainly scenario and futures methods with an element of quantitative analysis around long-term trends.

- Strategic: mainly reliant on medium-term structured analysis – either quantitative or qualitative – with some use of both scenario techniques and monitoring/early warning.
- Operational: uses the full range of approaches to plan across the whole cycle of activity from capability investment, operations planning and immediate deployment.

Gaps in Current Analytical Approaches and Data

The systemic mapping above identifies the range of information tools which are needed to underpin effective decision support on climate security, but currently there are many gaps in provision in these areas.

Despite a large number of institutions – both public and private – who produce indicators or forecasts of the risk of future instability and conflict, much of this is difficult to combine with information on climate change and resource use. The data underlying conflict models is mostly quite poor, and as such their predictive power and sophistication is quite limited. Most of these use an approach of weighted indicators, and none include quantitative or qualitative measures of climate change, energy security or resource use in their approaches.[107] The mainstream foreign policy community is still rather sceptical about the utility of these approaches, even when they are embedded inside government processes, such as the State Failure Task Force of the CIA. This lack of familiarity with structured quantitative modelling will raise barriers for incorporating the results of climate change and other studies into some foreign policy institutions.

A different set of problems exist with the analysis of climate change, resource use and energy security. Table 3 lists the range of data produced by key public bodies relating to climate change, resource use, energy security and governance. Though there is a lot of data produced in many areas, there is a major lack of integration and some large gaps in coverage, including:

- No obvious emergence of detailed integrated analysis, except through case studies such as in Darfur. Climate change and

[107] A critical analysis of these approaches can be found in Mabey and Liu, op. cit.

Table 3 Mapping of Existing Analysis Inputs for Climate Security Analysis

Body	Climate Change	Energy Security	Resource Management	Governance/Stability
UN	- 5 yearly IPCC reports	- None	- Millennium Ecosystem Assessment - UNEP/OSCE environment and security assessments	- OCHA quarterly early warning system for humanitarian crises
EU	- Occasional reports	- Energy observatory under discussions	- Satellite–based GEMS environment monitoring system will be active by 2008	- Council SitCen regular assessments of instability - RELEX Crisis Room uses public FAST monitoring system
World Bank	- Climate change vulnerability assessments 10-50 years	- Country sectoral and economic reports 1–3 years	- Country and sectoral reports	- Regular governance indicators
IMF	- None	- Regular analysis of economic impact of energy price rises	- None	- Regular assessment of country economic governance
UK Met Office	- Climate change modelling and scenarios 50–100 years	- None	-None	- None
Swisspeace/FAST	- None	- None	- Environmental triggers of conflict events recorded	- Monthly assessment of instability in 25 countries using sub-national networks of monitors
Paul Collier, Oxford University	- None	- Statistical impact of energy resources on development	- None	- Statistical analysis of impact of conflict and corruption on economic growth
Tyndall Centre	- Mapping impact of climate change	- Modelling of future energy systems	- Impact of climate change on resource use and productivity	- None

security is emerging as a new theme inside policy think-tanks, but there is much less primary research on the ground.

- There is a general split between scientific and quantitative analysis and qualitative analysis, which is mirrored inside governments, though there are new systematic quantitative measures of conflict and instability such as the FAST system which could be combined with scientific data more easily.
- Analysis of climate change vulnerability has been limited to high-level mapping of potential impact, and some national-level modelling which is not specific enough to link with many of the socio-economic factors driving instability.
- Energy security and climate change analysis is still generally unconnected, leading to a proliferation of inconsistent forecasts and policy recommendations.
- There seems to be no dynamic economic modelling which could estimate the combined future impact of climate change, energy security and supply, resource use and stability on development, despite the strong interconnections between these areas. The data and sub-models of such an approach exist in different institutions, but the integration has not been carried out.

Analysis of climate, stability and conflict is still at an early stage and there is no 'off-the-shelf' integrated risk assessment system which governments could buy into to help drive better decisions. However, there are several promising approaches or components of such an integrated approach but these need bringing together by information users because funding for the different analytical communities tends to follow traditional sectoral and disciplinary boundaries hindering integration.

