

FUTURE INTERNATIONAL ENVIRONMENTAL SECURITY ISSUES AND POTENTIAL MILITARY REQUIREMENTS OVER THE PERIOD OF 2010 TO 2025

**Jerome C. Glenn and Theodore J. Gordon
December 2001**

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**Jerome C. Glenn and Theodore J. Gordon
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The views expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of the U. S. Government, the Department of Defense or any of its agencies.

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ABSTRACT

This report is the result of a Delphi study chartered to explore future environmental security issues having potential military implications over the period of the Army Transformation. For the purposes of this study, environmental security is broadly defined as the viability of environmental (natural) systems to provide life support, with three sub-elements: preventing or repairing military damage to the environment; preventing or responding to environmentally caused conflicts; and protecting the environment due to the moral value of the environment itself. Panels of futurists, environmental scientists, and military personnel provided assessments of major issues and their causes. The study's participants concluded that military requirements are changing as a result of new kinds of weapons, asymmetrical conflicts, increasing demands on natural resources, urbanization that is making more people dependent on vulnerable public utilities, continued advances in environmental law with escalating environmental litigation, and globalization that is increasing interdependence. The study also reached a consensus on five major emerging issues worth further monitoring and assessment for their environmental implications to the Army: the use of biotechnology to build new kinds of weapons; a significant military conflict over water; the role of diseases in triggering conflicts; an increasing emphasis on the sustainable use of natural resources; and the role of the military in large-scale remediation of chemical, biological, nuclear, or nanotechnology incidents or weapons use.

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EXECUTIVE SUMMARY

For the purpose of this study, environmental security is defined as environmental viability for life support with three sub-elements: preventing or repairing military damage to the environment; preventing or responding to environmentally caused conflicts; and protecting the environment due to the moral value of the environment itself.

The purpose of this international assessment was to identify and discuss environmental issues that may affect the U.S. Army's Transformation efforts in the mid-term (2005-2010) and the long-term (2010-2025) 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.

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, and globalization increasing interdependency, all make the issues in this study timely for military consideration.

Participants in the study reported increasing awareness of environmental security matters among the militaries around the world; however, it is still a very low priority compared to other military matters. There were 88 participants in the study. Their demographics are:

National Orientation

Developing Countries = 37

US = 36

Other First World = 15

Professional Orientation

Military = 44

Futurists = 25

Environmentalists = 19

A three-round Delphi with an international panel resulted in eight environmental security developments and potential military requirements to address them. They were chosen on the basis of their importance and likelihood as well as their ability to generate a rich set of military requirements. More complete details are in Chapter 4. The eight developments and the years when they are estimated to influence military requirements are:

- Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once. (2015) This includes the possibility of the special case of adapted organism weapons developed to attack mono-culture agriculture. (2020)
- A major military conflict over water is understood by world leaders as extremely plausible. (2015)
- 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 biodiversity changes disease patterns, increasing antibiotic resistance, etc.). (2015)
- Increasing emphasis on the sustainable use of natural resources causes a complete revision of military operations including construction, base operations, and training management policies. (over 2050)

- The after-effects of biological, chemical, or nanotech weapons or a nuclear incident require a massive cleanup or other large-scale military response. (2010)
- A post-conflict battlefield remediation treaty is implemented. (2015)
- Military forces are given a new role in environmental conflict prevention and/or resolution. (2015)
- 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. (2015)

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 ten to twenty-five years, are now considered to be required much sooner. For example, prior to September 11th, 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 would be needed in fifteen years. After September 11th, 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 11th were judged to affect the military in over 10 years; after September 11th most of the suggested requirements were estimated to occur before 10 years.

The complete results of the participants' judgments about the military requirements to address the environment-related developments are in Chapter 4. For each of the eight developments, the top three requirements rated most effective by the panel are listed below with the average estimated year of occurrence. The panel also suggested additional requirements; samples of these are also listed for each issue (being newly suggested, they were not rated).

1. Biotechnology is used to build new kinds of weapons.

Coordination of military activities with civilian biological defense (2002)
Integration of military with national epidemiological systems (2003)
Training military for quick response after attack by bio-weapons (2003)
Focus intelligence cooperation with civilians on dispersal systems
Develop molecular biological models identification and rapid medical response
Provide input to the eventual biotechnology weapons treaty

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

Rapidly deployable water supply and water purification systems (2006)
Military engineers for water infrastructure training and technical assistance (2004)
Regional conflict prevention capacities within military force structures (2005)
First World training of Third World personnel in water resources management
The military should be prepared to protect water resources during war or strife
Water surveillance systems should be a shared civilian-military responsibility

- 3. A new and/or re-emerging disease threat or outbreak triggers conflict.**
 - Military medical intelligence and preventive medicine labs (2005)
 - Military collaboration with public health agencies (2005)
 - Establish/strengthen public health capacities in other countries (2006)
 - Increase liaison with WHO in global surveillance and response system
 - Develop special transportation norms to escape disease threat
 - Resolve disagreements on military role (such as in quarantines, treatment)
- 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.**
 - Sustainable use of natural resources as a requirement (2005)
 - Concept of environmental sustainability included in basic training (2005)
 - Energy efficiency of military installation infrastructure increased by 50% (2007)
 - Develop integrated sensor systems
 - Environmentally sustainable operations enforcement is politically dependent
 - Promote/communicate what the military is doing in environmental stewardship
- 5. The after-effects of biological, chemical, or nanotech weapons or a nuclear incident require a massive cleanup or other large-scale military response.**
 - Develop cheap sensors for after-effects of bio, nano, etc. pollution (2010)
 - Military provision of medical care for those who are already affected (2005)
 - "Off switch" in nanotech replicators to render them harmless (2015)
 - Strategy to affect enemy with "off switches" for bio-tech and nano-tech weapons
 - Develop new kinds of hazardous waste dumps
 - Develop foreign assistance and intervention protocols
- 6. A post-conflict battlefield remediation treaty is implemented.**
 - New models to measure impact of military operations (2006)
 - New relationships between military and private sector for post-conflict cleanup (2010)
 - Battlefield rapid remediation to lessen subsequent restoration (2012)
 - Resolve disagreements on likelihood and impacts of such a treaty
 - Military roles in multi-purpose crisis management and prevention teams
 - Develop division/battalion scale unit(s) that employ primarily non-lethal, non-environmentally impacting weapon systems, and doctrine.
- 7. Military forces are given a new role in environmental conflict prevention and/or resolution.**
 - Training of soldiers for environmental missions (2005)
 - New military equipment for environmental missions (2008)
 - UN doctrine for environmental security operations (2008)
 - Collaborate with the UN to quickly develop new doctrine and a manual
 - Mixed views and disagreements on implications and roles for the military

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.

R&D for defense against such asymmetrical attacks (2004)

Development of doctrine for military responses to attacks on the environment (2005)

Use of military forces to isolate 'Rogue' states (2004)

Intelligence cooperation with non-military sources for pre-emptive strikes

Rethink ENMOD convention, but use as the basis for future agreements

Create enforceable conventions and define "Rogue" States

The participants also suggested other developments for which new military requirements are likely. The complete list is in Chapter 4. Here is a sample:

- The future of failed nation-states will pose new military requirements
- Environmental refugees will have destabilizing regional impacts
- Increasing use of military forces in humanitarian response to natural disasters
- Increasing interest in some form of international military force to address environmental matters

Four themes were apparent in the list of requirements:

- Need for collaboration with other agencies
- Need for training
- Need to develop new technology
- Possible emergence of new environmental-related missions

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 the 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 as to be of concern to all of humanity and intervention authorized by the UN Security Council?

U.S. participants tended to judge the implementation of military requirements to be much sooner and more effective than the non-U.S. 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. (See Figure ES-1.)

Median Date vs. Efficacy

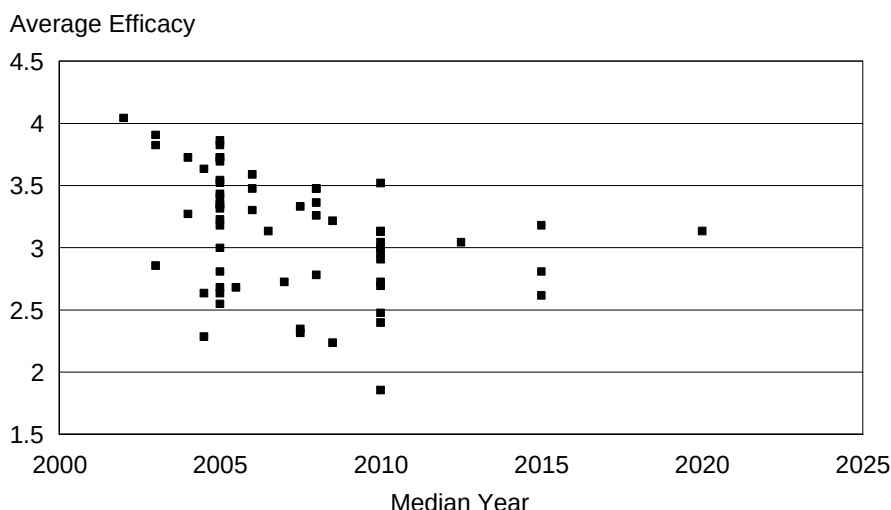


Figure ES-1

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.

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1. INTRODUCTION

This report was based on a three-round Delphi.

Beginning with a list of several hundred potential environmental security related events prepared by U.S. 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 D.C. 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 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 to rate the items as to their likelihood of occurrence, importance if the emerging environmental issues 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: U.S. military personnel. Group voting software was used to capture participants' views and ratings. These discussions are a rich source of information presented in Appendix E.

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: a) short descriptions of potential environmental security issues; b) 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; c) the effectiveness of the actions or requirements to address the issue; and d) the year the military in their country might implement the new requirement.

The following three chapters present the results of each Delphi Round. Full details of each round are in the appendices.

The text for the descriptions of environmental security developments in Chapter 4 were drawn from input from Rounds 1-3 and previous research by the Millennium Project of the American Council for the United Nations University for the Army Environmental Policy Institute.

2. Ratings of Initial List of Environmental Security Developments- Round 1

A list of 43 environment-related potential developments that could affect military requirements between 2010-2025 was included in Round 1. These developments were based on a list of environmental security events or emerging issues that might affect military requirements and preliminary discussions with military personnel, military attachés to Washington, D.C., environmentalists, futurists, and scientists.

Participants rated the developments by their importance, likelihood, and year when they might be actually adopted if they were to affect military requirements (be it statutory, regulatory, or by treaty). The participants also included other emerging environmental issues or events that are very likely and would have significant impact on the military between 2010 and 2025. The full questionnaire is available on the Internet at <http://acunu.org/millennium/es-rd1-01.html> and is included in Appendix A of this study.

The Results are listed below in three groups: developments likely to affect military requirements in about 10 years, 15 years, and 20 years. Within each group, the developments are listed in order of likelihood and of impact on military bases, operations, and/or systems (if they occur).

The numbers in parenthesis represent the average likelihood rated using the following scale:

- 5 = almost certain
- 4 = very likely
- 3 = possible
- 2 = not very likely
- 1 = will never happen

Developments likely to affect military requirements in about 10 years

- UN develops environmental health standards for peacekeeping troops. (3.71)
- Transboundary conflicts cause challenges between sovereignty and environmental security in a supranational forum. (3.68)
- The military is given a new role in environmental conflict prevention and/or resolution. (3.52)
- Domestic (homeland defense) operations of military forces generate environmental mitigation requirements. (3.46)
- Environmental concerns lead to the closure of a military installation. (3.45)
- Artificial genetic pollution is recognized as a global environmental safety or occupational health threat. (3.40)
- The first eco-sabotage event takes place against a military installation. (3.34)
- A rogue nation develops doctrine to target environmental quality as an objective of warfare. (3.30)

- A standing multinational force is created to respond to natural environmental disasters. (3.28)
- New climate change data causes hysterical protests threatening political stability around the world. (3.25)
- Military force is applied to curtail the smuggling of internationally banned substances (POPs, CFCs, etc.). (3.21)
- A global push for environment-friendly non-lethal weapons emerges. (3.07)
- The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements. (2.87)

Developments likely to affect military requirements in about 15 years

- A major military conflict breaks out over water resources/quality. (4.00)
- A major military conflict breaks out over energy resources. (3.77)
- Increasing public scrutiny and power causes military forces to change their environmental decision-making processes. (3.72)
- Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once. (3.62)
- Recognition that nuclear power plants require worldwide coordinated long-term monitoring and protection. (3.57)
- Adapted organism weapons are developed to attack mono-culture agriculture. (3.54)
- Urban conflicts supplant open country battles as the terrain of choice for initiators. (3.54)
- New sources and management of energy alter global political power relations. (3.41)
- A prominent national dispute/debate develops over the subject of giving up sovereignty over environmental issues for the global good. (3.35)
- Intergenerational equity emerges as a required factor in environmental decision-making. (3.31)
- World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control. (3.29)
- Perchlorates are banned from global use. (3.29)
- Environmentally-driven migration triggers an international conflict. (3.27)
- Telemetrics enables any environmental interest group to detect and measure almost any environmental pollutant from a standoff position. (3.21)
- A standing international tribunal is established to prosecute international environmental criminals. (3.19)

- Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies. (2.97)
- A post-conflict battlefield remediation treaty is implemented. (2.90)
- Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces. (2.76)
- The world's 20 largest military forces adopt ISO 14000. (2.73)
- A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict. (2.62)

Developments likely to affect military requirements in about 20 years and beyond

- The first space-based beamed energy system is deployed for use by military forces. (3.60)
- The civilian environmental protection agency develops regulations to control potential nano-pollution from the nano-bio-infotech industries. (3.42)
- Large-scale ocean farms are created. (3.42)
- Invasive species problems become pandemic and uncontrolled owing to unbridled trade & human movement; the economic losses pass the \$10 billion mark. (3.21)
- Water extraction from the air is developed as a desalination/water purification alternative technology for military forces. (3.00)
- The Army achieves a lead (Pb)-free military infrastructure. (2.86)
- Free market environmentalism drives the development of green and energy efficient military systems. (2.76)
- Military forces are deployed in drought prevention (not mitigation or relief) measures. (2.67)
- The last internal combustion engine is produced for the military usage. (2.44)
- Sub-ocean deposits of methane hydrates either boom (provide clean carbon) or blow-out (devastatingly auto-release to the atmosphere). (2.33)

Some highlights concerning the numeric (rating) responses in this first round:

The rating of the developments with respect to the significance of the impact on military bases, operations, and/or systems (if it occurs) was extremely tight, ranging from 3.93 to 2.76 (on a scale 5 to 1) for 43 items.

The five **highest** rated developments by respect to their **importance** were:

- Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.
- Adapted organism weapons are developed to attack mono-culture agriculture.

- A major military conflict breaks out over water resources/quality.
- World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control.
- A standing multinational force is created to respond to natural environmental disasters.

As for the **likelihood**, the ratings were more diverse, ranging from 4.00 to 2.33. The developments rated most likely to occur and affect military requirements were:

- A major military conflict breaks out over water resources/quality.
- A major military conflict breaks out over energy resources.
- Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.
- UN develops environmental health standards for peacekeeping troops.
- Transboundary conflicts cause challenges between sovereignty and environmental security in a supranational forum.

It is interesting to note that the only development that was rated very high for both importance and likelihood was: *A major military conflict breaks out over water resources/quality.*

The developments with the *highest disagreement* between respondents regarding the *year* it might occur were:

- New sources and management of energy alter global political power relations.
- A global push for environmental friendly non-lethal weapons emerges.
- Artificial genetic pollution is recognized as a global environmental safety or occupational health threat.

Appendix D presents another grouping of the developments: by higher importance with higher likelihood, and higher importance with lower likelihood.

