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# Future international environmental security issues and potential military requirements

**Jerome C. Glenn and Theodore J. Gordon**

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**Keywords** Environment, Security, Delphi method, Armed forces, Strategy

**Abstract** This article reports on an international assessment to identify and discuss environmental issues that may affect the US Army's transformation efforts. Many factors, such as new kinds of weapons, increasing demands on natural resources, urbanization and globalization, are making the planning of environmental viability for life support more important in the future. The article highlights eight environmental security developments and potential military requirements to address them.

This article reports on an international assessment to identify and discuss environmental issues that may affect the US Army's transformation efforts in the mid-term (2005-2010) and the long-term (2020-2025) time frames and to anticipate potential military requirements that could emerge in response to these issues. The study was conducted between June and December of 2001. For the purpose of the study, environmental security is defined as

environmental viability for life support with three sub-elements:

- (1) preventing or repairing military damage to the environment;
- (2) preventing or responding to environmentally caused conflicts; and
- (3) protecting the environment due to the moral value of the environment itself.

Changes around the world are making environmental security planning more important in the future. New kinds of weapons, asymmetrical conflicts, increasing demands on natural resources, urbanization making more people dependent on vulnerable public utilities, continued advancements in environmental law with escalating environmental litigation, globalization increasing interdependency, all make the issues in this study timely for military consideration. Although participants in the study reported increasing awareness of environmental security matters among the militaries around the world, it is still a very low priority compared to other military matters.

This article draws on a report by the Millennium Project of the American Council for the United Nations University entitled "Future international environmental security issues and potential military requirements over the period of 2010 to 2025", by Jerome C. Glenn and Theodore J. Gordon. The full report is published by the American Council for the United Nations University in *The State of the Future*, 2002, <http://millennium-project.org>.



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At the heart of the study was a three-round Delphi exercise. Beginning with a list of several hundred potential environmental security related events prepared by US Army Environmental Policy Institute (AEPI), the Millennium Project of the American Council for the United Nations University distilled the list to 43 items. This was done in consultation with AEPI, the project's planning committee, and staff. The study was introduced to military attachés to Washington DC at a meeting held at the World Bank. They were asked to participate in the study and/or recommend relevant military personnel in their countries. Their suggestions, plus those of the AEPI and the Millennium Project, created the international panel of futurists, military personnel with environmental expertise, and environmentalists with an environmental security background or interest. This panel was asked in Round 1 of the Delphi exercise to rate the items as to their likelihood of occurrence, importance if the emerging environmental issue were to occur, and the year when the item might affect military policy or procedures due to security concerns, or statutory, regulatory, or treaty requirements.

The results were used as a basis for Round 2, which was a series of three one-day workshops to discuss those items considered the most important, add new issues, and explore potential military requirements that these issues may cause. Each day had a different category of participants; day one: futurists, scientists, and environmentalists; day two: military attachés; and day three: US military personnel. Group voting software was used to capture participants' views and ratings.

Based on the discussions and ratings during Round 2, eight environmental security-related developments were selected for the Round 3 questionnaire. Each development was given a short description and a series of potential military requirements that were drawn from the discussions in Round 2. The international panel was asked to provide judgments about:

- short descriptions of potential environmental security issues;
- new military requirements in their country, including policy or procedures due to security concerns, or statutory, regulatory, or treaty requirements that will be necessary to address each;
- the effectiveness of the actions or requirements to address the issue; and
- the year the military in their country might implement the new requirement.

The rest of this article focuses on the results of the final Delphi round.

### **Focused review of environmental security developments and military requirements**

The third and final round of the Delphi was based on the results of the previous two rounds and focused on eight developments chosen on the basis of their importance,

likelihood, and their ability to generate a rich set of military requirements.

Each development was given a short description and a series of potential military requirements that were drawn from the discussions in Round 2.

The international panel was asked to provide their judgments about:

- the short description of potential environmental security development;
- the effectiveness of the actions or requirements to address the development;
- the year the military in their country might implement the new requirement; and
- what other more new military requirements might result in response to the development.

Results of these questions are presented below. The discussions of each of the eight developments are composed of the initial text from the Round 3 questionnaire, previous research by the Millennium Project on environmental security for the Army Environmental Policy Institute, and a distillation from the panel's comments on that text.

Following each description are the military requirements to address the issue listed in order of time. Those the panel estimated to be the soonest are listed first. In addition, the panel's coherence is also shown: those with the most agreement are in regular type; those with the greatest disagreement are in italics. The median year and average effectiveness are shown in parenthesis after each requirement. And last, the additional requirements and/or comments on the rated requirements are included.

#### **1. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once. This includes the possibility of the special case of adapted organism weapons developed to attack mono-culture agriculture**

Bio-weapons are already considered the "poor man's atom bomb". Existing pharmaceutical production technology can be used to make these weapons. The science of producing such organisms is already widely known and the cost is so low that even small groups, as well as poorer nations can afford them. The science of distributing, or "weaponizing" such organisms is rapidly advancing. Over the next 25 years, new kinds of organisms could be engineered to be more virulent than the recent Anthrax attacks in the USA. Infiltration of pharmaceutical manufacturers by hostile agents brings up other scenarios. A major concern is the mutation of a virulent strain of an organism that was not originally envisioned.

Scientists are already developing "adapted organisms" to attack drug crops. Binary bio-weapons might also be used for blackmail (e.g. disperse one part of the weapon, and then threaten to deploy the second part if demands are not met). Some scientists even speculate that viruses could be

designed to attack specific human groups. What happens if one day this technology for mass destruction becomes available to high school students?

The environmental consequences of using bio-weapons are important and may not be as limited and predictable as the impacts of chemical and nuclear weapons. If technical intervention to stop a bio-weapon does not exist, then it could exterminate humanity to a far greater extent than nuclear destruction, because the rain of death could continue in perpetuity. If the relevant infrastructures were severely disrupted, then unleashed bio-organisms would run their course through humanity unchecked. The resulting impoverished, sick populations would find it very difficult to maintain basic services and lack the infrastructure for advanced research to combat highly sophisticated and engineered organisms. Rogue nations or terrorists who want to wipe out large numbers are more likely to use such bio-weapons than anyone else.

**“Genetically modified organisms could be developed and used to contaminate crops, fuels, farm animals, or feedstocks for manufacturing for a variety of purposes, and even cause defoliation.”**

Rather than attacking human life directly, bio-weapons could also be designed to attack the environment that supports it. Genetically modified organisms could be developed and used to contaminate crops, fuels, farm animals, or feedstocks for manufacturing for a variety of purposes, and even cause defoliation. Super weeds, micro-organisms, insects, rodents, or other pests could be bred and used to carry biological agents into human settlements. Some speculate that such attacks are likely within the next two to ten years. Bio-engineered organisms which attack mass products (corn, potatoes, wheat, cattle, pigs, chickens, etc.) can have major impacts on all forms of life, and result in human unwillingness to buy/eat the items attacked and pushing economies into depression. Such bio-engineered items could be considered weapons of mass destruction. This is a new complication in the controversy over genetically modified crops.

