CLIMATE
EVERYONE'S
BUSINESS

Climate Change:
Implications for Defence

Key Findings from the Intergovernmental Panel on Climate Change Fifth Assessment Report

GLOBAL MILITARY
ADVISORY COUNCIL ON
CLIMATE CHANGE

The **Physical Science** of Climate Change

Rising temperatures:

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) concludes that climate change is unequivocal, and that human activities, particularly emissions of carbon dioxide, are very likely to be the dominant cause. Changes are observed in all geographical regions: the atmosphere and oceans are warming, the extent and volume of snow and ice are diminishing, sea levels are rising and weather patterns are changing.

Projections:

Computer models of the climate used by the IPCC indicate that changes will continue under a range of possible greenhouse gas emission scenarios over the 21st century. If emissions continue to rise at the current rate, impacts by the end of this century are projected to include a global average temperature 2.6–4.8 degrees Celsius (°C) higher than present, and sea levels 0.45–0.82 metres higher than present.

To prevent the most severe impacts of climate change, parties to the UN Framework Convention on Climate Change (UNFCCC) agreed a target of keeping the rise in average global temperature since pre-industrial times below 2°C, and to consider lowering the target to 1.5°C in the near future.

The first instalment of AR5 in 2013 (Working Group I on the physical science basis of climate change) concluded that by 2011, we had already emitted about two-thirds of the maximum cumulative amount of carbon dioxide that we can emit if we are to have a better than two-thirds chance of meeting the 2°C target.

Impact of past emissions:

Even if emissions are stopped immediately, temperatures will remain elevated for centuries due to the effect of greenhouse gases from past human emissions already present in the atmosphere. Limiting temperature rise will require substantial and sustained reductions of greenhouse gas emissions.

About this Document

The Fifth Assessment Report from the Intergovernmental Panel on Climate Change is the most comprehensive and relevant analysis of our changing climate. It provides the scientific fact base that will be used around the world to formulate climate policies in the coming years.

This document is one of a series synthesizing the most pertinent findings of AR5 for specific economic and business sectors. It was born of the belief that the defence sector could make more use of AR5, which is long and highly technical, if it were distilled into an accurate, accessible, timely, relevant and readable summary.

Although the information presented here is a 'translation' of the key content relevant to this sector from AR5, this summary report adheres to the rigorous scientific basis of the original source material.

Sincere thanks are extended to all reviewers from both the science and security communities for their time, effort and invaluable feedback on this document.

The basis for information presented in this overview report can be found in the fully-referenced and peer-reviewed IPCC technical and scientific background reports at: **www.ipcc.ch**

