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Sustaining Security

How Natural Resources Influence National Security

By Christine Parthemore with Will Rogers

Center for a New American Security

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Cover Image
U.S. Air Force Staff Sgt. Richard Robison, assigned to the Nangarhar Agri-Business Development Team at Forward Operating Base Finley-Sheilds, Afghanistan, provides security during an agricultural assessment operation in Nangarhar province May 2009.

(Staff Sgt. Shawn Weismiller/USAF)

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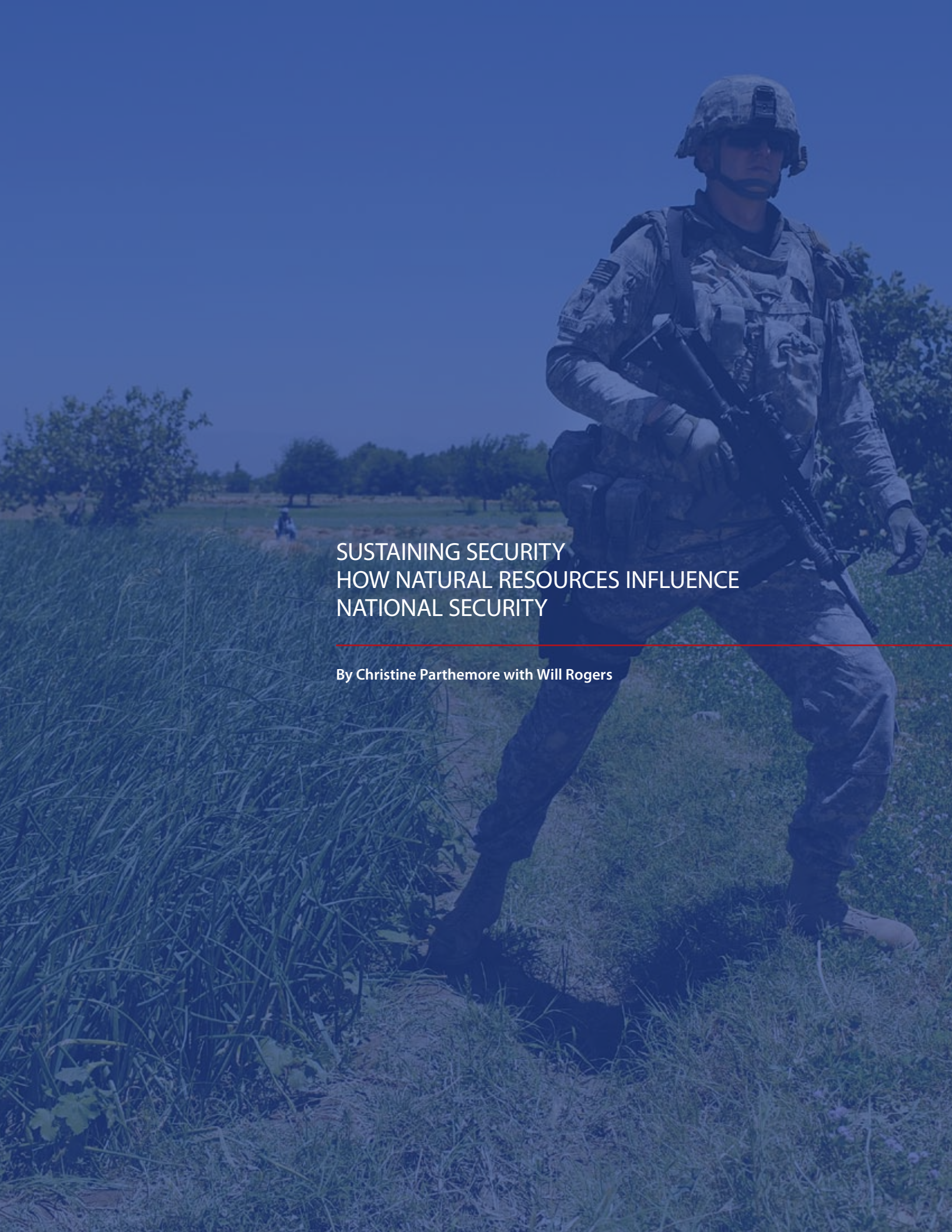


SUSTAINING SECURITY
HOW NATURAL RESOURCES INFLUENCE NATIONAL SECURITY

By Christine Parthemore with Will Rogers

"Over the next 20 years and more, certain pressures – population, resource, energy, climate, economic and environmental – could combine with rapid cultural, social and technological change to produce new sources of deprivation, rage and instability... [O]verall, looking ahead, I believe the most persistent and potentially dangerous threats will come less from ambitious states than failing ones that cannot meet the basic needs – much less the aspirations – of their people."

— Robert F. Gates, Remarks to the U.S. Global Leadership Campaign (July 15, 2008)

I. EXECUTIVE SUMMARY

By Christine Parthemore with Will Rogers

In the 21st century, the security of nations will depend increasingly on the security of natural resources, or "natural security." The global economy, developing countries and local economies throughout the world all rely on the availability of potable water, arable land, fish stocks, biodiversity, energy, minerals and other renewable and nonrenewable resources to meet the rising expectations of a growing world population. Yet the availability of these resources is by no means assured.

Stable and sustainable natural resource supplies influence an array of U.S. security and foreign policy interests. In Afghanistan, which derives 50 percent of its GDP from agriculture and ranching, frequent droughts in combination with unsustainable land use and deforestation have put 75 percent of land area at risk of desertification. Water scarcity and pollution reduce Pakistan's irrigation capabilities and agricultural productivity. Yemen, often cited as a potential safe haven for terrorists, is at risk of complete environmental collapse as both its water and oil reserves decline. The loss of Mexico's forests and fisheries has long influenced economic stability and internal security dynamics. The Somali government's inability to rein in illegal fishing and enforce regulations has contributed to the pernicious piracy that has drawn an international military response in the Gulf of Aden. Not all natural resource pressures carry consequences for national security, and many countries possess the means to meet their resource needs and to adjust to any deficiencies. However, in cases like those noted above, natural resources are closely intertwined with political stability and security.

The national security community is not yet well attuned to these challenges, in part because it lacks a common framework for considering natural resources in day-to-day operations. There is a particularly weak understanding of the role of *renewable* resources in promoting U.S. security interests. We recommend that national security

officials take two complementary approaches to better integrate resource concerns into their work.

First, a **targeted approach** would consider the role that natural resource degradation plays in specific geographic areas, particularly in current or potential zones of conflict. When taking this approach, analysts should assess how natural resource conservation could ameliorate drivers of conflict and assist the national security community in addressing current or potential instability in the near term.

Second, a **systemic approach** would consider the interconnection of natural resources and their broad strategic consequences. For instance, food and land use, hydrological and forest systems, energy and climate change are all tightly interrelated, and to address any one of them carries implications for the others, as well as for economic development, politics and national security. Analysts taking a systemic approach must look regionally or globally and consider the potential impact of conservation and environmental restoration in bolstering traditional security strategy.

Overall, the realm of natural security is one of missed opportunities and untapped potential. Seizing these opportunities will require better means of sharing knowledge as well as more networked institutions. The national security community should:

Form a natural security community. Government officials, NGOs, experts and scholars who understand the connection between resources and security should strive to form a natural security community by fostering networking, sharing advice, developing new concepts and better leveraging their available tools to meet U.S. national security goals.

Integrate natural security in U.S. plans and institutions. The U.S. government can improve how it manages and highlights natural security issues, by better incorporating these subjects into planning documents and processes, leveraging the country's civilian capacities in the Departments of State, Interior and Agriculture and other agencies, forming cooperative partnerships and academic grants to help ensure that non-governmental activities still align with U.S. interests and incentivizing private industries to promote conservation as it impacts national security.

Create a natural security index. A non-governmental consortium of conservation and security professionals should create a natural security index in order to provide a tangible, easily understood quantification of what natural security means and where the U.S. government and its partners should place greatest attention.

It is time for the national security community to recognize the growing importance of resource degradation to national interests. The stakes are clear: In many countries and regions with high significance for U.S. security and foreign policy interests, environmental degradation could directly undermine economic and political goals; conversely, preventing or remediating that degradation could serve as a valuable way of bolstering security. Ultimately, expanding the definition of national security to include the threats addressed here is not a matter of choice. This change is inevitable. But nations can choose either to react to such change as it happens or to shape the way such change unfolds and to prepare the best possible response.

II. INTRODUCTION: WHAT IS NATURAL SECURITY?

The security of nations depends increasingly on the security of natural resources, or "natural security." Local communities, as well as the economies of key nations and critical regions, rely on the availability of potable water, arable land, fish stocks, biodiversity, energy, minerals and other renewable and nonrenewable resources to meet the rising expectations of a growing world population. Natural resources contribute directly to the economic development and stability of countries; hundreds of millions of people depend directly on agriculture, fishing and other resources for their livelihoods. According to the World Bank, geography and natural resources are key variables in the ability of countries to benefit from the increasingly integrated global marketplace.

Reliable and sustainable supplies of natural resources are by no means assured. As population growth continues to rise and more nations continue down the path to development, natural resources are likely to come under increasingly severe strain, and this strain can harm economies and individuals. Much of the world's population depends directly on natural resources for its livelihood. Today almost 70 percent of the world's poor live in rural areas that depend on agriculture. About 30 percent of the world's population – two billion people – use fuelwood or other natural biomass as their main source of energy.[1] These pressures can lead to instability and conflict if not addressed and abated.

