



Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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INTRODUCTION

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RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

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HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

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The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

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The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate Change Impacts and National Security

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INTRODUCTION

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So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

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RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

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HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

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So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

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POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

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The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

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The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

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Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

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It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

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The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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MILITARY PREPAREDNESS

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Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

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The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

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So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Water access

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Within a country

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

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RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

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Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Climate Change Impacts and National Security

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

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The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

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INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning. EESI is funded primarily by foundations and other private donors.

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Issue Brief

Climate Change Impacts and National Security

July 2010

There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world's population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries' yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world's growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

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Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

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Issue Brief

Climate Change Impacts and National Security

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There is broad scientific consensus that our climate is changing, due primarily to the burning of fossil fuels for energy, deforestation, and other human activities that release greenhouse gases into our atmosphere. The debate surrounding climate change action has many facets, with significant attention given to issues such as the global competitiveness of American industry, the effect of climate legislation on job growth, and the potential environmental impacts of non-action. A frequently overlooked perspective is the impact of climate change on U.S. national security. This issue brief attempts to fill that void, examining the national security consequences of rising sea levels and changes in temperature and precipitation patterns across the globe. Topics addressed include resource conflict, economic stress, population dislocation, humanitarian relief and military preparedness. Other issues, such as the critical relationship between the U.S. energy supply (especially oil) and national security, are beyond the scope of this brief.

INTRODUCTION

National security is often characterized as defense against armed attack. In reality, it is a much broader and more complex issue; phenomena such as infectious disease, natural disasters, and climate change all have national security implications. The common factor among these issues is instability. Maintaining stability both among and within nations is a proven means of conflict avoidance; instability is a threat to security.

So while armed attacks have the potential to endanger large numbers of people, this is also true of climate change. Many experts agree that projected effects of climate change pose a threat to America's national security because they function as a "threat multiplier for instability" and are interrelated with U.S. dependence on fossil fuels.¹ This sentiment was recently echoed by the Intelligence Community (IC) in its National Intelligence Assessment on the national security impacts of global climate change to 2030. In his June 2008 Congressional testimony, Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council, said, "Climate change alone is unlikely to trigger state failure by 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions."²

RESOURCE SCARCITY AND CONFLICT

Access to and availability of natural resources historically has been a source of conflict across countries and cultures. Conflicts over water resources currently are linked with persistent poverty and instability in the Middle East, Africa, and Asia. As climatic changes continue, the likelihood of resource conflicts will grow as well.

Water access

An adequate water supply is a basic necessity for human activities such as drinking, irrigation, and sanitation. By 2025, five billion people are projected to live in water stressed countries, even without considering the potential impacts of climate change.³ If changes in critical sources of fresh water such as rainfall, snowmelt, and glacial melt are factored into projections for water stress – a likely scenario due to a changing climate – the people who already live in water stressed countries could see a further reduction in water availability. In some cases the effects are already visible. Experts currently estimate that glaciers, from which 40 percent of the world’s population receives about half of its drinking water,⁴ have been retreating at ever faster rates due to climate change.⁵ Because they lack the infrastructure to deal with water shortages, developing countries are particularly vulnerable to political, economic and social instability.

Food production

Access to food is a critical stability factor. Climate change threatens to inject instability into food production across the globe. Crop ecologists project that grain production will decrease 10 percent for each 1.8°F increase in temperatures above past averages.⁶ According to the Intergovernmental Panel on Climate Change (IPCC) estimates, some African countries’ yields from rain-fed crops could drop by 50 percent by 2020 due to climate impacts.⁷ Additionally, most of the world’s growth in food demand will occur in areas already facing food shortages such as the Indian subcontinent and sub-Saharan Africa.

Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

ECONOMIC STRESSES

Climate change will have serious implications for national economies and global markets. While it is impossible to attribute economic and state failures to global climate change alone, an increasing number of experts, both scientific and military, believe that a changing climate will exacerbate some of the central challenges facing weak economies and failing states.

