

Climate Change and Environmental Security in the Asia-Pacific Region

J. Scott Hauger, Ph.D.

Introduction: Climate Change and Environmental Security in the Asia-Pacific Region

Increasingly over the last five years, national and international security organizations in the Asia-Pacific region are recognizing global warming as a potential threat to environmental security – and thus as a challenge to national and regional security. Some island nations, including the Maldives¹ and Kiribati,² have concluded that climate change poses an existential threat, as rising sea levels could submerge their low-lying islands. Some larger nations, including Australia³ and the U.S.,⁴ are incorporating issues of climate change in their strategic defense planning in anticipation of a higher rate of humanitarian assistance and disaster relief missions. Their concerns center on forecasts of a growing incidence and severity of climate-related natural disasters such as flooding, tropical cyclones and drought, and the consequent impacts on food, fresh water and infrastructure. Such events, together with their potential impacts on human disease and migration, could pose significant stresses on vulnerable nations with limited abilities and resources to respond to environmental strains.

The likelihood of such events is uncertain. Over the next 20 years (2010-2030), best-case and worst-case scenarios based on projected levels of greenhouse gas (GHG) emissions do not diverge greatly. Current projections, extrapolated from historical observations, suggest a rise in average global temperature of about 1 degree C (2 degrees F) by 2030⁵ and a rise in sea level of about 6 cm (about 2.5 in).⁶ Because of the complexity of the climate system, however, scientists cannot unambiguously or precisely associate these phenomena with future environmental impacts and their human consequences. Moreover, linear extrapolations may not fully account for these phenomena as they will be experienced. Nonetheless, there is broad scientific agreement on the general trend: the extra energy input to the Earth's climate system as a result of global warming is resulting in more extreme weather events, and the impact will increase over time. Because the Earth's atmosphere acts as a reservoir for GHGs, there will be a substantial lag time between effective mitigation and any cooling effect at the Earth's surface, so that present trends and their security implications will continue over the next 20 years and more.

Longer-term impacts of climate change are difficult to predict, and will depend in part on the results of international cooperation to reduce GHG emissions in the interim.⁷ The Intergovernmental Panel on Climate Change (IPCC) working group on impacts, adaptation and vulnerability identifies some specific threats to the Asia-Pacific region. These include increased flooding and declining overall water resources in Asian rivers, coastal and river flooding in heavily-populated mega-delta areas, and reduced food production in central and south Asia. Water security problems will increase in southern and eastern Australia, while sea level rise will threaten small

islands in the Pacific and Indian Oceans.⁸ The working group report concludes that “adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions.” They further state that, although many options for adaptation are available, “... more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change. Existing barriers, limits and costs are not fully understood because they depend on specific, geographical and climate risk factors as well as particular institutional, political and financial constraints.”⁹

Climate Science, Environmental Science and the Security Sector

Climate and environmental scientists are sounding a clear alarm: climate change is likely to pose transnational threats to the security of nations in the Asia-Pacific region and worldwide. Leaders and security organizations across the region are considering and planning to address those threats with a strategic blend of policy initiatives. These include mitigation to reduce the scale of warming, adaptation to cope with the unavoidable impacts of a changing environment, and capacity-building for response to crises that may occur.

Mitigation is largely the concern of the industrial, energy, and transportation sectors. It is the subject of high-profile international negotiations to reduce GHG emissions and the carbon load in the atmosphere. Security organizations with a large carbon footprint can contribute to GHG mitigation. For example, the U.S. Department of Defense has set a goal of 34 percent reduction in facilities’ emissions between 2008 and 2020.¹⁰

Like other sectors, the security sector will have to adapt to emerging climate trends. Changes in polar ice, for instance, will likely impact naval operations. Rising sea levels may pose challenges to coastal area facilities. New patterns of rainfall, flooding, or desertification may impact agricultural systems and could result in long-term demographic changes in some Asia-Pacific nations. The IPCC *Synthesis Report* finds that as a result of climate change, freshwater availability in Asia will decrease in large river basins, while heavily populated, coastal “mega-delta” regions will be at risk from flooding. At the same time, climate change will “... compound the pressures on natural resources and the environment associated with rapid urbanization, industrialisation and economic development.”¹¹ These phenomena will challenge governments in the region and require a whole-of-government approach. As the U.S. Quadrennial Defense Review Report put it, “...climate change will shape the operating environment, roles and missions that we undertake.”¹² It is an assessment that applies to security organizations across the region.