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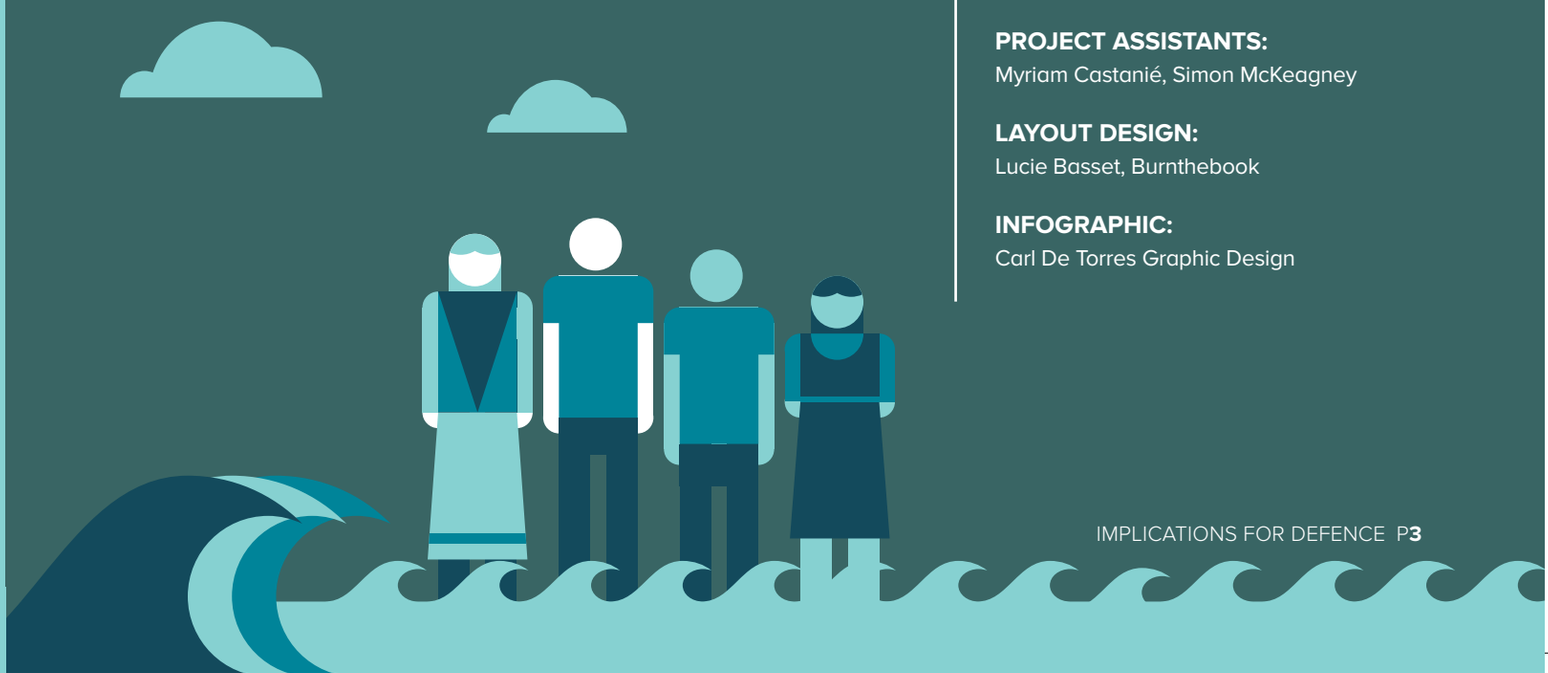


Key Findings

1. **Climate change poses an increasing threat to peace and security in the world.** Its impacts can undermine livelihoods, increase involuntary migration, and reduce the ability of states to provide security.

2. **Climate change acts as a 'threat multiplier'**, amplifying existing vulnerabilities among populations and existing threats to security, and can indirectly increase risks of violent conflict. The risks are highest in countries with weak or failing governments and/or with existing conflict. Climate impacts are likely to disproportionately affect these more vulnerable societies.

3. **Societies' responses to climate impacts may exceed the global or regional capacity to manage those responses peacefully.** Issues of most concern include populations displaced by extreme weather or sea-level rise, the spread of infectious disease, and lack of food and water. The need for major humanitarian support is likely to increase.

4. **Climate change will bring new challenges to states' ability to share resources and provide human security.** Changing resource availability may increase rivalry between states, while sea-level rise could raise disputes over national boundaries. Accordingly, climate change will increasingly shape national security policies. Further erosion of security can be mitigated by the presence of robust institutions.

5. **Military forces will be directly affected by climate change.** Sea-level rise and other climate impacts will directly affect facilities, requiring a response. As major fossil fuel users, military forces may have to reduce their greenhouse gas (GHG) emissions.

Executive Summary

This summary examines the key findings of AR5 through a defence analysis, which looks at safeguarding the security of the nation from internal and external threats, yielding a strategic view of the security impacts of climate change.

The primary purpose of military forces is to maintain peace and national security. In this context, 'peace' means not just the absence of war, but the maintenance of stable conditions that provide at minimum for people's basic needs. In this respect, climate change is a growing worldwide threat to general peace and security, and as such will become an issue of increasing significance for the military. Climate change is best understood as a 'threat multiplier', exacerbating existing pressures as well as presenting new challenges to security.

The overarching impact of climate change on the security environment stems from the additional challenges that states will face in meeting the basic human needs of a growing world population. These needs include food, shelter, clean water, and safety. In some parts of the world, food and water resources are already threatened by climate change, and this trend is projected to increase. Disease, damage to infrastructure from natural disasters, and flooding and storm surges resulting from sea-level rise are additional threats for large numbers of people. The human-related impacts of climate change – including rising temperatures, changes in precipitation patterns, reductions in snow and ice cover, sea-level rise, falling crop yields and destructive extreme weather events – have the potential to overwhelm the ability of societies to respond, particularly in more fragile or less developed countries. Many states view current and anticipated climate change as contributing to geopolitical concerns.