Strengthening Decision Support for Climate Security

Climate change, energy security and resource use will become increasingly important factors in development, stability and security in the future. Though much is going on in this area, the detailed analysis of impact is very fragmented and the depth of analysis highly variable, ranging from sophisticated long-term climate modelling to very poor quality and aggregate data on conflict and instability.

Many practical decisions to respond to climate security challenges can be made using less sophisticated approaches, and it can seem heavy handed to develop much more analytical architecture in this area than is used to analyse other security threats. However, climate change is described by scientific analysis and so at some point security analysis must effectively integrate this into its assessment techniques, if it is to be based on well-founded analysis.

The critical areas of focus in the next years should be driven by the following conclusions from the gap analysis:

- Building effective integrated analysis and strategic responses in this area is a long-term process; the field will remain fragmented in the near term.
- Integrated analysis will not emerge spontaneously from the analytical or academic community given the disciplinary barriers in current funding, but will need to be driven by specific commission from policy-makers and new grant-making structures.
- Given the complexity and immaturity of the area, the best approach is to engage in case studies of particular regions, rather than try and develop a cross-cutting approach immediately.
- There is a need for investment to build a community of analysts doing integrated analysis, especially on the combined economic and stability impact of these trends.

Immediate recommendations for action which could be taken to strengthen analysis in this area include:

- **Giving foreign and development departments joint leadership**: conflict assessment has traditionally been the domain of foreign ministries and their specialist skills in political and institutional analysis are vital for addressing climate security issues. However, development departments have a culture of working with economic and scientific data, strong practical experience with resource management systems in developing countries and the resources to stimulate necessary research in this area. Combining the strengths of both departments to jointly develop approaches in this area would provide the right mix or skills, experience and resources needed.

- **Government should focus on developing climate security response strategies in vulnerable areas such as the Caucasus/ Central Asia**: it is vital that a more integrated approach to these issues is seen to have policy relevance: without a live case study, cross-governmental discussions are unlikely to develop beyond an academic exercise. For example, the European Union could revise the recently agreed EU strategy on Central Asia and the Caucasus where all these issues have a very high political and security relevance, and climate change will have very large impact.
- **Initiate some detailed external studies which will bring together external networks of experts to undertake integrated 'mapping and monitoring' analysis**: it will be extremely hard to move forward integrated analysis inside government if external analysts and academics are still ignoring the interconnections between these areas or producing incompatible analysis of similar countries. There is a need to deepen primary research into the impact of climate change and resource degradation in developing countries, inside a framework that considers both political and economic factors. The aim would produce: detailed maps of where the vulnerability to instability and crisis from these factors is highest; recommendations for actions to reduce risks; and monitoring systems to measure critical factors which could lead to conflict (for example, using the European GEMS satellite system). Initial priorities for one to two year research projects could be: Sahelian Africa; Central Asia and the Caucasus; North Africa and the Middle East; and the Caribbean Islands.
- **Invest in building baseline data on conflict, crisis and development through the SwissPeace FAST system**: one of the main barriers to better analysis and action is a lack of detailed conflict and instability data which can be combined with economic, ecological and resource datasets for analysis. The primary existing public tool in this area is the SwissPeace FAST system. This is a sophisticated monitoring tool for analysing the incidence and dynamics of conflict and instability based on networks of local monitors in developing countries, and a web-based analytical system. FAST has been in use for five years in twenty-five countries, for an annual cost of around $1.3 million. FAST tracks environmental and other triggers of conflict and for a modest investment could be extended to cover all developing

countries at risk of instability (around sixty) through a consortium of donors.

- **Initiate research into building an economic model looking at the short-, medium- and long-term impact of energy security, resource scarcity and climate change, with Sub-Saharan Africa as a regional pilot**: the biggest gap in the research and modelling community in this area is integrated analysis of how climate change, energy security and resource use interact with economic development on a dynamic basis; that is, models which can estimate the impact of changing conditions over a two, five and ten year basis rather than the very long-term estimates that currently exist. Much of the data and structures for such a model exist in the World Bank and other institutions and co-operative approaches could be a good way forward, with an initial pilot in Sub-Saharan Africa where poverty impact will be large.