The most important and newly suggested developments were distilled and discussed during Round 2.

3. Discussions of Environmental Security Developments - Round 2

The results of the first round provided the input for the *second round*, a series of three workshops in which the list of suggested developments was extended and refined, judgments reasserted, and military requirements resulting from the developments were postulated and discussed.

The participants in the three one-day workshops were:

Day 1: August 8, 2001: futurists, environmentalists, and scientists

Day 2: August 9, 2001: Military Attachés to Washington, D.C.

Day 3: August 10, 2001: U.S. Military personnel

A group voting software that permitted participants to provide the answers through a computer terminal facilitated the workshops. The group's responses were then displayed on a monitor for discussion and refinement. Because of the limited time, not all the items were discussed in the workshops. The participants had the chance at the beginning of the workshop to select, by vote, the developments they wanted to discuss. Some 14 developments were reviewed at the first workshop, 19 at the second and 37 at the third.

The workshops produced a very rich list of possible developments related to environmental security, and provided estimates of importance, likelihood, and when a military requirement might emerge. Appendix D provides the complete list of developments discussed and rated during the workshops.

In addition, the workshop discussions provided many insights and suggestions about military requirements. Appendix E is the complete edited text of the comments.

For example, the discussions of military requirements surrounding the item

New disease threat or outbreak creates social instability or disorder (e.g., AIDS goes airborne, global warming changes disease patterns, loss of bio-diversity changes disease patterns, increasing anti-biotic resistance, etc.)

elicited the following comments:

- The possibility of containment / border control / transportation control
- What kind of R&D for countermeasures
- Counter-vector (spraying for mosquitoes, etc.) operations
- The more the military studies these diseases, the more they will be prepared.
- Ebola could be spread by martyrs-as they travel the world.
- Threat recognition analysis and verification systems for this type of transnational threat must be formulated.
- The military hospitals will work with other health care systems to assist people infected by the disease.

- Civil-military emergency prevention and law enforcement collaboration will be required.
- More intensive communications with CDC and WHO
- Effects will vary between nations depending on the public educational and health standards and the ability of the authorities to deal with such mishaps. The military has to take these matters more seriously and has to prepare itself to react in a very short time.
- Advanced planning is needed to complement the civilian health services, either with the military health corps, or with the employment of military health facilities; plan the use of the resources, tasks for the military and ways not to interrupt or interfere with the civilian health services, but to integrate our efforts with theirs.
- Where is the line between military and police functions in response?
- Who decides when it is the police and when it is the military? Does the government have such a department?
- Must have force protection before the troops are sent into a disease area
- All the environmental organizations in a country (civilian and military) have to have a central coordination office and then carry out tasks according to their capabilities.
- The military has to consider such environmental-related issues in its training.
- Is there a difference between how military forces would operate domestically vs. how they would operate in another country?
- We have to begin studying if this type of problem is a national issue or a regional or international problem.
- Should there be regional response teams created, composed of military units from various countries?

Highlights based on the quantified responses:

The most controversial issue was *conflict about water*; it was considered one of the most important and likely emerging issues by the futurists, but less likely and important by the military attaches and U.S. military representatives.

The same was the case for a *standing (or on call) multinational force is created to respond to natural environmental disasters* on which the military diplomats and representatives do not agree with the futurists who considered it very likely.

The following developments had the highest rate of agreement of the three groups with respect to likelihood, importance and timing:

- *Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.*
- *World economies bid wildly for energy after petroleum production peaks in the face of rising demand.*

For some actions, although there was a high agreement of all three groups on the importance and likelihood, there were considerable disagreements on the timing:

- *Adapted organism weapons are developed to attack mono-culture agriculture*: about 10 years by futurists, 5 years by military diplomats and over 20 years by the U.S. military.
- *Bio/nano/chemical weapons require mass cleanup*: about 10 years by futurists, 5 years by military diplomats and over 15 years by the U.S. military.
- *Nuclear facilities become targets*: about 1 year by military diplomats and just over 10 years by futurists and U.S. military.

Organized crime threatening decision-making was not considered happening in the next 15 years; however, it was seen likely and important by the futurists, but not so much by the two military groups.

Futurists and military diplomats agreed that a *new disease creating global panic* is important and likely to happen in about 15 years.

Futurists consider more important and likely than the U.S. military representatives that *military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements* and that *the last internal combustion engine [will be] produced for the military usage*. However, both groups agree that these are very long-term actions.

U.S. military representatives considered more likely and important than the military diplomats that:

- *New sources and management of energy alter global political power relations.*
- *Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.*

There was a high agreement between military diplomats and U.S. military representatives on importance, likelihood and timing (happening within the next 10 years) that *urban conflicts supplant open country battles as the terrain of choice for initiators*.

Both military groups considered of moderate importance that *the military is given a new role in environmental conflict prevention and/or resolution*, however, rated more likely and much sooner by the diplomats.

A global push for environmental friendly non-lethal weapons is seen more likely and important by the military diplomats than by the U.S. military, however, not earlier than 10 years.

Some edited comments from the workshops

[The full edited text of the workshops' discussions is included in Appendix E.]

The trend in this moment (concerning the military) is not so much on fighting, but on being an organized and well-equipped body of the nation to respond in difficult situations.

Military forces all around the world have to begin having the capabilities to deal with environmental issues: countries with many resources because of their global interests, and the other countries because they can be the only organizations with capabilities to deal with these issues.

If you don't prepare your organizations to fight wars your country won't win battles, if you do not prepare your military to deal with environmental issues they won't be able to deal with them in peace or in war.

U.S. military representatives consider that *having a standing multinational force created to respond to natural environmental disasters* would be a new mission for them if the U.S. military were to be involved. It certainly could provide a lot of transportation and quick response, but training is needed in these new missions. The command might be NATO with UN Security Council mandate, similar to peacekeeping operations.

Military attachés consider very likely to have an international military force, except it might be “on call” as the peacekeeping forces, and to cover all kind of ecological disasters, not just natural (e.g. eco-sabotage). However, considering the priority given to security over environment and the difficulty of getting the international community to act on today's security issues with a multinational force, it is difficult to count on an environmental force soon.

On the item *new climate change data (proving or disproving climate change) causes protests which threaten political stability around the world*, U.S. military representatives commented that new climate change data is already threatening stability when considered in the geo-economic world. Unproven data is currently being used to support unfounded positions.

The idea that *a rogue nation develops doctrine to target environmental quality as an objective of warfare* raised very controversial discussions ranging from examples of cases that already happened to denying this possibility due to the suicide-like effect. A suggested action to truly prevent future sophisticated weapons to affect the environment would be to place nano and/or micro sensors throughout the environment.

The general conclusion on *simulation* was that it will never be able to replace field training.

“GREEN” (environmental concerns) should encompass space. (Regarding the item *Space becomes the site or source of environmental damage (by intention or mistake)*.)

With reference to *perchlorates, which are a common oxidizer in military propellants, to be phased out of use in the future due to their effects on the thyroid gland*, the comments were that risk management is the key-not the toxicity of a particular compound. The fact that a particular compound has an adverse human health impact should not be the basis for discontinuing use or production of the compound. It all depends on the exposures to the public of those compounds.

Industry produces hundreds, probably thousands of hazardous compounds, which, if there were human exposure, would result in adverse effects. The key is whether they can be managed.

Concerning a possible *international conflict over water*, U.S. military representatives consider that political powers other than military should be used to prevent the water shortage problem from escalating to a conflict. They feel that if conflict was to occur, it might be regional or local rather than international. They feel that technical solutions come at too high a cost and the failure of Kyoto treaty would induce a similar fate on any agreements to be made about water.

Military attachés considered that the military should be involved in the protection of the environment as well as the protection of the water resources. This subject has been in the radar screen for a decade or so, but we have yet to see a war on water. [However, a participant in Round 3 mentioned five wars over water issues that were identified by a U.S. geological research study.] Yes, it creates tension; yes, it leads to small scale cross border clashes, but the fact is that the use of military force does not solve water shortage. The fact that it may deteriorate it, may have prevented in the past and may prevent in the future decision-makers from seeking military solutions to their water problems. If there were a war, the winner would have not only won the water, but also the need to provide water to the defeated country - so war itself over water may be less likely since in a real sense it is unwinnable.

Futurists consider that the water issue certainly could be a key input to conflict anticipation systems, and it will affect the viability of alliances and peacekeeping operations, particularly in Asia and in Africa. Clearly forecastable, why not take action by shaping clear win situations in preventing water conflict?

Regarding the possibility that *military forces are given a new role in environmental conflict prevention and/or resolution*, the U.S. military representatives were wondering what is the difference between environmental conflict prevention and general conflict prevention. If this would happen, it would mean the recognition of environment as a source of instability/conflict. This is as likely in the future as conflict from any other source.

The military attachés considered that this is already happening with the increased participation of military in peacekeeping/enforcing operations. The question that rose was: will the UN develop standing doctrine for UN operations, which includes protection of the environment, or the prevention of damage to the environment during peacekeeping and other operations? This action might be possible probably as a new multinational force under the UN.

On the *increasing public scrutiny and power causes military forces to change their environmental decision-making processes*, U.S. military representatives highlighted that this has been happening for 25 years and will continue. The power of public scrutiny will change military planning and thinking, and produce forecasts in military requirements. Public questioning and involvement in decision making will contribute significantly toward a more democratic process and the sharing of the decision-making process.

The military attachés agreed that the access that the media actually has to military operations and facilities makes the decision-making process think and reassess the doctrine in order to avoid being blamed for environmental damages.

Concerning the possibility that *a major military conflict breaks out over energy resources*, the opinions vary from one extreme to the other. Some believe that as non-renewable resources deplete, new renewable sources will be available if there is need and finance available. U.S. military representatives believe that such a conflict will occur again, but in a different form, e.g. digital battlefield, etc. The future conflict over energy might also be over other resources rather than oil. Conflict prevention roles of the Army come in the form of reducing their own energy requirement, increasing R&D on renewable resources and encouraging less developed nations to use renewable resources.

The military attachés mentioned that the damage that was caused by Iraq during the Gulf War is an example of tremendous consequences, not just for the environment in the gulf, but also because it set the example that a nation in its efforts to control oil can invade another country and/or in its "military" retreat burn it.

With reference to *the after-effects of a bio/chemical/nano weapon or a nuclear incident require a massive cleanup or other large-scale military response*, U.S. military representatives warned that the currently responsible organizations are totally unprepared for such a large-scale response. The military will be required to implement severe measures in order to stabilize an incident. It is not a question of "if," but "when".

U.S. military representatives consider that a *post-conflict battlefield remediation treaty* might be created and/or implemented regarding land mines, heavy metals etc. This might cause changes in tactics and insert consideration for the environment.

Concerning *new sources and management of energy alter global political power relations*, U.S. military representatives mentioned that if the Defense Department could achieve something as radical in this area as they did in information technology 40 years ago (Internet), this really would be "conflict prevention".

The military attachés consider that energy conservation technologies are available. The role of military involvement in environmental threat recognition and mediation will require a fundamental reorientation about the nature of transnational threat and security. This is possible and would be dependent on shared recognition capacities and on the interoperability of response protocols.

Military forces achieve a dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements is considered by the U.S. representatives very achievable; however, this is an instance where the military will follow instead of lead. Nevertheless, as efficiencies become available, the military has to have the systems and policies in place to allow their quick adoption. The Army should commit to the adoption of leading edge technologies, demonstration of solar, nuclear, renewable, and geo-hydrologic and biomass, and set goals for conservation, recycle, etc.

The internal combustion engine is phased out of military production is considered by the futurists, environmentalists, and scientists as probably more important than all the other items combined, in regard to the \$5 billion/year the Army now spends on the environment. In fact, new vehicle systems offer a major hope of reducing these costs, and changing the nature of cleanup requirements. However, U.S. military representatives consider this very unlikely within a timeframe of 25 years. This issue is already being worked, but it is the subject of early R&D and may never provide the performance needed to meet all military requirements.

The military attachés remarked that diesel engines, commonly used by military forces, are increasingly under scrutiny due to their emissions of particulate matter (which is linked to cancer); hence, in the future these may be phased out of military use.

Adapted organism weapons are developed to attack mono-culture agriculture is considered by most of the military participants a weapon that can be used for extortion by holding a nation's crops hostage. However, the role of the Army was not very clear and was not considered as being necessarily of military concern.

U.S. military representatives agreed that it is highly likely that *countries might be required to accept responsibility for the long-term consequences of defoliation*, and not just for defoliation. DoD has maintained bases in foreign countries for over 50 years, and past practices have caused environmental damage. As other countries environmental programs "catch up" to the United States, it might be held responsible for past actions. If that would happen, it could prove to be either very expensive, or have a major impact on overseas basing.

Concerning the possibility that *a global push for environmental friendly non-lethal weapons emerges*, the U.S. military representatives were very skeptical in the development and use of non-lethal weapons for/by the Army (DoD). The military attachés consider that this is already being worked on, and will continue to be developed because of economic, human rights, and environmental reasons. However, this will require access to the resources that will promote access to "environmentally friendly" non-lethal weapons technology.

"Junkstorms" (spacejunk falling on populated areas) cause international environmental incidents is considered by the U.S. military representatives as an area where the military would probably play an active role. The issue is the necessary training to be effective in this environment. However, they tend to consider that this is a low impact event, as the largest piece of "spacejunk" will not even come close to the damage caused by a tornado or a Category 3 hurricane. The futurists considered that it has high implications for the Army, mainly for the Air Defense.

Regarding *zero emissions, environmentally friendly bases becoming the standard for deployed UN peacekeeping forces*, U.S. military representatives stated that zero emissions is a concept like "Total Quality Management" neither zero or total is possible, but it is a direction for policy. The United States could push this goal - it would make the U.S. Army a world leader in this domain. Standard may be a goal, but such a goal will never be achieved. A commander could not deploy and operate a force at zero emissions. This would deter from the essential mission. Military attachés consider that this could be initiated per peacekeeping action rather than for all actions at once.

4. Focused Review of Environmental Security Developments and Military Requirements - Round 3

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:

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

Results of these questions are presented in this chapter. 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. Full details on the statistics are in Appendix F. And last, the additional requirements and/or comments on the rated requirements are included.

4.1 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 United States. 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.

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 feed stocks for a variety of purposes, and even cause defoliation. Super weeds, microorganisms, 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 upon all forms of life, and result in human unwillingness to buy/eat the items attacked and push 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, and 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 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 United States 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 enlighten 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-weapons 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 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 bioterrorism 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> connects over a 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 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 after next 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.

4.2 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 1 billion people lack safe drinking water. Nearly half the world lacks adequate sanitation, and 80% 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% 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 and 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 1/3 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 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 from 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 U.S. Global Climate Change Research Program (USGCRP) 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 quantity (e.g., individual to 5 person group).

Development of rapidly deployable groundwater and surface contamination modeling and water cleanup systems.

The United States 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 U.S. 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 United States 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 don't want the Military to become an extension of 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 U.S. 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. 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.

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.

4.3 A new and/or re-emerging disease threat or outbreak triggers conflict, social instability or disorder (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 microorganisms. 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% 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 United States 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, U.S. 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.

4.4 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 U.S. model. In the United States, 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 United States 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% (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 U.S. 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 better promote 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.

4.5 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 weapons 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 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 of 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 a 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 munitions 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 U.S. for some time already, but not for some futuristic threats like nano-weapons.

The attack on the World Trade Center (WTC) 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 United States, the National Guard may be used to channel people to relief centers until Federal Emergency Management Administration civilian personnel are available.

Military medical care will likely be limited for non-U.S. civilians if U.S. forces are involved in response. Another military action would be to train U.S. and non-U.S. 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 vis DOD/DOS/DOJ, etc. The best health care is rendered locally with appropriate augmentation of health care systems (fire dept, EMS, etc.) depending on the extent of the situation--mass casualty, etc.

