The IISS Transatlantic Dialogue on Climate Change and Security

Report to the European Commission

January, 2011

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Findings

1. **The earth is warming, and has been for at least a century.** The temperature record is undisputable. The warmest decade on record was the 2000s, with each of the three decade previous to that warmer than the decade before. 2010 was tied with 2005 as the warmest year on record, at 0.62°C (1.11°F) above the average global temperature for the 20th Century. This warming is directly attributable to the increasing emission of carbon dioxide and other greenhouse gases since the beginning of the industrial revolution.

2. **Variability and Uncertainty are features of the climate system.** No one knows how quickly climate change will happen, and what its specific effects will be.
   Climate models exhibit significant uncertainty about the sensitivity of the climate system to increasing concentrations of greenhouse gases. Scientists do not know how much warming increasing concentrations will cause.

3. **Action to reduce emissions of greenhouse gases will not prevent significant warming over the next 30-40 years.** International efforts to reduce emissions agreed over the next decade will determine the climate of the second half of the 21st Century, but most of the warming until 2050 is 'locked in' by the cumulative emissions of the last two centuries. Therefore, we should be preparing for an average warming of at least 0.2° Celsius per decade, consistent with trends since the 1970s.

4. **Climate change may already be changing weather and precipitation patterns.** The summer of 2010 featured extreme weather in European Russia and Central Asia, including a heat wave in Russia and flooding in Pakistan. While individual events can never be definitively attributed to climate change, scientists predict that man-made climate change will increase the number, power, and duration of extreme weather events.

EXECUTIVE SUMMARY

Findings

5. **Changes in water resources will be the most visible impact of climate change on human society.** Predicted rainfall changes and droughts in already arid regions could turn marginal farming and grazing lands into deserts, while annual reductions and seasonal variability in river flows will cause water shortages in areas that lack consistent rains. Meanwhile, rising sea levels and an increased probability for extreme weather will cause harmful flooding.

6. **Global food production will be adversely affected by climate change**. Positive benefits of warming such as a longer growing season in northern regions, and possible boosts to growth from increased carbon dioxide in the atmosphere, will be offset by higher temperatures in the tropics and changing precipitation patterns. The result will be declines in yields for the most important crops in developing countries. Achieving a secure food supply will become a challenge for more countries because of a combination of increased prices and changing areas for viable food production.

7. **The impact of climate change on energy security is complex, but likely to be negative.** Climate change presents clear risks for energy infrastructure along coastlines and rivers. Although dependence upon foreign energy and climate change are separate problems, climate change presents long-term strategic uncertainty to energy sources that will have to be addressed.

8. **The impacts of climate change combine to make it a clear threat to collective security and global order in the first half of the 21st Century.** The links between climate change and conflict are complex but clear. Changes in climate per se are unlikely to cause interstate wars between major military powers over the next 30-40 years. However, in areas with weak or brittle states, climate change will increase the risks of resource shortages, mass migrations, and civil conflict. These could lead to failed states, which threaten global stability and security.

EXECUTIVE SUMMARY

Recommendations

1. **Addressing climate change will require a 'whole of government' focus.** Actions to mitigate emissions, like increasing energy efficiency and promoting the development of new technology are important. So too are often overlooked areas like building resilience to climate change into domestic infrastructure and helping to finance climate adaptation in countries too poor to afford it.

2. **Climate change is a threat to international security, and security planners should play a role in addressing it.** Military and intelligence organizations have the most experience in strategic planning under conditions of uncertainty. They understand that waiting for certainty often means that you have waited too long. Intelligence communities in both Europe and America should fully examine and prepare for the many scenarios that a changing climate presents.

3. **Because some climate change is inevitable, governments should prepare for adaptation and disaster response.** Investments in climate change adaptation will be necessary. In many cases, good adaptation policies will double as good overall development policies. Even so, there will be events that overwhelm any preparations, and militaries should be prepared for more rapid and complex interventions into disaster-affected regions.

4. **Adaptation is not simply a matter of funding levels.** Areas that have experience with annual climate variability often have very high adaptive capacity, and donors should think carefully before substituting technical or financial solutions for community-based solutions that have been honed by centuries of experience. On the other hand, care should be taken when considering the option of injecting adaptation financing into regions at risk of conflict. New funding in these regions can unwittingly give rise to conflict by appearing to favour one interest-group over another.

EXECUTIVE SUMMARY

Recommendations

5. **Water should be at the center of climate adaptation efforts.** Water supplies will be heavily reduced by climate change in drought-prone areas, and water shortages are a likely cause of conflict around the world. Therefore, infrastructure investments and policy changes that can more efficiently deliver, store, and distribute water should be prioritized. In addition, where water supplies cross borders – whether domestic or international – negotiating water sharing agreements should be a priority.

6. **Preparing food systems for climate change while also preparing for a world of 9 billion people will require significant, sustained investment and robust global markets.** Food supplies could be substantially reduced by climate change over the next 30-40 years, but that is not a foregone conclusion. Significant levels of investment sustained over decades, at levels similar to the Green Revolution of the 1960s and '70s, into increasing agricultural productivity can offset the damage caused by climate change. In addition, because food supplies are a globally traded commodity, robust global markets with open access for all should help to alleviate temporary local shortages.

7. **Transitioning energy systems in order to reduce emissions and increase security will require sustained investment in infrastructure and new technologies.** A shift to renewable energy sources will be the most visible effect of efforts to mitigate emissions. However, focusing solely on the supply of energy misses half of the equation. Demand-side approaches, especially an electrification of transportation and efforts to increase efficiency have the potential to substantially increase energy security by moving away from strategic resources like oil, while also reducing carbon emissions.