Investment

Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

International markets

The global financial crisis that took hold in 2009 and continued through 2010 resulted in slower economic growth around the world. As markets slowly recover and financial regulations are reorganized, how the international markets respond is of direct relevance to U.S. national security. Climate change has the potential to disrupt progress, especially in emerging economies which are more vulnerable to instability. Economic disruptions associated with climate change will place increased pressure on weak nations which may therefore be unable to provide basic needs and maintain order for their citizens. In his February 2009 testimony before Congress, Director of National Intelligence Admiral Dennis C. Blair said, "The United States depends on a smooth-functioning international system ensuring the flow of trade and market access to critical raw materials such as oil and gas, and security for its allies and partners. Climate change could affect all of these – domestic stability in a number of key states, the opening of new sea lanes and access to raw materials, and the global economy more broadly – with significant geopolitical consequences."¹⁰ This also means that the export markets of many countries are likely to be negatively affected.

POPULATION DISLOCATION AND MIGRATION

Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

Within a country

Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

Across an international border

Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

Across large regions of the globe

A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

Weather intensification

The increased intensity of tropical cyclones, hurricanes, and other extreme weather events will result in greater infrastructure damage and economic losses.

Flooding and drought

It is very likely that there will be more frequent and intense drought and wildfire occurrences as a result of changing weather patterns and mid-continental drying. Because the landmass of the Indian subcontinent is expected to warm, scientists anticipate this will heighten the impact of monsoon rains and associated flooding of low-lying areas.

Shifting pattern of disease

Disease vectors will be altered in a warmer world, causing new worldwide health challenges. Public health experts project that between 90 and 200 million people could become more vulnerable to malaria, 1.4 billion could experience greater risk of dengue fever, and the number of children vulnerable to diarrheal diseases – the number one killer of children – will increase significantly.¹⁸

MILITARY PREPAREDNESS

The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

Weapons systems and platforms

According to CNA's 2007 report, "Operating equipment in extreme environmental conditions increases maintenance requirements – at considerable cost – and dramatically reduces the service life of equipment."¹⁹ Increased desertification, rising sea levels, and warmer temperatures in the Middle East, where the United States is projected to have a continued presence, will put U.S. military preparedness at risk. Equipment will require heightened maintenance to ensure adequate response times.

Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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Water access

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Fresh water and food are just two examples of resources that will be affected by a changing climate. The degree to which societies will experience the negative environmental and socio-economic effects of resource scarcity due to climate change depends in large part to their vulnerability to it. How dependent is a given society on natural resources and ecosystem services? Given a certain level of dependence, how sensitive are the resources to a changing climate? What is the capacity of the country to adapt to changes in availability of these resources and services? Thus, while the environmental and socio-economic effects of climate change are projected to be widespread, they will not be uniformly distributed because of varying vulnerabilities. Of central concern for U.S. security, however, is the reality that a majority of the resource impacts will be in countries with limited adaptive capacity, potentially making them particularly susceptible to the corrosive effects of instability.

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Climate change will require dramatic investment in infrastructure – both to preempt its effects and to rebuild communities after extreme weather events. Increasingly powerful and devastating tropical storms, like Hurricane Katrina, can be expected to occur as climate change causes ocean temperatures to rise.⁸ The damage ensuing from such destructive storms is financially overwhelming, and while the United States has the capacity, even if a finite one, to invest in prevention and rebuilding efforts, the same cannot be said for much of the developing world. In 2009, the World Bank estimated that developing countries would require \$75-100 billion annually during the period 2010-2050 to cope with the consequences of climate change.⁹

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Mass migration associated with climate change will challenge the world's political, economic, social and humanitarian relief capabilities. For example, a sea level rise of 3 - 15 feet would displace between 150 and 400 million people.¹¹ The IPCC projects that sea levels will rise between 7 and 23 inches (0.18 and 0.59 meters) above the 1980-1999 average by the end of this century, making it unlikely that these extreme projections will be realized in the near future.¹² Regardless of their numbers, however, displaced populations from developing countries are expected to move both to urban areas in their home countries and to neighbor countries as a temporary home until a move to a developed country with superior economic prospects is possible.¹³ There are three types of migration to consider:

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Migration within a single country, from coastlines to cities for example, can result in significant economic changes – both positive and negative. The United States was, for the most part, able to absorb the displacement of people from the Gulf Coast after Hurricane Katrina. Developing countries that lack strong political, social, and economic infrastructures are likely to face entirely different effects of major population shifts.