Security organizations typically have major responsibilities in responding to the kinds of natural disasters and humanitarian crises that climate change is expected to exacerbate. In some countries, the military is the only institution with the capacity to respond to a major disaster. Humanitarian assistance and disaster relief (HA/DR) operations are a significant part of the defense mission of

Asia-Pacific nations including the U.S., China, Australia, Japan and the Republic of Korea. An important rationale for such operations is their contribution to security and stability in the affected regions. In the absence of effective planning and action to provide assistance to nations affected by the direct impacts of climate change, it is security organizations that will have the responsibility for coping with the potential social, economic and political consequences of these events to include internal or external migration of climate refugees, disputes over access to water resources, rising food prices, or political instability in nations with inadequate resources to address the additional stresses imposed by climate change.

Meeting the challenges of climate change and security in the 21st century will require leaders and professionals in the security sector to work together with climate scientists, environmental scientists and engineers to develop a high level of understanding of climate change and its impacts over time. Policymakers must be able to pose the right questions to researchers and make good decisions about research funding. The science and technology (S&T) community must learn to communicate their findings to policymakers in a way they can understand and act upon. In the Asia-Pacific region however, networking and knowledge transfer between the S&T and security sectors are still in their early stages of development, especially regarding local knowledge that can support security sector planning for adaptation and response to climate change.

Collaboration Between the S&T and Security Sectors: Global Issues

Research is problem-driven. Issues of climate change, its environmental impacts and their societal impacts present a highly complex and multidisciplinary set of problems that depend in many ways on the needs, the missions and the perspectives of those who articulate the problem. A simplified schematic hierarchy of problems is presented in figure 1 (p. 58). The hierarchy of research questions provides a conceptual framework for understanding the ways in which different knowledge communities approach the problems of climate change. It also provides policy points of departure in terms of where those different communities must interact to frame questions and to share knowledge across professional boundaries.

Scientific communities typically ask the higher level questions in figure 1 and may be associated with the concept of fundamental or basic research. An important stimulus to climate change research, for example, was the work of a chemist, Dr. David Keeling, who developed a device that could accurately measure the atmospheric content of carbon dioxide and, in 1957, installed it at an observatory on top of Mauna Loa in Hawaii. The resulting data, released in 1984, showed that atmospheric carbon was increasing over time, and alerted the scientific world to the threat of global warming.^{13, 14}

Figure 1. A Hierarchy of Climate Change-Related Research Questions

1. What is happening to the Earth's climate and why?
2. What is likely to happen to the climate in the future?
3. What will climatic changes mean for the environment (biosphere)?
4. How will environmental impacts affect the human environment or social order?
5. What can we do to mitigate or adapt to those environmental impacts?
6. What do security organizations need to know to prepare to adapt and respond to those changes?

Global collaboration across S&T communities, with the intention of informing policymaking, was institutionalized four years later in 1988, when the United Nations Environment Program (UNEP) and the World Meteorological Organization established the IPCC. Since 1990, IPCC has issued four reports that synthesize the results of global research related to the physical science aspects of the climate system (Working Group I or WG I), the likely impacts of climate change on natural and socio-economic systems (WG II), and the technological options for mitigating climate change (WG III). Early reports focused on establishing the existence and causes of climate change, and establishing the need for better data to address its impacts. The third report (2001) provided a lengthier consideration of future climate scenarios as climate models improved. The fourth report (2007) continued this trend and provided more substantial consideration of future impacts of climate change on the environment.

IPCC was awarded a share of the Nobel Peace Prize in 2007 after the release of its fourth report. The fifth report is scheduled for release in 2013-2014. Scientists from 22 Asia-Pacific nations are named as lead authors and review editors of this upcoming report, with major representation from China, India, Australia, Japan, Canada, the U.S. and the Russian Federation. All three initial meetings of the global working groups will be held in Asia – China, Japan and the Republic of Korea.¹⁵

In the case of climate change, science has been the spur to policy. The first IPCC report in 1990 led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. Although the convention that took effect in 1994 addressed the mitigation of, and adaptation to, climate change, its activities were largely centered on issues of mitigation. This emphasis was continued in the 1997 Kyoto Protocol that was based on the second IPCC report issued in 1995. The third report, in 2001, informed the seventh Conference of the Parties (to the UNFCCC) in Marrakesh, which supported the world's 49 least developed countries in the preparation of a National Adaptation Programme of Action (NAPA).¹⁶ Between 2005 and 2011, 13 eligible Asia-Pacific nations completed NAPAs, with one still in progress.¹⁷ The fourth report, with its increasing emphasis on the inevitability of global warming and greater confidence in projecting its impacts on the human environment, influenced the 2009 Copenhagen meeting. While failing to establish a mitigation treaty, the meeting nonetheless agreed to develop an adaptation framework.

The 2010 meeting saw the adoption by the parties of the Cancun Adaptation Framework and their commitment to establish a UNFCCC Adaptation Committee to help developing countries formulate their national adaptation strategies and gain access to funds for their implementation, work that was advanced at the 2011 meeting in Durban, South Africa, through the establishment of a Green Climate Fund.