Climate change also has the potential to increase rivalry over access to resources in particular regions, including the Arctic and trans-boundary river basins. The combined impacts of resource scarcity, mass migrations and weakened governments are likely to increase potential for armed conflict between states seeking to safeguard or acquire vital resources, and between populations within states.

Security breakdowns and conflict generally emerge from the interactions of multiple factors. Climate change indirectly increases the risk of violent conflict in the forms of civil war, inter-group violence and violent protests, by exacerbating well-established drivers of these conflicts such as economic and political shocks. Poorly designed adaptation and mitigation strategies can also increase the risk of violent conflict.

Armed forces globally will need to adapt to the changing environment and consider climate change impacts on infrastructure and military installations. They are also likely to be affected by global requirements to change energy technologies and reduce their own GHG emissions.

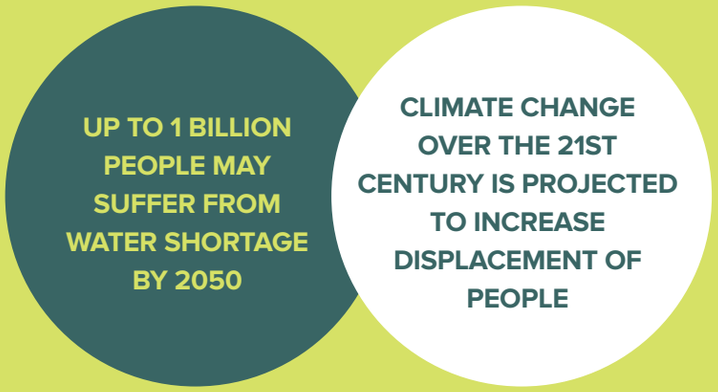
Impacts of Climate Change

Impacts and risks

- **Extreme weather and sea-level rise** could result in mass migrations, the spread of disease, food and water insecurity, and the need for major military humanitarian support.
- **Climate-related security threats are unevenly distributed.** Risk is greatest in countries with weak or failing governments and/or with existing conflict.
- **Changes in geography and freshwater availability** may increase rivalry over access to resources.
- **Impacts on defence infrastructure** will necessitate changes in logistics and operations.

Climate change poses a threat to **current and future human security**. Failures in human security almost never have a single cause, but instead emerge from the interaction of multiple factors. Climate change is set to pose an increasingly important threat by undermining livelihoods, compromising culture and identity, increasing mass migrations and challenging the ability of states to provide the conditions necessary for a stable society. Tensions arising from climate change effects on human security can have implications for **national security**. There is strong overlap between **governments and the defence sector**, because as well as protecting national security, the military is often deployed for support in conflict or humanitarian crises.

Some climate-related impacts are already being observed, such as changes in agricultural output and increases in coastal flooding. People living in places affected by conflict are particularly vulnerable to climate change.



Added to other stresses such as poverty, inequality and disease, the effects of climate change will make **sustainable development objectives** such as food and livelihood security, poverty reduction, health and access to clean water more difficult to achieve for many locations, systems, and affected populations. In recent years, many outbreaks of conflict have been in relatively poor tropical and/or arid countries where societies lack resilience. These societies are among those likely to experience the strongest climate change impacts.

Climate change could increase **risks of violent conflict** in the form of civil war, inter-group violence, and violent protests, by exacerbating drivers of these conflicts such as poverty and economic hardship.

Mass migrations may involve people driven by water and food shortages, disease, flooding, drought, or conflict. Extreme weather events have already led to significant **population displacement**, and changes in the incidence of these events will amplify the challenges and risks of such displacement. Each degree (Celsius) of warming is projected to decrease renewable water resources by at least 20% for an additional 7% of the global population. Much displacement is temporary, with economic factors often determining how quickly people seek to return and rebuild.

Low-income migrants can find themselves vulnerable to climate change in their new destinations, such as in poorer and high-density parts of cities. Meanwhile, not everyone will have the resources necessary to migrate at all.