The national security community is not yet well attuned to these challenges. Given the importance of supply chains to industry and the defense base, the national security community pays due attention to nonrenewable resources such as oil and minerals. Commodities prices for fossil fuels, minerals and metals attract substantial media attention. Though ensuring reliable and affordable supplies can seem taxing, the challenges surrounding nonrenewable resources are generally well defined and provoke well-considered national security debates. Less well considered in traditional security studies, however, are issues surrounding renewable resources, including water, forests and fish stocks and the consequences of accelerating natural resource consumption, biodiversity loss and climate change. This report focuses on these resource challenges and what they mean for U.S. national security.

With some notable exceptions, renewable natural resources have reliably supplied human communities throughout history, with their reliability stemming from sustainable use, low population levels or both. But now these renewable resources are being depleted faster than nature can replenish them. When watersheds are destroyed, or fisheries overfished to the point of exhaustion, or forests denuded and soils eroded, as is happening all over the world, nature can no longer provide the natural resource-based incomes or food and water sources it once did. Renewable natural resources exist in a living system – an ecosystem – in which the health of natural resources is deeply interlinked. Thus the loss of one renewable resource can damage other resources. (Fortunately, the converse is also true: The protection of one renewable resource can often benefit other resources.) For example, when an upland forest is lost – the soils of which act like a sponge holding and releasing water throughout the year – nearby rivers may fill with silt and eventually run dry. Human societies, as part of these ecosystems, are subject to the same principle: When coastal fisheries are overfished and disappear, for example, fishing communities typically migrate to other areas. Migration is itself not inherently problematic, but it can create major societal or environmental stress, depending on resource stress in neighboring areas and its interaction with other economic, social and political factors.

Ensuring a stable and sustainable resource base carries wide benefits for the international community, but an array of specific U.S. security and foreign policy interests are also at stake. The United States has immediate security goals that depend in part on sustainable and productive agriculture in Afghanistan benefitting that country's economy. Yemen, often cited as a high terrorism concern, is at risk of complete environmental collapse. Protecting fragile natural resources, such as Indonesia's tropical rainforests, will be a key facet of the emerging U.S. strategic partnership with Indonesia. The United States, as the top world consumer per capita of many of the world's most traded resources, is coming under increasing pressure to meet its own needs in a more sustainable way. Not all natural resource pressures carry consequences for national security, as many countries will possess the means to meet their resource needs and to adjust to any deficiencies. However, in cases like those noted above, natural resources are closely intertwined with political stability and security.

Ensuring a stable and sustainable resource base carries wide benefits for the international community, but an array of specific U.S. security and foreign policy interests are also at stake.

Environmental vulnerabilities can also serve as opportunities for positive engagement – including with foreign militaries, even when they are not the primary actors in conservation efforts. Military-to-military engagement, in the form of cooperation and combined training exercises around natural resource protection, can help achieve conservation goals and bolster a state's enforcement capacity of protected areas, especially in policing poachers and stopping illegal fishing in countries' territorial waters. U.S. Africa Command (USAFRICOM), the U.S. Navy and the U.S. Coast Guard have been actively engaged in West Africa, for example, conducting training exercises around fisheries protection.[2] "Fishing stocks represent a significant natural resource for African coastal communities," said Ambassador Mary C. Yates, then civilian deputy at USAFRICOM. But most of these coastal nations "lack adequate maritime resources to enforce," Yates said. Though the U.S. military is not practicing conservation directly, it is contributing to these goals by helping to develop the host government's capacity to do so.

While these types of issues will at times require the attention and involvement of the Department of Defense (DOD), depending on circumstances and U.S. security goals, DOD's own leaders have reminded us consistently that security is broader than military issues and homeland defense. It follows, then, that if security threats are not always military in nature, military operations are not the only means to achieve security, a point Secretary of Defense Robert Gates has made repeatedly – including explicitly as regards natural resources. "The challenges confronting our nation cannot be dealt with by military means alone," Gates noted in May 2009. "They require instead whole-of-government approaches."[3] Writing in *Foreign Affairs*, Secretary Gates noted that:

> The most likely catastrophic threats to the U.S. homeland…are more likely to emanate from failing states than from aggressor states. The kinds of capabilities needed to deal with these scenarios cannot be considered exotic distractions or temporary diversions. The United States does not have the luxury of opting out because these scenarios do not conform to preferred notions of the American way of war.[4]

Despite the importance of natural security to American interests, the U.S. national security community lacks the institutions and a common framework for conceptualizing these issues. American government agencies that manage natural resource issues often focus on specific types of resources (most often energy), and these structures normally change within and between presidential administrations. Work both within and outside of the federal government to promote natural security may be disconnected from related national security goals. No community consistently promotes U.S. natural security interests or watches for opportunities to leverage the sustainable use of natural resources to promote national security objectives.

Overall, the realm of natural security is one of missed opportunities and untapped potential. Seizing these opportunities will require a better means of sharing knowledge as well as more networked institutions. Ensuring natural security will also require better leveraging the country's civilian capacities in the Departments of State, Interior and Agriculture and other agencies to promote security, stability and development – tools that, according to U.S. military and political leaders, are often unused or underused.

III. PROMOTING NATURAL SECURITY

According to an analysis by the United Nations, at least 11 violent conflicts since 1990 have been fueled in part by the degradation of renewable natural resources.[5] While this is a concern in itself, the incidence of resource-driven conflicts may only grow if natural resources become scarcer over time, commensurate with population growth and unsustainable patterns of development. As the global population steadily climbs toward a projected nine billion in 2050 and global levels of consumption increase dramatically,[6] this growth is increasing demand for natural resources and putting unprecedented pressure on the global natural resource base. How we define security must account for these factors, and efforts to ensure U.S. interests must also address natural resource degradation.

Of course, the natural resource trends discussed in this report are not by themselves threats. Natural resource degradation does contribute to poverty, migration, resource competition, weak social institutions and other trends that more directly feed intrastate conflicts such as ethnic clashes and insurgencies in developing countries. However, scholars since the end of the Cold War have suggested that these variables are complex and the progression from natural resource scarcity to conflict is far from inevitable. Societies can and do avoid what one scholar calls "demographic and environmental stress" as a partial cause of conflict. Countries with higher levels of political inclusivity and lower levels of ethnic, religious or other social divisions can more easily take action to overcome such stresses.[7] But in states with many social divisions, where some groups are not included in decision making, natural resource degradation can play a larger role in creating the conditions for civil conflict: instability and weakened states that can undermine regional stability, affect trade and cause refugee and other humanitarian crises that sap the military, civilian and financial resources of developed countries.[8]

One military scholar has characterized natural resource scarcity as one of a handful of systemic vulnerabilities that, left unaddressed, have the potential to combine and intensify over time, creating intractable security threats that defy traditional security responses (e.g., a military response akin to conventional combat operations).[9] Security forces may struggle to respond adequately to ethnic violence, for example, or highly asymmetrical attacks by small groups of insurgents. It is difficult to know exactly what role natural resource degradation plays in these types of conflicts, but it is plausible that they could become a more important factor as natural resource scarcity worsens.

These types of conflicts and instabilities might never be as conspicuous as interstate wars, but they could seriously compromise the security of the United States and its allies. Resource-related civil conflict and instability particularly affect developing nations because local communities and groups depend to such a great extent on natural resources for their economic growth and, often, subsistence. Additionally, developing countries sometimes lack political and social institutions resilient enough to cope with these challenges.

Addressing Natural Security Challenges

Consistent consideration of natural resources concerns as part of security analysis, decision-making and action will require a better understanding of how resources affect economic, political and security trends. To promote this understanding, we propose two approaches to thinking about how renewable natural resources may intersect with security. These categories are not mutually exclusive, and they may overlap when applied to specific security challenges.

A **targeted approach** considers the role that natural resource degradation plays in specific geographic areas, particularly in current or potential zones of conflict. When taking this approach, analysts assess how natural resources conservation could ameliorate drivers of conflict and assist the national security community in addressing current or potential instability in the near term.

A **systemic approach** considers the interconnection of natural resources and the broad strategic consequences at stake. For instance, food and land use, hydrological and forest systems, energy and climate change are all tightly interrelated, and to address any one of them carries implications for the others, as well as for economic development, politics and national security. Analysts taking a systemic approach would look regionally or globally and incorporate the potential impact of conservation and environmental restoration into traditional security strategy. To take such a systemic approach therefore involves the acceptance of a broader definition of national security.

In most cases, the policies and work necessary to improve natural security would stem from multidisciplinary, collaborative methods involving experts in foreign policy, national security, natural resources issues, development, diplomacy and regional affairs. It is worth underscoring that in considering the relationship between renewable resources and security, we do not automatically assume that it is the responsibility of the U.S. military to address these issues.

THE TARGETED APPROACH

The targeted approach should be considered in situations in which there is a clear need to act and in which results will be clear and immediate. With this approach, security practitioners and their counterparts would consider immediate environmental and resource-related vulnerabilities and how to turn them into opportunities for improving conditions in current "hot" or potentially hot conflicts. In these cases, natural resource conservation efforts could *directly and immediately* serve as tools for increasing security or stabilization by:

Supporting economic development. A durable peace often requires the provision of basic economic services and the ability of communities or social groups to secure their economic livelihood. In most regions of the developing world, such services and economic development depend on a sound natural resource base.