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Environmental destruction is a major driver of migration across international borders. Such migration can often lead to intense political conflict and destabilization for both countries. The large migration from Bangladesh to India beginning in the 1950s, for example, affected both the economy and political context in the regions of India that absorbed this population and resulted in violence between natives and migrants.¹⁴ The IPCC has estimated that with a 45 centimeter (17.7 inch) increase in sea level, 10.9 percent of Bangladesh will be under water and 5.5 million people may be displaced.¹⁵ As a result, previously existing tensions may be exacerbated if this projected sea level rise does indeed occur.

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A final type of migration involves large regions of the globe. Europe has experienced such a migration influx from North Africa and the Middle East since the 1960s. The resulting shift in demographics can result in serious tensions along social, cultural, or religious lines, as evidenced by the 2005 civil unrest in France. A forced evacuation of low-lying island nations, such as the Maldives, the Republic of the Marshall Islands, Tuvalu and Kiribati, may be necessary if they are rendered uninhabitable by a sea level rise of one to two meters (3.2 - 6.5 feet).¹⁶

HUMANITARIAN RELIEF

The need for increased international aid is likely to be one of the most significant effects of climate change. Since the 1970s, the number of people affected globally by natural disasters has increased by about 50,000 to 60,000 people per decade.¹⁷ The number of reported disasters has also increased from an average annual total of 90 in the 1970s to almost 450 per year in this current decade. The impetus to provide funding in the wake of such domestic and international disasters, which is both moral and strategic, will come under intense scrutiny and pressure given America's own long-term budget scenario. Difficult choices will have to be made over competing trade-offs and priorities. Significant aid is likely to be required due to the following effects of climate change:

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The impacts of climate change on resource competition, economic development, population migration, and humanitarian issues will force changes in U.S. use of its military power. Climate change also will force change in how the United States operates its forces around the world; changes will affect ground operations and logistics as well as operations at sea and in the air. Sea level rise threatens large investments in U.S. facilities around the world. Desertification and shifts in the availability of water can change logistic patterns drastically for all U.S. forces. This section highlights some of the primary military preparedness issues that will confront the United States as a result of a changing climate.

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Bases threatened by rising sea levels

A rise in sea level would result in the loss of some strategic forward bases across the globe. In 2008, the National Intelligence Council disclosed that 30 or more U.S. military installations were seriously threatened by rising sea levels.²⁰

In particular, bases located on the East Coast of the United States are especially vulnerable to rising sea levels and increasingly frequent and powerful hurricanes. For example, were sea levels to rise by one meter, Norfolk, Virginia, an important base of the U.S. Navy, would be flooded. As U.S. military bases are put at risk, the ability of the military to protect the United States will be compromised.²¹

Military operations

In addition to the preparedness implications of climate change, severe weather impedes actual operations as well. Projected increases in storm intensity threaten to impact military installations situated in hurricane alleys, such as those on the East Coast of the United States. Storms and altered weather patterns can also impact energy supplies that are vital to the operation of fixed military operations. Moreover, the melting of Arctic sea ice is expanding the Northwest Passage. This has significant implications for international resource conflicts, maritime shipping lanes and an increased scope for U.S. naval operations.²²

CONCLUSION

Most of the public debate regarding climate change focuses on the size of the economic consequences of action and how these costs compare to those of inaction. Hurricane Katrina and other extreme weather events suggest a different way of thinking about the issue, in which the human and larger social consequences of these events outweighed the aggregate economic costs, at least in the context of a large and resilient U.S. economy. The concentrated impacts of such events, which are likely to be exacerbated by a changing climate, will have important national security implications, both in terms of a direct threat as well as broader challenges to U.S. interests in strategically important countries. At home, extreme weather events could put large numbers of people in harm, damage essential infrastructure (including military assets), and require mobilization and diversion of military personnel. Abroad, climate change is likely to promote instability in countries of strategic concern, which could lead to refugee and humanitarian crises as well as escalations in international conflict over resources, particularly water and food.

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