The destabilising effects of climate change in developing countries could have implications for **national security in the developed world**.

There are direct threats to human health from **infectious disease and other acute (heat-related) illness**. Climate change may increase the burden of a range of health outcomes, as it is a multiplier of existing vulnerabilities including insufficient access to safe water and improved sanitation, food insecurity, and limited access to health care and education.

In many regions, **food production** is likely to fall, with lower yields from major crops including wheat, maize and rice. Climate change is also projected to affect food security by causing a **large-scale geographical redistribution of fish**. This may increase rivalry among states over fishing access, and societies relying on fish for subsistence are likely to be disproportionately disadvantaged.

Climate change can indirectly increase risks of violent conflicts in the form of civil war and inter-group violence by amplifying drivers of these conflicts such as poverty and economic shocks.

An estimated 150 million people currently live in **cities with perennial water shortage** (i.e. less than 100 litres per person per day for basic human needs). Projections suggest that up to 1 billion urban dwellers may have insufficient water for basic human needs by 2050.

Climate change could shift the **comparative advantages of cities and rural areas** and differentially threaten or enhance their resources, assets and economic base, leading to significant structural changes and impacts.

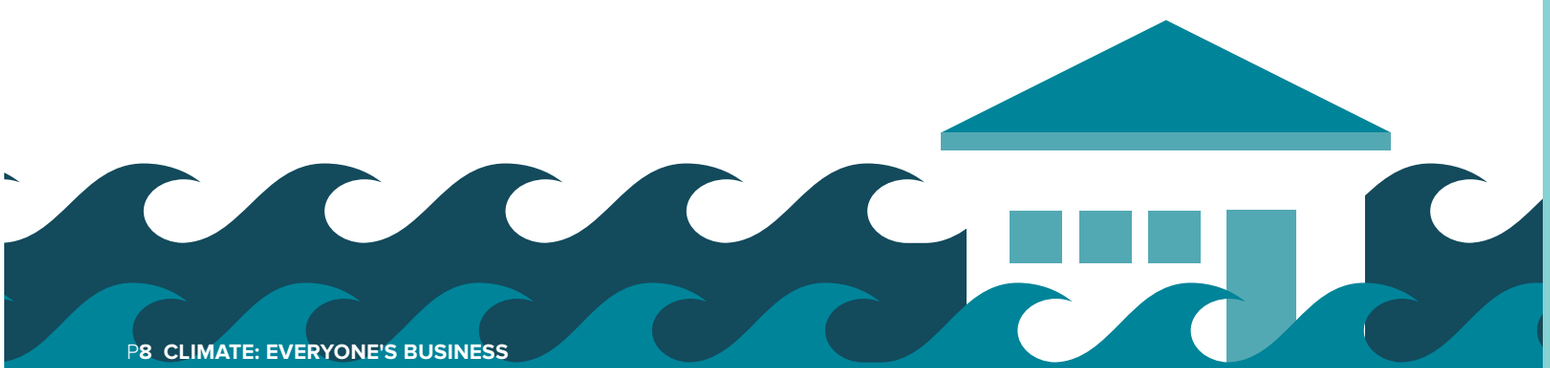
The **rate and intensity of natural disasters** may increase, resulting in more deaths and destruction of critical infrastructure, with epidemic/pandemic disease outbreaks sometimes following major disasters. A large proportion of Asia's population lives in Low Elevation Coastal Zones (LECZ) that are particularly at risk from climate change hazards, including sea-level rise, storm surges and typhoons.

Rising sea levels along gently sloping coastlines can challenge the territorial limits to the maritime jurisdiction of the states, as the distance from national baselines to the current outer limits of the Exclusive Economic Zone (EEZ) will increase beyond 200 nautical miles over time. Changes in coastal resources may also be coupled with **decreasing food security** to compound coastal poverty. This may lead, in some cases, to increased criminal activities such as piracy, illegal, unreported and unregulated (IUU) fishing, and human, weapons and drug trafficking.

The formation of new ice-free seaways through the Arctic may benefit some countries in terms of maritime access. Shipping and mineral extraction in the region are likely to increase. However, this may lead to increasing international tension, as states perceive new vulnerabilities or pursue new opportunities resulting from these **changes in geography**.