4.6 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 U.S. 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 U.S./UN effort to de-mine 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 the above narrative are current treaties on war and provisions to protect non-combatant and the environment. War (conflict) is a continuation of policy... and since the international community likely has failed to pre-empt 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 conflict 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. In WWI - poison gas was used (inefficiently) and in WWII the United States 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 ordinance.

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.

4.7 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 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 quickly develop 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 U.S. military there is an agency devoted in part to environmental care, the U.S. Army Corps of Engineers-Civil Works (USACE-CW). 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 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.

4.8 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 takeovers 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 United States 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 United States in order to prevent further rogue strikes. Note that in the current crisis, Italy, Russia, France, Britain, 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 will be needed 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 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 upon 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 the UN charter.

4.9 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 are especially probable. The current mass movement of people from South and Central America into the United States 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, and for plans to transport equipment to international humanitarian agencies in response 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 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. U.S. 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 it appears 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 is one option. 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 have had 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 sub-marines 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.

5. Major Themes

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

- Collaboration between the military and other organizations
- Technology
- Training
- 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).

5.1 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)

5.2 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 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)

5.3 Training

All three requirements involving training were rated relatively effective and necessary to be implemented sooner than 5 years.

- 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)
- Training of soldiers for environmental missions. (2005, 3.55)

5.4 New roles for the military

- 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)
- 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)

6. Conclusions and Recommendations

Many potential military requirements to address emerging environmental issues have been discussed in this report and its appendices. Leading developments and suggestions have been highlighted.

The factors that increase the pressure for evolving environmental security policy are increasing; hence, potential requirements discussed in the report should be considered as to how they could be implemented without reducing readiness.

A wealth of insights and ideas was collected during the workshops in Round 2. These are shared in Appendix E. For those interested in this level of detail, they might use key word searches in this appendix to select just those items of concern, and then cut and paste to create their customized report as to training and other future requirements.

Use or improve the following definition as a guide to policy: environmental security is 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.

Meta recommendations

Several meta recommendations should be considered:

Perform a gap analysis

As an immediate follow-on to this study, conduct an analysis of existing doctrinal, training, logistical, organizational, materiel, and soldier (DTLOMS) requirements against the issues and requirements raised in this report. As necessary, identify gaps in existing Army research, development, and acquisition (RDA) programs. This study points out the need for increased R&D cooperation (see below), to simultaneously assess research and development conducted and planned by other agencies (such as the Department of Energy and the Environmental Protection Agency) for utility in addressing the future challenges identified in the study.

Expand simulation in training

For example, some participants argued that computer simulation or virtual reality will never replace combat field training. Still, what future training objectives could be met by future virtual reality alternatives? None? To the degree it can be done, it should be done to reduce the environmental impacts of training.

Prevent environmentally related conflicts

When possible, it is better to prevent the damage than repair it. Similarly, if foreign military assistance can reduce destabilizing environmental problems, it is better to do so than respond later to environmentally related conflicts.

Non-environmental impacting weapons

The United States already has lethal, non-lethal, and covert weapons; add to that mix the possibility of non-environmental impacting weapons such as energy on targets rather than metal on targets.

Improve the R&D cooperation

Much of the material in this report points to the increasing need to integrate research and development in biology with physics. The sensors necessary to detect problems and the potential devices to counter these threats require interdisciplinary military research and increasing cooperation with civilian research. Although technology is not the total answer, it is central to the future military response to these threats.

Increase consideration given to international existing and upcoming treaties

Anticipate increasing environmental orientation to international treaties and prepare military positions in advance for U.S. negotiators, and consider policies that would make possible the implementation of potential requirements discussed in this study without reducing readiness.

A key question that will have to be struggled with on a continuing basis for many years, as conditions and attitudes change around the world, is: Under what conditions could environmental damage be so severe as to be of concern to all of humanity and intervention authorized by the UN Security Council? The military should continually assess the evolving answer to that question and develop its positions in response to the range of answers.

APPENDICES

- A. Round 1 - The Questionnaire
- B. The three one-day workshops (Round 2) - Paper for the workshops
- C. Round 3 - The Questionnaire
- D. Results - Round 1&2
- E. Highlights and edited comments of workshops
- F. Results - Round 3
- G. Participants in the study

Overview of the three rounds:

Round 1:

- Preliminary discussions with military attachés to Washington D.C., futurists and environmentalists
- Questionnaire
- Panel: military personnel from around the world, futurists, scientists, and environmentalists.

Round 2: Three one-day workshops:

- Panel:
 - Futurists, scientists, and environmentalists (day 1)
 - Military attachés (day 2)
 - U.S. military representatives (day 3)
- Discussions, ratings.

Round 3:

- Distillation of first two rounds and further consultation with experts
- Questionnaire
- Panel: military personnel from around the world, futurists, scientists, and environmentalists.

Appendix A: Round 1 - Questionnaire

Emerging Environmental Issues and Events that May Affect Military Requirements 2010-2025 - Round 1 -

On behalf of the Millennium Project of the American Council for the United Nations University, we have the honor to invite you to participate in an international study of emerging environmental issues and events that may affect military forces over the period 2010 to 2025.

You may remember that Military Attachés to Washington, D.C. participated in an assessment of emerging definitions, threats, and issues of environmental security that the Millennium Project conducted about three years ago. The results were distributed to all Military Attachés who participated.

Enclosed is the first round of a three-round Delphi questionnaire. Your views and those of experts you suggest from your country are requested about the likelihood and importance of emerging environmental issues and when they might affect military policy or procedures due to security concerns, or statutory, regulatory, or treaty requirements. No attributions will be made.

Round two will be conducted during a workshop 8 August 2001 in the Washington area. You will receive an invitation and background next week. The results of the enclosed Round 1 will be the basis for the workshop. The results of the workshop will be further developed in a Round 3 questionnaire. All those who respond to the enclosed questionnaire will receive a copy of the results in the *2002 State of the Future* and be listed as participants.

The Millennium Project is a worldwide effort to collect and synthesize judgments about emerging global challenges that may affect the human condition. Its annual *State of the Future* and other special reports are used by decision-makers and educators to add focus to important issues, clarify choices, and improve the quality of decisions. The Millennium Project is sponsored by the organizations listed below with additional support for this environmental security study from the U.S. Army Environmental Policy Institute.

Please contact us with any questions and return your responses to arrive at the AC/UNU Millennium Project by 1 August 2001. We look forward to including your views.

Sincerely yours,

Jerome C. Glenn, Director, AC/UNU Millennium Project
Theodore Gordon, Senior Fellow, AC/UNU Millennium Project

Instructions

This questionnaire can be downloaded from <http://acunu.org/millennium/es-rd1-01.html> or an email copy will be sent on your request.

A series of possible emerging environmental issues and events are listed in the questionnaire. You are asked to rate those items about which you have knowledge or special interest. You do not have to rate all of the items. You are asked to provide your judgments about the items in three ways:

1. How likely is it that the event or emerging issue will actually occur and affect military requirements?
2. If the emerging environmental issue or event were to make a change in military requirements in your country, how important would that be? For the purpose of this questionnaire, importance means significance of impact on military bases, operations, and/or systems.
3. Assume that the issue or event occurs. If it does affect military requirements (be it statutory, regulatory, or by treaty), by what year might the requirement be actually adopted in your country? If you believe it will never have an impact, then enter "NEVER" in the year column of the questionnaire.

Please use the following scale to rate importance and likelihood:

Likelihood:

- 5 = almost certain
- 4 = very likely
- 3 = possible
- 2 = not very likely
- 1 = will never happen

Importance:

- 5 = fundamental change in military doctrine
- 4 = significant impact
- 3 = some impact
- 2 = very little impact
- 1 = trivial

At the end of the questionnaire, please include other emerging environmental issues or events that you think are very likely and would have significant impact on the military between 2010 and 2025.

If you would like to comment on any of the given items, please do so at the end and include the item's number.

Please respond by 1 August 2001 and include your name, institutional affiliation and title, along with your post mail (where results should be mailed) and e-mail addresses and fax number. All responses are confidential, and no attributions will be made.

Send your response by e-mail to acunu@igc.org with a copy to jglenn@igc.org and Tedjgordon@worldnet.att.com or fax to +1-202-686-5179 or airmail to: The Millennium Project, American Council for the UNU, 4421 Garrison St. NW, Washington, DC 20016, USA.

Round 1 - Questionnaire

Emerging Issue or Event	Likelihood	Importance	Year
1. Environmental concerns lead to the closure of a military installation.			
2. Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces.			
3. A standing multinational force is created to respond to natural environmental disasters.			
4. A post-conflict battlefield remediation treaty is implemented.			
5. New climate change data causes hysterical protests threatening political stability around the world.			
6. A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict.			
7. A prominent national dispute/debate develops over the subject of giving up sovereignty over environmental issues for the global good.			
8. New sources and management of energy alters global political power relations.			
9. Sub-ocean deposits of methane hydrates either boom (provide clean carbon) or blow-out (devastatingly auto-release to the atmosphere).			
10. Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies.			
11. Military forces are deployed in draught prevention (not mitigation or relief) measures.			
12. The first eco-sabotage event takes place against a military installation.			
13. A rogue nation develops doctrine to target environmental quality as an objective of warfare.			
14. The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements.			
15. The military is given a new role in environmental conflict prevention and/or resolution.			
16. Artificial genetic pollution is recognized as a global environmental safety or occupational health threat.			
17. The first space-based beamed energy system is deployed for use by military forces.			
18. Free market environmentalism drives the development of green and energy efficient military systems.			

Emerging Issue or Event	Likelihood	Importance	Year
19. A global push for environmental friendly non-lethal weapons emerges.			
20. Telemetrics enables any environmental interest group to detect and measure almost any environmental pollutant from a standoff position.			
21. Intergenerational equity emerges as a required factor in environmental decision-making.			
22. The last internal combustion engine is produced for the military usage.			
23. World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control.			
24. Sub-ocean deposit of methane hydrate either boom (provide clean carbon) or blow-out (devastating auto-release to the atmosphere).			
25. The world's 20 largest military forces adopt ISO 14000.			
26. A standing international tribunal is established to prosecute international environmental criminals.			
27. UN develops environmental health standards for peacekeeping troops.			
28. Perchlorates are banned from global use.			
29. Military force is applied to curtail the smuggling of internationally banned substances (POPs, CFCs, etc.).			
30. Domestic (homeland defense) operations of military forces generate environmental mitigation requirements.			
31. Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.			
32. Recognition that nuclear power plants require worldwide coordinated long-term monitoring and protection.			
33. Urban conflicts supplant open country battles as the terrain of choice for initiators.			
34. The civilian environmental protection agency develops regulations to control potential nano-pollution from the nano-bio-infotech industries.			
35. Environmentally-driven migration triggers an international conflict.			
36. Transboundary conflicts cause challenges between sovereignty and environmental security in a supranational forum.			
37. The Army achieves a lead(Pb)-free military infrastructure.			

Emerging Issue or Event	Likelihood	Importance	Year
38. Water extraction from the air is developed as a desalination/water purification alternative technology for military forces.			
39. A major military conflict breaks out over water resources/quality.			
40. Invasive species problems become pandemic and uncontrolled owing to unbridled trade & human movement; the economic losses pass the \$10 billion mark.			
41. Adapted organism weapons are developed to attack mono-culture agriculture.			
42. Large-scale ocean farms are created.			
43. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.			
44. A major military conflict breaks out over energy resources.			

What other environmental issues or events are likely to face military forces over the period 2010 to 2025?

Comments: Please include the number of the items about which you are commenting.

Thank you very much for your participation. Please send your response by e-mail to acunu@igc.org with a copy to jglenn@igc.org and Tedjgordon@worldnet.att.com or fax to +1-202-686-5179 or airmail to: The Millennium Project, American Council for the United Nations University, 4421 Garrison St. NW, Washington, DC 20016, USA.

Appendix B: The Three One-Day Workshops (Round 2)

The participants in the three one-day workshops were:

Day 1: August 8, 2001: futurists, environmentalists, and scientists

Day 2: August 9, 2001: Military Attachés to Washington, D.C.

Day 3: August 10, 2001: U.S. Military representatives

In preparation for the workshops, the participants were given the results of the first round and suggested items to be discussed.

Preparation paper for the workshops

A. List of all rated responses by importance

B. Developments from Round 1: Higher Importance, Higher Likelihood

C. Developments from Round 1: Higher Importance, Lower Likelihood

A. List of all rated responses by importance

Round 1 Responses listed in order of importance	Avg Lik	Avg Imp	Avg Date	Med Date
43. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.	3.667	3.926	16.208	15
41 Adapted organism weapons are developed to attack monoculture agriculture.	3.565	3.909	17.200	15
39. A major military conflict breaks out over water resources/quality.	4.000	3.897	15.192	15
13. A rogue nation develops doctrine to target environmental quality as an objective of warfare.	3.276	3.862	12.125	10
23. World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control.	3.269	3.840	18.250	15
3. A standing multinational force is created to respond to natural environmental disasters.	3.200	3.833	11.840	10
44. A major military conflict breaks out over energy resources.	3.786	3.786	16.600	15
15. The military is given a new role in environmental conflict prevention and/or resolution.	3.448	3.714	13.480	12
8. New sources and management of energy alters global political power relations.	3.444	3.667	105.91	15
19. A global push for environmental friendly non-lethal weapons emerges.	3.148	3.593	102.77	11

5. New climate change data causes hysterical protests threatening political stability around the world.	3.200	3.586	13.593	12
31. Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.	3.733	3.567	12.889	15
33. Urban conflicts supplant open country battles as the terrain of choice for initiators.	3.577	3.560	13.368	15
17. The first space-based beamed energy system is deployed for use by military forces.	3.667	3.542	17.455	20
21. Intergenerational equity emerges as a required factor in environmental decision-making.	3.296	3.481	18.095	15
16. Artificial genetic pollution is recognized as a global environmental safety or occupational health threat.	3.375	3.458	59.714	10
10. Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies.	2.966	3.379	56.913	15
36. Transboundary conflicts cause challenges between sovereignty and environmental security in a supranational forum.	3.667	3.375	12.714	11
7. A prominent national dispute/debate develops over the subject of giving up sovereignty over environmental issues for the global good.	3.345	3.345	92.640	15
35. Environmentally-driven migration triggers an international conflict.	3.241	3.345	52.880	15
40. Invasive species problems become pandemic and uncontrolled owing to unbridled trade & human movement; the economic losses pass the \$10 billion mark.	3.217	3.318	16.647	18
6. A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict.	2.556	3.296	161.40	15
4. A post-conflict battlefield remediation treaty is implemented.	2.852	3.296	16.000	15
14. The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements.	2.909	3.273	124.11	10
18. Free market environmentalism drives the development of green and energy efficient military systems.	2.778	3.259	61.773	20
2. Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces.	2.786	3.250	54.480	15
25. The world's 20 largest military forces adopt ISO 14000.	2.760	3.240	156.23	15
26. A standing international tribunal is established to prosecute international environmental criminals.	3.267	3.233	16.731	15
38. Water extraction from the air is developed as a desalination/water purification alternative technology for military forces.	3.037	3.185	60.348	20
32. Recognition that nuclear power plants require worldwide coordinated long-term monitoring and protection.	3.571	3.179	13.500	12.5

20. Telemetrics enables any environmental interest group to detect and measure almost any environmental pollutant from a standoff position.	3.231	3.154	16.150	15
22. The last internal combustion engine is produced for the military usage.	2.500	3.130	72.737	20
30. Domestic (homeland defense) operations of military forces generate environmental mitigation requirements.	3.556	3.111	11.130	10
11. Military forces are deployed in draught prevention (not mitigation or relief) measures.	2.640	3.087	124.00	17.5
27. UN develops environmental health standards for peacekeeping troops.	3.704	3.074	13.217	10
34. The civilian environmental protection agency develops regulations to control potential nano-pollution from the nano-bio-infotech industries.	3.391	3.043	20.526	20
42. Large-scale ocean farms are created.	3.480	3.038	16.100	20
29. Military force is applied to curtail the smuggling of internationally banned substances (POPs, CFCs, etc.).	3.296	3.000	59.810	10
1. Environmental concerns lead to the closure of a military installation.	3.448	2.966	48.577	10
12. The first eco-sabotage event takes place against a military installation.	3.321	2.926	11.136	10
9. Sub-ocean deposits of methane hydrates either boom (provide clean carbon) or blow-out (devastatingly auto-release to the atmosphere).	2.429	2.821	214.70	20
37. The Army achieves a lead (Pb)-free military infrastructure.	2.857	2.773	66.950	20
28. Perchlorates are banned from global use.	3.385	2.688	14.727	15

B. Developments from Round 1: Higher Importance, Higher Likelihood

- 43. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.
- 41. Adapted organism weapons are developed to attack mono-culture agriculture.
- 39. A major military conflict breaks out over water resources/quality.
- 13. A rogue nation develops doctrine to target environmental quality as an objective of warfare.
- 23. World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control.
- 3. A standing multinational force is created to respond to natural environmental disasters.
- 44. A major military conflict breaks out over energy resources.
- 15. The military is given a new role in environmental conflict prevention and/or resolution.
- 8. New sources and management of energy alters global political power relations.
- 19. A global push for environmental friendly non-lethal weapons emerges.