Strengthening local political and social institutions. Conservation efforts often require financial and political investments in local institutions, and can help build legitimacy and trust among local populations that often see direct benefits from conservation. These investments can strengthen existing political institutions that may be struggling to establish credibility, or develop new cooperative institutions such as water management boards and timber management councils, which can bolster governance in regions critical to U.S. interests.

Contributing to reconciliation through cooperation and confidence-building. The need to manage shared natural resources can be an effective means to initiate dialogue, develop cooperative approaches and build trust and confidence between adversaries or potential adversaries. The opportunity is available both pre- and post-conflict – that is, as a means to prevent conflict as well as to restore peace once conflict is over. It is relevant to intrastate conflicts as a mechanism among competing groups, as well as to interstate conflicts among competing nations.

Conservation efforts can directly align with counterinsurgency doctrine as it has been employed in Iraq and the Philippines. For this reason, Afghanistan and Pakistan provide opportunities for the use of the targeted approach (see pages 12-13). Similar to the population-centric approach of counterinsurgency, conservation efforts often require the support of local communities and aim to accommodate their needs and interests (as opposed to focusing on the interests and desires of central or federal governments). Both conservation and counterinsurgency work often involve supporting economic development, creating jobs, strengthening civic institutions and empowering local people to maintain control of their own villages and towns. In both counterinsurgency and conservation efforts, success is contingent on the cooperation, security and work of local residents rather than solely on a central government or U.S. forces. The emphasis in both cases is sustainable security in the absence of a direct U.S. role and leaving an area secure and resilient.

Consistent consideration of natural resources concerns as part of security analysis, decision-making and action will require a better understanding of how resources affect economic, political and security trends.

THE SYSTEMIC APPROACH

A systemic approach involves broad consideration of how natural resources connect with and affect one another, and how environmental systems then affect U.S. political, economic and security interests. Unlike localized cases in which the targeted approach is appropriate, in some cases addressing single resource problems – for example, assisting Pakistan in boosting its clean water availability – will be inadequate for advancing U.S. interests because the resource challenges at hand are so intertwined.

Afghanistan and Pakistan: The Targeted Approach

President Obama's March 2009 strategic review of Afghanistan identified "sustainable economic development" – specifically "restor[ing] Afghanistan's once vibrant agriculture sector" – as a major ingredient in America's overall effort to sap the strength of the insurgency. Indeed, as the president noted, "It's cheaper…to help a farmer seed his crops than it is to send our troops to fight."[10] However, the effects of environmental degradation have been devastating for the people of Afghanistan and Pakistan – and will confound long-term U.S. goals in the region unless addressed.

Overstocking and overgrazing in Pakistan contribute to exposed soils which can lead to erosion from wind and water and affect livelihoods.

(STOCKXCHNG.COM)

AFGHANISTAN

Land: Fifty percent of Afghanistan's GDP is derived from agriculture and ranching. However, frequent droughts, in combination with unsustainable land use and deforestation, have put 75 percent of Afghanistan's land area at risk of desertification.[11]

Forests: Approximately 70 percent of Afghanistan's forests have already been cleared – including pistachio, almond and juniper trees that once provided incomes for rural communities. If deforestation continues at the present rate, it is estimated that all of Afghanistan's remaining forests could be lost within the next three decades.[12] Not only does deforestation increase the susceptibility of land to erosion and desertification, it also increases the vulnerability of rural populations to natural disasters such as floods and landslides.[13]

Water: Only 31 percent of the population has access to safe drinking water. Most of the water available in urban areas is polluted with effluents from industries and households, with a lack of proper sewage treatment as a major contributor to water quality degradation. By 2012, it is estimated that the groundwater resources supplying Kabul will be unable to cope with increased demand from refugees fleeing environmental degradation in rural areas.[14]

Minerals: Afghanistan holds reserves of minerals such as copper and granite. Improved mining methods could increase the economic prospects of many villages – and indeed, if the United States and its allies can assist with improving the country's mining sector, some analysts indicate that it could reap benefits for the U.S. counterinsurgency campaign.[15]

PAKISTAN

Land: Soil erosion from the destruction of natural vegetation and overgrazing exacts a large economic toll on the country. Some of Pakistan's poorest communities rely on rangelands and are especially vulnerable to environmental degradation and natural disasters such as droughts and floods. Overstocking and overgrazing result in soil compaction and extensive vegetation removal, which exposes soils and leads to erosion from wind and water. It is estimated that 85 percent of the country's rangeland has been degraded.[16]

Water and Land: Given that Pakistan is one of the most water-stressed countries in the world,[17] in many ways economic and even political stability in the country are directly related to irrigation. With the world's largest irrigation system,[18] a staggering 80 percent of all

Pakistan's cropland is irrigated.[19] Any reduction in this land's productivity will have a significant impact on the country's economic growth as well as on food availability. Poor management practices throughout the country have resulted in 40 percent of irrigated cropland becoming water-logged and 14 percent saline. Because water availability is highly inconsistent, farmers irrigate crops when water is available, even if the crops do not need it, which leads to over-watering, decreased crop productivity, degraded soil quality and increased water scarcity. More than one-quarter of irrigated land in Pakistan is highly degraded due to salinity, which costs the economy almost a percentage loss in GDP every year.[20] To paint a picture of the importance of these factors, 25 percent of Pakistan's GDP comes from agriculture, which employs two-thirds of the country's labor force and accounts for 80 percent of exports.[21] Pakistan has already experienced food riots over drought-induced grain shortages.[22]

Forests: Deforestation rates are 10 times the regional average.[23] Between 1990 and 2005, Pakistan lost almost 25 percent of its forest area.[24] Studies suggest that at current rates of deforestation, Pakistan's forests will be completely gone within 30 years.[25] Forests provide fuelwood, grazing land, watershed protection, soil conservation and revenue for the government; all of these uses will be lost if deforestation continues unabated.[26]

Energy: Pakistan suffers from major energy supply issues, which lead to frequent power outages and regulations limiting electricity use. This has the effect of dampening economic output and has sparked riots on several occasions.[27]

THE BIG PICTURE

A 2009 U.N. Environment Programme report found that most of Afghanistan's natural resources are severely degraded and that any agricultural recovery would depend on restoration of these resources.[28] Of the 28 million people in Afghanistan, 80 percent live in rural areas and are directly dependent on land, forests, groundwater and other natural resources for their livelihoods and their survival.[29] Three decades of violent conflict in the country have led to the weakness or collapse of most national and local institutions. In their absence, natural resources were mismanaged and overexploited, causing severe degradation of the environment including soil erosion, desertification, deforestation and water scarcity and contamination.[30]

For Pakistan, policy reviews in both the Bush and Obama administrations have identified economic growth and rural job creation as key components of building political stability and blunting the influence of extremists.[31] And yet accelerating natural resource degradation threatens the prospects for both economic growth and rural job creation in the country. Rapid population growth in Pakistan – 2 percent per year – is increasing the demands on the country's natural resource base. Deforestation, soil erosion, desertification, pollution and fresh water scarcity are already estimated to cost Pakistan approximately 6 percent of GDP annually. The economic loss falls most heavily on the poorest communities. Over 60 percent of the population is rural and directly dependent on natural resources including agricultural land, rangelands, water and forests.[32]

Luckily, there are many ways for the United States and its allies to assist Afghanistan and Pakistan in addressing these problems. Some of this important work has already begun. In 2005-06, USAID initiated a program to strengthen the capacity of government and other stakeholders to improve biodiversity conservation and natural resources management in three areas of biological significance. The Wakhan Corridor contains some of the last pristine wildlife populations and habitats in Afghanistan. The Hazarajat Plateau is home to the Ajar Valley Wildlife Sanctuary and the lakes of Band-e Amir. The Eastern Forests complex has the last remaining arid conifer woodlands in the country, important for economic development. The Wildlife Conservation Society is conducting surveys of the biodiversity in these regions and working with the Afghan government to draft effective conservation laws and regulations. Following floods in the mountains north of Kabul, USAID supported a project that used a community-based approach to establish agroforestry enterprises to promote forest and watershed management and create a sustainable source of revenue for impoverished farmers. Woodlots are economically viable businesses and reduce pressure on natural forests for fuelwood and construction materials. USAID and the U.N. Green Afghanistan Initiative are developing nurseries and agroforestry to reduce erosion and desertification and conserve watersheds. This initiative also supports local communities by funding the planting of tree nurseries and educational programs to manage and care for the new woodlands, as the crop has significant economic value.[33]

In other cases, the greatest opportunities to enhance economic or security interests will span the borders of multiple countries. In these cases, the United States must consider regional and global strategic dynamics in its efforts to address natural resources degradation.

This systemic approach would involve U.S. security and foreign policy practitioners better integrating natural resources into diplomatic, development and defense approaches to meeting American goals globally and promoting its interests abroad. In other words, it involves the acceptance of a broader definition of national security, one that accounts for the natural world, not just human dynamics, on a regular basis. This approach would also match the scale of the environmental challenges at hand: The massive ***biodiversity loss*** that scientists agree is occurring may be the most urgent sign of a form of "global systems failure." In interdependent ecosystems, the loss of one species typically leads to further losses, which can ultimately compromise an entire ecosystem. The ***changing global climate*** similarly defies borders and carries secondary and tertiary effects for all of the world's ecosystems. It is therefore important to identify how these systemic challenges, like declining biodiversity and a changing climate, are interacting with U.S. security concerns.