8. **Cooperation between Europe and the United States on climate security is important in building support for further action on climate change.** Much of the thought leadership in the USA on climate change is being undertaken by the military and intelligence communities. In order to better influence American climate policy, the EU must more effectively engage the American security community on climate and energy policy. Ensuring that the implementation of the Cancun Agreements enhances security will be an important starting point.

The IISS Transatlantic Dialogue on Climate Change and Security

Report to the European Commission

Introduction

On February 25, 2009, the International Institute for Strategic Studies (IISS) launched the "Transatlantic Dialogue on Climate Change and Security", funded by a grant from the European Commission, with the purpose of analyzing the impact of climate change on global security and stability. The dialogue has included some of the foremost environmental and security experts from government, including the military and intelligence communities, academia, international organizations, and the private sector. The results, presented here, are intended to inform policymakers on both sides of the Atlantic on how to most effectively address climate change.

The IISS' traditional focus has been on questions of conflict and international security. As climate change has developed into a threat to the environment and human society, it is important to understand how it will affect security and stability around the world. It is appropriate, therefore, for the IISS to study how a changing climate might affect international security. The IISS has already published an *Adelphi Book* – a series that constitutes the Institute's primary contribution to security scholarship – entitled "Climate Conflict: How Global Warming Threatens Security and What to do About it". This report will build upon the results of that book, as well as a series of workshops, conferences, and seminars held throughout 2009 and 2010 that assessed the impacts of climate change on water, food, and energy security, and how those will impacts could threaten security. Finally, it will attempt to provide results-based recommendations to governments and security planners about how best to

alleviate the security threats presented by climate change. It will become clear that although climate change does present a threat to international security, it cannot be solved with the traditional tools of security – guns and bombs – instead, it should be addressed by 'whole of government' initiatives. The recommendations promulgated by this report reflect this.

This report will broadly follow the trajectory of the workshops, conference and seminars which the IISS held throughout 2009 and 2010, both in Europe and the United States. Successive sections will discuss the results of how climate change will impact water, food, and energy systems, and how those present a threat to security.

Identifying Climate Change as a Security Threat

Throughout the past decade, the threats posed by climate change to security have climbed up the priority list for policy planners. Climate change was first enshrined as "a common concern of humankind" at 1992's 'Earth Summit' in Rio de Janeiro with the signing of the United Nations Framework Convention on Climate Change. However, those security policy planners that looked at environmental issues tended to dismiss climate change because of the perceived remoteness of the threat, while focusing instead on issues like population growth or environmental degradation. By 2005 and 2006, however, the threats of climate change had climbed up the perceived threat levels after a series of high-profile reports like Al Gore's *An Inconvenient Truth*, the Stern Review on the Economics of Climate Change the Stern Review, and the IPCC's Fourth Assessment Report. These all identified climate change as an increasingly pressing threat to the environment and to human society, and advocated policies that would reduce emissions in order to avert this threat.

Subsequent to these reports about the impacts of climate change, a series of reports from defense and foreign policy think tanks were released that analyzed how climate change would affect national and international security. These studies were catalyzed by an April, 2007 debate within the UN Security Council on the impacts of climate change on security, chaired by the British Foreign Secretary, Margaret Beckett. Subsequently, the Center for Naval Analysis (CNA), the Center for Strategic and International Studies (CSIS), the Council on Foreign Relations, and the IISS all published reports and analyses by late 2007 which identified climate change as a "threat multiplier" (CNA) that "will aggravate existing international crises" (CSIS) and "is at the heart of both national and collective security" (IISS). By the time of the United Nations Climate Change Conference was convened in Bali, Indonesia in December, 2007, it was established that a warming planet posed threats to international security.

In response to these reports and the political pressure that they brought, intelligence and foreign policy planners

within governments began looking at the threats of climate change. Since 2008, transatlantic security institutions have completed a series of reports that have linked climate change and international security. Within the Intelligence Community, the US National Intelligence Council produced a (classified) National Intelligence Assessment in June 2008, and the US Central Intelligence Agency opened a 'Center on Climate Change and National Security' in September 2009. In the European Union, the High Representative for Foreign and Security Policy, Javier Solana issued a report in March 2008 on "Climate Change and International Security", which recommended integrating climate security within the European Commission's Directorate General for External Relations.

The best examples of the recent mainstream acceptance of climate change as a security threat within the security community can be seen in a series of recently-released security planning documents. The United States Department of Defense's Quadrennial Defense Review – released in February, 2010 – called climate change "an accelerant of instability or conflict", while the US National Security Strategy – released in May, 2010 – stated that "the danger from climate change is real, urgent, and severe." The National Security Strategy of the United Kingdom – issued in October, 2010 – said "Climate change is potentially the greatest challenge to global stability and security, and therefore to national security." NATO's New Strategic Concept, adopted at the Lisbon summit on 19-20 November, noted that "Key environmental and resource constraints, including health risks, climate change, water scarcity and increasing energy needs will further shape the future security environment in areas of concern to NATO and have the potential to significantly affect NATO planning and operations." It is notable that institutions focused on a full range of national and international security issues identified climate change as a looming challenge.

Climate change is not happening in a vacuum: in many areas of the world it will be accompanied by rapid population growth, resource shortages, and energy price increases. Analytically, it is difficult to separate the effects of climate change from other factors, such as food shortages, migration, ethnic tensions and other issues that could drive violence. However, the potential impacts of climate change on water, energy, and agriculture will make it a central driver of conflict. The impacts of climate change combine to make it a clear threat to collective security and global order in the first half of the 21st Century.

Finding: The impacts of climate change combine to make it a clear threat to collective security and global order in the first half of the 21st Century.