- 5. New climate change data causes hysterical protests threatening political stability around the world.
- 31. Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.
- 33. Urban conflicts supplant open country battles as the terrain of choice for initiators.

C. Developments from Round 1: Higher Importance, Lower Likelihood

- 10. Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies.
- 6. A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict.
- 4. A post-conflict battlefield remediation treaty is implemented.
- 14. The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements.
- 18. Free market environmentalism drives the development of green and energy efficient military systems.
- 2. Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces.
- 25. The world's 20 largest military forces adopt ISO 14000.
- 22. The last internal combustion engine is produced for the military usage.
- 11. Military forces are deployed in draught prevention (not mitigation or relief) measures.

Appendix C: Round 3 - Questionnaire

Emerging Environmental Issues and Events that May Affect Military Requirements Round 3 - Instructions

This questionnaire can also be downloaded from <http://acunu.org/millennium/es-rd3.html> and filled out offline.

The numbers after the developments come from Round 1 and/or Round 2 workshops' numbering so that participants can trace the evolution of the study.

You do not have to comment on all the issue descriptions or rate all of the actions. You are asked to provide your judgments just about those in which you have special expertise or interest.

1. In the space provided after the description of the development, issue, and/or threat, please add what you think will give the statement more insight, usefulness, and veracity.
2. In the space provided in the column after each suggested new requirement, provide your judgment about how effective it will be to address this issue. Use the following scale:

Efficacy Scale

- | | |
|---------------------------------|-----------------------------------|
| 5 = Will solve the issue | 2 = Will have little effect |
| 4 = Will be very effective | 1 = Will make the situation worse |
| 3 = Will help address the issue | |

3. In the next column, provide your estimate of what year this requirement might be implemented by the military in your country. If you believe it will never happen, then enter "NEVER." If you believe it has already occurred, enter "Now"; however, the survey is asking when "new" requirements will be implemented. For example, militaries already have immunization programs, but you are asked when a change will require a new immunization program.
4. If you believe other military requirements will result from the development, issue, and/or threat, then please add those - with the year you think it might be implemented by the military in your country -- in the space provided after the list of suggested requirements.

Please respond by 1 December 2001 and include your name, institutional affiliation and title, along with your post mail (where the *2002 State of the Future* should be mailed) and e-mail addresses and fax number. All responses are confidential, and no attributions will be made.

Send your response by e-mail to acunu@igc.org with a copy to jglenn@igc.org and Tedjgordon@worldnet.att.com or fax to +1-202-686-5179 or airmail to: The Millennium Project, American Council for the United Nations University, 4421 Garrison St. NW, Washington, DC 20016, USA.

Round 3 - Questionnaire

1. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once (43). This includes the special case of: *“adapted organism weapons are developed to attack mono-culture agriculture”* (41).

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 United States. Infiltration of pharmaceutical manufacturers by hostile agents brings up other scenarios.

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. Rogue nations or terrorists who want to wipe out large numbers are more likely to use them. Rather than attacking human life, bio-weapons might also be designed to attack the environment that supports it, e.g., to cause defoliation, or to eliminate a crop or farm animal from a nation's economy.

This threat could be the most important future focus for a nation's military forces. However, some see little military role in addressing this kind of threat, because existing health, environmental, and agricultural systems already have the knowledge necessary to address it. Others think that it should be a military concern because any use of such bio-weapons in fact constitutes an attack by an enemy nation or terrorist network.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action/requirement	Efficacy	Year
Pre-emptive military strikes to destroy bio-weapons		
Using military forces to conduct mass vaccinations of the populace in response to a defined bio-weapon threat		
Development and use of wide-spectrum vaccines		
Development and use of human immune system boosters		
Limits to immigration enforced by military		
Enforcement of biotech export controls by military		
Restricting movement of troops to prevent spread of biological agents		
Restricting movement of the populace by the military to prevent spread of biological agents		
Development of stand-off bio-sensors		
Training military forces for quick response after an attack by such bio-weapons		
Assisting in the formation and training of biological defense units in other countries		
Establishing international / regional biological defense agreements		
Coordination of military activities with civilian biological defense assets		
Integration of military epidemiological systems with national epidemiological systems		

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

2. A major military conflict over water is understood by world leaders as extremely plausible (39)

Water tables are falling on all continents, while human demand for water increases worldwide. Global warming is shrinking mountain snow packs, reducing summer water supplies. Water quality and availability affect environmental quality for life support in general.

Although lack of potable water and availability of water for agricultural use may not be the only causes of wars, they could contribute to the cause of conflicts. Several recent transborder water problems have increased pressure for diplomatic cooperation and technological innovations in desalinization and water efficiencies in agricultural and urban usage. Water problems could also contribute to potential internal strife in China and India, which together account for over 1/3 of the world's population.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Development of rapidly deployable water supply and water purification systems		
Using military engineers to conduct training and technical assistance for water infrastructure and management to prevent conflicts		
Military protection of water supplies		
Military security and oversight for selected civilian water systems		
Development of national database of water resources by military		
Military development and maintenance of a global database of water resources		
Development of regional conflict prevention capacities within military force structures		
Deployment of micro- and nano-sensors in water systems		

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

3. A new and/or re-emerging disease threat or outbreak triggers conflict, (6) social instability or disorder (e.g., AIDS goes airborne, global warming or loss of bio-diversity changes disease patterns, increasing anti-biotic resistance, etc.) (N01)

(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 microorganisms. 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.

Some argue that use of military forces is not a logical or effective means to address this issue. 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. 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. 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 US for joint exercises because of the threat of spreading hoof and mouth disease.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Establish and maintain military medical intelligence and preventive medicine labs		
Enhance military collaboration with public health agencies such as the EPA, WHO, and CDC		
Forecasting disease mutations, epidemiology, and resulting conditions for conflict		
Military transborder intervention to prevent international impacts		
Collaboration with or helping to establish / strengthen public health capacities in other countries		
Development and use of wide-spectrum vaccines		
Development and use of human immune system boosters		
Immigration disease screening enforced by military		
Restricting movement of troops to prevent spread of pathogens		
Restricting movement of the populace by the military to prevent spread of pathogens		

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

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 (10). Increasing public scrutiny and power causes military forces to change their environmental decision-making processes (31).

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 them to be, 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.

In the United States, 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 with respect to how a military installation operates over the long-term in its environment and in its community will have to change.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action’s effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Contract military land management to civilians who manage the sustainable use of natural resources		
Turn over military installations to local municipalities to manage in perpetuity for the military (as a long-term tenant)		
Develop GIS (Geographic Information Systems) tools to better manage military training areas and monitor local encroachment factors		
Improve the energy efficiency of military installation infrastructure by 50% (compared to 2000 energy efficiency)		

Military action	Efficacy	Year
Simulation fidelity reaches a point when it can replace field training of military forces		
Include the concept of environmental sustainability in basic training		
Military services define what the requirements and objectives are for sustainable bases, sustainable operations, and sustainable systems		
Military services include sustainable use of natural resources as a procurement requirement.		
Phase out of production internal combustion engines for the military		
Establish a "Best Practices Database" that contains models of military environmental planning and operations that can be replicated in other regions		
Military installation managers state environmental issues impacting natural resources in operating terms		

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

5. The after-effects of biological, chemical, or nanotech weapons or a nuclear incident require a massive cleanup or other large-scale military response. (N02)

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 weapons 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. If future nanotech weapons were 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.

The Kirsk (Russian submarine) incident shows that the country which caused the problem has the responsibility to clean up; however, international pressure was necessary, and Norway may assist in its own interest. Hence, responsibilities can be shared, depending on the spread of contamination and the risks to human health and ecosystems.

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. The UN Security Council could be the vehicle for authorization and coordination of cleanup operations. As the UN authorized a forced-entry operation for food security in Somalia, it could do so one day for environmental security elsewhere.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Military provision of medical care for those who are already affected		
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		
Program an "off switch" in nanotech replicators to render them harmless		
Create a self-destruct or "end-state" in bioweapons to render them harmless		
Plan for creation of safe emergency dumps for mass disaster cleanups		
Create mechanisms to comply with eventual treaties that define what the responsibilities of the various parties are		

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

6. A post-conflict battlefield remediation treaty is implemented. (04)

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.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Development of rules of engagement that avoid environmental damage		
Development of ordnance that has a zero "dud" rate and/or which has pre-programmed self-destruct features		
Development of battlefield rapid remediation technologies to lessen subsequent restoration requirements		
Development of new institutional relationships between the military and the private sector to assist in such post-conflict cleanup operations		
Development of non-toxic explosives		
The development of new models and instruments to measure the environmental impact of military operations		
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)		

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

7. Military forces are given a new role in environmental conflict prevention and/or resolution (15)

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. Prevention of environmental destruction, 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.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Development of a UN doctrine for environmental security operations		
Development of new military equipment for environmental missions		
Training of soldiers for environmental missions		
Simulation fidelity reaches a point where it can replace field training of armed forces		

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

8. Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces. (A5) A rogue nation develops doctrine to target environmental quality as an objective of warfare. (13)

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 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. 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. This has already happened in many international conflicts of the last decade.

Additional comments on the text above:

Some suggested military actions to address this issue are listed below. Please provide your estimate of the action's effectiveness for addressing the issue using the scale 5 (highest) to 1 (lowest) as shown in the instructions, and the year in which you estimate it to become a requirement for the military forces of your country:

Military action	Efficacy	Year
Use of military forces to isolate 'Rogue' states		
R&D for defense against such asymmetric attacks		
Development of doctrine for military responses to attacks on the environment		

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

9. What other environmental developments, issues, or threats do you think will create new military requirements sometime between 2010 and 2025?

What new requirements and when do you think they might be implemented?

Thank you very much for your participation.

Please send your response by e-mail to acunu@igc.org with a copy to jglenn@igc.org and Tedjgordon@worldnet.att.com or fax to +1-202-686-5179 or airmail to: The Millennium Project, American Council for the United Nations University, 4421 Garrison St. NW, Washington, DC 20016, USA.

Appendix D: Results - Rounds 1&2

Emerging Environmental Issues and Events that May Affect Military Requirements

Results of Round 1 and additional suggestions from a three-day Workshop with Military Attachés to Washington, DC, futurists, environmentalists, and US Army representatives

These results are available online at <http://acunu.org/millennium/es-results.html>

The results presented in this appendix are organized in the following sections:

- D.1 List of all rated responses by importance
- D.2 Issues/Events newly suggested and/or rated during Round 2 (the three-day workshop)
- D.3 Developments from Round 1: Higher Importance, Higher Likelihood
- D.4 Developments from Round 1: Higher Importance, Lower Likelihood

D.1 Environmental Issues and Events rated in Round 1, listed in order of importance

The Issues/Events were rated using the following scales:

Likelihood:

- 5 = almost certain
- 4 = very likely
- 3 = possible
- 2 = not very likely
- 1 = will never happen

Importance:

- 5 = fundamental change in military doctrine
- 4 = significant impact
- 3 = some impact
- 2 = very little impact
- 1 = trivial

The last column indicates approximately the year by which the issue/event would affect military requirements (be it statutory, regulatory, or by treaty) assuming that it occurs. Where no year is given there was a huge disagreement between respondents as to the event ever occurring.

Emerging Issue or Event	Importance	Likelihood	By Year
43. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.	3.926	3.667	2015
41. Adapted organism weapons are developed to attack mono-culture agriculture.	3.909	3.565	2020
39. A major military conflict breaks out over water resources/quality.	3.897	4.000	2015
13. A rogue nation develops doctrine to target environmental quality as an objective of warfare.	3.862	3.276	2015

Emerging Issue or Event	Importance	Likelihood	By Year
23. World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control.	3.840	3.269	2020
3. A standing multinational force is created to respond to natural environmental disasters.	3.833	3.200	2010
44. A major military conflict breaks out over energy resources.	3.786	3.786	2015
15. The military is given a new role in environmental conflict prevention and/or resolution.	3.714	3.448	2015
8. New sources and management of energy alters global political power relations.	3.667	3.444	
19. A global push for environmental friendly non-lethal weapons emerges.	3.593	3.148	
5. New climate change data causes hysterical protests threatening political stability around the world.	3.586	3.200	2015
31. Increasing public scrutiny and power causes military forces to change their environmental decision-making processes.	3.567	3.733	2010
33. Urban conflicts supplant open country battles as the terrain of choice for initiators.	3.560	3.577	2015
17. The first space-based beamed energy system is deployed for use by military forces.	3.542	3.667	2020
21. Intergenerational equity emerges as a required factor in environmental decision-making.	3.481	3.296	2020
16. Artificial genetic pollution is recognized as a global environmental safety or occupational health threat.	3.458	3.375	
10. Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies.	3.379	2.966	Over 2050
36. Transboundary conflicts cause challenges between sovereignty and environmental security in a supranational forum.	3.375	3.667	2015
7. A prominent national dispute/debate develops over the subject of giving up sovereignty over environmental issues for the global good.	3.345	3.345	Over 2050
35. Environmentally-driven migration triggers an international conflict.	3.345	3.241	Over 2050

Emerging Issue or Event	Importance	Likelihood	By Year
40. Invasive species problems become pandemic and uncontrolled owing to unbridled trade & human movement; the economic losses pass the \$10 billion mark.	3.318	3.217	2020
6. A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict.	3.296	2.556	Over 2050
4. A post-conflict battlefield remediation treaty is implemented.	3.296	2.852	2015
14. The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements.	3.273	2.909	Over 2050
18. Free market environmentalism drives the development of green and energy efficient military systems.	3.259	2.778	Over 2050
2. Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces.	3.250	2.786	Over 2050
25. The world's 20 largest military forces adopt ISO 14000.	3.240	2.760	Over 2050
26. A standing international tribunal is established to prosecute international environmental criminals.	3.233	3.267	2015
38. Water extraction from the air is developed as a desalination/water purification alternative technology for military forces.	3.185	3.037	Over 2050
32. Recognition that nuclear power plants require worldwide coordinated long-term monitoring and protection.	3.179	3.571	2015
20. Telemetrics enables any environmental interest group to detect and measure almost any environmental pollutant from a standoff position.	3.154	3.231	2015
22. The last internal combustion engine is produced for the military usage.	3.130	2.500	Over 2050
30. Domestic (homeland defense) operations of military forces generate environmental mitigation requirements.	3.111	3.556	2010
11. Military forces are deployed in draught prevention (not mitigation or relief) measures.	3.087	2.640	Over 2050
27. UN develops environmental health standards for peacekeeping troops.	3.074	3.704	2015
34. The civilian environmental protection agency develops regulations to control potential nano-pollution from the nano-bio-infotech industries.	3.043	3.391	2020