The threats from bio-weapons could be the most important future focus for a nation's military forces. In more advanced countries the military role will be less than in the developing world. In most of the developing world, the military is the only national organization that has the training,

discipline, organizational capacity, equipment, logistical support to address a large scale bio-event (intended or accidental). While health, environmental, and agricultural experts will provide the framework for the response in poorer countries, implementation will still depend on the military. Developing country militaries must be trained in the mitigation, control, containment, and in prevention by developing intelligence gathering and monitoring capabilities.

Richer countries' health, environmental, and agricultural systems have the knowledge necessary to address these threats. Whether rich or poor, the military has a role in addressing these threats because any use of such bio-weapons constitutes an attack by an enemy nation or terrorist network. The use of tactical nuclear weapons by the USA in response to a major bio-weapons attack and to pre-empt further use of enemy bio-weapons is likely.

Since the capabilities of bio-weapons are diverse and access could become so broad, preventing the motivation of their use through general education to enlightenment of the public, and the mitigation of hostilities among nations, societies, and social groups may be the only realistic long-range approaches to prevent bio-disasters.

*Suggested military actions to address this issue:*

- Coordination of military activities with civilian biological defense assets (2002, 4.05).
- Integration of military epidemiological systems with national epidemiological systems (2003, 3.91).
- Training military forces for quick response after an attack by such bio-weapons (2003, 3.83).
- Assisting in the formation and training of biological defense units in other countries (2005, 3.73).
- Establishing international/regional biological defense agreements (2005, 3.73).
- Using military forces to conduct mass vaccinations of the populace in response to a defined bio-weapon threat (2005, 3.35).
- Enforcement of biotech export controls by the military (2005, 2.68).
- *Limits to immigration enforced by the military* (2005, 2.64).
- *Development of stand-off bio-sensors* (2006, 3.30).
- Pre-emptive military strikes to destroy bio-weapons (2008, 3.22).
- *Development and use of wide-spectrum vaccines* (2008, 3.48).
- Restricting movement of troops to prevent spread of biological agents (2009, 2.24).
- Development and use of human immune system boosters (2010, 2.73).
- Restricting movement of the populace by the military to prevent spread of biological agents (2010, 2.48).

*Additional military requirements and/or comments on the above suggested requirements*

Pre-emptive strikes imply better intelligence to locate bio-weapons than we currently have. Combine intelligence services of friendly nations and civil society groups to define, anticipate, prevent, and/or limit the impact of bio-attacks.

The dispersal of bio-weapons may be more difficult for terrorist groups than the manufacture of organisms for bio-weapons. Increased intelligence and focus on likely means of dispersion could be the most efficient use of both military and civil intelligence assets to prevent these threats.

Bio-weapon treaties should be created that would specifically state and define that bio-weapon organisms would have genetic triggers to cease replication. This may be the only humane means to limit uncontrolled bio-organism/warfare. This could be verified via third parties through the United Nations or other international treaty organizations for checking weapons stockpiles. Such humane development/technological restrictions to bio-weapon agents may also necessitate the proliferation of the technical means to engineer such genetic "death triggers" so that this can be used. This approach is most likely applicable to major nation states but offers absolutely no protection for technologically sophisticated apocalyptic oriented terrorists bent on destruction of all life.

Develop molecular biological models for disease identification and rapid immunological and vaccine development in response to biological agents. Such technology would scan and quickly develop a remedy. Although this is a fantasy now, necessity is the "mother of invention". A side benefit of the new age of bio-terrorism may be the development of technology to quickly characterize disease organisms and use biology "in silico" or in computerized medical simulation formats that would develop treatments or vaccinations at a more fundamental molecular biological level in rapid response. Computational chemistry is in its infancy, but United Devices <[www.ud.com](http://www.ud.com)> connects over one million volunteer computers via the Internet to calculate potential matches between molecules and cancer cure requirements. New developments in DNA chip technology may provide the means for efficacious and rapid drug development. Developing such responses to disease would greatly advance our ability to treat diseases of natural origin and would also provide a military deterrent. The logic would be that the new medical response would be developed and distributed to populations quickly enough to eliminate the time and scientific research investment for a bio-weapon.

Develop generation next after individual nuclear, biological, and chemical protective systems (integrated clothing, respirator, personal water recovery, thermal control, sensors, etc.) designed for both military and civilian applications.

Develop instructional materials and training programs for public protection from bio-weapons.

The focus is key for using military forces to conduct mass vaccinations of the populace in response to a defined bio-weapon threat. The *modus operandi* for vaccinations of populations in the First World for the foreseeable future will be civilian action.

Wide-spectrum vaccinations do not take into account mutation of strains with time and need for continuing research to develop vaccines that will counter or minimize organisms' effects.

Vaccines should be immune system boosters of a highly efficacious kind. Others would seem to be too non-specific to be of great utility in response to bio-attack.

Stand-off bio-sensors have been in development for two to three years.

## **2. A major military conflict over water is understood by world leaders as extremely plausible**

Water tables are falling on all continents, while human demand for water increases worldwide. Nearly 450 million people in 29 countries live in water-short locations, which could increase to 2.5 billion people by 2050. More than one billion people lack safe drinking water. Nearly half the world lacks adequate sanitation, and 80 per cent of all diseases in the developing world are water-related. Agricultural land is becoming brackish worldwide, and groundwater aquifers are being polluted. Global warming is shrinking mountain snow packs, reducing summer water supplies.

About 40 per cent of humanity lives in river basins shared by more than two countries. If present trends continue, two out of every three people on Earth will live in "water-stressed" regions by 2025. Business-as-usual will lead to world water crises, causing mass migrations, disease, and contribute to the causes of wars. Water quality and availability affect environmental viability for life support in general.

Water problems could also contribute to potential internal strife in China and India, which together account for over one-third of the world's population. The most optimistic water scenario for China presented at the recent international conference on water at The Hague showed continued deterioration of the water situation for the next 10-15 years before general conditions begin to improve. In some locations in India, water tables fell three meters last year.

Water systems are vulnerable to industrial catastrophe, agricultural pollution, and terrorist attack. Unilateral action by a Middle Eastern nation to control water resources also has the potential to destabilize a region, e.g. Turkey's action to construct a major reclamation and hydro power project to control the Tigris-Euphrates basin – the Southeastern Anatolia Project. Many smaller conflicts are possible all around the world, like the strife in Azerbaijan due to the Garabag extremists restricting water to Azerbaijani farmers.