This report accepts the results of previous reports on the risks of climate change to security: 'the risks posed by climate change are real' and it is both a 'threat multiplier'

and a 'ring road issue' that will possibly lead to 'climate-induced instability and conflict' and to 'escalating security risks in affected societies and neighbouring regions'. Clearly, this is an issue about which much has already been written. The IISS should see no need to restate the results of other institution's reports. The purpose will be to outline action that governments should take. While the many government policy statements, intelligence threat assessments, and think tank reports were effective in making the case that climate change is a threat to national security, they generally have avoided specific recommendations of how to address this threat, other than international efforts to reduce emissions. However, as the consensus science now predicts, the climate is changing, and will continue to change for at least 30 years, even if greenhouse gas emissions cease today. Therefore, the purpose of this report will be to detail how to reduce the threats that the effects of climate change, particularly on water, food, and energy systems, pose to global security.

The Science of Climate Change

This report does not seek to debate the science of climate change. However, a basic understanding of the state of climate science, including what is certain and what is uncertain is important in order to draw conclusions about how climate change will impact security.

Greenhouse gas emissions – including carbon dioxide, methane, nitrous oxide, and others –grew significantly in the 20th century, and continue to grow today. In 1900, global carbon dioxide emissions were about 2 ½ billion metric tonnes. They doubled by 1950, then accelerated to increase more than four-fold between 1950 and 2000. Today, human activity is responsible for emitting over thirty billion metric tonnes of carbon dioxide every year. The result of two centuries worth of accelerating emissions is that concentration of carbon dioxide in the atmosphere has increased from 280 parts per million (ppm) prior to the industrial revolution to its current level of 388 ppm, an increase of 38%. Other greenhouse gases have seen similar increases. Human activity over the past two centuries, including fossil fuel use and changes in land use, has caused this increase in concentration.

Finding: The earth is warming, and has been for at least a century

The earth is warming, and has been for at

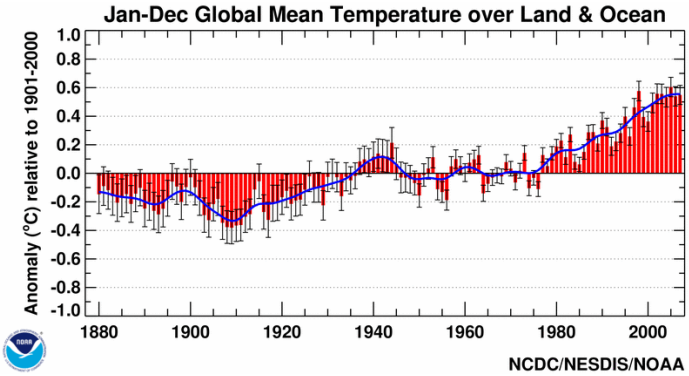

Figure 1 – Source: US National Oceanic and Atmospheric Administration

least a century. Twenty of the warmest years on record have occurred in the past twenty-five years. The warmest decade on record is the 2000s, with each of the three decade previous to that warmer than the decade before. Figure 1 shows a graphic representation of the trend. As the IPCC stated in its 4th Assessment Report in 2007, *"Warming of the Climate System is Unequivocal". S*cientists are now confident that the warming observed since the middle of the 20th Century is due to the increased concentrations of greenhouse gases in the atmosphere, produced by human emissions.

Although the scientific basis for the theory of the greenhouse effect is strong, and the case that man-made emissions are responsible for the recent warming trends is robust, predicting how climate change will evolve and what consequences it will have remains difficult and ambiguous. Variability and uncertainty are features of the climate system. No one knows how quickly climate change will happen, and what its specific effects will be. The scientific community is still uncertain about the sensitivity of the climate system to increasing concentrations of greenhouse gases: how much warming will increasing concentrations cause? This uncertainty is reflected in the broad ranges for predictions of climate change, with the IPCC scenarios predicting an increase of 1.1-6.4° Celsius by 2100.

At a global level over long period, the picture is becoming clearer as climate scientists continue to update their computer models with more accurate measurements and a greater understanding of the climate system.

Finding: Action to reduce emissions of greenhouse gases will not prevent significant warming over the next 30-40

However, security planners do not operate over century-long periods. The longest time period relevant to security planners is about 30-40 years, as any projections about global security beyond this time scale become pure speculation. Action to reduce emissions of greenhouse gases will not prevent significant warming over that time period. International efforts to reduce emissions agreed over the next decade will determine the climate of the second half of the 21st Century, but most of the warming until 2050 is 'locked in' by the cumulative emissions of the last two centuries. Therefore, the world should be preparing for an average warming of at least 0.2° Celsius per decade, consistent with trends since the 1970s.

However, 'positive feedbacks' could speed up the warming process. These are changes in natural systems that intensify climate change like the replacement of light-colored Arctic sea ice, which reflects light and heat, with dark colored open water that absorbs heat. Particularly dangerous feedbacks could be triggered when warming causes the further release of more greenhouse gases. For example, permafrost in Arctic regions sequesters large amounts of methane and carbon. When it melts, those greenhouse gases will

be released into the air, potentially triggering rapid climate changes that could quickly move beyond human attempts to control them. The danger of such positive feedbacks is that the climate may reach a tipping point beyond which dangerous climate change becomes inevitable and uncontrollable, leading to warming of 6° C or more.

Meeting of Ice and Sea in the Arctic

Variability over the short term and uncertainty over the long term will continue to be features of the climate system, and instead of relying on models to erase that uncertainty, planners will have to embrace it. Security and government planners should not rely exclusively on the predictions of computer models, as this will create a false sense of security. Noting that long-term predictions can be wrong should not give government policymakers comfort. On the contrary, the uncertainty about how sensitive the earth's climate system is to increased emissions means that policymakers must be very cautious about what judgments they make.

Finding: Variability and Uncertainty are features of the climate system.

The Effects of Warming

Global climate change has already had definite, observable effects on the global environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Climate change may already be changing weather and precipitation patterns. The summer of 2010 featured extreme weather in European Russia and Central Asia, including a heat wave in Russia and flooding in Pakistan. While individual events can never be definitively attributed to climate change, scientists predict that man-made climate change will increase the number, power, and duration of extreme weather events.