Military bases and operations will be directly impacted by sea-level rise, extreme weather events, loss of Arctic sea ice, and other climate impacts. For many nations, conducting operations in response to climate change could increase the cost of national security or threaten the ability to address traditional threats.

Temperature rise could affect the **effectiveness and efficiency of the military**. The US military suspends all physical training and strenuous exercise when the Wet Bulb Globe Temperature (WBGT) exceeds 32°C. One estimate suggests that global labour productivity will be reduced during the hottest months to 60% in 2100 if GHG emissions continue to rise at the current rate. Tropical and mid-latitude regions including India, northern Australia, and the Southeastern United States will be particularly negatively affected.



Examples of Regional Climate Impacts

Water insecurity and the Tibetan Plateau

There are concerns that tensions will increase due to climate-driven water variability in the trans-boundary drainage systems linked to the vast Tibetan Plateau in central Asia, where rivers supply more than one billion people with water. Climate change is expected to alter the dynamics of water runoff, and warming will bring forward the snow melt season in all but the coldest regions. This is likely to increase the flood risk during seasons of high precipitation and increase water shortage in others. High levels of international interdependence on the trans-boundary river systems of the region connect the rivers with the relevant national development trajectories. Concerns about water insecurity are particularly relevant where challenges stemming from rising consumption and growing populations are present.

Human insecurity in the Arctic

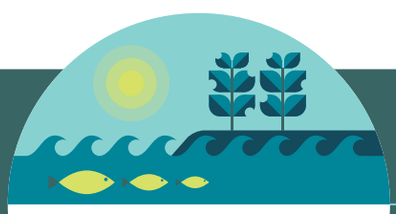
Over the past two decades, Arctic sea ice and northern hemisphere spring snow cover have markedly decreased. There is at least a two-thirds chance that the Arctic Ocean will be nearly free of sea ice in summer before 2050. This will contribute to geopolitical concerns and human insecurity in the Arctic region. Issues include food insecurity affecting specific cultures, energy security implications through opening of subsea oil and gas reserves, increased shipping, increased pollution, search and rescue challenges, and an increased military presence in the region. Changes may create or revive terrestrial and maritime boundary disputes among Arctic countries, although there is little evidence that a changing Arctic will become a site for violent conflict between states. However, it can be expected that nations will have to adjust defence policies and military force structure in response to these new challenges.

Climate change may undermine peace and security

Climate change exacerbates existing pressures on security as well as bringing new challenges, and the potential for violent conflict could increase. The operational responsibilities of the defence sector could also expand in the event of large-scale climate-driven disasters.

Security-Related Climate Change Impacts

Increase in Drought and Inland Flooding
Food and freshwater insecurity, pandemic/epidemic disease outbreaks, loss of food production and arable lands, population displacement, livelihood insecurity.



Rising and Extreme Temperatures
Lower agricultural output, spread of disease, food insecurity, less renewable water resources, more heat-related illness, change in large-scale fish catch potential.

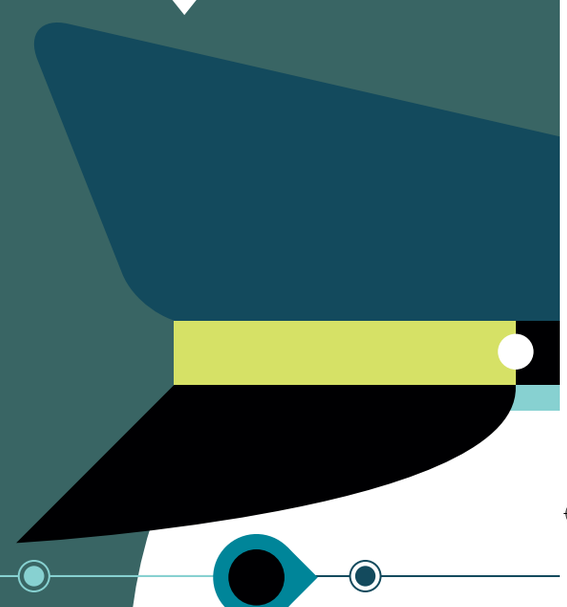
Geopolitical Concerns
Uneven distribution of impacts among countries depending on geographic setting and other factors affecting national and human security. Climate-related security threats greatest in countries with weak or failing governments and/or with existing conflict.