The last 20 years, then, have seen the development of global-level institutions for the synthesis and reporting of climate and environmental research in support of policymaking – first with regards to understanding the phenomenon of global warming and then to mitigating the problem through the reduction or capture of greenhouse gases. More recently, the scope of interest has broadened to include issues of adaptation to the phenomenon of global warming which is thought to be inevitable. This interest in adaptation to climate change at the global level as expressed in Marrakesh, Copenhagen, Cancun and Durban, is helping to promote collaboration between scientists and policy professionals working in the arena of international development in both governmental and non-governmental agencies. Much of the focus of these emerging programs is on improving the resilience of national infrastructures to respond to an anticipated increase in climate-induced natural disasters.

However, progress in adaptation planning and implementation at the national level remains a lagging indicator. As of 2010, total funding of NAPA projects through the Least Developed Countries Fund (LDCF) established in 2001 amounts to \$113 million, with less than \$25 million going to Asia-Pacific countries. As a consequence, the Cancun COP instituted measures to improve the ability of nations to design NAPA strategies and to access the fund.¹⁸ Moreover, nations that are challenged by climate change but are not categorized among the least developed, e.g., Vietnam, Indonesia, Pakistan and the Philippines, must rely more heavily on their own initiative and resourcefulness to develop adaptation strategies.

Collaboration Between the S&T and Security Sectors: National and Regional Issues

Policy communities who have need of science-based information to address an issue (possibly associated with applied research) typically ask the lower level questions in figure 1. Since 2005, a growing number of government agencies and non-governmental organizations (NGOs) concerned with environmentally sustainable economic development are asking questions regarding the potential impacts of climate change in their areas of responsibility. In 2007, for example, drawing on the work of academic researchers, consultants and technical staff, the U.S. Agency for International Development (USAID) published *Adapting to Climate Variability & Change: A Guidance Manual for Development Planners*. The agency identified the manual as the “first of several tools” it is developing to “assist planners and stakeholders as they cope with a changing climate.”¹⁹ That same year, the United Kingdom’s Department for International Development (DFID) and Canada’s International Development Research Center (IDRC) co-funded an Asia-wide review of climate change adaptation research.^{20,21,22}

Various reports acknowledge the novelty of these efforts in adaptation research. For instance, the Chinese Academy of Sciences reports that:

“Scientific research capacity in China is strong. Most research attention continues to be devoted to the effects of climate change, including issues of data collection, modeling and climate forecasting. There is also growing attention to the impacts of forecast changes on ecosystems and biodiversity, and to assessments of aggregate costs of climate change impacts and adaptation. However, adaptation as a specific domain of research effort in China is a new concept.”²³

DFID and IDRC are following up on these recent initiatives. DFID, for example, is including climate change research as one of six agency research areas for the five-year period 2008-2013.²⁴ USAID commissioned a feasibility study for the establishment of an Asian regional Center of Excellence on Climate Change and Development.²⁵ The Japan International Cooperation Agency (JICA), in collaboration with the World Bank and the Asian Development Bank, undertook a study of the impacts of climate change on Asian coastal areas. In December 2010, it published *Climate Change Adaptation and International Development*, which presents case studies of climate change and adaptation in Asia and Africa and considers improvements to the international architecture for climate change adaptation assistance.²⁶

Non-governmental organizations (NGOs) concerned with international development, environmental conservation or humanitarian assistance are playing a seminal role in applied research and synthesis to address issues of environmental and human impacts of climate change and to bring the results to the attention of policymakers and other stakeholders. For example, the Woodrow Wilson Center established its Environmental Change and Security Program in 1994, and since 1997 has managed a China Environment Forum to encourage dialogue on environmental and energy challenges in China. The early work of the Pew Center on Global Climate Change established in 1997 was largely concerned with mitigation and its political and economic impacts. However, since 2004, it has increasingly sponsored projects that consider adaptation.^{27,28}

In some Asia-Pacific nations, NGOs are taking a lead in addressing adaptation and security issues related to climate change. For instance, beginning in 2007, Leadership for Environment and Development (LEAD) Pakistan became the first organization in the country to build a database on climate change and in 2008 partnered with the British High Commission to conduct a scoping study on options for adaptation to and mitigation of climate change. In 2009, LEAD established a Climate Action Program, bringing together senior scientists and policymakers to increase the level of awareness of decision makers in Pakistan, to enhance the national capacity and resources to respond to climate change, and to encourage unified government policy responses to the threat.^{29,30}