Global warming is causing documented grassland and forest expansion, especially in the northern temperate



regions, with currently marginal grazing lands becoming farmlands in the future. This will place more demand upon those water resources and shift the demand northward.

Water issues can also lead to cooperation. For example, the Indus Water Treaty between India and Pakistan has been a source of good relations in spite of conflicts between these nations. Several recent transborder water problems have increased pressure for diplomatic cooperation and technological innovations in desalinization and water efficiencies in agricultural and urban usage. Although the technology of desalination plants is well-understood and widely used, it is still too expensive for most of the world. Yet, improvements in this technology could prevent water wars, and desalination plants will become more widespread with pipelines to continental interiors. Nevertheless, such plants could become terrorist targets. Other water efficient technologies will emerge such as genetically modified seeds that require less water, drip irrigation, closed environmental agriculture, etc.

A US Global Climate Change Research Program indicated that the number of conflicts over water in the history numbered less than five. The consequences of water conflicts seem so terrible that more reasonable minds may have prevailed. According to USGCRP, Syria controlled some of Israel's water supply. It was speculated this water supply control would never be used as a military target or the military repercussions would be drastic.

*Suggested military actions to address this issue:*

- *Military security and oversight for selected civilian water systems (2003, 2.86).*
- *Using military engineers to conduct training and technical assistance for water infrastructure and management to prevent conflicts (2004, 3.27).*
- *Development of regional conflict prevention capacities within military force structures (2005, 3.23).*
- *Military development and maintenance of a global database of water resources (2005, 2.682).*
- *Military protection of water supplies (2005, 3.00).*
- *Development of national database of water resources by military (2005, 2.29).*
- *Development of rapidly deployable water supply and water purification systems (2006, 3.59).*
- *Deployment of micro- and nano-sensors in water systems (2008, 2.783).*

*Additional military requirements and/or comments on the above suggested requirements:*

- *Development of person-portable water supply and purification systems for small quantities (e.g. individual to five person group).*
- *Development of rapidly deployable groundwater and surface contamination modeling and water cleanup systems.*

The USA has done work over the years on the requirements with reference to rapidly deployable water supply and water purification systems and using military engineers to conduct training and technical assistance for water infrastructure and management to prevent conflicts. The US Army Corps of Engineers can continue to provide training and engage with other nations in water resource management, and water and wastewater treatment. Unfortunately, the force structure has been cut in the Medical Service Sanitary Engineer Corps to the point where there are only limited active and reserve forces of military engineers trained to do this work. At a 1989 meeting of Pacific Nations, all the developing countries asked for this type of assistance, but the USA and other provider nations were only offering to send combat arms and special forces to train their military.

Although the military knows where all water sources are world wide as part of contingency planning, local responsibilities for management during crises should be with civilian agencies. You do not want the military to become an extension of the police.

The military should be prepared to protect water resources during war or strife.

Water surveillance systems should be a shared civilian-military responsibility. Civilian authorities rather than the military should be used to provide training and technical assistance.

A national database already exists in non-military portions of the US government. It may be that some databases may become classified for military and selected civilian use. This also applies to certain models and analytical programs which were openly available on the Internet before September 11, 2001. The military may have a greater role due to concerns about terrorism as well as the security of allies, strategic countries and susceptible governments in countries that do not participate in alliances.

Water should be viewed through the prism of peace research. It should not be militarized. That is one important lesson for South Asia and Indo-China relations.

The military has limited capability to provide the volume of potable water that would be needed should a major civilian water system become contaminated because of terrorist or enemy action.

**3. A new and/or re-emerging disease threat or outbreak triggers conflict, social instability or disorder (e.g. AIDS goes airborne, global warming or loss of bio-diversity changes disease patterns, increasing anti-biotic resistance, etc.). (Unlike issue 1 above, which addresses a man-made biological threat, this issue focuses on natural biological threats and their mutations)**

Globalization increases the likelihood that some variation of this development will occur. As human migration increases, the biota carried within each person and by human transportation systems are inadvertently transferred to new

hosts and ecosystems more often. Man-made changes to the environment, whether through direct application of biocidal agents or through secondary effects such as global warming, will increasingly cause mutations of naturally occurring micro-organisms. This increasing distribution and rate of mutation poses challenges for the environmental, public health, and military communities.

For example, if the AIDS virus mutated and became an airborne pathogen, it would be easy to imagine many scenarios of panic and conflict. New diseases could also inadvertently trigger the loss of one or more major crops. This issue suggests a large range of other cascading effects on the environment.

Infectious diseases cause about 30 per cent of deaths worldwide. Great progress has been made in the fight against these conditions, but this progress has lulled many people into a false sense of security. In the last 20 years, more than 30 new and highly infectious diseases have been identified, such as Ebola and AIDS; for many of these there is no treatment, cure, or vaccine. Furthermore, over the last 20 years, 20 known strains of diseases such as TB and malaria have developed resistance to treatment due to the widespread use and misuse of drugs. Simultaneously, old diseases such as cholera, plague, dengue fever, meningitis, hemorrhagic fever, diphtheria, and yellow fever have reappeared as public health threats after years of decline.

Some argue that the use of military force is not a logical or effective means to address this issue. Civilian surveillance and response is the first line of defense. The most effective way to fight disease is through the success of policies that promote progress, nutrition, and better occupational conditions. The military should be used to prevent migration and enforce quarantine during such outbreaks and provide support for containment by working with the civilian authorities. Military forces may participate in a logistical capacity, and may have to protect themselves, but too many other national resources could be used for a national response. The military is used as a last resort for purposes that are not military. Police and auxiliaries should be used for quarantine purposes. Even if military forces were able to protect civilians via means of quarantine, their use would be a significant national security public policy question.

Others argue that at the transnational level, or to ensure social stability, military forces may have to be used. Although some countries like Finland do not permit their military forces to be used outside of their territory, Finland Defense Forces are prepared to assist other governmental bodies if environmental emergency situations occur. Conversely, military forces may have their operations restricted in order to prevent spread of pathogens. Recently, UK troops were denied the ability to move equipment to the USA for joint exercises because of the threat of spreading foot and mouth disease. Regardless of the policy, advanced military medicine will be called into action. For example, US military

preventive medicine and its medical community have vast experience and expertise associated with pathogens not generally seen by the civilian medical community.

In a country with limited resources, as compared to the relatively vast area to defend such as Finland with 337,000 square km, five million inhabitants, and a small defense budget, security is a task for all government bodies. During peacetime each governmental office of Finland has an obligation to constantly up-grade its emergency plan and, from time to time, practice the implementation of the plan, including different scenarios.