Declining Snow and Ice Cover
Access to offshore resources in newly ice-free areas, freshwater insecurity, changes in geography and new openings for traffic.

Sea-Level Rise and Storm Surges
Increased vulnerability in the Low Elevation Coastal Zones, damage to infrastructure, changing territorial limits and integrity, population displacement, disease spread, loss of arable land, change in coastal resources.

Extreme Weather
Destruction of critical infrastructure, population displacement, pandemic/epidemic disease outbreaks, humanitarian disaster.

Responding to Climate Change Impacts



Medical Support
Providing large-scale emergency medical treatment, mobile hospitals, sanitation measures, preventative medicine.

Routine Military Operations
Peacekeeping in fragile areas, refugee control, policing, conflict resolution, engineering activity, border protection.

Key Findings from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) | For more information please visit **www.cisl.cam.ac.uk/ipcc**

Reducing the Carbon 'Bootprint'

In many nations, defence forces are the largest single consumer of fossil fuel. Reducing fuel consumption would in turn reduce greenhouse gas (GHG) emissions.

More Efficient Vehicles
Light-duty vehicles could be 40–70% more fuel efficient by 2035 than now.

Alternative Fuels
New aircraft typically offer 20–30% improvement in efficiency. Shifting from kerosene to biofuels offers +30% cuts in direct GHG emissions.

Operational Efficiencies
Aviation carbon dioxide (CO_2) emissions can be reduced through more efficient planning of operations, including routes, altitudes and speeds.

Resilience Strategies

Military Bases
Possible relocation, use as medical centres and support areas for refugees.

Support for Mass Displacement and Evacuation
Safely moving populations and supplies while providing security, clearing debris, water treatment and waste management.

Refugee Support
Rapidly constructing and maintaining facilities to provide critical services for a displaced population for extended periods of time.

Humanitarian Operations
Rebuilding and adapting infrastructure, maintaining sanitation facilities, providing shelter, protecting vulnerable populations against emerging threats, mortuary services.

Flexible Response
Even with adaptation measures, changes in climate can have unexpected, adverse effects on military operations. Flexibility in planning and response will be essential in meeting long-term defence and security responsibilities.

Reducing Risk
Action with an emphasis on disaster risk reduction can increase climate resilience while helping improve human livelihoods.

Planning for Displacement
Millions of people could depend on adaptation measures to reduce displacement caused by coastal flooding and land loss.

Anticipating Climate Risk
Anticipating climate risks can help planners reduce impacts. Numerous facilities may need to be relocated and/or strengthened, notably to secure naval bases against flooding and sea-level rise.

Adjustments in Security Analysis
Nations will need to update strategic security planning to take into account risks and impacts of climate change.

Scenarios for Lack of Resources
Reduction of fresh, clean water resources could require increased peacekeeping in areas prone to conflict over extreme scarcity, as well as logistical adaptation for troop supplies.

Resilience

Large-scale violent conflict harms assets that facilitate adaptation, including infrastructure, institutions, natural resources, social capital, and livelihood opportunities.

Many adaptations to climate change that involve the military can result in significant co-benefits, such as alleviating poverty and enhancing development, especially in developing countries. Various adaptation interventions promote well-being and security through the diversification of income-generating activities, adaptive migration in agricultural and fishing communities, insurance systems and education of women.

Flood preparedness

The benefits of protecting against increased coastal flooding and land loss due to submergence and erosion at the global scale are greater than the social and economic costs of inaction. Without adaptation, hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss by 2100. The majority are in East, Southeast and South Asia. However, some low-lying developing countries (e.g. Bangladesh, Vietnam) and small island states are expected to face unavoidable land loss and annual flooding damage.

Relocating military installations and bases

Numerous naval bases located in coastal areas may need to be relocated further inland if the coast is not protected. Some may require relocation even with coastal protection.

Preparing for population displacement

Some migration flows are caused by changes in resource availability and ecosystem services. Major extreme weather events have in the past led to significant population displacement, and the likely increase in extreme events will amplify the challenges and risks of such displacement. Climate change effects of this type present chronic and episodic challenges to state capacity and to the fundamental welfare of populations at a scale that raises questions of state stability. The military has the ability to provide infrastructure immediately, bringing medical supplies, lift capability and communications to devastated regions.