Biodiversity Loss

Today, many scientists believe that the Earth is on the verge of an ecological transformation unprecedented in the history of human civilization (if not in the geological history of the planet). Less than one-fifth of the world's original forest cover remains in unfragmented tracts.[34] Fifty-four nations are more than 90 percent deforested.[35] Approximately one-third of the world's coral reefs and mangroves – globally important ecosystems that support fisheries and protect coastal communities from severe storm surge – have been lost or damaged.[36] More than three-quarters of fish stocks, which provide a significant source of protein for two billion people, are fully or over exploited.[37] Approximately 90 percent of the ocean's large predatory fish have been cleared from the world's seas in the last 50 years.[38] Nearly one-third of the world's cropland has been abandoned in the past 40 years because erosion has made it unproductive.[39]

With the loss of so much natural habitat around the world, we are at the beginning stages of the greatest mass extinction of plant and animal life in the known history of human civilization.[40] A single wave of extinction on this scale could undermine the global web of ecosystems that help sustain a large portion of the world's human population.[41] This would be unprecedented. A certain amount of "background extinction" is normal (about one species per million species per year), and mass extinctions have happened before, according to fossil records, but experts have estimated a current extinction rate ten thousand times greater than the natural background rate of extinctions before humans came into existence.[42] One of the most comprehensive recent biodiversity assessments concluded that habitat destruction rates translate roughly into an extinction rate of about .25 percent annually.[43] That is an extraordinarily rapid loss of 25 percent of the world's species in 100 years. Some experts paint an even grimmer picture, given that long before a species is declared extinct, its population levels may become so anemic as to be essentially unrecoverable. One study estimates that somewhere between one- and two-thirds of the world's species will be near extinction by the end of this century.[44]

Human societies depend on a diverse array of species – known as "biodiversity" – in ways that are both obvious and not so obvious. The need for plants and animals as a food source may be obvious, but consider the role that biodiversity plays in world agriculture. For example, one-third of all food consumed by humans relies on pollination from wild bees, bats, butterflies and more than 100,000 other animal species.[45] The Ecological Society of America also estimates that 80 percent of the global population relies on medicines derived from wild plant and animal species, and one-third of all prescription drugs contain an active ingredient discovered in nature.

Indonesia and the Systemic Approach

A good, current example of the systemic approach is the U.S. State Department's efforts to integrate climate change and energy into the strategic partnership it is developing with Indonesia. Over time, natural resources issues will likely increase in importance for this partnership – and this will be important for achieving regional security goals as well, given their tight linkage to the economies of Southeast Asia. With Indonesia's 17,508 islands (almost half of which are covered by forest) and the world's second-highest level of biodiversity,[53] assisting with conservation efforts in Indonesia will be an important piece of the American strategic partnership with that country.

The forests of Indonesia, Malaysia and southern Thailand contain about 25,000 vascular plant species, about 60 percent of which are endemic to that region, and more than 160 animal species that live nowhere else on Earth, making them a clear environmental priority. Indonesia's biodiversity loss may be difficult to monitor, as reports indicate that at least half of its biodiversity is not currently catalogued.[54] However, the effects of this loss and the causes of it are clear, and they intertwine with Indonesia's historical security and stability trends.

Conflict and economic dislocation surrounding Indonesia's natural resources go back four decades, during which pulp, paper and oil palm industries routinely seized forested land inhabited by local communities. Tensions between local communities and national-level energy plans have often heightened internal tensions. For example, Exxon-Mobil's natural gas facilities in Aceh once served as targets for separatist groups, which long held remission of 80 to 90 percent of that province's natural resources revenues to Java as one of their primary complaints.[55]

Illegal logging, fishing and mining have been particularly problematic thorns in the government's side for decades. For example, the black market accounts for almost 73 percent of all logging in the country,[56] which results in the loss of as much as 1.5 billion U.S. dollars in tax revenue annually.[57] Some estimates indicate that as much as a third of Indonesia's potential income from fisheries is poached by illegal foreign boats,[58] and the missions of its military services include assisting in stemming this activity. However, as one report describes, "the navy is still a long way away from winning this battle. It has only 20 ships available for a mission that requires at least 50, according to an admiral investigating the illegal fishing cases."[59]

Underlying many of Indonesia's natural resource problems are poor law enforcement and governance, corruption and a tendency to treat these issues in isolation from one another. Climate change, energy and agricultural policies will also be major concerns for this bilateral partnership. The case of Indonesia shows the systemic approach in action: U.S. policymakers have determined that American regional and global interests are best served by incorporating concerns for natural resources into our planning, international coordination and diplomacy.

In short, the world has been converted from a wild, natural place to one in which human beings – one of an estimated 10 million species – are consuming almost half of the total biological productivity of the planet and using more than half of all of the available renewable fresh water.[46] With as many as three billion additional people being added to the world's human population in the next 50 years, some societies are very likely to have a difficult time maintaining or enhancing their affluence and well-being.

Rather than a clear contributor to conflict, migration, civil tension and instability, biodiversity loss (and changing biodiversity locations and patterns) is better thought of as a strong indicator of the damage being done to the whole range of renewable natural resources on which humans depend. Wild animals pollinate a large portion of the agricultural crop species that feed the world,[47] contributing an estimated 200 billion dollars a year to world agriculture. Plant breeding programs

involving genetic enhancements from the wild relatives of agricultural crops have helped feed billions of people around the world and are valued at an estimated 115 billion dollars per year.[48] Bush meat and game are important food sources for local communities around the world. For example, between 60 and 80 percent of the 24 million people who live within the forested regions of Central Africa rely on wildlife meat as their primary source of animal protein.[49] Biodiversity loss can challenge the ability of human populations to guarantee healthy economies in light of these dependencies.

Climate Change

While the challenges posed by biodiversity loss are less recognized by the security community today, there is a growing awareness of the link between climate change and national security. For example, the 2010 Quadrennial Defense Review, the DOD's primary strategy document, explicitly identifies climate change as a trend that will shape the future security environment. Security practitioners are acutely aware that one effect of climate change will be to intensify existing trends and exacerbate existing tensions and instabilities, serving as a "threat-multiplier," according to a 2007 CNA report. A recent National Intelligence Assessment (NIA) on the national security implications of climate change concluded the following:

> [T]he most significant impact for the United States will be indirect and result from climate-driven effects on many other countries and their potential to seriously affect US national security interests. We assess that climate change alone is unlikely to trigger state failure in any state out to 2030, but the impacts will worsen existing problems – such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions.[50]

The NIA concluded that climate change could threaten domestic stability in some countries and contribute mostly to intrastate conflict due to water scarcity, increased pressure on agriculturally productive land and migrations caused partially by natural resource scarcity. Many of these trends are severe enough by themselves to affect U.S. security and international interests, and climate change may be accelerating the pace.

The Arctic is becoming a clear example of the systemic nature of resources and security challenges. In that region, climatic change, changing biodiversity and related changing economic patterns are coalescing as important U.S. national security concerns. According to a 2010 report by the Circumpolar Biodiversity Monitoring Program, which examined about 35 percent of known Arctic vertebrate species from 1970 to 2004, species in the High Arctic have declined by about 26 percent and in the Sub-Arctic region by about three percent, while species in the Low Arctic have increased by about 46 percent.[51] Patterns of fish movement are also changing. Recently the Alaskan pollock fish industry, which provides two billion pounds of fish annually and is a billion dollar industry for the United States, has been suffering in part, scientists believe, due to climate change. Warming waters are driving pollock fisheries north across international boundary lines and into Russian waters. Some observers believe that this could become a geopolitical dispute as dwindling global fish stocks squeeze an already suffering industry.[52] If these changing environmental patterns continue to drive human populations that depend on these species for food or economic reasons to shift geographically as well, it can directly affect U.S. Navy and Coast Guard missions to protect the environment and indigenous populations and to ensure the United States' exclusive economic zone and the global maritime commons.

Applying these approaches to considering the nexus of resources and security is useful for analytical purposes, and for considering national policy options. However, a deeper look at specific natural resources as they explicitly affect current U.S. security interests is warranted.

IV. THE ROLE OF NATURAL RESOURCES IN NATIONAL SECURITY

The following sections examine the natural resources challenges that are most closely associated with many of today's pressing national security concerns.

Water

While water is abundant on the planet, it is unevenly distributed and most (about 97 percent) is saltwater in the oceans, unsuitable for human consumption and agriculture. Seventy percent of the world's freshwater is frozen in the polar ice caps and mountain ice, and most of the other 30 percent is present as soil moisture or lies in deep underground aquifers; less than 1 percent is readily accessible in lakes, rivers and underground sources shallow enough to be tapped at an affordable cost. In other words, if all of the earth's water fit in a gallon jug, available freshwater would equal just over a tablespoon.[60]

This presents challenges to populations worldwide. According to the United Nations, nearly one-fifth of the world's population lacks access to safe drinking water.[61] A larger proportion of the world's population – three billion people – live in developing countries affected by water stress.[62] Under the strain of growing populations and a changing climate, the U.N. World of Water report concludes that almost half of the world's population will live in areas of high water stress by 2030.[63] In addition to human consumption, agriculture accounts for 80 percent of global water consumption, with almost half of crops worldwide dependent on irrigation.[64] Accounting for population growth, it is estimated that 14 to 17 percent more freshwater will be needed for irrigation by 2030.[65] Basic industrial and manufacturing processes and most electricity generation also require significant quantities of water on a daily basis.

While there is little evidence that nations will actually declare war over water, there is certainly an ample record of conflict within societies, tension between states and other water-related national security challenges, including the use of water resources as a tool of political influence.