Major international foundations have also instituted programs for climate change adaptation. The International Organization for Migration, for example, recognizes migration as a legitimate adaptation strategy to climate change.³¹ In 2008, the Rockefeller Foundation established an Asian Cities Climate Change Resilience Network.³² In 2009, the MacArthur Foundation created a

research program on Climate Change, Environmental Security and Natural Disasters³³ and provided funding to develop an Ecosystems and Livelihoods Adaptation Network, explaining that, “mitigation is a necessary but insufficient response. We can no longer afford to dismiss adaptation as ‘giving in’ or worry that it will reduce incentives for addressing the root causes of climate changes. This creative new network will nurture the emerging field of adaptation science, helping to build knowledge and catalyze new ideas.”³⁴

NGOs, think tanks and quasi-governmental institutions operating in the defense and security sectors are also beginning to synthesize climate change research and apply findings to inform policymakers in the security sector. Notable examples include the influential 2007 report by the Center for Naval Analyses (CNA), *National Security and the Threat of Climate Change*,³⁵ and the German Advisory Council on Global Change (WBGU) 2008 report to the German Federal Government, *Climate Change as a Security Risk*.³⁶ These much-cited reports drew upon the fourth IPCC report and social science research on topics related to environment and conflict to provide the first extensive considerations of climate change and its implications for the security sector.

Organizations in the Asia-Pacific region have followed suit: Drawing upon the German report, the Bangladesh Institute of Peace and Security Studies in 2009 published an issue brief on climate change and security, and in 2010, with support from the MacArthur Foundation, launched a research project on the security impacts of climate change on Bangladesh and South Asia.^{37,38} In 2009, New Delhi’s Institute for Defence Studies and Analyses published a report, *Security Implications of Climate Change for India*, addressing issues of adaptation as well as the impact of climate change on warfighting and on India’s bilateral relations with neighboring countries.³⁹ In 2010, Singapore’s Institute of International Affairs published a conference paper on “Climate Change and Security in the Asia-Pacific for presentation at the 2nd Tokyo Seminar on Common Security Challenges.”⁴⁰

These examples illustrate the point that over the last five years, policy-oriented think tanks and NGOs around the region have increasingly come to play an intermediary role between S&T communities and policy communities on topics related to climate change adaptation. Most of that work has been within the development community with a focus on sustainable development and resilient infrastructure in the face of anticipated climate change. This past five years, however, have seen security organizations in the developed nations framing and posing questions about adaptation and response to climate change.

Collaboration Between the S&T and Security Sectors: Security Organizations

In 2010, both the U.S. Department of Defense and the Department of State issued major policy documents recognizing climate change as a transnational threat. The U.S. State Department’s first *Quadrennial Diplomacy and Development Review* identified climate change as one of six focus areas for U.S. development efforts.⁴¹ These policy documents drew upon a growing body of agency and agency-sponsored research and analysis as well as that of academia, international organizations and NGOs. For instance, in 2007, the U.S. Army War College’s Strategic Studies Institute

conducted a colloquium on national security implications of climate change. The proceedings of the conference include 21 essays that tackle issues of climate science, environmental and human impacts, and military planning in the context of climate change.⁴² In 2009, the U.S. Navy established Task Force Climate Change (reporting to the Chief of Naval Operations), and in 2010, published the first “U.S. Navy Climate Change Roadmap” that focused on the identification of S&T needs to inform naval operations in the context of a changing climate.⁴³ As noted above, in 2009, the Australian national defense strategy addressed issues of climate change and its threat to security in the Asia-Pacific region.⁴⁴ These national level policies are only beginning to show up in planning agendas at lower echelons.

The Chinese government is also responding to climate change issues at the intersection of science and policy. English language resources include a major policy document “China’s National Climate Change Programme” approved by the State Council in June 2007. The program focuses on mitigation but also addresses adaptation, with considerations of agriculture, forestry, water resources, and the threat to coastal zones.⁴⁵ Chinese policy for adaptation to climate change is framed by an economic development perspective, and emphasizes the need for sustainability in development activities. Duncan Freeman argues that climate change has only a marginal position in Chinese security policy, and that China resists the notion that security and climate change are linked.⁴⁶ However, according to a report by China scholar Michael Davison, the Chinese People’s Liberation Army (PLA) created a Military Climate Change Expert Committee in November 2008 to discuss the threat of climate change to military capabilities. The committee suggested strategies for disaster relief missions, and the PLA National Defense University has conducted a preliminary study.⁴⁷

The security dimension of climate change in other Asia-Pacific nations is often less developed and not as readily transparent. For instance, the Bangladesh Climate Change Strategy and Action Plan managed by the Ministry of Environment and Forestries identifies the National Disaster Management Council as a lead agency for responding to climate change. It also identifies a role for the Meteorological Department as well as the National Space Agency that falls under the jurisdiction of the Ministry of Defence.⁴⁸ In Indonesia, an observer with the Centre for Strategic and International Studies notes that the country’s Ministry of Defence had no specific national security agenda for climate change as recently as 2008. After the election of a new president in 2009, however, a strategic defense review and a “Minimum Essential Force” document identified climate change as a potential threat for consideration in developing Indonesia’s strategic security requirements.^{49, 50}