Preparing for water insecurity

Climate change is projected to reduce both the quantity and quality of freshwater resources in many regions of the world. Groundwater resources will be reduced in many regions. Adaptation measures can include water resource management projects, additional water treatment systems, and water conservation. Many of these methods are expensive and take significant amounts of time to implement. This may limit their application in poorer countries.

Increasing resilience

Strategies and actions with an emphasis on disaster risk reduction can be pursued that increase climate resilience while at the same time helping to improve human livelihoods, social and economic well-being and responsible environmental management.

Mitigation Potential

The global military complex is an energy-intensive industry and in many nations, defence forces are the largest single consumer of fossil fuels. Given the significance of its impact on climate conditions, the defence sector may come under significant pressure to reduce its GHG emissions – especially if governments enact policies to curb climate change in line with the globally agreed 2°C target. However, reducing fuel consumption may benefit operations, particularly for deployed forces where moving large quantities of fuel is costly and dangerous.

More efficient vehicles

Internal combustion engines and jet turbines are becoming increasingly efficient. Expectations are for 40–70% improvements in the fuel efficiency of light-duty vehicles by 2035 compared to present. New aircraft typically offer a 20–30% improvement in fuel efficiency over existing models, driven by improved engine performance, weight reductions, and design. Further gains of 40–50% between 2030 and 2050 are possible, compared with 2005 levels.

Alternative fuels

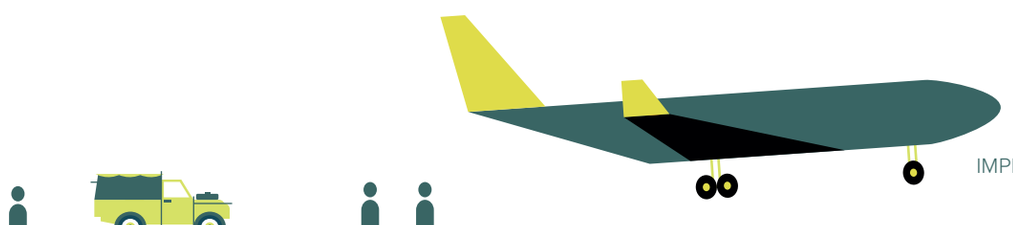
It may be possible to replace kerosene with biofuels, which offers direct GHG emission reductions of +30%. Shifting to electric or hydrogen-fuelled vehicles promises to dramatically reduce emissions.

Operational improvements

Aviation carbon dioxide (CO_2) emissions can be reduced through more efficient planning of operations, including routes, altitudes and speeds.

Unintended consequences

Some efforts to mitigate emissions and adapt to climate change can increase insecurity and the risk of armed conflict. Where these efforts change the distribution of or access to resources, they have the potential to cause or aggravate conflict. For example, biofuel production can lead to disputes over land, food price spikes and rioting. Offering payments for Reduced Emissions from Deforestation and Forest Degradation (REDD) projects may trigger conflict over land and property rights. And some forms of low-carbon power, such as hydropower, have led to conflict over forced resettlement.



Climate change has the potential to increase the risk of conflict and insecurity.

Conclusion

The impacts of climate change on the critical infrastructure and territorial integrity of many states are expected to influence national security policies.

Climate change has the potential to increase the risk of conflict and insecurity because factors such as poverty and economic hardship, associated with a higher risk of violent conflict, are especially sensitive to climate change. Although many climate risks warrant further investigation and there is a need for more comprehensive evidence across multiple locations and over long durations, it is likely that climate change over the 21st century will lead to new challenges to states and will increasingly shape national security policies.

The effects will be unevenly distributed among countries depending on their geographical setting and other factors that affect security. Economically and politically strong nations will be able to adapt to moderate impacts of climate change, and in so doing greatly reduce security threats (although security is at risk for vulnerable populations even in rich countries). On the other hand, the most vulnerable nations may struggle to respond even to moderate climate impacts without considerable assistance. People in places with existing violent conflict are particularly vulnerable to climate threats, and the highest defence threats are in fragile states subject to multiple impacts of climate change.