While there is little evidence that nations will actually declare war over water,[66] there is certainly an ample record of conflict within societies, tension between states and other water-related national security challenges, including the use of water resources as a tool of political influence.[67] For example, the 1947 partition of India and Pakistan divided a complex system of irrigation canals constructed over some hundreds of years, with the lion's share of the network ending up in Pakistan's West Punjab. Disputes were unavoidable: India's East Punjab cut off water to West Punjab's canals in 1948. Just one year after the dispute was resolved, India threatened to direct water away from Pakistan if that country went ahead with proposed water projects that India feared could periodically flood Indian territory.[68] The two countries have been relatively cooperative on sharing these transboundary water resources lately, but minor water disputes continue to exert tension between them. Pakistan is only one of the

Fish Stocks and Conflict: Historical Cases

Fish stocks may not seem an obvious issue of concern for the security community, but if history is any guide, declining fish stocks could lead to regional instabilities, increased migration and intra- and interstate conflict.[81]

INTERNATIONAL CONFLICTS

- Chinese and Vietnamese fishermen have clashed violently over access to dwindling fish stocks in the Gulf of Tonkin since the Vietnamese fishing fleet tripled its capacity there over the last 20 years (catches have nonetheless plummeted to one-quarter of their 1985 levels).[82] In January 2005, for example, Chinese patrol boats killed nine crewmen on Vietnamese fishing trawlers when they opened fire on the boats.[83]
- Fish populations in the Gulf of Thailand have declined by 86 percent since 1961,[84] which has sent the Thai trawl fleet into the waters of other nations' exclusive economic zones –often with armed vessels to thwart potential arrest. Thai trawlers have provoked violent altercations with Burmese, Indonesian and Vietnamese fishermen.[85]

INTRA-STATE CONFLICTS

- In the village of Tombo, Sierra Leone, industrial trawlers are illegally entering an exclusive zone for small-scale fishermen, who claim the trawlers are catching most of the fish that the impoverished local communities would otherwise consume for protein. There are between 500 and 600 family fishermen in Tombo who rely on these fish for income and food. The fishermen report having to go farther out to sea to find fish, and they fear fish stocks are collapsing under the intensive catches by industrial vessels.[86]
- In Cambodia, where fish make up more than 75 percent of protein intake, increases in population, overfishing, siltation from deforestation and pollution have all contributed to declining catches. Conflicts among user groups have become intense in several coastal areas and around the Tonle Sap Great Lake, where half of the more than three million people living on or near the lake rely on fishing as a primary or secondary occupation. The worst conflicts have arisen when commercial fishers have infiltrated public fishing areas and used armed guards to deter use of these areas by small-scale, non-commercial fishermen.[87]
- In Ghana, where fish stocks have declined by at least 50 percent, the 10 million people who rely on fish for protein and their livelihoods have been driven to exploit the land and wildlife in Ghana's nature reserves. Plummeting fish stocks have helped lead to a 76 percent population decline among 41 wild species in Ghanaian parks. Illegal poaching and the wildlife trade have endangered naturally available protein sources for Ghana's residents.[88]
- In 1995, tensions between Canada and Spain over the declining North Atlantic turbot catch culminated in Canadian gunboat fire, seizure of a trawler and the arrest of its captain. Thousands of Spanish demonstrators thronged the Canadian Embassy in Galicia in response, armed with eggs and dead fish. Anger against Canada's turbot catch moratorium, declared to prevent overfishing, spread among several European Union nations, pitting them also against the United Kingdom, which supported Canada.[89]

many countries of high strategic interest to the United States for which water issues are of high concern. By one assessment that measured total renewable water resources, annual withdrawal, percent of population with access to potable water and population changes, Afghanistan was considered the country of highest risk for internal conflict due to water stresses, followed by several countries in the Middle East and the Horn of Africa.

Climate change and population growth are likely to strain access to freshwater further in many parts of the world. Indeed, water trends may instigate a paradigm shift in interstate relations if wholly new patterns of demand and scarcity – including

absolute scarcity – emerge. It is worth considering that the past may not be a guiding post for the future as far as cooperation around transboundary water resources are concerned.[69]

Yemen is a vivid current example of water issues combining with other factors to worsen U.S. security concerns. According to a recent CNAS report:

> A destabilized Arabian Peninsula would shatter regional security, disrupt trade routes and obstruct access to fossil fuels. With Saudi Arabia already at war in northern Yemen and the country increasingly at risk of becoming a haven for transnational terrorists, the United States must actively work to avoid the potentially dire consequences of a failing state there.[70]

Underlying and exacerbating the security challenges, Yemen's poor irrigation practices and increasing water scarcity are increasing instability and undermining the government's legitimacy in its efforts to rein in ungoverned territories used by international terrorist groups like al Qaeda. Diminishing state oil reserves are also crippling the government's ability to subsidize diesel water pumps, leaving farmers to their own devices to support their irrigation, including hijacking water projects.

Fish Stocks

In addition to freshwater constraints, marine and freshwater fisheries are a vital component of global human food security. In 2009, Chief of Naval Operations Admiral Gary Roughead specifically pointed to dwindling fish stocks as one of the resource concerns the U.S. Navy is taking into consideration in the future international security environment, including how scarcity will impact the livelihoods of the nearly three billion people worldwide who rely on fish as a primary protein source.[71] Likewise, the 2010 Joint Operating Environment (JOE) indicated that:

> Competition for access to these resources has often resulted in naval conflict. Conflicts have erupted as recently as the Cod War (1975) between Britain and Iceland and the Turbot War (1995) between Canada and Spain. In 1996, Japan and Korea engaged in a naval standoff over rocky outcroppings that would establish extended fishing rights in the Sea of Japan. These conflicts saw open hostilities between the naval forces of these states, and the use of warships and coastal protection vessels to ram and board vessels. Over-fishing and depletion of fisheries and competition over those that remain have the potential for causing serious confrontations in the future.[72]

The U.N. Food and Agriculture Organization further estimates that the economic livelihoods of nearly 48 million people depend directly on fishing or fish farming. In 2006, for example, global fish harvesting provided 92 million tons of fish, and global marine capture fisheries were valued at 86 billion U.S. dollars annually.[73] Many experts estimate that the total mass of commercial fish stocks have fallen by up to 90 percent since industrial fishing began,[74] resulting in the loss of 50 billion U.S. dollars in economic benefits due to overexploitation.[75] A full 80 percent of the world's scientifically assessed fish stocks are overfished or are already being fished at maximum capacity.[76] Scientists predict that unless overfishing and marine degradation are curtailed, the world's major commercially harvested wild seafood stocks will be exhausted by 2048.[77] Observers expect that continued population growth, reduced options in the agricultural sector, poverty and food insecurity will put increasing pressure on fish stocks to provide food and livelihoods. Climate change is likely to exacerbate this problem.

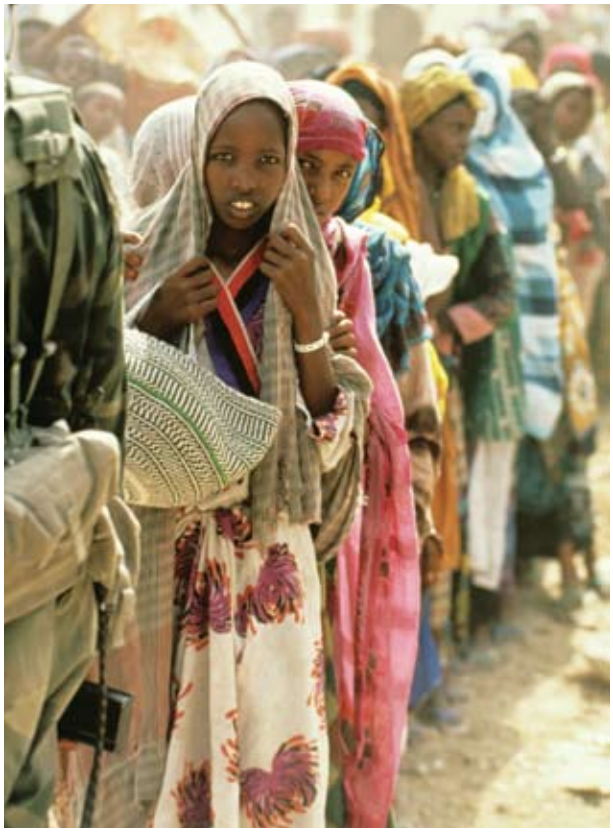
In **Somalia** in August 2009, the Minister of Fisheries for northeastern Somalia reported to the United Nations that foreign ships were threatening local fishermen and denying them access to international water for fishing. Local observers have reported that attacks from foreign vessels have discouraged local

fishermen from fishing, which may have played a role in the increase in piracy and other illegal activity.[78] "Illegal fishing is the root cause of the piracy problem," according to one Somali resident in an interview with the BBC in October 2008. "They call themselves coast guards."[79] The Somali government's inability to curtail illegal fishing and enforce regulations has contributed to the pernicious piracy in the Gulf of Aden that has drawn an international response. Today, the United States is participating in Combined Joint Task Force-151, an international effort to quell the threat of piracy in the Persian Gulf. Analysts predict that the large ransoms paid for commercial ships are appealing to criminal gangs, which are becoming increasingly violent and could require an increased U.S. military presence.[80] Without a sustainable fishing economy to which to return, it is less likely that the Somali fishermen-turned-pirates will be deterred from their illicit activities (especially considering the lucrative bounty).