Regional security organizations and conferences are also beginning to serve as forums for knowledge exchange on climate change. In March 2010, for example, the Tokyo-Seminar on Common Security Challenges included a session on “Climate Change and the Role of the Armed Forces.”⁵¹ In April 2010, the leaders of ASEAN issued a statement on climate change in response to the Copenhagen Accord. The statement was in two sections. The first articulated a set of common policies toward GHG mitigation. The second called for regional cooperation in addressing resilience (adaptation) to climate change, including scientific collaboration to determine local

impacts, and cooperative research for food security. The joint statement is written from a sustainable development perspective, and does not address traditional security issues such as humanitarian assistance or disaster relief.⁵² In April 2010, the South Asian Association for Regional Cooperation (SAARC) issued the Thimphu Statement on Climate Change by which its members agreed to a set of 16 actions to cooperate on climate change issues of mitigation and adaptation. It also exhibits a development-focused conceptual framework. Only one of its 16 articles addresses security sector issues: Section (xiv) calls for the establishment of a SAARC Inter-governmental initiative on climate-related disasters to be supported by a SAARC Disaster Management Center.⁵³

One can argue that the securitization of climate change is an emergent issue in the region. Government ministries in the U.S. and Australia and non-governmental or quasi-governmental think tanks in nations including Japan, India and Bangladesh are starting to consider the role of the security sector in adaptation and response to the impacts of climate change. Most documents recognize a need for better science-based knowledge of local impacts to guide policy for climate change adaptation. However, robust institutions for a science-security dialogue are largely notable for their absence.

Collaboration Between the S&T and Security Sectors: Interagency Collaboration

The interface of science and policy at the national level implies an effective mechanism for interagency cooperation that brings together scientific and security agencies. China, for instance, established a National Working Group for Dealing with Climate Change in 1990 and a National Coordination Committee on Climate Change in 1998. The 2007 national climate change program drew upon the committee's *National Assessment Report on Climate Change* (2006), a collaborative effort of nine government departments including the Ministry of Science and Technology, the China Meteorological Administration, the Chinese Academy of Sciences, the State Environmental Protection Administration, the National Development and Reform Commission and the Ministry of Foreign Affairs. The new national policy in turn upgraded the working group to a National Leading Group headed by Premier Wen Jiabao under the jurisdiction of the National Development and Reform Commission.^{54,55,56}

In the U.S., Congress created a U.S. Global Change Research Program in 1990 under the White House Office of Science and Technology Policy. The program coordinates and integrates federal research on changes in the global environment across 13 federal agencies including the Departments of State and Defense. Until recently, the program focused on the fundamental questions of climate science and environmental science at the top of figure 1. But in 2008, the program revised its strategic plan to consider the associated issues of climate change impacts, adaptation, vulnerability and sustainability, as well as decision support to stakeholders.⁵⁷ Interagency consideration of science and policy for adaptation to climate change assumed higher visibility with the establishment of an Interagency Climate Change Adaptation Task Force in 2009, and its charge by the President that agencies should participate actively to develop a domestic and international strategy for adaptation to climate change.⁵⁸ A year later, in its first progress report, the task force established a set of five goals

that included improving the integration of science into decision-making to support adaptation and enhancing efforts to lead and support international adaptation. This goal specifically addressed a need for collaboration among international development, national security and technical support agencies.⁵⁹

The importance of such interagency coordination is underlined by a May 2010 report from the French Institute of International Relations, an NGO, which recommended that Japan should “improve the governance on climate change by enhancing governmental coordination. Lack of intra-governmental communication and cooperation prevents the elaboration of a consistent and coordinated approach to tackle the issue of climate change. A supra-bureaucratic organ should coordinate the different administrations.”⁶⁰

Other Asia-Pacific nations have formed interagency groups to link science and policy. In 2010, Singapore’s Inter-Ministerial Council on Climate Change, established in 2007, was reconstituted as the National Climate Change Secretariat and assigned to the Prime Minister’s Office.⁶¹ Australia took a different approach, creating a cabinet-level Department of Climate Change in 2007 that was recently reorganized as the Department of Climate Change and Energy Efficiency.

Climate change issues are a concern for the whole of society. They engage the energy and transportations sectors on issues of mitigation. They inform economic development as well as the security sectors on issues of adaptation and response. They require the engagement of the research and development sectors for their understanding and solution. Interagency coordination and collaboration will be necessary to effectively address these complex problems. Transnational interagency collaboration through multilateral and bilateral relationships must also be developed to address transnational problems. Sharing of best practices among nations and the development of better practices within and among nations will be an important part of the agenda for the future.