Emerging Issue or Event	Importance	Likelihood	By Year
42. Large-scale ocean farms are created.	3.038	3.480	2015
29. Military force is applied to curtail the smuggling of internationally banned substances (POPs, CFCs, etc.).	3.000	3.296	Over 2050
1. Environmental concerns lead to the closure of a military installation.	2.966	3.448	Over 2050
12. The first eco-sabotage event takes place against a military installation.	2.926	3.321	2010
9. Sub-ocean deposits of methane hydrates either boom (provide clean carbon) or blow-out (devastatingly auto-release to the atmosphere).	2.821	2.429	Over 2050
37. The Army achieves a lead(Pb)-free military infrastructure.	2.773	2.857	Over 2050
28. Perchlorates are banned from global use.	2.688	3.385	2015

Complete list of the suggested/discussed developments in Round 2:

- Army becomes lead (Pb)-free
- Military develops best practices database
- Artificial genetic pollution
- Military gain 50% energy efficiency
- Biotech mass-destruction weapons used
- Military in environmental conflict prevention
- Bio/nano/chemical weapons require mass cleanup
- NATO in environmental protection
- Civilian agency regulates nano-pollution
- New disease creates global panic
- Climate change threatens political stability
- Nuclear facilities become targets
- Conflict over energy sources
- Nuclear plants require monitoring & protection
- Conflict over water
- Ocean farms
- Debate over giving up sovereignty
- Open country battles for initiators
- Disease triggers conflict
- Organized crime threaten decision-making
- Domestic military generate environmental mitigation requirements
- Organisms target mono-culture agriculture
- Eco-sabotage against military
- Perchlorates banned

- Electronic or electro-magnetic pollution
- Post-conflict remediation treaty
- Energy distribution alters political power relations
- Post conflict remediation treaty
- Environmental international tribunal
- Problem of naval ops in Caribbean sea
- Environmentally driven migration triggers conflict
- Public changes environmental decision-making
- Environmentally friendly non-lethal weapons
- Radiation created for military
- Environmental concerns closes a military installation
- Rogue nation targets environment
- Environmental concerns for space, e.g., ionosphere heating.
- Simulation replaces field training
- Falsified environmental information causes damage
- Space-based beam energy system
- Free market develops energy efficient military systems
- Standing multinational force for natural disasters.
- Future conflicts driven by rogue states
- Sustainable resource use changes military policies
- HIV/AIDS impacts military
- Telemetrics enables standoff measurement
- Intergenerational equity
- Threats of new fix remedies environmental concerns
- Internal combustion engine phased out of military use
- Transboundary conflicts complicates supranational environmental security
- Invasive species costs above \$10bn
- UN develops environmental health standards for its forces
- ISO 14000 for 20 largest military states
- U.S. accepts consequences of defoliation
- Junkstorms from space
- U.S. help remove landmines
- Last internal combustion engine produced for military
- Water extraction from air for military
- Mercenaries and new tech. replaces soldiers
- Weather modification weaponized
- Methane hydrates boom/blow out.
- Wild bids for energy after petroleum production peaks.
- Military applied to curtail smuggling
- Zero emissions & environmental concerns
- Friendly bases for UN forces
- Military deployed in drought prevention.

D.2 Issues/Events newly suggested and/or rated during Round 2 (synopsis of all three days)

Issue or Event	Importance	Likelihood	By Year
A new disease threat or outbreak creates social instability or disorder (e.g., AIDS goes airborne, global warming changes disease patterns, loss of bio-diversity changes disease patterns, increasing anti-biotic resistance, etc.)	3.45	3.59	2015
The after-effects of a bio/chemical/nano weapon or a nuclear incident require a massive cleanup or other large-scale military response	3.43	3.77	2010
NATO becomes a strong force in environmental protection			
Electronic and/or electromagnetic radiation weapon or countermeasure is created for military purposes	3.11	3.11	2015
"Junkstorms" (spacejunk falling on populated areas) cause international environmental incidents	1.45		2025
Other forms of radiation created for military purposes: ionizing (new forms), microwave, laser, etc. become of concern	3.57	2.75	2010
Weather modification or climate change techniques are developed and used including uses as weapons	2.09		2025
The U.S. is required or accepts the responsibility to deal with the long-term consequences of defoliation it used in warfare (e.g. Hoi An area in Vietnam)	3.08	2.76	2015
U.S. takes the responsibility to help remove landmines	3.43		
HIV/AIDS impacts military forces significantly in the developing world, giving rise to strict rules against risky sexual activity while in the military service			
Birth rate reduction and aging populations increase the need for mercenary armies and stimulate the development of new technologies replacing soldiers, etc. since both have no identity and sell themselves to the one paying best.			
Computer games/simulations replace naval operations and exercises.			
A new techno-info-nano-geno fix is developed as a potential remedy of some of the negative impact of human activities on environment - but the fix also carries its own threats.	2.09	1.87	2025

Issue or Event	Importance	Likelihood	By Year
Space becomes the site or source of environmental damage (by intention or mistake) about which concern is expressed: new military applications in space (e.g., intentional ionospheric heating, and the use of intentional debris clouds (sand and needles) in space (LEO) to deny military or civilian space.)	2.97	2.91	2020
Civilian and government nuclear facilities, materials and technologies in this country and abroad including waste storage sites become "interesting" targets.	3.65	3.60	2010
Organized crime grows to the point that it counters countries' decision-making processes environmental threats.	2.92	2.32	2020
Environmental information falsified by a third party (non-military) causes the Army to take actions that have unintended environmentally damaging effects.	2.63	1.87	2015
Military forces establish a "Best Practices Database" that contains models of military environmental planning and operations that can be replicated in other regions	3.68	2.68	2010
Simulation replaces field training	1.865	2.91	2025

D.3 Issues/Events rated in round 1 with Higher Importance, Higher Likelihood

(The numbers in parenthesis indicate the event/issue order in Round 1 questionnaire.)

- Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once. (43)
- Adapted organism weapons are developed to attack mono-culture agriculture. (41)
- A major military conflict breaks out over water resources/quality. (39)
- A rogue nation develops doctrine to target environmental quality as an objective of warfare. (13)
- World economies bid wildly for energy after petroleum production peaks in the face of rising demand. Greed, opportunism and desperation vie for control. (23)
- A standing multinational force is created to respond to natural environmental disasters. (3)
- A major military conflict breaks out over energy resources. (44)
- The military is given a new role in environmental conflict prevention and/or resolution. (15)
- New sources and management of energy alters global political power relations. (8)
- A global push for environmental friendly non-lethal weapons emerges. (19)

- New climate change data causes hysterical protests threatening political stability around the world. (5)
- Increasing public scrutiny and power causes military forces to change their environmental decision-making processes. (31)
- Urban conflicts supplant open country battles as the terrain of choice for initiators. (33)

D.4 Issues/Events rated in round 1 with Higher Importance, Lower Likelihood

- Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies. (10)
- A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict. (6)
- A post-conflict battlefield remediation treaty is implemented. (4)
- The military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements. (14)
- Free market environmentalism drives the development of green and energy efficient military systems. (18)
- Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces. (2)
- The world's 20 largest military forces adopt ISO 14000. (25)
- The last internal combustion engine is produced for the military usage. (22)
- Military forces are deployed in drought prevention (not mitigation or relief) measures. (11)

Appendix E: Highlights and edited comments of workshops

Day 1: August 8, 2001 participants: futurists, environmentalists, and scientists

Day 2: August 9, 2001 participants: Military Attachés to Washington, D.C.

Day 3: August 10, 2001 participants: U.S. Military representatives

Because of time limits, not all the items were discussed in the workshops. The participants had the chance at the beginning of the workshop to select by vote, the developments they want to discuss. Therefore, there are no ratings and/or comments on all the items from all the three workshops.

Highlights

- based on the quantified responses -

The most controversial issue was *conflict over water*; it was considered one of the most important and likely emerging issues by the futurists, but much less likely and important by the military diplomats and representatives.

The same was the case for a *standing multinational force is created to respond to natural environmental disasters* for which the military diplomats and representatives do not agree with the futurists who considered it very likely.

There was a high agreement between the three groups on all points of view that:

- *Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.*
- *World economies bid wildly for energy after petroleum production peaks in the face of rising demand.*

For some actions, although there was a high agreement of all three groups on the importance and likelihood, there were considerable disagreements on the timing:

- *Adapted organism weapons are developed to attack mono-culture agriculture:* about 10 years by futurists, 5 years by military diplomats and over 20 years by the U.S. military
- *Bio/nano/chemical weapons requires mass clean up:* about 10 years by futurists, 5 years by military diplomats and over 15 years by the U.S. military
- *Nuclear facilities become targets:* about 1 year by military diplomats and just over 10 years by futurists and U.S. military.

Organized crime threaten[ing] decision-making was not considered happening in the next 15 years; however, it was seen likely and important by the futurists, but not so much by the two military groups.

Futurists and military diplomats agreed that a *new disease create[ing] global panic* is important and likely to happen in about 15 years.

Futurists consider more important and likely than the U.S. military representatives that *military receives dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements* and that *the last internal combustion engine [will be] produced for the military usage*. However, both groups agree that these are very long-term actions.

U.S. military representatives considered more likely and important than the military diplomats that:

- *New sources and management of energy alter global political power relations*
- *Increasing public scrutiny and power causes military forces to change their environmental decision-making processes*

There was a high agreement between military diplomats and U.S. military representatives on importance, likelihood and timing (happening within the next 10 years) that *urban conflicts supplant open country battles as the terrain of choice for initiators*.

Both military groups considered of moderate importance that *the military is given a new role in environmental conflict prevention and/or resolution*, however, rated more likely and much sooner (if it were to occur) by the diplomats.

A global push for environmental friendly non-lethal weapons is seen more likely and important by the military diplomats than by the U.S. military, however, not earlier than 10 years.

U.S. Military representatives believe very likely and important that *increasing emphasis on the sustainable use of natural resources [will] cause a complete revision of military construction, base operations, and training management policies* in maximum 10 years.

It was not considered important or likely by the U.S. military representatives that:

- *zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces.*
- *military forces are deployed in draught prevention (not mitigation or relief) measures.*

Observations from some military attachés: Military all around the world have to begin having the capabilities to deal with environmental issues. Countries with many resources because of their global interests and the other countries because they can be the only organizations with capabilities to deal with these issues.

If you do not prepare your organizations to fight wars your country will not win battles, if you do not prepare your military to deal with environmental issues they won't be able to deal with them in peace or in war.

Edited comments on the developments

A major military conflict over water is understood by world leaders as extremely plausible.
(Item 39 in Round 1)

U.S. military representatives consider that political powers other than military should be used to prevent the water shortage problem from escalating to a conflict. They feel that if conflict occurs, it might be regional or local rather than international. They feel that technical solutions come at too high a cost and the failure of Kyoto treaty would induce a similar fate on any agreements to be made about water.

Military attachés considered that the military should be involved in the protection of the environment as well as the protection of the water resource.

This subject has been in the radar screen for a decade or so, but we have yet to see a war on water. Yes, it creates tension; yes, it leads to small scale cross border clashes, but the fact is that the use of military force does not solve water shortage. The fact that it may deteriorate it, may have prevented in the past and may prevent in the future decision-makers from seeking military solutions to their water problems. If there were a war, the winner would have not only won the water, but also the need to provide water to the defeated country- so war itself over water may be less likely since in a real sense it is unsuccessful.

Water is a source of cooperation rather than conflict. Ex. Brazil and Argentina armies developed joint efforts and exercises to fight flood situations.

Turkish unilateral decision to divert a major waterway to solve a short-range (2 - 3 years) problem created high tension with its downstream neighbors, but it did not lead to war. Jordan and Israel, and Jordan and Syria have agreed formally to share their water resources. European countries have agreed to share the water and navigate in the Danube River. There is more room for cooperation than confrontation between nations over water. For example, in the Middle East people cope with this problem for many years and actually they begin to cooperate on water issues. A military conflict would not solve, but worsen the situation.

That's a real world issue right now. But it has a visible link with population growth as well as the increasing concerns on it around the world.

Yes, this is an issue that is very likely to happen, especially in those countries where there is a lack of this resource.

The issue is clear enough - but the solutions are very elusive. Can the developed countries help solve the problem with effective R&D?

Technology solution to water scarcity works only if the country has funds to buy the technology.

Is it the military matter to prevent such a conflict? To help agriculture put in new systems that get more "crop per drop" of water? To assist in construction projects that might move river flows OR large-scale closed environmental agriculture OR catch rain fall and store this water OR create "gray" water and pipe it for non-human drinking purposes such as in irrigation?

Military conflict prevention over water scarcity implies that military equipment and manpower is brought to bear against the challenge of building and running sustainable water systems that ensure the long-term security of a country from water scarcity.

There is a higher requirement of military to military cooperation.

Futurists, environmentalists, and scientists gave as examples on the cases of Turkey - Syria - Iraq; Israel - Palestine; Egypt - Ethiopia. Shortages within a country can reduce food self-sufficiency (as is happening in China, where the Yellow River has largely dried up much of the year), and this can affect stability. About 30 countries, including the U.S., now have net water deficits.

This will be synergistic with other issues on the list. Mountain snow-picks that are the source of summer waters in many parts of the world are melting and are likely to decline water availability, worsening the security problems in those areas.

This issue certainly should be a key input to conflict anticipation systems. And it will affect the viability of alliances and peacekeeping operations, particularly in Asia and in Africa. Clearly foreseeable, why not take action? By shaping clear win situation in preventing water conflict.

This problem might be forcing some political collaboration. Do "policy changes" alter the likelihood of water resource conflicts? Policy changes will better prepare all those involved for these inevitable events. Economic and social integration among countries could help with political stability and addressing problems such as water.

What is the percentage use of water by "rich countries" versus "poor countries?" Will inequalities of this nature also create conflict?

Some Middle East nations have great interest in new desalinization technology -- this may require lots more energy use, and impact world oil markets.

Should military role be prevention? Corps of military engineers can help maintain water availability; e.g. military is upgrading water systems now. Regional engagement systems would be helpful.

Water quality is another aspect; it is just as important as quantity.

Water supplied by US could be a "currency" for encouraging countries to follow policies seen as favorable. US should take leadership in solving the problem.

It is necessary for the military to increase the level of action, R&D, etc. - shape, respond, and repair.

Providing water may be part of peace keeping.

Increasing emphasis on the sustainable use of natural resources causes a complete revision of military construction, base operations, and training management policies. (Item 10 in Round 1)

U.S. military representatives made many comments regarding doctrines and mindsets of decision-makers. This then is hoped to change various aspects of the Army such as the sustainable use of natural resources in the products and processes the Army uses. The methods of training used will pose high resistance to change of field training because of its necessity. Since the value of a base is dependent upon its sustainability, this issue will be important, but hard to measure. Cultural resources?

A new and/or re-emerging disease threat or outbreak triggers a regional or global conflict. (Item 6 in Round 1)

U.S. military representatives' comments cover the issues from the raiding of disease manufacturers and forecasting mutations to dealing with the problem when it occurs. Operational problems such as immunizing soldiers, sovereignty problems across borders, and the transnational nature of diseases caused by globalization and the low capability of the current infrastructure to deal with these diseases were pointed out. Other difficulties lie in the role of the Army, as this is essentially a national security policy issue. Another perspective is that the conflict will be a socio political one rather than a military unless the cause was a nationalist action. The socio political conflict arises in prevention of immigration and an example was the refusal to move British Army equipment due to the foot and mouth disease. A couple of issues are: AIDS impact in the African continent after 2020; and possibility of a purposeful or inadvertent loss of one or more of the major strains of rice or grains.