Land and Food

"Land is a political hot potato," said Jacques Diouf, Director-General of the United Nations Food and Agriculture Organization (FAO).[90] Land supports food supplies and provides economic resources for billions of people. Its degradation or scarcity is common in every region of the world and can serve as a driver for conflict. For example, land degradation and the resulting drought played a role in the rise of the Sendero Luminoso guerrillas in southern Peru.[91] Land shortages in Bangladesh have sent millions of migrants into India, triggering ethnic conflict in the Indian state of Assam.[92] Meanwhile, cropland degradation in the Philippines is widely viewed as having contributed to that nation's communist insurgency during the 1970s and 1980s.[93]

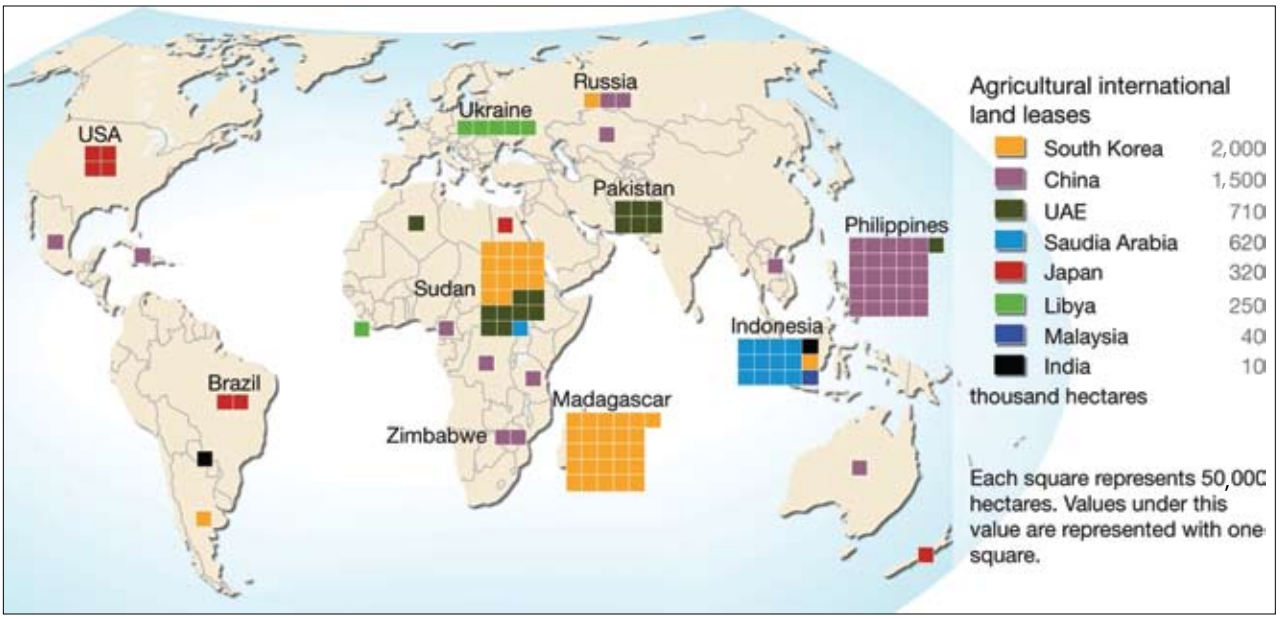
According to the 2010 JOE, food shortages often result from policy decisions (such as poor distribution), population growth and dietary trends. However, "The main pressures on sufficient food supplies will remain in countries with persistently high population growth and a lack of arable land, in most cases exacerbated by desertification and shortages in rainfall."[94] Land degradation trends in developing regions of the world are not encouraging. The number of people living on ecologically fragile land doubled to 1.3 billion in the past 50 years. Such fragile areas cover almost three-quarters of the planet's land surface and have a limited ability to sustain large populations.[95] As a result of these types of trends, hundreds of millions of people are subsisting on small plots of low-quality land; the worst affected areas are in Africa and Latin America, especially the Sahel, East and Southeast Africa, southern Mexico, Central America and the Andean Highlands.



Somali women wait in line for food in Mogadishu, Somalia. The inability of the government to provide food to its people contributes, in part, to the instability persistent throughout Somalia.

(Photo by Andrea Boomer)

Figure 1: An increasing number of countries are leasing land abroad to sustain and secure their food production



Source: UNEP/GRID-Arendal

According to the World Food Programme, almost one billion people are not getting enough food.[96] Ironically, the undernourished are concentrated in rural areas of agriculturally-based economies, which highlights the complexity of today's problems of land and food. These problems are partly related to who has access to food, as well as to the technologies – such as irrigation – that can improve food production and land use. As a recent World Bank report noted, "agriculture's ability to generate income for the poor, particularly women, is more important for food security than its ability to increase local food supplies."[97]

Regardless of whether the causes stem from poor policies or degraded environmental conditions, the results can raise serious security concerns. Riots and civil unrest erupted in some 40 countries between 2005 and 2008 over high food prices, causing fatalities and exacerbating grievances in already precarious states such as Bangladesh, Haiti, Kenya, Mexico, Mozambique and Pakistan.[98] Although the crisis in food pricing has subsided somewhat, prices are still 24 percent higher than they were in 2005 and the risk of unrest continues.[99]

Access to arable land is also forming an important new dynamic in shaping international relations. Today more countries and international corporations are engaged in land leasing arrangements in less-developed countries. In some cases, governments of African, Latin American and Southeast Asian countries are signing over growing rights to land in leases that will last for decades. In other cases, increasing land use for agriculture is threatening forest area and previously preserved land.[100]

In **Madagascar**, a deal to dedicate land for direct export of crops to South Korea contributed to civil unrest in the country that ultimately led to the overthrow of the government in early 2009. According to the International Food and Policy Research Institute, in 2008 South Korea's Daewoo Logistics Corporation negotiated to secure 1.3 million hectares (or almost half) of Madagascar's arable farmland for grain and palm oil production to be exported back to South Korea.[101] This kind of arrangement is becoming more common in Africa and Southeast Asia, and the results for popular sentiment within the countries leasing land to foreign investors are often negative.

Natural Security and Mexico

Mexico has recently become an unexpected focus of the national security community due to a complicated web of persistent problems. Today, Mexico is embroiled in a protracted conflict with its many drug cartels that is having profound implications on stability and security. More than 6,000 drug trade-related deaths were reported in Mexico in 2008,[110] posing a strong challenge to the state and cross-border law enforcement.

Notably, Mexico also faces resource challenges that touch on each of the issues outlined in this report. The case of Mexico also illustrates potential points of engagement that bridge the objectives of the national security and conservation communities.

Forests and Water: Mexico has the 12th largest forest area in the world but also one of the highest deforestation rates in the world.[111] Forests play an important role in local economic life. Given the aridity of a large portion of the country, Mexico's forested areas absorb and hold a tremendous amount of the country's freshwater. Mexico's forests capture 50 cubic kilometers of water each year,[112] which is more than 60 percent of the total amount of water withdrawn by all agricultural, industrial and residential water use in the country.[113] Forests and wetlands, including coastal mangrove forests, protect inland areas against billions in damages from natural disasters such as hurricanes, landslides and floods.[114]

Energy: Mexico is a top supplier of oil to the United States. The country's oil production, which makes up about 40 percent of government revenue, is estimated to have declined by 310,000 barrels per day in 2008, due in part to an aging infrastructure and a lack of investment in new extraction technologies.[115] Shrinking oil production, combined with diminishing government revenue, will make it increasingly difficult for the state to exercise authority, to provide the social programs its people need and to stem the tide of social unrest.

Fisheries: Mexico's fisheries industry, which is ranked among the 20 largest in the world, is also under threat. The Gulf of California accounts for more than half of Mexico's total fishery stock, yet the ecosystem is threatened by pollution and overfishing.

Mexican fisheries directly benefit from the country's coastal mangrove forests, which keep inland sedimentation and excess nutrient loads from damaging marine areas that nurture fish populations. But coastal wetland forests have been reduced to less than half their original extent of 3.7 million acres to 1.6 million acres. Their loss not only threatens fisheries but also eliminates valuable environmental services such as regulation of fresh water and protection from storm damage.[116]

Biodiversity: With 23 distinct ecosystem types, Mexico is one of five countries with the highest variety of ecosystems and biological diversity. With just 1.4 percent of global land area, the country contains as much as 12 percent of the world's species,[117] many of which are at risk of extinction from land use change and environmental degradation.[118]

THE BIG PICTURE

Approximately 47 percent of the country's population is poor; fourteen percent live in extreme poverty.[119] Poverty levels are particularly high in areas that were once covered by forests.[120] Between 1993 and 2002, natural resource-dependent activities – agriculture, livestock, forestry and fishing – comprised one-seventh of the overall economy but were also the lowest earning sectors of the Mexican economy.[121]

Government programs have attempted to increase production in these sectors, but poor environmental management has ended up depressing production in some cases.[122] Water scarcities reduce agricultural productivity, intensify poverty and have led to desperate residents commandeering water tanker trucks.[123] The economic costs of deforestation, soil loss, oil depletion and water mismanagement have reduced Mexico's GDP by approximately nine percent annually,[124] and the economic effects are compounded by natural disasters, including droughts, floods and hurricanes. Some observers believe these factors could play a role in undermining the Mexican state, potentially resulting in the state compromising control over its territory and resources.