Summary Observations and Conclusions

There can be little doubt that the threat to environmental security of global warming is real and of central interest to security organizations in the Asia-Pacific region and the world. Scientific understanding of the cause and the process of climate change is extensive and growing and provides a knowledge base for national and international efforts to mitigate GHG emissions. Many Asia-Pacific nations are active in fundamental climate and environmental research and participate in the IPCC system. All are engaged in the UNFCCC process. Knowledge sharing on mitigation issues is institutionalized, and security agencies are engaged in meeting national goals for GHG mitigation.

In recent years, especially since the fourth IPCC report in 2007, policymakers across the region are increasingly concerned with problems of adaptation to climate change. NGOs concerned with sustainable development are playing an important role in framing the problems of adaptation to climate change and have an intermediary role in linking the S&T and policy communities. Increasingly, security organizations – at this time primarily defense and foreign ministries in the major developed nations – are starting to anticipate the need to adapt to the impacts of climate

change on human and environmental security and thus on national security and regional stability.

Perhaps most importantly, Asia-Pacific nations are building their capacity to address the security problems associated with climate change. Interagency task forces are bringing together scientists and security professionals at senior levels to foster a whole-of-government approach to the problems of climate change. Multilateral security organizations and conferences are considering issues of adaptation as well as mitigation. Agencies and organizations at the national, regional, and global levels are cognizant of the need for better scientific knowledge of the local impacts of climate change on the physical and social environments.

At this time, the emerging linkages between S&T communities and security communities are most apparent in developed nations at the national agency level, with a focus on issues of adaptation. Many less developed countries do not appear to be well-engaged in research and planning for adaptation to climate change. Sub-national-level actors who will typically be tasked with responding to chronic or acute security impacts of climate change are not transparently engaged in formulating the questions for research. Nor are the pathways for knowledge transfer fully developed.

As the security sector develops plans for adaptation and considers planning for response to the impacts of climate change, there is an emerging need for more robust institutions to support a broader and deeper dialogue between S&T and security communities. Security practitioners should develop questions to task research communities and then work together to develop requirements and approaches to respond to the stresses imposed by climate change. Multinational forums should seek to develop common frameworks for addressing security problems in response to climate change. A corresponding need exists for sharing research, knowledge transfer, and problem assessment between developed and developing nations.

Notes

1. Mohamed Latheef, "Climate Change and the Maldives: Adaptation, Mitigation, and Innovation" (speech to the United Nations General Assembly, 2007), <http://www.un.org/ga/president/61/follow-up/climatechange/statements/statementMaldives.pdf>.
2. "Kiribati Seeks Relocation as Climate Change Sets In," *Solomon Times Online*, Feb 16, 2009, <http://www.solomontimes.com/news.aspx?nwID=3584>.
3. Australia Department of Defence, *Defending Australia in the Asia Pacific Century: Force 2030* (2009): 39-40, http://defence.gov.au/whitepaper/docs/defence_white_paper_2009.pdf.
4. U.S. Department of Defense, *2010 Quadrennial Defense Review Report* (February 2010): 84-88, http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf.
5. "How Much More Will Earth Warm?," *Earth Observatory* (U.S. NASA: 2008), <http://earthobservatory.nasa.gov/Features/GlobalWarming/page5.php>.
6. "The Rising Sea Level," *Earth Observatory* (U.S. NASA: 2008), <http://earthobservatory.nasa.gov/IOTD/view.php?id=6638>.