*Suggested military actions to address this issue:*

- Establish and maintain military medical intelligence and preventive medicine labs (2005, 3.86).
- Enhance military collaboration with public health agencies such as the EPA, WHO, and CDC (2005, 3.83).
- *Development and use of wide-spectrum vaccines* (2005, 3.35).
- *Immigration disease screening enforced by military* (2005, 2.64).
- Collaboration with or helping to establish/strengthen public health capacities in other countries (2006, 3.48).
- Forecasting disease mutations, epidemiology, and resulting conditions for conflict (2008, 3.48).
- Restricting movement of the populace by the military to prevent spread of pathogens (2008, 2.35).
- Restricting movement of troops to prevent spread of pathogens (2010, 2.40).
- *Military transborder intervention to prevent international impacts* (2010, 2.70).
- *Development and use of human immune system boosters* (2010, 2.96).

*Additional military requirements and/or comments on the above suggested requirements*

Develop special transportation norms to escape disease threat.

Military liaisons should increase their support for the network of collaborating laboratories run by the World Health Organization (WHO) to create a global surveillance system and a rapid international medical deployment capacity to respond to outbreaks of infectious disease.

#### **4. Increasing emphasis on the sustainable use of natural resources causes a complete revision of military operations including construction, base operations, and training management policies. Increasing public scrutiny and power causes military forces to change their environmental decision making processes**

Urban sprawl is causing military installations and facilities to compete with other local stakeholders for natural resources. Public perception that the military does not adequately protect these resources often drives this local competition. Although military lands may be in better condition than the

public believes, societal demands on the military and its use of land are nevertheless changing. Public complaints over dust and noise, demands for urban development of “prime” real estate, and increasing requirements for water are all external forces that compete with the use of lands by the military. If these external trends continue, military installations will be forced to cease operations due to the loss of a sustainable symbiosis with their local communities.

Others argue that in cases when people build next to military bases they have no right to complain, because they knew what they were buying into as far as jet and weapons noise, etc. In many cases the public complains when a base closes resulting in falling property value and depressed local economy.

A healthy balance exists between military training and land preservation in India. Maneuvers are done in non-agricultural planting seasons. The armed forces are deeply committed in eco restoration on their fragile borders. The military of India does occupy prime and large tracts of urban real estate; however, the pressures on it are not environmental, but due to escalating land value. There is little or no perception that these installations degrade the environment; most believe that land quality is preserved under military control. The biggest threat to urban military installations in India is a financial crisis – an impoverished government that sells the land to counter deficit spending.

Problems in the developing world cannot be compared to the US model. In the USA, military leadership refers to these external forces as “encroachment”. Since training in the field is the “holy grail” of military training, any externality that impinges on field training will be resisted by the military culture. Because these encroachment trends are not likely to reverse, military bases will have to adapt. Military leaders’ and new soldiers’ mindsets will have to change with respect to how a military installation operates over the long-term in its environment and in its community.

The knowledge gap between the public and the military about the role of the military in today’s society is growing. This is due in the USA to an all-volunteer army. Fewer people have any affiliation with the military.

#### *Suggested military actions to address this issue:*

- Military services include sustainable use of natural resources as a procurement requirement (2005, 3.53).
- Develop GIS (geographic information systems) tools to better manage military training areas and monitor local encroachment factors (2005, 3.18).
- Include the concept of environmental sustainability in basic training (2005, 3.41).
- Military services define what the requirements and objectives are for sustainable bases, sustainable operations, and sustainable systems (2005, 3.32).
- Military installation managers state environmental issues impacting natural resources in operating terms (2005, 2.55).

- Establish a “best practices database” that contains models of military environmental planning and operations that can be replicated in other regions (2005, 2.81).
- Improve the energy efficiency of military installation infrastructure by 50 per cent (compared to 2000 energy efficiency) (2007, 3.33).
- *Contract military land management to civilians who manage the sustainable use of natural resources* (2008, 2.32).
- Turn over military installations to local municipalities to manage in perpetuity for the military (as a long-term tenant) (2010, 1.86).
- *Simulation fidelity reaches a point when it can replace field training of military forces* (2010, 3.00).
- *Phase out of production internal combustion engines for the military* (2015, 2.81).

#### *Additional military requirements and/or comments on the above suggested requirements*

Develop integrated sensor systems that simultaneously provide real-time information on both military training (i.e. a digital systems for monitoring and controlling maneuver, firing, and aviation) and the ecosystem condition (i.e. assess the baseline condition of the ecosystem and track natural variations versus training induced impacts and/or “external” impacts such as regional transport of air pollutants).

The US Army has worked its land management in coordination with the States for many years to the good effect of both. Whenever there is a difference between State and Federal land management and protection laws, the more stringent applies. We will use internal combustion engines until something better comes along. It is the only technology known that is reliable. Perhaps nuclear-electric may be in the future? But we are not going to park an electric tank to plug it in to recharge and expect the enemy to hold off politely when there is a war on.

Expecting non-military local municipalities to control military land is equally silly. It is appropriate for them to control their city parks, not military maneuver lands. During wartime, the Army already goes to great lengths to preserve lands because of operational security.

Simulations will never replace field training. We will not just use simulators to train high school students how to drive a car and then let them loose on the expressway. You have to learn in the field how to do things, in all weather, with all kinds of “enemy” actions thrown in by the war-game controllers to see responses and results. You have to train in the heat, mud, sleet, snow, ice, rain, mosquitoes, skunks, blowing sand and dust, etc. and become proficient in all these situations. Only a truly proficient, professional, trained and ready military should be acceptable by any of our citizens. We want a country with a landscape worth protecting, and to do that we must apply common sense, respect and protect the land, and at the same time train hard. We can do both.



The concept of environmental sustainable operation of Federal agencies was an executive directive of the Clinton White House. This directive will be deferred until party control of Congress changes hands and increasing international pressure for environmental sustainable operations of military establishments grows.

The military has to promote better what it is doing on its installations in the area of sustainable development. It should make known its work in soil and vegetation restoration, and forestation. Military services can receive new land in bad condition and remediate it in peacetime.

### **5. The after-effects of biological, chemical, or nanotech weapons or a nuclear incident require a massive cleanup or other large-scale military response**

Nuclear, biological, and chemical weapons are considered to be weapons of mass destruction because of the large-scale destructive effects that they produce. Developments in the field of nanotechnology are likely to produce another class of weapons of mass destruction in the future. Although the environmental contamination and effects of chemical and nuclear weapons can be predicted with good accuracy, biological weapon impacts are less predictable, and due to the emerging state of the science, the effects of nanotechnology-based weapons are mostly speculative at this time. In the future, if nanotech weapons will be intelligent and self-organizing, then their impacts could be entirely unpredictable.