Finding: Climate change may already be changing weather and precipitation patterns.

In addition, planners should expect increased unpredictability and variability in seasonal and annual weather patterns. The climate system is so complex that computer models will never be precise enough to make weather entirely predictable. For example, until this past summer, most security analysts and weather forecasters focused on Pakistan's vulnerability to drought. Unfortunately, the disaster that befell the country was too much rain, not too little – a result that had not been predicted.

Projected regional impacts of global climate change *(source: IPCC)*

North America: Decreasing snowpack in the western mountains; variable impacts on agricultural regions, including expanded fertility in some areas, increased frequency, intensity and duration of heat waves.

Latin America: Gradual replacement of tropical forest by savannah in the eastern Amazon rain forest; significant changes in water availability and mountain snowpack and glaciers.

Europe: Increased risk of inland flash floods; more frequent coastal flooding and increased erosion from storms and sea level rise; glacial retreat in mountainous areas; reduced snow cover; increased aridity across southern Europe.

Africa: Decreased water availability in areas already experiencing water stress; increased annual variability in rain, with an increase in the prevalence of droughts.

Asia: Freshwater availability projected to decrease in Central, South, East and Southeast Asia by the 2050s; coastal areas will be at risk due to increased flooding.

The impacts of warming will vary in their severity, duration, and extent around the world. Though predictions are uncertain, we can make some generalized predictions at regional levels. Increased temperatures, in general, will increase the total amount of global rainfall, by speeding up evaporation. However, this will be far from universal. Scientists predict that many areas that are already prone to heavy rains will see more, while already dry areas will become more arid. But, average annual precipitation changes in climate models differ greatly.

Water Security

Climate change is likely to reduce precipitation in many arid regions, leading to water shortages. However, these shortages will not happen in a vacuum: in many areas of the world they will be accompanied by rapid population growth, resource shortages, and energy price increases. Water is central to energy, development, agriculture, and almost all economic activity: changes in water resources will be the most visible impact of climate change on human society. When water insecurity is mixed with urbanization, migration, pollution, radicalization, and the proliferation of small arms, it is not difficult to see a scenario resulting in conflict. Taken to the international level,

Finding: Changes in water resources will be the most visible impact of climate change on human society.

when a country determines that its water resources are at risk, there are clear reasons for it to use all manner of statecraft in order to protect those resources, including war.

Cross Border Water Conflicts

When a major river flows through an otherwise arid region, there are incentives for interstate competition over water resources between upstream and downstream countries. Countries controlling the headwaters have incentives to hoard water as a scarce and valuable resource, while downstream countries have incentives to enforce their will on weaker neighbours. Using these criteria, many of the major river basins of Asia and Africa, including the Nile, the Tigris and Euphrates, the Mekong, and the Indus are areas where countries compete over scarce water supplies. However, historical evidence shows that countries seldom go to war simply over water resources. In fact, it is far more often that countries form some sort of negotiated agreement over water supplies.

The most volatile of the river basins listed above is the Indus, shared between India and Pakistan – historical rivals, each possessing nuclear weapons. Future predictions of Indus water flows are uncertain, but some predictions indicate that warming will reduce total glacier and snow melt from the Himalayas as well as reducing rainfall from the annual monsoon. Pakistan – since before the partition in 1948 – has relied on the Indus for the largest contiguous irrigation system in the world for its food production. India, on the other hand, has drawn off much of the water from the upper reaches of the Indus' tributaries to irrigate new areas of farmland in North West India. It is not difficult to imagine a war fought between these two countries over diminished water flows along the Indus. Over the past several years, there has been increasing rhetoric from the Pakistani side that India is taking too much water, and that their intensifying dam-building programme is giving India a strategic advantage that will allow it to control Pakistani water flow. However, rhetoric aside, the truth is that the Indus Water Treaty, agreed in 1960, is a global model for how two nations can agree to share water supplies. It has survived two wars, and its structure, whereby each side is allocated a percentage of water, not a set amount, is likely to make it durable through times of reduced water supplies. Along the Indus, water has proved to be a point of rare cooperation between two neighbours that seldom talk.

Overall, interstate water wars – conflicts driven by water issues alone – are unlikely, even in areas with reduced annual flows. However, disputes over water are reality today in arid regions. Climate change will put greater pressure on these disputes. Governments should seek to solve these disputes through mutual negotiations, and international institutions should seek to support cooperation to the greatest extent possible.

Civil Conflict over Water Resources

Although interstate war over water resources may be unlikely, the more pressing threats of water shortages are the potential to create or exacerbate local civil and ethnic conflicts. Water shortages or imbalances of water distribution can be driver of civil conflict in a marginalized society. In terminology, 'water riot' is more appropriate than the often citied 'water war' for this type of conflict. Examples of small-level riots - some leading to deaths - can be shown in Nigeria, South Africa, Yemen, Egypt, India, and Ecuador. These water riots can be expected to show similar characteristics to the food-related riots that erupted around the world in 2008. Areas of particular risk are those with strong ethnic or tribal divisions, and the effects of water riots may be to drive disaffected and marginalized parts of society away from areas of water stress.

In March, 2009, the BBC reported that 70,000 people were displaced in rural Ethiopia because of a conflict over the location of a new borehole for water located near the border between two of Ethiopia's ethnically-based regional states – Oromia and Somali. Hundreds were killed and the construction of the borehole was destroyed in the dispute. Low-scale civil conflicts like this exemplify how water is central to overall security. Changes in water supplies caused by climate change should be expected to produce similar results.

Recommendation:
Water should be at the center of climate adaptation efforts.