7. Susan Solomon et al., “Technical Summary,” *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2007): 70.
8. Martin L. Parry et al., “Summary for Policymakers,” *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2007): 13-15.
9. Ibid., 19.
10. U.S. Department of Defense, *Strategic Sustainability Performance Plan* (Public Version), August 26, 2010, 1-12, http://www.acq.osd.mil/ie/download/green_energy/dod_sustainability/DoD%20SSPP-PUBLIC-26Aug10.pdf.
11. Allali Abdelkader et al., “Climate Change 2007: Synthesis Report,” <http://www.ipcc.ch/>, 50.
12. U.S. Department of Defense, *2010 Quadrennial Defense Review Report*, 84.
13. Justin Gillis, “A Scientist, His Work and a Climate Reckoning,” *New York Times*, December 21, 2010, 1. <http://www.nytimes.com/2010/12/22/science/earth/22carbon.html?scp=6&sq=Justin%20Gillis&st=cse>.
14. “40 Years of Mauna Loa CO2 Data from Keeling,” Oak Ridge National Laboratory (1998), http://cdiac.ornl.gov/new/keel_page.html.
15. Information on lead authors is available at the IPCC website: http://www.ipcc.ch/meetings/session32/inf07_p32_ipcc_ar5_authors_review_editors.pdf. Information on future author meetings may be found at <http://www.ipcc.ch/>.
16. United Nations Environment Programme [undated]. “National Adaptation Programmes of Action (NAPAs) under the Climate Change Convention,” <http://www.unep.org/DEC/OnLineManual/Compliance/NegotiatingMEAs/NationalImplementationPlans/Resource/tabid/627/Default.aspx>.
17. The 13 are Bangladesh (2005), Bhutan (2006), Cambodia (2007), Kiribati (2007), Laos (2009), Madagascar (2006), Maldives (2008), Nepal (2010), Samoa (2005), Solomon Islands (2008), Tuvalu (2007), Vanuatu (2007) and Timor-Leste (2011). Burma is in progress.
18. Global Environment Facility, “Least Developed Countries Fund” (2010), <http://www.thegef.org/gef/ldcf>.
19. U.S. Agency for International Development. *Adapting to Climate Variability and Change: A Guidance Manual for Development Planning* (August 2007), http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf.
20. Bernadette P. Resurreccion et al., “Climate Change in Asia: Knowledge Gaps and Research Issues in South East Asia,” ISET-International and ISET-Nepal, June 2008, http://www.preventionweb.net/files/8126_ClimateAdaptationSEASep081.pdf.
21. “Climate Adaptation in Asia: Knowledge Gaps and Research Issues in South Asia,” ISET-International and ISET-Nepal, September 2008, <http://www.preventionweb.net/english/professional/publications/v.php?id=8125>.
22. “Climate Adaptation in Asia: Knowledge Gaps and Research Issues in China,” ISET-International and ISET-Nepal, September 2008, http://www.preventionweb.net/files/8127_ClimateAdaptationCHINASep081.pdf.
23. Ibid., 3.
24. Department for International Development, *Research Strategy 2008-2013* (U.K.), http://www.dfid.gov.uk/r4d/PDF/Outputs/consultation/DFID_ResearchStrategy2008LOWRES.pdf.
25. Tetra Tech Inc., “Asia Regional Center of Excellence on Climate Change and Development (ARC): Feasibility Assessment,” June 1, 2010.
26. Ryo Fujikura and Masato Kawanishi, eds., *Climate Change Adaptation and International Development: Making Development Cooperation More Effective* (London: Earthscan, 2010).

27. William Easterling, Brian Hurd and Joel Smith, *Coping with Global Climate Change: The Role of Adaptation in the United States* (Pew Center on Global Climate Change: June 2004), http://www.pewclimate.org/global-warming-in-depth/all_reports/adaptation.
28. Joel B. Smith et al., *Adapting to Climate Change: A Call for Federal Leadership* (Pew Center on Global Climate Change, April 2010), <http://www.pewclimate.org/publications/report/adapting-to-climate-change-call-for-federal-leadership>.
29. “Changing Climates: Pakistan’s Options for Adaptation and Mitigation,” *Lead Update*, February 22, 2008, www.lead.org.pk/cc/attachments/Seminars_Conferences/4_BHC_PSH/BHC_PSH_Update.pdf.
30. LEAD Pakistan, “Climate Action: The Challenge of our Times,” Program brochure (2009), www.lead.org.pk/attachments/brochure/L-CAP_brochure.pdf.
31. International Organization for Migration, “Migration, Climate Change and the Environment,” July 16, 2011, <http://www.iom.int/jahia/Jahia/pid/2068>.
32. ISET, “Asian Cities Climate Change Resilience Network (ACCRN): Responding to the Urban Climate Challenge,” (Boulder, CO: ISET, 2009), http://www.rockefellerfoundation.org/uploads/files/2d4557bc-6836-4ece-a6f4-fa3eda1f6c0c-accrn_cop15.pdf.
33. “MacArthur Asia Security Initiative, Cluster 3: Internal Challenges” (2009), <http://www.asicluster3.com/index.php?page=climatechange>.
34. “New \$2 Million Network to Help Threatened Ecosystems and Societies to Adapt to the Impact of Climate Change,” MacArthur Foundation Press Release, February 3, 2009, <http://www.macfound.org/atf/cf/%7Bb0386ce3-8b29-4162-8098-e466fb856794%7D/CLIMATECHANGE-PR-090203.PDF>.
35. The CNA Corporation. *National Security and the Threat of Climate Change* (Alexandria, Virginia: The CNA Corporation, 2007), <http://www.cna.org/sites/default/files/news/FlipBooks/Climate%20Change%20web/flipviewerxpress.html>.
36. German Advisory Council on Global Change. *Climate Change as a Security Risk* (London: Earthscan, 2008).
37. Bangladesh Institute of Peace and Security Studies, “Climate Change and Security: The Security Dimensions of Climate Change,” *Issue Brief 7* (2009), <http://www.bipss.org.bd/index.php/page/issue-brief>.
38. Bangladesh Institute of Peace and Security Studies, “BIPSS Launches Major Regional Climate Change and Security Research Project,” press release, 2009.
39. IDSA Working Group. *Security Implications of Climate Change for India* (New Delhi: Academic Foundation, 2009).
40. Simon Tay and Phir Paungmalit, “Climate Change and Security in the Asia-Pacific,” March 26, 2010, <http://www.siaonline.org/?q=research/publications/climate-change-and-security-in-asia-pacific>.
41. U.S. Department of State, *2010 Quadrennial Diplomacy and Development Review*, x and 12, <http://www.state.gov/documents/organization/153142.pdf>.
42. Carolyn Pumphrey, ed. *Global Climate Change: National Security Implications* (Carlisle, PA.: Strategic Studies Institute, 2008), <http://www.strategicstudiesinstitute.army.mil/pubs/download.cfm?q=862>.
43. U.S. Navy Task Force Climate Change, “U.S. Navy Climate Change Roadmap” (April 2010), www.navy.mil/navydata/documents/CCR.pdf.
44. Australia Department of Defence, “*Defending Australia in the Asia Pacific Century: Force 2030*” (2009), http://defence.gov.au/whitepaper/docs/defence_white_paper_2009.pdf.
45. People’s Republic of China, National Development and Reform Commission, “China’s National Climate Change Programme,” June 2007, www.cchina.gov.cn/WebSite/CCChina/UpFile/File188.pdf.
46. Duncan Freeman, “The Missing Link: China, Climate Change and National Security,” *BICCS Asia* 5, no. 8 (2010): 2.