Military forces are given a new role in environmental conflict prevention and/or resolution.
(Item 15 in Round 1)

U.S. military representatives were wondering what is the difference between environmental conflict prevention and general conflict prevention. If this would happen it would mean the recognition of environment as a source of instability/conflict. Since this is as likely in the future as conflict from any other source, this means a new type of work for the Army. However, skepticism rises as to whether there will be changes in the military role as the driving cause of conflict prevention moves to environmentalism. Generals do not know how to run cities.

The military attachés considered that this is already happening with the increased participation of military in peacekeeping/enforcing operations.

With the intervention of these peacekeeping units, through education and prevention, countries can keep the environmental stability and prevent the destruction and employment of weapons and systems that harm it.

The question that rose was: will the UN develop standing doctrine for UN operations that includes protection of the environment, or the prevention of damage to the environment during peacekeeping and other operations?

This action might be possible, probably as a new multinational force under the UN.

Increasing public scrutiny and power causes military forces to change their environmental decision-making processes. (Item 31 in Round 1)

U.S. military representatives highlighted that this has been happening for 25 years and will continue. The power of public scrutiny will change military planning, thinking and produce forecasts in military requirements. Public questioning and involvement in decision-making will contribute significantly toward a more democratic process and the sharing of the decision-making process. Another issue that sprung is the possibility of letting military manage civilian installations. This was disputed and one person suggested military leadership should develop skills necessary to manage effectively or even have the military and civilian learn from each other. An example of already existing processes is the public outreach program.

The military attachés agreed that this is underway (“just look at this meeting”). However, they question if such scrutiny will cause a modification of military operations. For example, will the following warnings make any difference: “don’t attack in that direction because biodiversity will be damaged” or “change the type of weapons used so you don’t harm an endangered species”?

Yes, the access that the media actually has to military operations and facilities makes the decision-making process think and reassess the doctrine in order not to be blamed about environmental damages.

Futurists, environmentalists, and scientists consider that in a way, this has already happened: Vieques activism caused the Bush administration to reverse the course on Navy use of the island. Makua activism has halted Army training in the Makua Valley on Oahu. New England activists have caused changes in the way MMR operates.

A major military conflict breaks out over energy resources. (Item 44 in Round 1)

U.S. military representatives said that this scenario has already occurred; the Gulf War was an example. Opinions vary from one extreme to the other. Some believe that as non-renewable resources deplete, new renewable sources will be available if there is need and finance available. Pessimists believe such a conflict will occur again, but in different form, e.g. digital battlefield, etc. The future conflict over energy might also be over other resources rather than oil. Conflict prevention roles of an Army come in the form of reducing their own energy requirement, increase R&D on renewable resources and encourage less developed nations to use renewable resources.

The military attachés mentioned that some people have said that this is the rationale behind the Gulf War. Maybe the next will be GW2. They consider that this is one of the most probable causes of a future war over natural resources, not just oil, but water, strategic minerals, etc. The damage that was caused by Iraq during the Gulf War was given as an example of tremendous consequences, not just for the environment in the gulf, but also because it set the example that a nation in its efforts to control oil can invade others or in a “military” retreat burn that same country.

The after-effects of a bio/chemical/nano weapon or a nuclear incident require a massive cleanup or other large-scale military response. (Newly suggested item, N02)

U.S. military representatives warned that the currently responsible organizations are totally unprepared for such a large-scale response. The military will be required to implement severe measures in order to stabilize an incident. It is not a question of “if”, but “when”.

This action might possibly be combined with issue 7 (*A prominent national dispute/debate develops over the subject of giving up sovereignty over environmental issues for the global good.*)

The futurists, environmentalists, and scientists mentioned that it is already the case for nuclear, why shouldn’t bio/chemical/nano follow? This is a straightforward question.

Cleanup after what? U.S. overseas? Nuclear bomb or plant accident? And at which stage/phase should the military intervene? Environmental and social/political concerns after Chernobyl were enormous. After a bomb, multiply by 1,000. And we don't really know what they all would be.

A new doctrine is required for nano tech and for incidents overseas. If something happens in Asia, what would the United States do?

Question depends on where such an event occurs (domestic release or on foreign soil).

Use of weapons of mass destruction (chem/bio/nuc) will require cleanup, it's a fact.

Who is responsible for the cleanup? Unknown (host nation military forces? U.S. by invitation?)

It is a significant question: what happens if the United States is not invited in?

Many "informed" people have indulged in thoughtless speculation on the nano side. Self-replicating nanorobots seem very questionable at present -- a vision without an idea, and much of the deepest worries assume that kind of nanorobot. If nanorobots are not self-replicating, how big could the cleanup issues get? Or the weapons potential? Significant, but not on the scale of the other things.

Bio and chemical weapons: there is a deep problem in managing this, because we don't want to publicly discuss the worst cases. That makes analysis hard.

A post-conflict battlefield remediation treaty is implemented. (Item 4 in Round 1)

U.S. military representatives consider that a post-conflict battlefield remediation treaty will be created regarding land mines, heavy metals etc. This might cause changes in tactics and insert consideration for the environment. Since the post-conflict battlefield is occupied by the winner, it may cause commanders to consider the environment before the battle, which is undesirable as it ties their hands. The general feeling is that environmental objectives should not interfere with the needs of the battle, even if it meant a small change in rules of engagement. Suggestion: use of easily deminable mines.

The military attachés consider that unexploded ordnance, leaking explosives and heavy metals into groundwater, will in the future become the central focus of an international cleanup treaty. But, as discussed before, how does this become enforced as a military requirement?

The enforcement of past actions is one problem; but future challenges can be addressed through the development of procurement requirements that dictate self-destruct features, the use of non-toxic explosives, etc.

There will be instruments that will measure the environmental impact of military operations, and serve as the basis for remediation. The ubiquity of cheap, remote sensors in the future will allow for stand-off detection of pollution on military bases or of military operations by third parties (like environmental groups).

The futurists, environmentalists, and scientists questioned who cleaned up after the Gulf War (oil well fires, oil slicks in Gulf, burned out vehicles, etc)? Who paid for the cleanup?

New sources and management of energy alter global political power relations. (Item 8 in Round 1)

U.S. military representatives mentioned that military procurement and transportation systems could cause alterations. The United States should increase energy independence -- mostly through clean energy technologies. If the Defense Department could achieve something radical in this area as they did in information technology 40 years ago (Internet) this really would be "conflict prevention".

The military attachés said that energy conservation technologies are available. Their efficient application will alter the economies of both developed and undeveloped countries.

The role of military involvement in environmental threat recognition and mediation will require a fundamental reorientation about the nature of transnational threat and security.

Recent history has documented this scenario as both possible and likely.

It is difficult to envision participation in deliberate environmental degradation that will not have shared consequences.

This is possible and would be dependent on shared recognition capacities and on the interoperability of response protocols.

Military forces achieve a dramatic gain in energy efficiency (50%) due to climate change and energy conservation requirements. (Item 14 in Round 1)

U.S. military representatives considered that this is very achievable. Look at energy efficiency improvements over the last 25 years. They also highlighted that if it's tactical energy, the reason will be to reduce the logistical tail; not because of global warming.

This is an instance where the military will follow instead of lead. Due to their limited impact on the economy, they will only be able to adopt practices economically viable in greater society. However, as efficiencies become available, the military has to have the systems and policy in place to allow their quick adoption.

Installations for energy conservation will require external direction from OSD or the WH, or Congress, to meet 50%. There are no incentives under current management policies.

The Army should commit to the adoption of leading edge technologies, demonstration of solar, nuclear, renewable, geo-hydrologic and biomass; set goals for conservation, recycle, etc.

Alternative technologies are great and will gain market share, but will tend to be a small fraction of total energy consumption on a U. S. wide basis and driven by population growth. Coal, nuclear, oil, gas -the traditional energy sources- will dominate for many years to come regardless of the new alternative technologies that look so good.

The futurists, environmentalists, and scientists pointed out that if 80 percent of the Army energy use is on bases, it would be most rational to use COTS technology and not invest so heavily, as it is not so mission critical. Not something that has big spillover effects on the larger environment. (Still, the Army could be an entry niche market for some new high-efficiency products.)

The internal combustion engine is phased out of military production. (Reworded item 22 in Round 1)

U.S. military representatives consider this very unlikely within a timeframe of 25 years. This issue is already being worked, but it is the subject of early R&D and may never provide the performance needed to meet all military requirements. Military combustion engines are a miniscule percentage of the total in the United States. In fact the military is a small player when it comes to environmental emissions compared to the big industry emitters, yet the military is vilified in the press as the U.S.'s biggest polluter. How many environmentalists currently drive a hybrid vehicle? You cannot assume a PM will make a decision that you in your personal life will not make! This is the conundrum of environment vs. performance. Developments in sterling cycle technologies and/or in fuel cells would be possible.

If this were to occur, an extremely unlikely event in the mid-term, the military would use whatever replaces the diesel engine in the millions of private industrial uses.

This may happen, however it may not be military led. Private industry has more at stake in this. As the military moves more toward buying commercial products and processes, there is already a transition underway in this kind of issues.

The military attachés remarked that diesel engines, commonly used by military forces, are increasingly under scrutiny due to their emissions of particulate matter (which is linked to cancer); hence, in the future these may be phased out of military use.

The futurists, environmentalists, and scientists consider that this is probably more important than all the other items combined, in regard to the \$5 billion/year the Army now spends on the environment. In fact, new vehicle systems offer a major hope of reducing these costs, and changing the nature of cleanup requirements. Yet present government activities/investments do not capture most of what would help here. Yes, there are major PEM deployment efforts. But present PEMs have deep problems with whole-system efficiency, lifetime and cost -- basic research to address these problems is not nearly as effective or extensive as it could be. There is hardly any major effort in carbon-tolerant alkaline fuel cells, which are otherwise more promising. Likewise, a recent breakthrough in external combustion, (Stirling-derived technology, as per STM) could allow very substantial near-term opportunities to move to methanol and get more efficiency. With alkaline fuel cells, there are historic records buried in microfilm at the ARO office in North Carolina that could have a revolutionary impact (e.g. the whole Allis-Chalmers history) if made publicly available. Mickey Mouse problems with report filing and transcription have become a major problem, that the Army could solve at low cost.

Military could lead the way. The requirement may be put on the military as racial integration was.

Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces. (Newly suggested item)

U.S. military representatives indicated that military forces used in response to rogue states or terrorists will be deployed in different ways -- they will often not be on what is considered "hostile" territory. They will be concerned about the economic and public health end-state of the

conflict. They will be required to follow specific environmental rules of engagement. This has already happened in most of the conflicts and deployments of the last decade.

The use of military force needs to be able to isolate rogue states capabilities to minimize impact. BMD and other technologies will need to be integrated into force structure and deployed.

Expect that many such conflicts will be fought among civilian targets and in cities. Many will be with gorilla forces. Public safety and human welfare will likely dominate these, which affects what weapons and tactics.

Zero emissions, environmentally friendly bases become the standard for deployed UN peacekeeping forces. (Item 2 in Round 1)

U.S. military representatives stated that zero emissions is a concept like "Total Quality Management" neither zero or total is possible, but it is a direction for policy. For example, one might get to zero air emissions, but suddenly, as a result, get more solid or hazardous waste emissions. ("Standard" should be replaced by "goal" or "objective".) The United States could push this goal - it would make the U.S. Army a world leader in this domain.

Standard is not possible. It certainly may be a GOAL. But such a goal will never be achieved. A commander could not deploy and operate a force at zero emissions. This would deter from the essential mission.

ISO 14000 is another environmental standard which is likely to achieve international acceptance for the military and for joint peacekeeping forces.

Military attachés consider that this could be initiated per peacekeeping action rather than for all actions at once. International environmental / safety / health standards will be developed for wheeled vehicles; these standards will have an impact on military vehicles to.

A standing multinational force is created to respond to natural environmental disasters. (Item 3 in Round 1)

U.S. military representatives consider this a new mission if the U.S. military were to be involved. It certainly could provide a lot of transportation and quick response, but training is needed in these new missions.

Under whose command would this happen? It might be NATO with the UN Security Council mandate, similar to peacekeeping operations.

Why not a multi-national force to deal with all disasters? Even environmental disasters will be associated with a geographical region, so multi-national response is unlikely.

The first step is to form a multinational force for conflict-resolution purposes. Then environmental missions might be added to the mission list of the force. NATO has many potential reasons for deploying forces, for example; but in an environmental disaster, the military may be called in to provide logistical and communications support, however, there are many other agencies and private industry that are better suited to first responder duties.

It is already happening in the Middle East. A regional environmental response team composed of military forces from the Gulf States. Why not elsewhere in other regions?

The Army is an excellent quick-response force in times of a crisis; responding to environmental disasters is not new. A multinational force may provide the legitimacy for U.S. forces to operate within the country threatened by such crisis. Especially when that country has provided support to the multi-national force.

Argentina has made a similar proposal.

Military attachés questioned how are the natural environmental disasters different from man-made environmental disasters? It could be both for natural as well as human caused disasters. Would this same force be used to respond to ecosabotage? Who organizes, runs, and pays for this force?

Instead of a "standing" force, maybe an "on call" force that has been trained together, with similar equipment and protocols could or would be called on by the UN Security Council as peacekeeping forces are today. Standing multinational forces are too expensive. After a bilateral agreement, some sort of "on call" forces could be created regionally or under the UN.

Regional alliances might be more reasonable, focusing on the likely environmental challenges for their region.

This is likely, unless many different nations are affected. To have a multinational force ready to respond to a national disaster does not seem to be a good solution. Instead, each has to have its own structure to prevent natural disasters and to overcome its consequences. Foreign assistance will be available from those countries who have taken this humanitarian responsibility and, of course, have power and interest in doing so.

It is a good action, but first the nations agreement should be obtained. Who makes the decision, and who is going to pay for it.

This is an area where military cooperation is necessary as it gives and develops confidence among countries and among armed forces. With the deterioration of the global environment, natural disasters have become more common, and the effects more destructive, therefore the employment of an "on call" humanitarian/disaster relief military organization is needed!

In the United States there is FEMA. Other countries have similar non-military agencies. Does there need to be a similar standing (or on-call) agency under the UN flag or under regional flags? The effects of a natural disaster are so huge, that the military cannot keep aside, All the nations resources are needed, and the first response needs to include the armed forces, because their availability, their training, and their discipline are most needed in that type of situation.

Apart from the most developed nations, no other country has the resources, and the organizations to face a major natural disaster and especially its effects. FEMA is the organization that assesses, plans and addresses the disaster in the beginning, but in any event in the last years, since the hurricanes in Florida, the U.S. armed forces have been employed to relieve the effects.

The trend in this moment (concerning the military) is not so much on fighting, but on being an organized and well-equipped body of the nation to respond in difficult situations.

Futurists, environmentalists, and scientists commented that the deep problems are chronic, not acute (though acute events then get triggered). Acute events commonly involve a natural crisis overlaid on a chronic vulnerability. A special international force might, or might not, help in addressing the chronic aspects -- hurt by enabling complacency (like folks who rebuild houses in a flood plain) or help by reducing despair and encouraging positive action and international cooperation. But it is all second-order matter.

Given the priority transferred to security over environment and the difficulty of getting the international community to act on today's security issues with a multinational force, it is difficult to count on an environmental force soon.

This could be the peaceful equivalent to war.

Wouldn't this force inevitably turn into a peacekeeping force?