Pakistani Helicopter over the Indus Flood, 2010

The key to minimizing the chance of civil conflict over water insecurity is preventive action: funding and planning must be in place to adapt to climate change and water shortages. Climate adaptation funding can have beneficial overlapping effects by funding much-needed traditional water resource management as well. Very often the question is not the one of actual physical water scarcity, but one of improper and inefficient water management and poor water quality. In areas where agriculture relies on dam-based canal irrigation, more effective methods of irrigation, like pressurized drip or sprinkler irrigation should be analyzed.

Water shortages caused by climate change present complex problems, requiring initiatives at both the local and international level. Because of the threats that water shortages present to international security, efforts to conserve water should be at the center of climate adaptation efforts.

Food Security

In the next forty years, the world's population is expected to grow from approximately 6 billion people to 9 billion. How to feed the people already on the planet, while preparing for 3 billion additional people is a problem that is rising on the global agenda. Climate change will make the problems of growing the food necessary to feed this many people more difficult.

In 2008, international prices of for staple foods – rice, corn, cereals, and soybeans – spiked to levels that had not been seen in over 30 years. In the two years from June 2006 until June 2008, food prices (as measured by the UN Food and Agriculture Organization's Food Price Index) increased by more than 75%. This dramatic nature of the spike was most visible in rice prices – the staple food source for approximately 3 billion people – which more than tripled in just four months, with Thai white rice increasing from $380 per tonne in January, 2008 to a record of $1080 per tonne in April, 2008. The international market prices for wheat, corn (maize), soybeans, and other foods also hit record highs. Prices of food fell, due to the economic downturn and other reasons, but they have remained higher than previous levels, causing 1 billion people to be classified as 'hungry' for the first time.

Finding: Global food production will be adversely affected by climate change

Increases in prices in global food markets had social and political impacts around the world. Food insecurity presents a threat to global stability because it threatens already weak states. As the food crisis reached its peak last summer, there were riots and protests over the price of food in more than thirty countries. Food prices contributed to the overthrow of at least three governments, in Haiti, Mauritania, and Madagascar.

In the long term, ensuring food security to 2050 will require a concerted international effort that cuts across government agencies, donors, farmers, and corporations. By 2050, population is expected to peak at approximately 9.1 billion, 3 billion more people than today. The UN estimates that this will require 70% greater food production over the next 40 years.

Global food production will be adversely affected by climate change. The International Food Policy Research Institute's models indicate that changes in precipitation, increases in variability, and higher temperatures will reduce the agricultural productivity in every major

crop. Wheat and rice production will be reduced significantly, while maize production is reduced only slightly. These models also indicate significant regional variation, with production in South Asia and Sub-Saharan Africa being seriously reduced, while Latin American and East Asia see significant productivity increases. Overall, there will be broad changes in the location of arable land and the viability of certain crops, requiring new flexibility and adaptability for farmers.

Global Markets

Robust global markets in food can reduce the impact of regional droughts or crop failures that account for the main threat to security. However, the food crisis of 2008 showed that global markets in strategic commodities like food are far from robust. The most important driver of food price spikes was not drought; it was the decision by food-exporting nations such as Thailand to restrict exports in order to ensure adequate supplies for their internal markets. By doing this, they protected their domestic consumers from price increases, but caused drastic increases in global prices, harming importers. Unfortunately, this was not a unique occurrence: Russia's government has prohibited the export of grain since the fires and heat wave of the summer of 2010.

As climate change causes certain areas to become less agriculturally productive, those living there will either be forced to move to where food is, or food will have to be brought to them. Northern regions, particularly Russia and Canada, may see significant gains in agricultural productivity and it may prove possible to use some of these surpluses to mitigate pressures for migration from deficit countries. Bringing food to people looks to be a more cost-effective and less socially or politically destabilising option than leaving people to migrate to where the food is. As well as helping to adapt to the long-term effects in arid regions, open international trade markets in food should be a resource for regions experiencing the increased variability that is predicted from climate change.

Investment in Agricultural Productivity

Preparing food systems for climate change while also preparing for a world of 9 billion people will require significant, sustained investment and robust global markets. Over the next 30-40 years, advances in technology, increased education among farmers, and increased government investment in agriculture should be expected to bring large productivity gains that will allow the world to meet global demand for food. These were the tools that allowed the 'Green Revolution' in East Asia, Latin

Recommendation: Preparing food systems for climate change while also preparing for a world of 9 billion people will require significant, sustained investment and robust global markets.

America, and India to overcome the threatened famines predicted in the 1960s and 1970s. New regional partnerships in Africa, like the Alliance for a Green Revolution in Africa and the New Partnership for Africa's Development are promising to extend the 'Green Revolution' into areas, like Africa, that did not benefit from the productivity increases of the 1960s and 1970s. But climate change could vitiate such gains. Significant and sustained investments in agricultural adaptation could alleviate the pressure arising from climate change. There are a number of 'win-win' policies that will enhance food security and environmental resilience while also fighting climate change. These include expanding no-till farming practices, increased investment into agricultural research, building rural roads, and natural disaster planning.

Investment in agricultural productivity should be encouraged from all areas, including from climate financing, governments, and the private sector. While some have cited the danger of 'land grabs' by wealthier, but food insecure countries –notably from the Persian Gulf or East Asia – it should be noted that the infrastructural investment associated with such projects offers significant benefits. On balance it is the investors who carry most of the risks in that they have limited scope to take sanctions against states who fail to deliver food supplies to which they are contracted.

Adaptation in agriculture, however, does not have to be finance-intensive. For example, index insurance is a new insurance product that allows farmers, governments, and relief agencies to insure against weather and climate-related risk to livelihoods. These insurance payments are triggered in cases of droughts or other climate-related damage can be an important way to smooth seasonal variability and reduce short term risk. Expanding these products into vulnerable developing countries will be a cost effective way to ensure agricultural livelihoods.