Although some international rules currently exist for addressing such large-scale contamination, these new threats will require new approaches. Current organizations are generally unprepared for a large-scale response to a nuclear accident and would be required to implement severe measures to stabilize an incident.

Responsibility for environmental restoration following combat operations has not been tested in an international court. Hence, there is no legal precedent on the topic. However, historic precedent is very clear. The nation owning the territory has always assumed responsibility, conducted cleanup operations, controlled access to contaminated areas or otherwise managed, or mismanaged, contaminated areas. Where transnational borders are involved, environmental restoration responsibilities can be shared, depending on the spread of contamination and the risks to human health and ecosystems, as may become the case with the Norwegian offer of assistance to Russia to assist in efforts with the Kirsik submarine. Other examples could include treaty violations for open air testing of nuclear weapons or biological agent treaties (such as with Iraq).

When a nation refuses help, or is not party to a relevant treaty, then the international community must enforce help. This implies potential forced-entry operations that impinge on national sovereignty. The criteria for such intervention are still evolving. As the United Nations Security Council authorized a forced-entry operation for food security in

Somalia, it could do so one day for environmental security. A concept of "enforced help" is more likely to be applied to critical situations in developing countries, than the Permanent Members the Security Council. The Permanent Members of the Security Council would veto such enforced help and have greater abilities to manage.

*Suggested military actions to address this issue:*

- *Military provision of medical care for those who are already affected (2005, 3.44).*
- *Develop cheap, remote sensors to allow for stand-off detection and monitoring of the after-effects of biological, chemical, or nanotech weapons or nuclear incident pollution (2010, 3.52).*
- *Plan for creation of safe emergency dumps for mass disaster cleanups (2010, 2.91).*
- *Create mechanisms to comply with eventual treaties that define what the responsibilities of the various parties are (2010, 3.14).*
- *Program an "off switch" in nanotech replicators to render them harmless (2015, 3.18).*
- *Create a self-destruct or "end-state" in bio-weapons to render them harmless (2020, 3.14).*

*Additional military requirements and/or comments on the above suggested requirements*

The technology for genetic switches is in place now and can be employed for bio-weapons. (See related comments on the first item.) The drawback is that apocalyptic insane individuals bent on human destruction will not employ bio-weapons with an "off-switch".

The "off switch" in nanotech replicators could be defeated by an enemy programmer. This leads to a new kind of intellectual arms race. And that is only for the ones "we" make. How to create an "off switch" in enemy or terrorist nano replicators? The same is true for munition end-state self-destruction. That is being done with mines, because you want to be able to clean up after a war. But we have no control over what other countries are doing.

Remote sensors have been in development in the USA for some time already, but not for some futuristic threats like nano-weapons.

The attack on the World Trade Center exposed the need for new kinds of hazardous waste dumps. WTC debris was tested on the spot for asbestos, and some metals. It was deemed acceptable for disposal at Fresh Kills Landfill. There was no alternative if the test results had showed the debris contained unacceptable levels of contamination.

Emergency dumps are necessary, but just for containment until they can be environmentally safely disposed of. We cannot just bury things. Things buried come back later to bite us. Treaty mechanisms are necessary, but there must be effective enforcement mechanisms.

Civil personnel will have to treat civilian patients, perhaps advised by military as well as civil doctors. In the USA, the

National Guard may be used to channel people to relief centers until Federal Emergency Management Administration civil personnel are available.

Military medical care will likely be limited for non-US civilians if US forces are involved in response. Another military action would be to train US and non-US civilian medical and emergency response communities in specialized decontamination and other applicable response approaches.

Military assistance can be given to foreign countries to develop their capabilities to provide medical care for those already affected.

A reviewer of the initial draft of this report commented on the above last three paragraphs: health care is provided to respective beneficiaries but the rules change when it involves life or limb – everyone is treated in emergency situations. When deployed, there are legal issues that can be resolved by agreements or plans viz. DOD/DOS/DOJ, etc. The best health care is rendered locally with appropriate augmentation or health care systems (fire dept, EMS, etc.) depending on the extent of the situation – mass casualty, etc.

## 6. A post-conflict battlefield remediation treaty is implemented

A post-conflict battlefield environmental remediation treaty seems inevitable. The environmentally destructive effects and by-products of military operations, such as unexploded ordnance which leaches explosives and heavy metals into groundwater, fuel spills and other chemicals released as a result of military action, and the destruction of vegetation by military vehicles or explosives will become central drivers for an international cleanup treaty.

This will lead commanders to consider what environmental impact their actions might have and force the development of weapons systems that create less pollution to begin with. Some argue that this could lead to reduced protection of soldiers to accommodate an ill-advised treaty. Others believe that this does not imply a reduction in force protection – just in what happens after the bullets stop flying. New military technologies, new doctrine, and new rules of engagement could result in less need for post-conflict remediation, without compromising protection of forces during the conflict.

The past emphasis of steel-on-target is moving to energy-on-target. Technological advances in electric capacitors is quickly driving the development of laser, microwave, and other energy weapons for direct fire against point targets which will be totally non-polluting. Some estimate that these energy weapons will be deployed in the battlefield within ten years.

*Suggested military actions to address this issue:*

- Development of new models and instruments to measure the environmental impact of military operations (2006, 3.14).

- *Ubiquitous cheap, remote sensors to allow for stand-off detection of pollution on military bases or of military operations by third parties (like environmental groups) (2007, 2.73).*
- Development of new institutional relationships between the military and the private sector to assist in such post-conflict cleanup operations (2010, 3.13).
- Development of non-toxic explosives (2010, 3.04).
- *Development of rules of engagement that avoid environmental damage (2010, 3.00).*
- *Development of ordnance that has a zero “dud” rate and/or which has pre-programmed self-destruct features (2010, 3.00).*
- Development of battlefield rapid remediation technologies to lessen subsequent restoration requirements (2012, 3.04).

*Additional military requirements and/or comments on the above suggested requirements*

The premise is entirely correct: we only have one planet and must protect it. After the battle, the battlefield must be cleaned up. Before and after the battle it is a place where people live.

We will *never* allow a lessening of force protection. Less protection does not keep a war from happening; it encourages someone to attack. That is why we lock our doors at night. Peace comes from overwhelming strength, the willingness to use it, and the enemy knowing that we will use it. That said, however, post-conflict remediation is necessary. It is necessary to map one's minefields so they can later be removed. The US Army has done that routinely for many years. Explosive ordnance demolition personnel will be needed to remove explosives, metal fragments, etc. from battlefields. Already, there are many private contractor companies which do only battlefield clean up and ordnance removal. They contract to many countries across the globe, clearing up after past wars.

Yes, and a test case is Afghanistan. We hope that the US/ UN effort to demine and rebuild that country may be the new Marshall plan for humanity.