A peacekeeping division within the U. S. Army has previously been proposed (re-flagging the 10th Mountain Division) with deployment for peace missions only (humanitarian assistance, peacekeeping, disaster relief, etc.)

There are difficulties of information sharing regarding vulnerability analysis and assessment.

The global warming-exacerbated threats of increasing storm intensity, flooding of coastal cities as a result of sea-level rise, etc., will put such heavy demands on military forces (which initially have the best available equipment and manpower for coping with disasters) that these disasters will bring about a de-facto shift in those forces' main missions. More broadly, we will move to a new conception of "invasion," with climatic and biological invasions (and perhaps of refugee flows) becoming predominant.

The United States has this capability domestically - it's called the National Guard.

New climate change data (proving or disproving climate change) causes protests which threaten political stability around the world. (Item 5 in Round 1)

U.S. military representatives commented that new climate change data is already threatening stability when considered in the geo-economic world.

Unproven data is currently being used to support unfounded positions.

The new data will generate potential political instability, which will cause the politicians to react. It already has. The European politicians, for example, are much stronger proponents of the Kyoto treaty than are the U.S. politicians. Why? Same data. The reason is that the European people are more concerned about global warming than the U.S. citizens.

Sea level rise in places like Bangladesh, The Netherlands, or Indonesia might create an international crisis.

There were already protests on Kyoto, WTO, etc., but do they really threaten political stability? Will these protests in the future cause a change in governments?

Impact for the DoD would be our ability to operate. Global pressure may cause major changes in allowable pollutants, degrading out the ability to conduct operations of war or direct national defense.

Military attachés consider that global warming symptoms will be blamed for natural disasters such as floods, hurricanes, droughts, etc.

This development can be seen in two ways. First the data on which warming forecasts and warming models were wrong in a way that means earlier and more intense warming than originally thought. Second, the data and models were wrong and we are not in nearly as much trouble as we thought. Either way, the reaction could be hysterical protests. But for hysteria to threaten political stability implies a degree of order to the hysterical elements of the population to the degree that they can overthrow a standing government.

Yes, each time more groups of "concerned citizens" are taking the streets to demonstrate against the countries that according to their knowledge are damaging the environment or not, pledge to some environment agreements.

There will be political reaction before it will begin happening. Hence, it is difficult to see the necessity for military involvement.

The mass movements will get decision-makers to react before that happens.

A rogue nation develops doctrine to target environmental quality as an objective of warfare. (Item 13 in Round 1)

U.S. military representatives considered this development obvious. It leads back to the military being able to isolate and minimize a nation's ability to implement its policy. BMD and enhanced technology.

Already happened: Gulf War. Saddam targeted the desalination plants in Saudi Arabia when he opened the valves on the oil-loading island. Environmental quality is an aspect of life quality. Palestinian terrorists target people, but they also could just as easily target quality of life -- the Israeli responses are often in this mode.

Defense against such attacks have to be considered. Would we need nano- or micro-sensors in water systems, etc. raising questions of big brother?

The Chinese published a doctrine a couple of years ago that included attacking the environment as a part of "total war".

Military attachés commented that this is like suicide bombing-it kills the combatant. That is unless a way can be found to make the rouge nation immune from the chaos it causes. This could be done through local ecosystem destruction - for example, the Romans salted the fields of Carthage centuries ago - a local environmental impact that did not affect the Romans.

Iraq's hitting Kuwait's oil fields is an example where it did not cause chaos to Iraq.

To truly prevent future sophisticated weapons from affecting the environment, would not nano or micro sensors have to be placed throughout the environment?

Unlikely, because it can quickly turn around against it. These capabilities are not too difficult to develop, so nations will always be conscious of the possibility of counter strike.

Why rogue nation? The United States did this in Viet Nam.

A *futurist* commented that China has already published a doctrine on targeting the environment, but they could not be called a "rogue nation".

Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once. (Item 43 in Round 1)

U.S. military representatives agreed that we need to be prepared for such new weapons. They may require vaccination, etc. and may result in limiting immigration and restricting the movement of troops.

The response of an INTEGRATED Homeland Defense Force, a centralized control utilizing local, regional and national assets will be required.

Military attachés indicated that this has been a constant effort by most developed countries as presently there is a tendency of some rogue nations to have access to these weapons of mass destruction. Developed nations have to take the lead in countering the manufacturing of such material in order to convince smaller nations to follow the example.

The development of new kinds of weapons is an incentive for the developed nations.

Bio-weapons are already considered the "poor man's atom bomb". The same technology used for pharmaceutical production can be used for production of biotechnology weapons. So the capability is there, but when is the first use of such weapons likely?

There are important environmental consequences to biotech weapons. Some may be designed to attack the environment, e.g. defoliation, elimination of a crop or farm animal from a nation's economy.

Futurists, environmentalists, and scientists questioned what bio-weapons were referred to. Maybe viruses that target specific groups, engineered organisms that attack unprotected troops, or the bio equivalent to Agent Orange attacking plants? Does this include plasmids & prions?

The Army implication is that National Guard Civil Support Teams need technology to rapidly detect/counter.

What happens when technology for mass destruction becomes available to high school students?

It was also questioned whether psychologically, anyone interested in mass destruction isn't more likely to choose a weapon that goes for human life rather than for that which supports it.

Simulation fidelity reaches a point where it can replace field training of armed forces. (New item suggested at the workshop)

U.S. military representatives were generally skeptical concerning this action. It is certainly coming, but how good will simulation get? Don't you have to get dirty on the ground to learn? On the other hand commercial pilots learn new aircraft this way.

Simulation will never replace the real thing. We already accept a steep learning curve in combat. Now we will learn to accept the same type of learning curve for deployments and contingency operations, as forces that have never left their home base actually have to go do something for real. Simulators are effective to a point. Field operations are also necessary to validate systems and the relationships among systems (people, equipment, and procedures). Unless the environmental impacts of training are very clearly adverse AND irreversible, traditional training on Army lands should not be discontinued even if simulation gets better and better.

ATEC is developing virtual proving grounds to minimize the need for live fire testing. Check their website. This is happening and is an example where simulation will minimize vegetation destruction.

Simulation will never be able to replace field training.

Military attachés agreed that certainly some is already happening, but with the increasing focus on the urban environment, it will be difficult to train in cities, hence increasing need for simulation.

Space becomes the site or source of environmental damage (by intention or mistake) about which concern is expressed. (Newly suggested item in Round 1 (N14))

U.S. military representatives questioned what is the Army's role in space. Lasers in orbit, orbiting mirrors making daylight, microwave heaters, etc. all potentially impact on earth's environment.

Futurists, environmentalists, and scientists commented that U.S. Space Command currently tracks space debris (over 10,000 items). Studies have already been conducted to assess the effects of sand/needles/etc. on space systems. It was questioned if the Army Space Command is part of the Space Command.

Implications to the Army include environmental impacts to ground (Army) sites attacked from space.

It was also questioned if there will be any international treaty developed that addresses space pollution, or the pollution of exoatmospheric space, or the pollution of the atmosphere, land, and water from space.

“GREEN” should encompass space.

HAARP produces heating of the ionosphere

Mirrors in orbit are potentially dangerous

Urban conflicts supplant open country battles as the terrain of choice for initiators. (Item 33 in Round 1)

U.S. military representatives agreed that as urbanization of the planet occurs, doctrine will have to change. Military has been focusing on urban combat for the last 10 years, or more.

The military attachés commented that civilian control of military institutions is going to influence the attention paid to environmental issues.

The futurists mentioned that "sewer wars" might mean new environmental health challenges for the military

A civilian or government nuclear facility (or materials and technologies, including waste storage sites) becomes a target. (Newly suggested item in Round 1 (N15))

U.S. military representatives commented that these are already political targets for domestic protests. They may also be targets of military concern, but that is already known and part of a defense strategy.

The futurists, environmentalists, and scientists questioned how would we be able to distinguish accidents from deliberate attacks.

This is already starting. Present systems cannot reduce diversion options below a certain percentage of the nuclear material present. If the world increases the (non-U.S.) nuclear material in process by an order of magnitude (as many energy scenarios propose), the number of potential nuclear actors increases, and the likelihood of criminal connections also increases.

What happens when nuclear materials get in the hands of transnational crime?

Organized crime grows to the point that it affects (or counters) countries' decision-making processes in reference to environmental threats. (Newly suggested item (N16))

U.S. military representatives commented that military already has a counter-drug mission, but this goes beyond just drugs (NGB Counter-Drug, Navy's ROTH).

What if the mafia is paying off government officials to influence the development of environmental policies? (Does anyone think that the mafia is a "green" organization?) This could cut both ways (lax environmental laws or very strict). If the influence drives strong environmental laws, it could shut down the Army (i.e., do away with one threat to the criminal element).

Free market environmentalism drives the development of green and energy efficient military systems. (Item 18 in Round 1)

U.S. military representatives commented that free market environmentalism is not driving energy efficient, low noise, minimal weight system development. Operations and logistic considerations are. Environmental benefits are by-products of all good Science and Technology. Weapons of the future may focus on prevention, intercepting threats, disabling strike capacity, locking up natural resources, and temporarily sequestering food or fiber.

The military procurement system has to be flexible enough to adopt technologies as they become available. This is an enormous problem.

After petroleum production peaks, political/economic power relationships become unstable. (Item 23 in Round 1)

U.S. military representatives said that this has been projected for years, and each time the projection changes. Is the supply of hydrocarbons really finite (in a practical sense)? Also, economics will drive the use of alternative sources. The military danger here is the instability caused by changing the status quo.

Likewise new sources of energy, natural resources, etc. will likely change the winners and losers in terms of economic development. The Defense community will see new areas of national interest, and they will also weigh their choices in terms of irreversible commitments of natural resources, pollution generation and content, and political stability.

Military attachés agreed that this will affect the relationship in order to keep or obtain access to these sources or to install governments easy to handle in the aspect of their exploitation; in the need for oil, some countries don't hesitate to damage the environment sustainability.

This is good news, because the industrial nations will be forced to look for other sources of energy. The most obvious, economic and available is natural gas, which is more environmentally friendly. Good news for the Middle East too, because it has the largest reserve in the world (Iran has 800 years at the current rate of use).

The futurist, environmentalists, and scientists were questioning the timing of peaking - 25 years, as it depends on several variables. By the time this happens, governments and investors will have recognized that those who do not invest in alternative energy technologies will be left behind economically. So, this greed and opportunism may play out around the laggard fringes of the world economy rather than among main players.

The IEA has relatively reliable numbers, far more reliable than the extreme optimism or pessimism one hears from alleged, but biased, "experts" in various other places. Once prices reach the level again where they create a "J-curve," a frustration of world expectations of economic growth, one can indeed expect disruptive behavior worldwide. (cf. The literature on J-curves and political revolutions, going back to Feierabend.)

Technology could dramatically reduce the probability of this, but present government spending programs and NASDAQ noise and such do not advance more than a tiny fraction of what is possible here. (Ref. the question on internal combustion engines.). Curiously, "positive thinking" has been a problem here -- people who claim that PEMs are ready for mass deployment do not easily manage efforts to solve the key problems with PEM head-on, or to support a broad, diverse portfolio of really basic research to reinvent PEM or fuel cells in general.

Terrorists might "seed" oil with material that damages the users.

Chemicals could be injected into oil supplies to affect the buyers' health after it is used.

Perchlorates, which are a common oxidizer in military propellants, will be phased out of use in the future due to their effects on the thyroid gland. (Item 28 of Round 1)

U.S. military representatives agreed that the Army will need to find new "environmentally friendly" propellants - this is a very specific requirement for the RDA community.

AMCOM scientists have been working this issue for five years in developing new liquid and gel propellants. The developments have favorable test results and NASA and AF are carrying forward other development.

Industrial ecology could lead Army and AF manufacturing and assembly plants to co-locate waste processors on their facility that might derive new products from their wastes or reduce waste treatment costs or find other constructive uses for them.

The fact that a particular compound has an adverse human health impact should not be the basis for discontinuing use or production of the compound. It all depends on the exposures to the public of those compounds. Industry produces hundreds, probably thousands of hazardous compounds, which, if there were human exposure, would result in adverse effects. The key is whether they can be managed. You don't see production of scores of organic compounds being terminated simply because these compounds are hazardous substances or cancer producers. The distribution and use of these compounds simply need to be managed as with perchlorates or any other compounds. Risk management is the key-not the toxicity of a particular compound.

Adapted organism weapons are developed to attack mono-culture agriculture. (Item 41 in Round 1)

U.S. military representatives considered that there is no difference between this and any other chem-bio weapon. This is a weapon that can be used for extortion by holding a nation's crops

hostage, however, the role of the Army was not very clear. Is it supposed to guard crops? Troop deployments to guard agriculture is not going to happen.

Preventive measure taken by the military is very unlikely, but quick response to provide assistance after the attack is likely. There will be no training to prevent such attack.

anthrax and other toxins have long been cultivated. Fungi could be used as well.

Military attachés agreed that this is a scary development, but not a military concern.

This is happening with the different drug crops, the former ways to destroy them had failed, so there is the perception that the United States is developing this class of "adapted organisms" to attack drug crops.

This could be a binary weapon - the first part is applied to crops with no effect. The second part kills the crop. So a terrorist could hold agriculture for ransom by threatening to apply the second part.

Futurists, environmentalists, and scientists consider that this is an Army or a USDA/FAO responsibility.

Establish a "Best Practices Database" that contains models of military environmental planning and operations that can be replicated in other regions (Newly suggested Item)

U.S. military representatives agreed that this is useful and is already started by various groups and agencies. It is part of the COE labs requirements (CERL,CREL.WES). Installation commanders are doing this to a certain degree already for their own installations. It can be like an extension to the CALL system at Leavenworth. It also exists in the ITAM program. Also Field Manual: 20-400, Military Environmental Protection.

The "Best Practices Database" should be developed as a website. {#320}

Countries are required to accept responsibility for the long-term consequences of defoliation. (e.g. Hoi An area in Vietnam). (Newly suggested Item, N08)

U.S. military representatives agreed that this is highly likely, and not just for defoliation. DoD has maintained bases in foreign countries for over 50 years, and past practices have caused environmental damage. As other countries environmental programs "catch up" to the United States, it might be held responsible for past actions. If it would happen, it could prove to be either very expensive, or have a major impact on overseas basing.

This is not reparation-rather it's a matter of fixing up what was damaged, and hence, it should be the responsibility of the agency that did the damage to do the repair.

How far back would this concept extend? One can think about the contamination that still exists from WWI - mustard agent in France.

The use of "required to accept" is vague. The use of the military as an instrument of national power "to require" countries to accept responsibility is not likely to happen. This type of force is better left to diplomatic, economical, or informational instruments of national power.

Hague and Geneva Conventions already include sections that prohibit damage to "property." These are generally applied by the winner to the loser of the conflict. But, even after the Gulf War, UXO had to be cleaned up -- in that case, Kuwait paid for the cleanup; but it could have been the United States, at least on friendly soil (SA and Kuwait). We are still cleaning up in

CONUS for military activity as far back as it went. Defoliation is not allowed by the ENCON conventions.

The futurists group said that this issue is already under discussion with the State Department.

A new techno-info-nano-geno fix is developed as a potential remedy of some of the negative impact of human activities on environment - but the fix also carries its own threats. (New item, N13)

U.S. military representatives admitted that as technology marches on, the military will adapt as the situation demands.

The futurists, ecologists, and scientists acknowledged that this is a huge catchall, giving as example the mirrors in space as one important possibility worth considering and concern about mini-Ice-Ages that might make it worth developing.