Energy Security

Energy security has been a high priority concern on both sides of the Atlantic for almost 40 years. The oil embargoes of 1973 and 1979 were proximate causes for recession and inflation, and caused trillions of dollars of lost economic growth. Since the first Arab oil boycott in 1973, European and American governments have worried that hostile foreign governments, terrorist, or other external events would restrict their access to energy in a way similar to those shocks. Access to energy supplies has in the past given rise to conflict and continues to have the potential to do so. The impending referendum in Sudan to determine whether the south of the country should secede will be driven inter alia by the reality that the oil deposits are all in the south while the exporting infrastructure is in the north. Nor is the risk of conflict restricted to developing countries. Competition in the Arctic to exploit the estimated 20% of known global

hydrocarbon deposits located beneath a rapidly diminishing ice-cap.

The impact climate change will have on energy security is complex. Overall the planet is not short of sources of energy and recent technologies such as the development of more efficient and less environmentally damaging techniques for extracting non-conventional shale gas have substantially increased global availability of fossil fuels. But a range of factors, including investment and supply bottlenecks, fluctuations in demand and the readiness of some supplier states to use access to energy supplies as an instrument of statecraft, mean that global energy markets remain volatile –and tight – over the short term. Some of this volatility may be mitigated over time depending on the speed with which alternative energy sources, most relying on proven technologies but suffering from low levels of investment, can take up the slack. Some oil-producing states, including Saudi Arabia, are actively planning for a post-oil future, and have expressed concerns about the possible implications for their long-term plans of a decline in demand occasioned by the introduction of these technologies; though this currently seems a remote contingency.

Finding: The impact climate change will have on energy security is complex, but likely to be negative.

Energy Security will be undermined by climate change

The effects of climate change – including sea level rise, increased risk of storms, and warmer temperatures – will impact energy security by adding to the volatility and unpredictability of energy markets. The energy system that supplies the modern, globalized economy is a complex, interconnected web in which a disruption in one part of the infrastructure can easily cause severe discontinuities elsewhere in the system.

Trans-Alaska Pipeline

Unlike water security or food security, there is not as clear a line between changing climactic conditions and reduced energy security. Oil and gas will come out of the ground no matter what the temperature. However, the main threat to energy security from climate change comes from direct threats to existing energy infrastructure. Low lying infrastructure on the US Gulf Coast, Europe, and the Chinese Pearl River Delta is directly threatened by rising sea levels and storm surges. Water availability – which could change drastically due to climate change –

is critically important to most energy production, whether for cooling a reactor, contributing to ethanol production, or powering hydroelectric dams. Melting permafrost will undermine significant investments in Arctic pipeline and energy infrastructure. These threats to infrastructure mean that changing climactic conditions could severely alter supplies, causing spikes in market prices and damage to economic growth. Preparing energy supply chains and infrastructure will require sustained investment in upgraded infrastructure and new technologies.

The Coming Energy Transition

The world is entering an era of transition in energy use. The catalysts for this transition area combination of factors: the need to reduce emissions in order to mitigate climate change, the worry that finite supplies of fossil fuels will lead to a peak in production, and the demographic and economic pressures of a rapidly growing world. The 19th Century saw a similar energy transition, as first coal, and then oil and natural gas replaced wood and animal power as the most widely used sources of energy. Because fossil fuels are geographically spread out, the 19th Century was characterized by a struggle for strategic resources that drove a quest for empires and even started wars. Even today, fossil fuels resources, particularly oil and natural gas, are a strategic commodity, the protection of which has been defined as a national priority by governments across the globe.

Recommendation:
Preparing energy supply chains and infrastructure will require sustained investment in upgraded infrastructure and new technologies.

However, focusing solely on the supply of energy misses half of the equation. Demand-management especially an electrification of transportation and a change from coal power electricity to natural gas, have the potential to substantially increase energy security by moving away from strategic resources like oil, while also reducing carbon emissions. If countries only focus on protecting and securing energy supplies, there will be a global scramble for increasingly hard to access oil and gas supplies, as well as increasing production of coal, with its high carbon emissions. A focus on demand, however, will drive efficiency gains and should promote a cooperative international approach to emissions reductions.

Offshore Wind Turbines in Denmark 1

Reducing global emissions enough to stabilize climate change will require a revolution in energy, both in demand and supply. In absolute terms, the world will have to reduce energy demand while sustaining economic and population growth. Currently available technologies based on renewable power, like wind or solar power will have to be deployed much faster than their current rate. Meanwhile, research and development into new and unproven technologies, like carbon capture and sequestration or fusion power, will require more funding, and significant technological breakthroughs.

Politicians and policymakers should not believe that there are any-term short 'magic bullets' that will instantly solve each of these problems. Instead small steps, leading to larger transition, can be taken incrementally to improve both energy and climate security. Given the long-term strategic uncertainty presented by the energy transition and climate change, it would be prudent to take preventative actions before climate change or energy dependence force policymakers into far more costly and damaging actions. Energy, climate change, and security intersect in a powerful nexus that can only be addressed together.

Adaptation

Regardless of future greenhouse gas emissions, some amount of future climate change will occur. The effects of climate change pose threats to water, food, and energy security. Adapting to the effects of climate change will therefore be necessary, and the report has listed recommendations in specific area. However, there are general recommendations on adaptation that are important.

In certain regions, adaptation efforts will require significant investments. The need for adaptation may be highest in areas most vulnerable to extreme events. However, according to the IPCC, "adaptation alone is not expected to cope with all the projected effects of climate change, and especially not over the long term as most impacts increase in magnitude."

Recommendation: Because some climate change is inevitable, governments should prepare for adaptation and disaster response.

The effectiveness of adaptation is not simply a factor of funding levels: it is also important to have a long-term plan. In developing countries, the adaptation process is guided by the National Adaptation Programmes for Action (NAPAs), which provide the outline of a plan for a country's adaptation to climate change. These have been submitted to the UN Framework Convention on Climate Change (UNFCCC) by forty-five developing countries, to date. Although many of these plans have been criticized as flawed – in that they promote the idea that adapting to climate change is simply an exercise in box-ticking – they provide developing country governments with an

important way to begin to focus on climate change.