As borders become better defined, the role of the military will become more defensive and its offensive capability will be replaced by it becoming a large multi-purpose crisis management and prevention team. This is a likely scenario and will define the difference between rogue nations and those that are not. It is not clear that nations with poor economies or despotic governments will care or can be held accountable for environmental damage. For example, the Taliban in Afghanistan have not paid attention to such issues and would not respect such a treaty. On the other hand the international coalition fighting them would care as they foresee the cost of reconstruction and because the survival of the coalition would depend on good practices being adopted. So the treaties would be very beneficial even though their application would be asymmetric.

Such a treaty would attempt to identify responsibility for costly environmental restoration operations. Nations will be hard pressed to ratify any such agreements. Management of unexploded ordnance and demining operations following combat operations has historically been accomplished through humanitarian assistance missions and non-government organizations (NGOs).

Absent from above narrative are current treaties on war and provisions to protect non-combatants and the environment. War (conflict) is a continuation of policy . . . and since the international community likely has failed to preempt the war (battles), what makes that community believe that the primary (successful) combatant will be willing to share in damages if that combatant believes they did all they could to prevent the conflict in the first place? On the contrary, a post-conflict battlefield environmental remediation treaty is not inevitable. International resources should be placed on preventing conflicting and holding nation states (and individuals) accountable, but not simply for the cost of remediation.

**“Once war begins a nation may be forced to use all necessary force at its disposal based on how it views its survival . . . again, those in leadership should be held accountable for their actions after war termination. ”**

Once war begins a nation may be forced to use all necessary force at its disposal based on how it views its survival . . . again, those in leadership should be held accountable for their actions after war termination. In the First World War, poison gas was used (inefficiently) and in the Second World War the USA used nuclear weapons to end the war with Japan and to save American lives that would have been lost in any invasion. Again, it is admirable and should be a goal to develop non-toxic or low-toxic weapons that can be used in low-intensity conflicts; however, it is doubtful that other more environmentally damaging weapons will be held in abeyance if national survival is at stake.

Naturally such a treaty is needed, but also specific monitor and enforcement provisions, including financial and/or restoration procedures.

It is likely that post-conflict peacekeepers will have environmental remediation goals/objectives as part of their oversight and terms for turning portions of the country back to the citizens and new government. Add land mines to unexploded ordnance.

Develop division/battalion scale unit(s) that employ primarily non-lethal, non-environmentally impacting weapon systems and doctrine.

Future conflicts may assume features that are asymmetric in nature. This may result in major difficulties when trying to estimate globally a post-conflict battlefield remediation treaty system. Possibly new approaches could utilize some existing regional, or even sub-regional systems. This could include new military technologies and doctrines. If the Kyoto Protocol is still far from being in force and actually implemented, then the international community is most likely to have even greater difficulties in finding any relevant approach for a global war-time or post-war-time treaty.

New rules of engagement can help “minimize”, but avoiding environmental damage may be virtually impossible. Independent third-party intervention during post-conflict should be strictly controlled, given safety, security, adverse public affairs, and political considerations. Better that such third-party intervention be conducted in conjunction with military teams – sharing results/samples.

## **7. Military forces are given a new role in environmental conflict prevention and/or resolution**

Since environmental factors are just as likely to contribute to instability as political, social, or economic ones, environmental conflict prevention or resolution may be an important part of environmental security. For example, the military could be called upon to provide water resources where it is too dangerous for regular development agencies, or to prevent further deforestation of rainforests that have been reduced to the point of threatening a critical element of global life support systems.

As the UN puts more emphasis on environmental security, which will be reflected through its peacekeeping operations, national militaries that participate in UN peacekeeping will be influenced. Environmental destruction prevention, environmental education, and environmental restoration could become elements of future peacekeeping missions. However, some argue that prevention of environmental problems that could contribute to conflicts is the province of other (non-military) agencies.

*Suggested military actions to address this issue:*

- Training of soldiers for environmental missions (2005, 3.54).
- Development of new military equipment for environmental missions (2008, 3.36).
- Development of a UN doctrine for environmental security operations (2008, 3.26).
- Simulation fidelity reaches a point where it can replace field training of armed forces (2015, 2.62).

*Additional military requirements and/or comments on the above suggested requirements*

None of the above military actions actually supports “environmental conflict prevention and/or resolution” . . . they

are primarily reactive or logistical – logistics is a strength of the military. The military is subordinate to civilian authority and would not develop a UN doctrine. This would have to come from civilian sources at the UN, since there is no standing UN military force. (Authors' note: the military could advise their civilian representatives who participate in such UN doctrine development.)

Environmental security is the most sophisticated outcome of the security dialogue that overlaps with the concept of human security. The military should collaborate with the UN to develop quickly doctrines, equipment, training, and a manual or publication to sell the concept. Currently there is no mention of the environment in the two-week syllabus for international peacekeepers at the Indian UN Center.

Prevention of environmental problems that could contribute to conflicts belongs to non-military agencies. The UN has difficulties in running peacekeeping operations. This reflects the lack of will of major member states to participate in UN-led major military operations, because "there are more important tasks to be done". If peacekeeping operations in the future were more environment oriented, the UN could find it difficult to acquire troop-contributing nations, even in the numbers it has today.

Protecting the rainforests is very problematic; this one has no easy answers. We cannot threaten *campesinos* with rifles nor can we dictate to other countries how they will care for their resources. We can encourage, we can help, but not dictate.

Unless under UN/international mandate, external military forces used to protect the rainforest would not be tolerated.

Such an environmental doctrine could be adopted by coalitions, geographic alliances, and the UN.

At least in the US military there is an agency devoted in part to environmental care, the US Army Corps of Engineers-Civil Works. The USACE-CW builds roads, drills wells, builds schools, creates power-plants, and many more projects around the world as part of "nation-building" efforts. These efforts do a lot to defuse fights over various resources, especially water. All nations need to do even more of this. However, USACE-CW is almost not even a part of the military. It does not go to war. It grew out of the nation's early need to map the frontier and build fortifications. Today it is located in Corps of Engineers Districts, most of which are geographical, and they act as contracting agents for Federal construction projects, such as Post Offices, using civilian construction contractors. The regular Corps of Engineers does go to war, the Combat Engineers.

Military equipment is not for environmental missions, and soldiers are not for non-military missions. Equipment for environmental work is only in the private sector. When there are environmental needs for equipment and personnel efforts entrepreneurs step in and provide what is needed under contract to governments.

Other than in cases of shared scarce water resources or massive development of air or water polluting industry upstream, what environmental issues can cause transnational conflict?

Military support on water resources will be limited compared to existing civilian systems. The military can provide training on broad water resource management issues and more specifically on deployable field (small) water treatment systems.