According to a 2008 U.S. Joint Forces Command report, "Any descent by Mexico into chaos would demand an American response based on the serious implications for homeland security alone."[125] Policymakers cannot fully predict what the worst-case scenario would entail for U.S. national security. However, the

Individuals plant trees in Mexico, which has the 12th largest forest area in the world but also one of the highest deforestation rates in the world.

(Mark Godfey/TNC)

consequences of resource degradation still carry serious implications for American national security. At a minimum, the inter-relationships among drug trafficking, natural resource extraction, trade and commerce, environmental degradation and long-term stability require further examination.

A more thorough examination should include the ways in which natural resources conservation efforts could contribute to broader efforts at economic development and social stability in Mexico, and could build on several current initiatives. For example, the Rainforest Alliance and USAID/Mexico have provided technical assistance to community managed forests that helped improve management of 500,000 hectares of high-biodiversity forests in some of Mexico's most important watersheds. This has improved overall quality and quantity of the timber output, while significantly reducing waste and pollution into the watershed. Revenues increased by one million dollars, while wasted material decreased significantly.

World Wildlife Fund and USAID worked in the states of Oaxaca and Chihuahua to develop sustainable land use plans, municipal/indigenous councils and fire prevention plans. They also established community protected areas throughout Oaxaca and Chihuahua.[126]

As land and food scarcity become more acute, national security practitioners will need to be mindful of the private sector's role in shaping situations like that of Madagascar as well.

Haiti offers the best example of how deforestation, by removing economic opportunities, can exacerbate civil unrest, violence, migration and natural disasters. It is the most deforested country in the Western Hemisphere.

Forests

Indicators involving the world's forests also paint a stark picture. Less than one-fifth of the world's original forest cover remains unfragmented (i.e., forests that are unbroken by infrastructure development, such as roads and human settlements) and capable of sustaining a healthy ecosystem. What is left is being lost at an accelerating rate.[102] If current trends continue, most of the remaining tropical forests in South Asia, Southeast Asia and Central America will be gone in about 20 to 30 years. What is left will be concentrated in the Congo and Brazil.

At the same time, according to the World Bank, 1.6 billion people rely directly on forests for their livelihoods.[103] (Forestry, for example, provides as many as 60 million jobs in developing countries.) One-third of the world's forests are mainly used for production of wood, fiber and non-wood products. But perhaps the most important economic use of the world's forests remains its use as a source of energy. Even as industrialized countries are pioneering ways to move beyond fossil fuel, as much as 40 percent of the wood removed from forests is used as fuelwood.[104] Two and a half billion people around the world – 38 percent of the world's population – still rely on fuelwood as their primary source of household energy.[105]

Rice fields in Madagascar. In 2009, a deal to dedicate land for direct export of Malagasy crops to South Korea contributed to civil unrest in the country that contributed to the overthrow of the government.

(STOCKXCHNG.COM)

Haiti offers the best example of how deforestation, by removing economic opportunities, can exacerbate civil unrest, violence, migration and natural disasters. It is the most deforested country in the Western Hemisphere, and the most important driver of forest loss is the use of fuelwood and charcoal for energy. With 76 percent of the population below the poverty line, timber and firewood are not only a primary source of energy but also of income for thousands of Haitians. In addition to economic development focused on generating employment, the introduction of better forestry practices, alternative sources of energy and reforestation should be key elements of any effort to reduce poverty and establish greater stability in the country.[106] Reforestation efforts would also help

to reduce the intensity of future natural disasters. Eroded soil from deforested hillsides has already contributed to more intense and devastating mudslides in the wake of major storms and hurricanes – some of which elicited a U.S. civilian and military response. USAID/Haiti is working with local communities to stop destructive agricultural practices and to reduce soil erosion and deforestation on the steeply sloped lands by reseeding areas with local tree and plant species. This adds economic stability to impoverished communities while building a base for the return of biodiversity and reducing the threat of landslides.[107]

Minerals

The ways in which countries are meeting increasing demand for minerals and raw materials are reshaping international relations. The starkest case is perhaps China, which is on a quest to secure mineral resources throughout much of the Eastern Hemisphere.[108] This effort is creating a new global power dynamic as it weaves a broad web of relationships with countries possessing major mineral deposits. The United States, Europe and Japan have also long sought mineral supplies abroad, but the scope and scale of China's global mineral strategy has many security analysts concerned about the effects of these relationships.

U.S. leaders are increasingly concerned about securing sufficient mineral supplies to meet domestic economic needs, especially for defense-critical applications. As of 2009, the United States was 100 percent dependent on imported supplies of 17 minerals. The U.S. Congress was concerned enough about one class of these 17 – rare earth elements – that the 2010 National Defense Authorization Act required that DOD examine how these minerals are used in all of its equipment and cite areas of possible substitution. Though minerals are of high concern for defense and broader U.S. supply chains, the national stockpiling system no longer reflects modern economic needs, according to a 2008 National Academies of Science report.[109]

America's transition away from petroleum-based fuels could include use of electric vehicles and hybrid engines as important solutions to curbing oil consumption. Increasing the use of these technologies would imply the need for sustainable supplies of lithium, which is used to produce the requisite high-efficiency batteries and engines. Yet nearly 50 percent of the global supply of lithium lies beneath Bolivia's salt flats – a country with a sometimes frosty relationship with the United States. According to a recent examination of this issue by the *New Yorker*, "Bolivians have begun to speak of their country becoming 'the Saudi Arabia' of lithium."[127] While it is unclear if the Bolivian state will be able to profit much from its vast reserves – or how it will treat U.S. companies – the overall concentration of global reserves of lithium may indicate that the U.S. government and the private sector should look for opportunities to leverage other supplies and increase recycling of lithium as a means of hedging against potential foreign policy implications.

Energy

Recognition of the geostrategic, strategic and operational vulnerabilities associated with the current world energy system is growing. With world demand for high-carbon fuels growing and their effects on climate change better understood, the importance of moving away from a heavily fossil fuel-based energy economy is increasingly clear. At a geostrategic level, access to fossil fuels colors and determines U.S. relations with key supplier nations around the world, including Russia, Saudi Arabia and Iran, but also with major consumer nations such as China. At a strategic level, the DOD is already highly engaged in missions to protect U.S. and global access to world oil markets; the physical vulnerability of the global production and supply infrastructure and the chronic instability in key oil supplying nations also mean that the department could have to contend with a serious supply disruption at any time. At the operational level, reliance

on oil is costly and constitutes a force protection challenge (supply convoys have been heavily targeted by fighters in Iraq and Afghanistan). The risks this system imposes on U.S. and global security are considered a top concern by many analysts.

Nigeria, one of the world's top 15 oil producers and top 10 highest world oil reserve holders, is a persistent cause of concern, given its rank as 15th on the 2009 *Failed States Index* and the presence of insurgents who routinely attack western corporations operating in the state. Nigeria's internal environmental woes stem in part from its energy use: It produces and consumes over 60 million cubic meters of fuelwood every year, and due to these pressures, Nigeria has one of the highest rates of deforestation in its region. It lost 410,000 hectares of forest between 1990 and 2000 and another 410,000 hectares between 2000 and 2005.[128] Violent conflict over natural resources began in the 1990s and has continued in the Niger Delta for a range of reasons; in many cases, local communities are dissatisfied with the type or amount of compensation by oil companies for environmental damage. Analysts, in turn, have documented the Nigerian state's harassment of ethnic minorities who have taken a stand against oil companies, which has included overt state violence such as flogging, torture, rapes and killings.[129] In September 2009, the Movement for the Emancipation of the Niger Delta (MEND) declared war against foreign-owned oil companies in the Niger Delta. MEND has cited among their grievances the looting of natural resources and the pollution of wetlands and drinking water sources by criminal gangs and government military forces.[130]

These examples all show distinctly how natural resources can affect U.S. security interests or serve as tools for advancing U.S. diplomatic or development goals. They also point to several logical next steps in advancing the U.S. security and foreign policy communities' understanding of the intersection of resources and security.

V. RECOMMENDATIONS

While many Americans still think of national security in traditional military-to-military terms, security for many ultimately means safe, reliable and affordable access to the basic needs in life: food, water, shelter. If the United States cannot manage the increasing pressures on Earth's ecological support systems from growing populations, growing economic expectations, unsustainable development and a changing climate, these pressures will continue to strain access to basic resources. Some nations have already begun to implement long-term strategies to protect their access to arable land and other environmental goods. But natural resource conservation is still a largely missing element in security.

In particular, the field of national security needs deeper consideration of how the degradation of renewable natural resources can affect conflict dynamics in the near and medium terms, how conservation provides opportunities to enhance security and stability in current conflicts and how long-term trends could preempt potentially fundamental threats to national and global security. In the long run, the national security and foreign policy communities need to take into account the plausible consequences of widespread ecosystem degradation and mass extinction in their scenario planning and as part of any analysis of the future strategic environment.

Managing the interconnecting challenges outlined above will begin with an improved understanding of the relationships among natural resources and U.S. security interests. It will also require improving knowledge of how to better leverage the tools the United States has to offer in promoting natural security, among all federal agencies, private sector actors and others. At the heart of the following recommendations are the continued efforts to raise awareness among national security policymakers that natural resource issues are important to their work.