Adaptation plans should not be based on a top-down 'one-sized fits all' approach. Among donors, there is a strong bias towards large, highly visible projects, like the construction of large dams. From a technical point of view, donors reproduce first world systems which are often inappropriate for the needs of third world countries. In addition, the focus in the developing world has been on urban areas, especially capital cities, while provincial cities and rural areas are neglected. Instead, efforts should be devised for sharing and disseminating indigenous information, technology and expertise from the bottom-up. Ultimately, however, developing country adaptation plans will succeed or fail based upon the level of financing received.

Recommendation: Adaptation is not simply a factor of funding levels

A notable shortfall of international adaptation planning to date is that there is no methodology in place to promote the adaptation process in conflict areas. Western countries should be very careful about inserting adaptation funding into areas at risk of conflict. Substantial outside funding of any sort can inadvertently benefit one side of a dispute, enhancing the chances of conflict. However, if funding can be used to create a participatory process that includes all sides of a real or potential conflict, then outside funding can be an important builder of peace. In conflict areas, donor cooperation will be very important in preventing conflict.

The Implications for Strategic Planners

Climate change is a threat to international security, and security planners should play a role in addressing it. Military and intelligence organizations have the most experience in strategic planning under conditions of uncertainty. They understand that waiting for certainty often means that you have waited too long. Intelligence communities in both Europe and America should fully examine and prepare for the many scenarios that a changing climate presents. Intelligence failed in 1941 before Pearl Harbor and in 2001 before 9/11 because threats came from places where planners were not looking. There is no excuse for this in respect of climate change.

Recommendation: Climate change is a threat to international security, and security planners should play a role in addressing it.

Climate Change and Conflict

The impacts of climate change combine to make it a clear threat to collective security and global order in the first half of the 21st Century. The links between climate change and conflict are complex but clear. Changes in climate are unlikely to cause interstate wars between major military

powers over the next 30-40 years. However, in areas with weak or brittle states, climate change will increase the risks of resource shortages, mass migrations, and civil conflict. These could lead to failed states, which threaten global stability and security.

Areas that are most vulnerable to climate change do not precisely correlate with weak, fragile, or failing states, but there are significant areas where they overlap (see Figure 2 for a map). Particular regions that are of note as both weak states and vulnerable to climate change are: Central and West Africa, Afghanistan and Pakistan, and Iraq. These regions feature weak states that are already at risk. A changing climate in any of these countries is not likely to be the proximate cause of state failure, but it will shift the tipping point into which a country may fall into conflict. Notably, many of these countries are already high priority countries for security planners, due to continued military involvement by European and American forces.

Recommendations to Security Planners

What we don't know, especially about variability in the climate, leads to more questions, and that should worry planners. Because small changes in climate could lead to large and unknown effects on