Simulation fidelity will assist training, but will never replace field training under field conditions.

## **8. Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces. A rogue nation develops doctrine to target environmental quality as an objective of warfare**

Since September 11, 2001, it is increasingly clear that future conflicts are likely to be more asymmetric and driven by "rogue" states and terrorists. Several years ago, one major country published a military doctrine that included attacking the environment as a part of "total war". These factors will change the nature of the environmental challenges facing military forces. For example, military forces will increasingly be used in areas not considered "hostile" territory, forcing them to consider the economic and public health end-state of the conflict in addition to the political and military outcomes. Such conflicts will be fought among civilian targets and in cities. Many will be with guerilla forces.

These situations will also encourage pre-emptive strikes, and coalition take-overs of rogue states and subsequent forced internal re-organization, as is occurring in Afghanistan. Public safety and human welfare will likely dominate these conflicts, which will affect what weapons and tactics are used. Military forces will be required to follow specific environmental rules of engagement.

*Suggested military actions to address this issue:*

- R&D for defense against such asymmetric attacks (2004, 3.7).
- Use of military forces to isolate "rogue" states (2004, 3.64).
- Development of doctrine for military responses to attacks on the environment (2005, 3.69).

*Additional military requirements and/or comments on the above suggested requirements*

All the various intelligence sources will need increased emphasis to ascertain capabilities and intentions. More often in the future, when a hostile intent is discovered, there will be a willingness to make pre-emptive strikes. Once we have a massive strike at the USA by a rogue state or group in which several hundred thousand citizens are killed, there will be very little further domestic hesitation to have pre-emptive strikes by the USA in order to prevent further rogue strikes. Note that in the current crisis, Italy, Russia, France, the UK,



Japan and some other countries volunteered military assets well before they were asked for. They are insisting they be allowed to participate, for they know they may be next.

Closer partnerships between military and civilian intelligence communities to improve both the capability to anticipate terrorist attacks on environmental targets and to improve real-time military responses to respond to the attacks.

A development of a military doctrine for the prevention of military attacks on the environment needs to be developed by the UN. Specific sanctions and military action against rogue states should be considered if they destroy an ecosystem. Market forces and other mechanisms (sanctions) also must be used to isolate "environmental destroyer" rogue states.

There is a need to have enforceable conventions to ensure that those (including rogue states and individuals in leadership roles) who needlessly damage the environment during total war are held responsible on war termination.

Future agreements or conventions should be enforced by previously defined military procedures by the UN for intervention in case of violation.

Rethink ENMOD convention. Let us not have too many treaties and conventions (only to be understood by academics, selected policy makers and international lawyers), rather like a principle of war simplicity is the key in addressing environmental issues. ENMOD should be the base.

Create a definition of "a rogue state" based on concepts of international law and charter of the UN.

## **9. Other environmental developments, issues, or threats that will create new military requirements sometime between 2010 and 2025**

The future of failed nation states will pose new military requirements. Today, many developing nations (and Russia) are regressing. Health and education systems are failing, life expectancy is dropping, environment is degrading through pollution and abuse, human rights are being violated, and resources are being abused. In many cases a very large part of the problem is ignorant, despotic leaders. Will the international community label these rulers as rogues and create laws that provide a mandate to agencies like the UN Security Council to label these rulers as criminals? Will they give authority to an international military coalition to bring them to justice in an international court of law, by use of force if necessary? If so, then that will create new military requirements. The state of the world suggests that such measures will need to be contemplated by 2010.

Environmental refugees will have destabilizing regional impacts. For example, desertification will become more of a problem on the margins of the Sahel, Sahara, Gobi, Mesabi, Mexico, and many other deserts due to overgrazing and over-farming. Greece, Lebanon, and many other formerly forested areas have been laid bare to the rocks. People will

want to migrate out of these areas, and into the expanding northern temperate forests that are expanding due to global warming. Northern temperate zone forests are becoming demonstrably leafier and more productive, and spreading into areas formerly just grasslands. Formerly marginal grazing lands are becoming better farmlands, such as in the Ukraine and the steppes of Mongolia. As conditions in these areas get better more people will be attracted to them. Attempts at expansion by China into these areas is especially probable. The current mass movement of people from South and Central America into the USA can be expected to increase dramatically. Mass movements of people will be accompanied by military attempts on one hand to assist, and on the other to resist.

A related development is the rapid urbanization in less developed nations with lack of institutional capacity to manage the influx of population causing increased societal stress such as the problems of unemployment and youth crime.

Increasing use of military forces in humanitarian response to natural disasters, e.g. flood, drought, gives rise to the requirement for military forces to be better equipped to respond, transport equipment to international humanitarian emergencies, and plans to respond to these emergencies.

Electromagnetic "broadcast" field weapons that could affect the psychological states or the ability to accurately perceive the environment may be developed and used. Large or very directed portions of the population could be affected for a small amount of cost and reused. Research is ongoing now on the changed state of individual mental states (euphoria, ecstasy, terror) experiencing a magnetic field as a possible explanation for religious or near death states. As this becomes better known, means to induce it at a distance may become possible.

The threat of intentional, unintentional or accidental use of weapons of mass destruction will need a good and creative disaster response (to some degree this is related to item 5). The UN Department of Peacekeeping is not prepared for this possibility. A global fund may have to be created and military in each region given the wherewithal to undertake disaster management operations. NATO can be a role model and can start programs for various regions, if requested by the UN. US military with others like China and India could conduct training and seminars. UN University has a crucial role to play. It would be better to attempt this project through peace research (a more difficult path) than through militarization of security. There is always "strategy" which is deeply embedded as the military dimension of international relations. The change of the mindset is the most important, but difficult as it has strains of idealism. The UN University of Peace (different from the UN University which is part of the UN system and headquartered in Tokyo; the UN University for Peace is headquartered in Costa Rica and not part of the UN system) has peace and security as its charter through

education, training, and research. Their approach is peace with each other, peace with nature, and peace within ourselves. Such ideas may need to be incorporated so that they appeal to the non-military actors as well at the psycho-spiritual level.

International military forces could be established with carefully defined tasks, authority, and rules of engagement. This must be at the main focus of global governance.

An alternative approach to a UN standing military is that governments could identify troops to provide a rapid response capability for UN peacekeeping and building who have been trained together, with compatible equipment and communications.

Increasing the role of the coast guard in all phases of border protection and assisting in immigration. The Army and other active forces should not be in this business. There is too much effort being made to use the military for domestic issues, when other agencies are paid for the role for years. For example, the immigration and naturalization service (INS) should be upgraded to control and track all immigration to counter disease and terrorist threats.