47. Michael R. Davidson, "Seminar on Post-Copenhagen Climate Change Cooperation," in a Summary of a talk entitled, "Sino-American Military Cooperation on Emerging Climate Threats," August 13, 2010, <http://ewinds.wordpress.com/category/chinal/>.
48. Republic of Bangladesh Ministry of Environment and Forests, *Bangladesh Climate Strategy and Action Plan* (September 2008): 36, <http://www.sdnbd.org/moef.pdf>.
49. Evan A. Laksmana, "Climate Change Is also a Defense and Security Problem," *The Jakarta Post*, November 2, 2009, www.thejakartapost.com/print/234094.
50. Evan A. Laksmana, "Indonesia's National Defence Forces: Recent Strategic Changes and Implications," *RSIS Commentaries*, August 26, 2010, www.rsis.edu.sg/publications/Perspective/RSIS1012010.pdf.
51. "The Second Meeting of Senior Defense Officials on Common Security Challenges in the Asia-Pacific Region," *Japan Defense Focus 18*, August 2010, www.mod.go.jp/e/jdf/no18/special.html.
52. ASEAN, "ASEAN Leaders' Statement on Joint Response to Climate Change," Press Statement, April 9, 2010, www.aseansec.org/24515.htm.
53. <http://www.saarc-sec.org/2010/04/29/news/Thimphu-Statement-on-Climate-Change/23/>.
54. People's Republic of China State Council Information Office, "White Paper: China's Policies and Actions on Climate Change," October 29, 2009, www.chinaenvironmentallaw.com/wp-content/uploads/2008/10/china-white-paper-climate-change.doc.
55. Joanna I. Lewis, "China's Climate Change Strategy," *China Brief* 7, no. 13 (June 24, 2007). http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews%5Btt_news%5D=4263&tx_ttnews%5BbackPid%5D=197&no_cache=1.
56. Gregory C. Chow, "China's Environmental Policy: A Critical Survey," CEPS Working Paper No. 206 (April 2010), <http://www.princeton.edu/~gchow/CEPS206China's%20Environ%20Policy.pdf>.
57. U.S. Climate Change Science Program. *Revised Research Plan for the U.S. Climate Change Science Program* (May 2008), <http://www.climatechange.gov/Library/stratplan2008/CCSP-RRP-FINAL.pdf>.
58. *Federal Register* 74 no. 194, October 8, 2009.
59. U.S. White House Council on Environmental Quality, "Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy," October 5, 2010, <http://www.whitehouse.gov/sites/default/files/microsites/ceq/Interagency-Climate-Change-Adaptation-Progress-Report.pdf>.
60. Celine Pajon, "Japan's Ambivalent Diplomacy on Climate Change," IFRI Health and Environment Reports No. 5, May 2010, http://www.ifri.org/downloads/japanambivalentdiplomacyonclimatechange_1.pdf.
61. "National Climate Change Secretariat to Be Strengthened," *Channelnewsasia.com*, March 12, 2010, www.channelnewsasia.com/stories/singaporelocalnews/view/1043155/1.html.