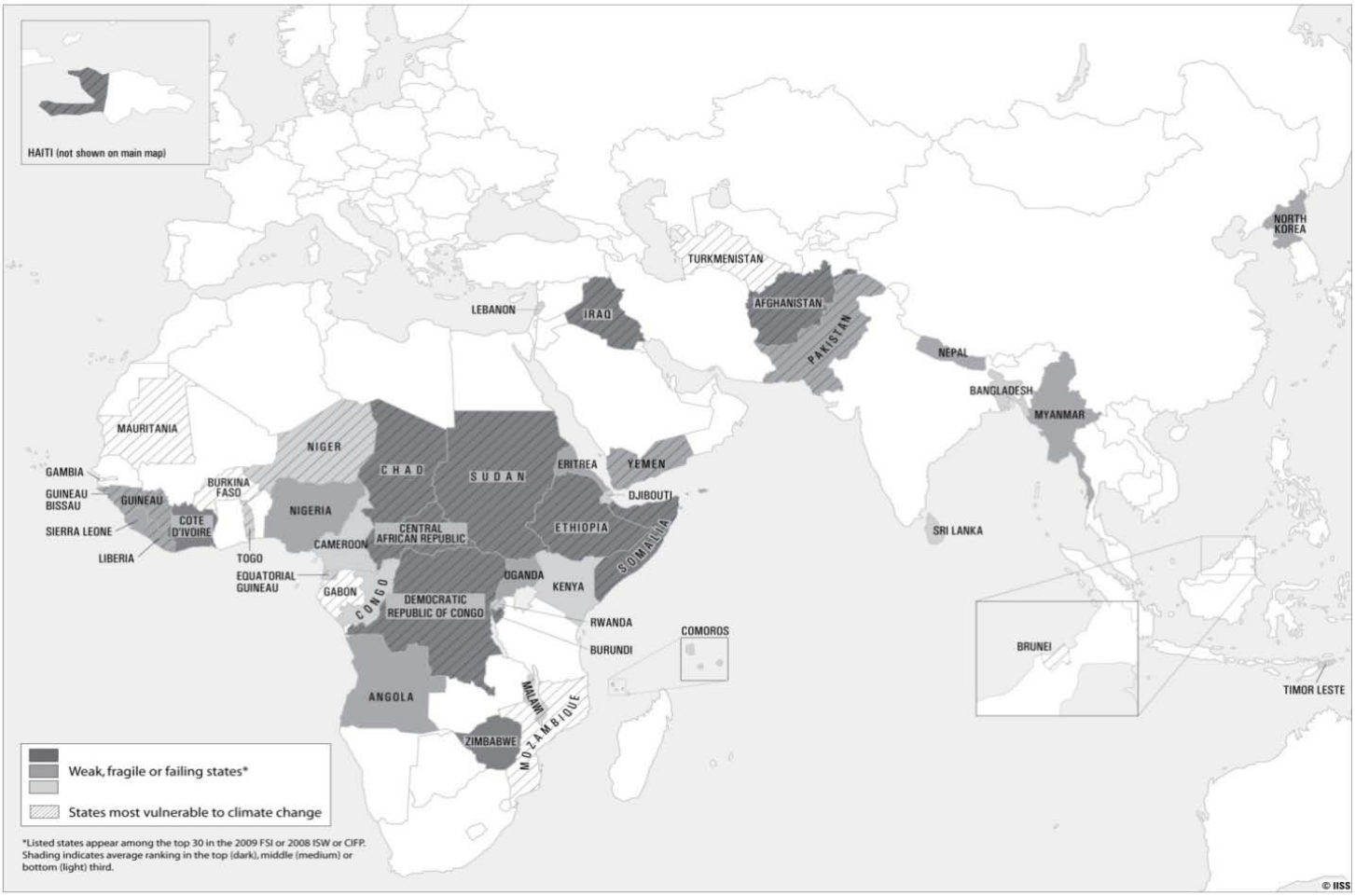

Figure 2- Source, Mazo "Climate Conflict"

complex and interrelated systems, such as energy supplies, we should be very careful about predictions.

One of the most pressing concerns will be to discourage counterproductive solutions. Countries are tempted to isolate themselves from problems beyond its borders. However, resilience is built by stronger international cooperation: if nations seek food security and energy security solely from domestic supplies, do not respond to neighbours' crises, or close their borders to climate migrants, the result will be a weaker, more fragmented world far less able to confront the challenges it faces.

Recommendation: Addressing climate change will require a 'whole of government' focus.

Planners should adapt their thinking to meet the modern threats posed by climate change. This will require new doctrines, mindset, and equipment. The challenges will be significant, and will include the protection of infrastructure, humanitarian assistance, resource wars, and the protection of global commons. Notably, many of these missions are best addressed by civilian departments of government rather than by the military. Addressing climate change will require a 'whole of government' focus. Instead of isolating climate efforts into 'security missions' and non-security missions, adaptation, mitigation, international aid, or crisis response should all be planned jointly across governments.

Conclusion: A Transatlantic Response to Climate Change

The clear threats posed by climate change to collective international security will require concerted international action both to reduce emissions and to adapt to the inevitable effects of warming. Together, the United States and the European Union account for 34% of carbon emissions and 52% of the global economy. Pooling their efforts and capabilities could exercise a significant impact on the future direction of international climate negotiations. However, since climate change became an issue of international concern in the early 1990s, the transatlantic relationship has been characterised more by disagreements than co-operation. Europe and the United States have addressed the problem of climate change in very different ways.

During a period when the Bush administration was reluctant to focus on climate change, Europe adopted an activist posture and developed a series of emission-reduction policies involving ambitious targets. This impression of Europe as leader and the USA as laggard however obscured a more complex underlying reality. To US eyes, the European approach seemed long on rhetoric but short on delivery. Europe meanwhile failed to recognise the degree of progress on emission reductions being achieved in the USA at a state and regional

level and in the field of technological innovation. Europe also appeared to put too much faith in the ability of President Obama, whose administration took seriously the issue of climate change, to effect change at either a national or international level. This lack of mutual comprehension was most clearly evident at Copenhagen, where Europe lacked both a negotiating strategy or a single voice and found itself marginalised from an end-game that turned out to be more about protecting national positions than securing a globally binding agreement.

> **Recommendation:** Cooperation between Europe and the United States on climate security could be important in building support for further action on climate change.

Looking forward, dealing with a USA no closer than before to bringing about domestic legislation on climate change and emissions reduction will continue to be a challenge for Europe. This issue needs to be looked at in the wider context of a USA whose international standing has been diminished by the global financial crisis and whose strategic preoccupations have been shifting inexorably away from Europe towards Asia and the Pacific. Much of the thought leadership in the USA on climate change is being undertaken by the US military and intelligence communities, which tend to enjoy high levels of public trusts. But it is hard for Europe institutionally to engage with these constituencies since key relationships are conducted on a bilateral basis by individual states.

Europe is now better placed institutionally to deal with the USA than at the time of Copenhagen by virtue of the identifiable one-stop shops which have emerged from the Lisbon Treaty. However, Europe is more likely to be able to influence US thinking by example, especially in areas such as the development of alternative energy sources, especially where these can be shown either not to damage or actually to enhance economic performance. There is much too that Europe can do to influence US thinking both in terms of its use of financial assistance to the developing world and through the normative impact of its legislative programme. The experience of Copenhagen suggests that a cautious, bottom-up approach is more likely to have impact with US policy-makers. Engagement at state level, where much innovative emissions-reduction activity is already under way, is also desirable. A major concern of US policy-makers has been the failure of a cautiously recovering US economy to create jobs. To the extent that the development of a green economy can be presented as a net creator of employment, this too can be expected to have significant impact.

By addressing the security risks of climate change, Europe can build relationships with some of the key constituencies involved with early action on climate change in the United States – the military, the intelligence communities, and the

substantial business community that caters to them. Building relationships with these key stakeholders can help European institutions to share their accumulated expertise on climate action – both mitigation and adaptation.

The positive, if limited, result from December 2010's Cancun Conference of the Parties, in contrast to the 2009 Copenhagen Conference, will be a test of the theory that incremental action on international climate change policy can be effective in the longer term. Cancun resulted in agreements on forestry, technology transfer, adaptation, and the creation of a climate financing fund. These deals will all now have to be implemented. Properly implemented, these agreements can build long-term security. However, it will be important that security considerations are included in the architecture of these new processes, so that new financing does not mistakenly harm stability and security. Cooperation between Europe and the United States on ensuring that implementing the Cancun agreements in a manner that increases security could be important in building support for further action on climate change.