Reinstatement of universal service and training for the population will become a necessity in the future. The whole population will need at least basic military training to ensure their ability to survive in an unstable society. The military has historically trained large numbers of young people who return to the community with basic skills to serve the nation. Many of the current police, fire and health care professionals got training via the military. This is a good thing for building the national identity of a shared experience regardless of ethnic, religious or other differences.

The prohibition of nuclear powered battle-ships and submarines by 2020.

Military forces trained in low-intensity conflict are better able to assist police and National Guard (equivalent) in other nations – complex urbanized peacekeeping operations. Applicable legal authorities will need to be granted to allow military forces to engage in this manner.

### Major themes

There was broad disagreement about the degree of military responsibility vs. civilian responsibility for environmental security. In general, richer countries saw civilian environmental agencies as having a much larger role than the poorer countries. Third World countries, with few civilian environmental systems in place, saw the military as having the leadership role in environmental security. As a result, First World environmental security assistance to developing countries should focus on improving military capacity in the short-run and civilian environmental sector in the longer-run.

However, research for counter measures in developing countries has to originate from civilian research and development, as military research is less developed in the Third World than their civilian sector. Hence, First World

research assistance on environmental security matters should be conducted with civilian institutions in the Third World.

Some participants maintained a strong sentiment that the role of the military is distinct from environmental issues and that the military should not be involved in environmental protection.

There was broad agreement that a military doctrine for the prevention of military attacks on the environment needs to be developed by the UN. National sovereignty issues must be faced and resolved. Under what conditions could environmental damage be so severe to be of concern to all of humanity and intervention authorized by the UN Security Council?

US participants tended to judge the implementation of military requirements to be much sooner and effective than the non-US respondents. In general there was a high correlation between the implementation dates and the perceived effectiveness of the requirements: more effective the requirement, sooner the year for implementation.

There were divergent opinions over civilian vs. military control of water systems to prevent a crisis or protect them during a crisis. Also, it was considered that creating effective “off-switches” for bio-weapons and nano-weapons will be an on-going intellectual arms race.

Since the capabilities of bio-weapons are diverse and access could become so broad, preventing the motivation of their use through general education to enlighten the public, and the mitigation of hostilities among nations, societies, and social groups may be the only realistic approach to prevent bio-disasters in the long run. Nevertheless, there are new requirements that the military could implement that could help address potential environmental security threats.

The requirements/actions were grouped in four major themes that were evident:

- (1) collaboration between the military and other organizations;
- (2) technology;
- (3) training;
- (4) new roles for the military.

The items in the groups are listed with respect to the year of implementation and rank ordered by efficacy (indicated respectively in parenthesis).

### Collaboration between the military and other organizations

Many of the developments/actions/requests that were rated of high effectiveness and with earliest implementation year showed the need for collaboration between the military and other organizations:

- Coordination of military activities with civilian biological defense assets (2002, 4.05).
- Integration of military epidemiological systems with national epidemiological systems (2003, 3.91).

- Enhance military collaboration with public health agencies such as the EPA, WHO, and CDC (2005, 3.83).
- Development of new institutional relationships between the military and the private sector to assist in such post-conflict cleanup operations (2010, 3.13).

### Technology

The need to develop new technology(ies) was involved in many actions, although those were not necessarily between the highest rated with respect to effectiveness:

- Development of rapidly deployable water supply and water purification systems (2006, 3.59).
- Development of stand-off bio-sensors (2006, 3.30).
- Ubiquitous cheap, remote sensors to allow for stand-off detection of pollution on military bases or of military operations by third parties (like environmental groups) (2007, 2.73).
- Development and use of wide-spectrum vaccines (2008, 3.48).
- Deployment of micro- and nano-sensors in water systems (2008, 2.87).
- Develop cheap, remote sensors to allow for stand-off detection and monitoring of the after-effects of biological, chemical, or nanotech weapons or a nuclear incident pollution (2010, 3.52).
- Development of non-toxic explosives (2010, 3.05).
- Simulation fidelity reaches a point when it can replace field training of military forces (2010, 3.00).
- Development of ordnance that has a zero "dud" rate and/or which has pre-programmed self-destruct features (2010, 3.00).
- Development and use of human immune system boosters (2010, 2.73).
- Program an "off switch" in nanotech replicators to render them harmless (2015, 3.18).
- Phase out of production of internal combustion engines for the military (2015, 2.81).
- Create a self-destruct or "end-state" in bio-weapons to render them harmless (2020, 3.14).
- Using military engineers to conduct training and technical assistance for water infrastructure and management to prevent conflicts (2004, 3.27).
- Establish and maintain military medical intelligence and preventive medicine labs (2005, 3.86).
- Development of doctrine for military responses to attacks on the environment (2005, 3.70).
- Use of military forces to isolate "rogue" states (2005, 3.64).
- Military provision of medical care for those who are already affected (2005, 3.44).
- Military development and maintenance of a global database of water resources (2005, 2.68).
- Enforcement of biotech export controls by military (2005, 2.68).
- Limits to immigration enforced by military (2005, 2.64).
- Immigration disease screening enforced by military (2005, 2.64).
- Development of national database of water resources by military (2005, 2.29).
- Restricting movement of the populace by the military to prevent spread of pathogens (2007, 2.35).
- Pre-emptive military strikes to destroy bio-weapons (2009, 3.22).
- Military transborder intervention to prevent international impacts (under item: new and/or re-emerging disease threat. . .) (2010, 2.67).
- Restricting movement of the populace by the military to prevent spread of biological agents (2010, 2.48).
- Restricting movement of troops to prevent spread of pathogens (2010, 2.4).
- Development of battlefield rapid remediation technologies to lessen subsequent restoration requirements (2013, 3.05).

### The impact of September 11

Finally, a note about September 11. It is the opinion of the authors that the events of September 11, 2001 and subsequent Anthrax attacks via the mail have changed the views of participants on the international panel for this study. Threats that would have seemed many years in the future, now seem much more likely to occur sooner than before. Military requirements that might have been estimated to go into effect in 10-25 years, are now considered to be required much sooner. For example, prior to September 11, the participants in this study estimated that new military requirements to address the use of biotechnology to build new kinds of weapons of mass destruction in 15 years. After September 11, the panel estimated military requirements to address this issue would come into force on the average six years from now. Taken as a whole, suggested developments prior to September 11 were judged to affect the military in over ten years; after September 11 most of the suggested requirements were estimated to occur before ten years. ■

### Training

All three requirements involving training were rated relatively effective and necessary to be implemented sooner than five years.

- (1) Training military forces for quick response after an attack by such bio-weapons (2003, 3.83).
- (2) Assisting in the formation and training of biological defense units in other countries (2005, 3.73).
- (3) Training of soldiers for environmental missions (2005, 3.55).

### New roles for the military

- Military security and oversight for selected civilian water systems (2003, 2.86)