Individual studies differ in their conclusions on whether violence has a statistically significant association with climate, but there is higher confidence that climate variability has such an impact. As climate change progresses, it is likely to increase the variability of freshwater supplies and agricultural yields.

It is likely that the military will be tasked with providing progressively more humanitarian support missions, having to organise large-scale logistics support and provide medical resources to respond to epidemic disease, border security operations, and rising tensions over natural resources. The defence sector will also need to consider how it adapts or relocates facilities, equipment and operations.

Security threats from climate change will be amplified at high levels of warming, which – if emissions continue to rise at the current rate – will cause environmental conditions to change faster than at any time in human history. Accordingly, policies that reduce GHG emissions across all sectors are likely to reduce the security threats of climate change in future decades. As a major user of fossil fuels, military forces are also likely to be increasingly tasked with reducing their own emissions, which may bring benefits in terms of the cost and complexity of operations.

Glossary

ADAPTATION

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects.

ARMED CONFLICT

Conflicts that involve more than 25 battle-related deaths in a year.

BIOFUEL

A fuel generally in liquid form, produced from organic matter or combustible oils produced by living or recently living plants.

CLIMATE CHANGE

Any significant change in climate that persists for an extended period, typically decades or longer.

CLIMATE IMPACT

The effects of climate change on natural and human systems.

CO-BENEFIT

The positive effect that a policy or measure aimed at one objective might have on other objectives.

DEFENCE

Activities of a nation with the primary purpose of securing the nation from internal and external threats to peace.

GREENHOUSE GAS

A gas in the atmosphere, of natural and human origin, that absorbs and emits thermal infrared radiation. Water vapour, carbon dioxide, nitrous oxide, methane and ozone are the main greenhouse gases in the Earth's atmosphere. Their net impact is to trap heat within the climate system.

HUMAN SECURITY

A condition that is met when the vital core of human lives is protected, and when people have the freedom and capacity to live with dignity.

MASS MIGRATION

The migration of large groups of people from one geographical area to another. Mass migration is distinguished from individual or small scale migration. In the context of climate change, migration can be an adaptive or an emergency response.

MITIGATION

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

NATIONAL SECURITY

The responsibility of government to maintain the health of the state through the use of economic power, diplomacy, military and political power.

PEACEKEEPING

Military forces applied to prevent or end armed conflict between other armed forces.

PROJECTION

A potential future evolution of a quantity or set of quantities, often computed by a model. Projections involve assumptions that may or may not be realized, and are therefore subject to substantial uncertainty; they are not predictions.

RESILIENCE

The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure.

SUSTAINABLE DEVELOPMENT

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

THREAT MULTIPLIER

A factor that exacerbates the negative effects of other drivers of change.

"It is essential that the security community understands the science of the IPCC AR5 report in order to be able to analyse the implications and risks associated with climate change. In Pakistan, we are witnessing how changes to the climate are already impacting our national security. At the same time, many in the military would freely admit a lack of understanding of and thus an inability to act on this issue. It is the key need of our time."

LIEUTENANT GENERAL (RET) TARIQ WASEEM GHAZI, PAKISTAN

"This project to interpret the content of the IPCC AR5 report for the armed forces and security community in a timely and simple manner is vitally important for future planning given the global security concerns in a rapidly changing environment and a changing climate with its many consequences."

MAJOR GENERAL (RET) JOSEPH G SINGH, GUYANA

Disclaimer:

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The family of summaries, of which this report is part, is not meant to represent the entirety of the IPCC's Fifth Assessment Report (AR5) and they are not official IPCC documents. The summaries have been peer-reviewed by experts both from the business and science communities. The English version constitutes the official version.

About us:

CISL brings together business, government and academia to find solutions to critical sustainability challenges.

GMACCC is a global network of serving and retired military officers, and associated institutions, committed to highlighting the potential security implications of a changing climate and advocating action, including by the military, to minimise the risks.

The IES is an international NGO established in 2002 in The Hague, in order to increase political attention to environmental security as a means to help safeguard essential conditions for peace and sustainable development. The IES set up GMACCC in 2009 as part of its programme on Climate Change and International Security.

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