To enhance understanding of how natural resource degradation influences U.S. national security, the national security community should:

1. Form a Natural Security Community

Many government agencies and programs are doing work related to U.S. natural security even if their activities are not defined as such: USAID; the international affairs office of the Fish and Wildlife Service; the National Oceanic and Atmospheric Administration; the Treasury Department's management of funds for development banks; and several other agencies currently supporting a total of approximately 300 million dollars annually for conservation efforts abroad (either through direct grants to NGOs or national or local governments).[131] The State Department's Oceans and Environment Bureau also supports conservation efforts through grants to NGOs and by negotiating treaties. Several offices within the DOD conduct related work as well, and professors are engaging students at U.S. military colleges on natural security issues.

For practitioners in all related communities to more effectively implement the approaches outlined above, it is important to cultivate connections among related actors and promote networks among security and environmental analysts. This community building can stem from new requirements or bureaucratic changes within the government. For example, a loose network of individuals within the DOD now works on energy security and climate change issues in part because Congress now requires the DOD to consider such issues directly in its planning and strategy documents, such as the Quadrennial Defense Review. Community building activities should also be catalyzed by nongovernmental organizations.

Establishing a framework to understand better how natural security activities can combine to contribute to national security and stability – coupled with an effort to define and engage this community of agencies, NGOs, experts and scholars – would help foster a network that can develop new concepts, share advice and better leverage one another.

2. Integrate Natural Security in U.S. Plans and Institutions

The U.S. government should incorporate a more holistic view of resource challenges into existing national security institutions, plans and processes. The nation has a plethora of strategy documents that shape U.S. national security and foreign policy, including the National Security Strategy, the National Military Strategy, the National Defense Strategy, the National Strategy for Homeland Security, the National Intelligence Strategy, the Quadrennial Diplomacy and Development Review and other more focused strategy exercises. Any and all of them could incorporate natural security more thoroughly – or at least address it explicitly. The authors of these reviews should consider implicitly or explicitly applying the targeted and systemic approaches in their analyses of what environmental dynamics mean for specific security concerns.

Many U.S. government institutions already have competencies in natural security but as yet lack the direction or coordination to pull together a comprehensive look at how natural security affects their portfolios. New requirements and a shift in emphasis may be all that is needed to increase the country's understanding of and develop a framework for addressing these issues. The National Security Council may be best positioned to help foster such a strategy; Senior Directors for Strategic Planning and Institutional Reform and Global Development, Stabilization and Humanitarian Assistance could take the lead in that effort. The greatest challenge will be translating that strategic vision into whole of government action.

The international community, NGOs, universities and for-profit businesses should play strong roles as well. International conservation organizations bring tremendous scientific and technical expertise

in developing and managing conservation programs in the field. Businesses participating in programs that certify the sustainability of forest, marine and other natural resources products help construct markets that incentivize conservation, and can generate new technologies that promote sustainable growth. The buck cannot stop with the U.S. government. To address natural resource management effectively, vulnerable states also need support from the international community to monitor the environment, effectively manage natural resource extraction and build governance and enforcement capacity. For example, the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) directly promotes sustainable management of forest resources while fostering economic development. And the Extractive Industries Transparency Initiative (EITI) promotes transparency for natural resources trade in order to foster sustainable development and prevent exploitative behavior. While these activities are not solely directed by the U.S. government, incentives, cooperative partnerships and academic grants can help to ensure that nongovernmental activities align with U.S. interests.

3. Create a Natural Security Index

A gap exists between scientists and policymakers, one that makes it increasingly difficult for the two communities to collaborate and share information. CNAS has studied this gap for some time, particularly the acute gap between the climate science and national security communities. The foundational challenge, by and large, remains the same across a wide range of natural security issues: Scientific observations are difficult to translate into social science and public policy terms. That is to say, it is difficult to take observations and data related to diminishing natural resources and reliably forecast human trends, such as migration, and develop tailored policy responses.

The development of a compelling new framework that links conservation and security is an important first step toward the more effective integration of resource trends into security planning, the improvement of U.S. government capacity to engage in and support conservation efforts and, perhaps most importantly, the sustained engagement between the conservation and security communities in prioritizing and addressing existing and potential natural security challenges. Analysts need more effective tools for understanding the complex relationships between security and resources. A "Natural Security Index" would rank the top U.S. national security priorities in which natural resources issues play a critical role. It would provide a tangible, easily-understood quantification of what natural security means and where the U.S. government and its partners should place greatest attention.

In many fields of scholarship, analysts develop an index to capture agreed-upon, recognizable and measurable key variables that, when assessed together, capture and quantify potential threats and challenges: for example, the Failed States Index or the Human Development Index. The conservation and national security communities could begin their collaboration in earnest by developing a Natural Security Index that would reflect U.S. security interests and incorporate the expertise, knowledge and tools that natural resources and conservation groups can bring to bear. In order to ensure that this index is not misconstrued as government policy, it would be best for a nongovernmental organization to develop this index and form the necessary partnerships to do so. This index of conservation's links to national security would offer a tremendous impetus for translating increased awareness into action and help policymakers set priorities.

VI. CONCLUSION

Substantial evidence in the historical and archeological record demonstrates how societies have declined in the face of resource and environmental challenges. Today systems analysts are not sure whether the more complex and interconnected world will generate greater or lesser resilience in the face of change. The environmental and natural resource trends identified in this paper potentially represent an existential threat to our 21st century society, or at the very least to some of the ways our society has traditionally functioned. At a minimum, it is important to understand what are already sweeping global environmental trends and how they affect the security and prosperity of countries around the globe. It is also worth considering a more dire long-term scenario: The dramatic environmental changes that scientists are warning of today indicate that more existential threats to life on earth are possible.

Even as experts disagree about the scope, scale and pace of global changes, a strong consensus exists that the serious global degradation of natural resources could lead to a period of mass extinctions, with climate change accelerating and deepening these developments. Human civilization is entering uncharted territory. Social scientists tell us that human civilization developed when a high degree of stability existed in global environmental conditions. It is difficult to predict how profoundly dramatic environmental changes could affect societies at different levels of development and complexity.

Ultimately, expanding the definition of national security to include the threats addressed here is not a matter of choice. This change is inevitable. But nations do have the choice either to react to such change as it happens or to shape the way these changes unfold and prepare the best response capabilities and practices. The reactive approach is likely to be costly – both in financial and human capital – and inadequate to the task. The proactive approach has the potential to minimize the costs and to maximize the opportunities. It is hard for governments to prioritize an issue like conservation. Moreover, quantifying the consequences in ways that are actionable for national security practitioners will be a constant difficulty. These obstacles can and must be overcome through sustained engagement among relevant communities, improved analysis and possibly minor institutional adjustments.

Just as the nation's understanding of what constitutes a threat is changing, so is our understanding of how we achieve peace and prosperity. As this young century unfolds, the security of the United States, and that of most nations, will increasingly depend on our ability to identify how natural resource trends engage national security – our "natural security."

A Growing Commitment to Natural Security

Scholars and government officials began to explore explicitly and in earnest the connections among natural resources and U.S. national security in the immediate aftermath of the Cold War.

Academics and practitioners in the national security field have long realized that there are security implications to natural resource consumption, but the dramatic realignment of the international system sparked by the end of the Cold War generated a more serious debate about what security means for America, and specifically how natural resources and environmental issues interact with a wide variety of factors that affect national security.[132]

Early signs that those in the U.S. government were beginning to integrate environmental issues into security-related work emerged during the George H.W. Bush administration. Thomas Pickering, then ambassador to the United Nations, warned in 1989 that "eco-conflicts" could become a major problem in North-South tensions.[133] In congressional testimony supporting the State Department's FY 1991 budget request, Secretary of State James Baker noted that "traditional concepts of what constitutes a threat to national and global security need to be updated and extended to such divergent concerns as environmental degradation, narcotics trafficking and terrorism."[134]

This more expansive view of the linkages between security and the environment started to gain traction within the U.S. security community in the late 1990s. The Clinton administration's 1996 National Security Strategy, for example, stated:

> America's security imperatives… have fundamentally changed. The central security challenge of the past half century – the threat of communist expansion – is gone. The dangers we face today are more diverse… [L]arge-scale environmental degradation, exacerbated by rapid population growth, threatens to undermine political stability in many countries and regions.[135]

In 2000, the NIC's Global Trends 2015 report took one of the intelligence community's first serious public looks at global demographic and environmental trends. In one of the most comprehensive press reports on the publication, *The New York Times* stated that the NIC's report suggested a growing understanding in some national security circles that "issues like the availability of water and food [and] changes in population…will increasingly affect the security of the United States."[136]

Even after 9/11, when the security community's focus shifted to the threat of terrorism and weapons of mass destruction, natural resources concerns remained a focus of several thoughtful security analysts and policymakers. Secretary of State Colin Powell stated in a 2002 speech:

> Sustainable development is a compelling moral and humanitarian issue. But sustainable development is also a security imperative. Poverty, destruction of the environment and despair are destroyers of people, of societies, of nations, a cause of instability as an unholy trinity that can destabilize countries and destabilize entire regions.[137]

Today, many scholars classify cases into four ways in which natural resource degradation has played a role in conflict and instability within and among nations—and could increasingly do so as scarcity trends worsen: localized conflict over the specific use of a resource, such as logging or dam construction; ethnic conflict arising from mass migrations due to the disappearance of critical natural resources; civil strife, such as insurgencies and coups, caused by natural resource degradation that undermines economic livelihoods; and conflicts over water.[138] It will be important to continue to build on this foundation, even as the U.S. security communities work to integrate these considerations more regularly into analyses and planning.

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