Military forces are deployed in drought prevention (not mitigation or relief) measures. (Item 11 in Round 1)

U.S. military representatives agreed that this does not seem a likely mission for the OBJ Force of 2020. Advances in technologies: more drought resistant crops, best management practices for agriculture, cloud seeding, etc. are best left to the technical community, NGOs, and other relief organizations. Drought prevention is not a military mission; it's a social / political decision. Each country has to take its own measures. In the United States, the military would be involved only as a last-resort backup to civilian institutions and private industry. DOD's Carbon sequestration initiative is a testament to not get involved with technical issues of this magnitude.

A global push for environmentally friendly non-lethal weapons emerges. (Item 19 in Round 1)

U.S. military representatives strongly debated this issue, concluding that weapons development is determined by many factors and environmental friendliness may be among them, but not at the top of the list. . One of the deterrents to armed conflict is that it is lethal and not very nice. Non-lethal weapons might be of interest primarily to police forces. However, interests in these type of weapons already exists i.e. USMC is actively seeking new non-lethal weapons in support of PKO. This interest will continue, but the push will be from within.

What is the incentive to rogue nations and developing nations?

The military attachés consider that this is already being worked on now, and will only continue to be developed because of a variety of reasons: economics, human rights, as well as the environment. However, this will require access to the resources that will promote access to "environmentally friendly" non-lethal weapons technology.

There are already some restrictions and efforts, especially from the most developed nations not to affect the environment and especially not to employ weapons that could harm their own troops; and with the compliance of ISO 14000, more companies are going to produce materials environmentally friendly.

The threats will be very grateful, but they will not adhere to it.

What kinds of weapons are environmentally friendly? Stun guns, microwaves for heating? Sound blasters for crowd control? Are they really environmentally friendly?

The futurists, environmentalists, and scientists mentioned that the Marine Corps is the executive agent on NLW for DOD. Many non-lethal weapons are already being developed for police forces.

Water extraction from the air is developed as a desalination/water purification alternative technology for military forces. (Item 38 in Round 1)

U.S. military representatives believe that this would cause significant changes in the TO&E structure for the Army as it implies a completely different set of equipment used to provide water to the troops. It would certainly reduce the log tail and cost falls over time due to technology.

Currently water purification units reside in Quartermaster units. With this type technology, units could be fielded in units most likely deployed to arid regions. Those units that are first-deployed are not likely to have the benefit of the long logistical tail, which brings the ROWPUs. Also, it may not be applicable in some regions - arid desert areas, for example.

Weather modification or climate change techniques are developed and used, including their use as weapons. (Newly suggested item, N07)

U.S. military representatives said that very good statistical data is needed in order to determine whether the last weather anomaly (e.g. hurricane) was natural or whether it was an attack. Like a WMD, a biochemical dumped into the drinking supply system of a large metropolitan area, the responsible party is very difficult to determine, unless the group announces responsibility. However, if responsibility can be demonstrated, an immediate asynchronous response by the military is warranted and should be targeted against the rogue party.

The climate change or weather modification would have to be extreme to have measurable impact on military operations. DoD forces are already equipped to deal with weather extremes outside the society living in the area of operations.

Environmental information falsified by a third party (non-military) causes the Army to take actions that have unintended environmentally damaging effects. (Newly suggested item, N17)

U.S. military representatives highlighted that the DoD routinely defends itself against mis- and dis-information. However, a process of checks and balances should be in place to minimize this possibility. It is unlikely that such a campaign could lead to the military taking actions with environmentally damaging effects. However, if this becomes an issue, the military would have to develop secure systems for validating environmental information on which it acts.

In a way this is already happening. Key vocal activists along with regulatory support are already making the military commit scarce resources to unneeded characterization studies and monitoring programs that exceed all common sense.

The world's 20 largest military forces adopt ISO 14000. (Item 25 in Round 1)

U.S. military representatives consider that this would have minimal impact outside of cost (for U.S. forces and allies at least).

This is an example of where leadership would be better than simple public relations.

"Junkstorms" (spacejunk falling on populated areas) cause international environmental incidents. (Newly suggested Item, N05)

U.S. military representatives consider that this is an area where the Air Force would probably play an active role. The issue is the training necessary to be effective in this environment. However, they tend to consider that this is a low impact event, as the largest piece of "spacejunk" will not even come close to the damage caused by a tornado or a Cat 3 hurricane. The military would be involved only if it is their junk falling from the sky.

The futurists considered that it has high implications for the Air Force.

Other Comments

- NATO becomes a strong force in environmental protection. *Futurists, environmentalists, and scientists* wonder if this means that NATO takes environmental responsibility. UNU research shows that Europe tends to get more accurate information on environmental and energy problems than the United States, but the United States has better information on breakthrough new technologies. Hence, a better NATO liaison to share information may be crucial to global effectiveness in these areas. Mechanisms for sharing models as well as data may be essential. Effective integration of multiple sector models, and the derivation of policy sensitivities from coupled models, may be important.
- Will SDI lead to alternate ways to get nuclear, etc. devices into the United States?
- Governments find it increasingly difficult to control what happens within their borders, therefore, some national issues may become international issues/problems.
- How reliable is the information on the environment that comes from other sources than the military? How can the Army validate the information on which it acts? Could a third party insert false data that triggers Army action? Ideology plays a very important role in the interpretation of data that affect strategic decisions globally.
- Requirement for the Army to share data on environment is particularly important when new hyper multi spectral scanning satellites are in orbit.

Appendix F: Results of Round 3 and Analysis of Numeric Data

The *third round* was a questionnaire that concentrated on eight developments distilled from the results of the previous two rounds. The questionnaire focused on the military requirements themselves. The eight trigger developments were chosen on the basis of their importance and likelihood as well as their ability to generate a rich set of military requirements. The eight items are:

1. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.
2. A major military conflict over water is understood by world leaders as extremely plausible.
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 biodiversity changes disease patterns, increasing antibiotic resistance, etc.).
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.
5. The after-effects of biological, chemical, or nanotech weapons or a nuclear incident require a massive cleanup or other large-scale military response.
6. A post-conflict battlefield remediation treaty is implemented.
7. Military forces are given a new role in environmental conflict prevention and/or resolution.
8. Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces.

Plausible military requirements that derived from the workshop discussions were listed under each of the developments. The questionnaire asked the participants:

- To add what they think will give to the statement provided on the development more insight, usefulness, and veracity.
- For each suggested new requirement, provide their judgment about how effective it will be to address this issue, using the following scale:

Efficacy Scale

5 = Will solve the issue

2 = Will have little effect

4 = Will be very effective

1 = Will make the situation worse

3 = Will help address the issue

- To provide for each action their estimate of what year the respective requirement might be implemented by the military in their country. If believed that it will never happen, then enter “NEVER.” If believed that it has already occurred, enter “Now”; however, the survey asked when “new” requirements will be implemented.
- Add other military requirements that might result from the development, issue, and/or threat - with the year they think it might be implemented by the military in their country.

In analyzing the timing response, answers of “now” or earlier years than the present were interpreted as 2001; “never” answers were interpreted as 2050. Of course these interpretations would distort the analysis if a simple averaging of the dates were used. For this reason, the analysis used the median response.

The eight tables below show the responses (and the number of respondents), rank ordered by anticipated effectiveness:

1. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Coordination of military activities with civilian biological defense	2002	4.045	19
Integration of military with national epidemiological systems	2003	3.909	18
Training military for quick response aft attack by bio-weapons	2003	3.826	20
Establishing international biological defense agreements	2005	3.727	17
Assisting in training of biological defense in other countries	2005	3.727	18
Development and use of wide-spectrum vaccines	2008	3.478	15
Mass vaccinations in response to a defined bio-weapon threat	2005	3.348	16
Development of stand-off bio-sensors	2006	3.304	16
Pre-emptive military strikes to destroy bio-weapons	2008.5	3.217	18
Development and use of human immune system boosters	2010	2.727	12
Enforcement of biotech export controls by military	2005.5	2.682	15
Limits to immigration enforced by military	2004.5	2.636	16
Restricting movement of the populace ... biological agents	2010	2.478	15
Restricting movement of troops ... biological agents	2008.5	2.238	12

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

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Rapidly deployable water supply and water purification systems	2006	3.591	19
Military engineers to technical assistance for water infrastructure	2004	3.273	17
Regional conflict prevention capacities within military force structures	2005	3.227	17
Military protection of water supplies	2005	3.000	16
Military security and oversight for selected civilian water systems	2003	2.857	14
Deployment of micro- and nano-sensors in water systems	2008	2.783	16
Military development of a global database of water resources	2005	2.682	16
Development of national database of water resources by military	2004.5	2.286	14

3. A new and/or re-emerging disease threat or outbreak triggers conflict, (6) social instability or disorder. (e.g., AIDS goes airborne, global warming or loss of biodiversity changes disease patterns, increasing antibiotic resistance, etc.)

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Military medical intelligence and preventive medicine labs	2005	3.864	18
Military collaboration with public health agencies	2005	3.826	17
Establish / strengthen public health capacities in other countries	2006	3.478	17
Forecasting disease mutations, and resulting conditions for conflict	2008	3.478	17
Development and use of wide-spectrum vaccines	2005	3.348	14
Development and use of human immune system boosters	2010	2.957	13
Military transborder intervention to prevent international impacts	2010	2.696	16
Immigration disease screening enforced by military	2005	2.636	14
Restricting movement of troops to prevent spread of pathogens	2010	2.400	12
Restricting movement of the populace to prevent spread of pathogens	2007.5	2.350	13

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.

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Sustainable use of natural resources as a requirement.	2005	3.524	16
Concept of environmental sustainability in basic training	2005	3.409	18
Energy efficiency of military installation infrastructure by 50%	2007.5	3.333	15
Military define the requirements for sustainable bases...	2005	3.318	18
GIS tools to better manage military training areas	2005	3.182	17
Simulation reaches a point when it can replace field training	2010	3.000	14
Phase out of internal combustion engines for the military	2015	2.810	12
Best Practices Database	2005	2.810	13
Military installation managers state environmental issues	2005	2.550	14
Military land management to civilians who manage natural resources	2007.5	2.318	13
Military installations to local municipalities to manage	2010	1.857	10

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

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Develop cheap sensors for after-effects of bio, etc. pollution	2010	3.522	16
Military provision of medical care for those who are already affected	2005	3.435	17
"Off switch" in nanotech replicators to render them harmless	2015	3.182	14
A self-destruct in bioweapons to render them harmless	2020	3.136	15
Mechanisms to comply with treaties that define responsibilities	2010	3.136	13
Safe emergency dumps for mass disaster cleanups	2010	2.909	12

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

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
New models to measure impact of military operations	2006.5	3.136	14
New relationships between military and the ps for post-conflict cleanup	2010	3.130	15
Battlefield rapid remediation to lessen subsequent restoration	2012.5	3.045	14
Development of non-toxic explosives	2010	3.045	13
Rules of engagement that avoid environmental damage	2010	3.000	16
Ordnance that has a zero "dud" rate and/or self-destruct features	2010	3.000	13
Cheap sensors to allow for stand-off detection of pollution	2007	2.727	14

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

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
Training of soldiers for environmental missions	2005	3.545	17
New military equipment for environmental missions	2008	3.364	15
UN doctrine for environmental security operations	2008	3.261	17
Simulation can replace field training of armed forces	2015	2.619	13

8. Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces.

<i>Action</i>	<i>Median Year</i>	<i>Average Efficacy</i>	<i>Count No.</i>
R&D for defense against such asymmetric attacks	2004	3.727	17
Doctrine for military responses to attacks on the environment	2005	3.696	17
Use of military forces to isolate 'Rogue' states	2004.5	3.636	16

In order to analyze the levels of agreement or disagreement, the responses were also grouped according to their perceived effectiveness (percentage of answers in each rating group):

- **Low** - the requirement would make the situation worse or have little effect (1 or 2)
- **Medium** - the requirement would help somewhat to address the issue (3)
- **High** - the requirement would be very effective or solve the problem (4 or 5)

Items about which higher disagreement exists (no category over 50%) are shown in *italics*.

1. Biotechnology is used to build new kinds of weapons of mass destruction and these weapons are deployed at least once.

Action	1 or 2	3	4 or 5
Coordination of military activities with civilian biological defense	0.0	9.1	90.9
Integration of military with national epidemiological systems	0.0	27.3	72.7
Assisting in training of biological defense in other countries	4.5	27.3	68.2
Training military for quick response aft attack by bio-weapons	4.3	30.4	65.2
Establishing international biological defense agreements	13.6	22.7	63.6
Pre-emptive military strikes to destroy bio-weapons	21.7	30.4	47.8
<i>Development of stand-off bio-sensors</i>	13.0	39.1	47.8
<i>Development and use of wide-spectrum vaccines</i>	21.7	30.4	47.8
Mass vaccinations in response to a defined bio-weapon threat	21.7	34.8	43.5
<i>Limits to immigration enforced by military</i>	45.5	31.8	22.7
Enforcement of biotech export controls by military	36.4	50.0	13.6
Development and use of human immune system boosters	31.8	54.5	13.6
Restricting movement of the populace ... biological agents	47.8	39.1	13.0
Restricting movement of troops ... biological agents	57.1	42.9	0.0

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

Action	1 or 2	3	4 or 5
Rapidly deployable water supply and water purification systems	18.2	31.8	50.0
Regional conflict prevention capacities within military force structures	27.3	22.7	50.0
<i>Military engineers to technical assistance for water infrastructure</i>	13.6	45.5	40.9
<i>Military protection of water supplies</i>	27.3	40.9	31.8
<i>Military security and oversight for selected civilian water systems</i>	28.6	42.9	28.6
Military development of a global database of water resources	31.8	50.0	18.2
Deployment of micro- and nano-sensors in water systems	26.1	56.5	17.4
<i>Development of national database of water resources by military</i>	47.6	47.6	4.8

- 3. A new and/or re-emerging disease threat or outbreak triggers conflict, (6) social instability or disorder. (e.g., AIDS goes airborne, global warming or loss of biodiversity changes disease patterns, increasing antibiotic resistance, etc.)**

Action	1 or 2	3	4 or 5
Military medical intelligence and preventive medicine labs	9.1	13.6	77.3
Military collaboration with public health agencies	0.0	34.8	65.2
<i>Establish / strengthen public health capacities in other countries</i>	<i>13.0</i>	<i>39.1</i>	<i>47.8</i>
<i>Forecasting disease mutations, and resulting conditions for conflict</i>	<i>13.0</i>	<i>43.5</i>	<i>43.5</i>
<i>Development and use of wide-spectrum vaccines</i>	<i>17.4</i>	<i>39.1</i>	<i>43.5</i>
<i>Military transborder intervention to prevent international impacts</i>	<i>43.5</i>	<i>26.1</i>	<i>30.4</i>
<i>Development and use of human immune system boosters</i>	<i>30.4</i>	<i>43.5</i>	<i>26.1</i>
<i>Immigration disease screening enforced by military</i>	<i>40.9</i>	<i>45.5</i>	<i>13.6</i>
Restricting movement of troops to prevent spread of pathogens	55.0	40.0	5.0
Restricting movement of the populace to prevent spread of pathogens	55.0	40.0	5.0

- 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.**

Action	1 or 2	3	4 or 5
Sustainable use of natural resources as a requirement.	9.5	38.1	52.4
GIS tools to better manage military training areas	22.7	27.3	50.0
<i>Simulation reaches a point when it can replace field training</i>	<i>28.6</i>	<i>28.6</i>	<i>42.9</i>
Military define the requirements for sustainable bases...	9.1	50.0	40.9
Concept of environmental sustainability in basic training	4.5	59.1	36.4
Energy efficiency of military installation infrastructure by 50%	4.8	66.7	28.6
<i>Phase out of internal combustion engines for the military</i>	<i>28.6</i>	<i>47.6</i>	<i>23.8</i>
Military installation managers state environmental issues	30.0	55.0	15.0
Best Practices Database"	19.0	66.7	14.3
<i>Military land management to civilians who manage natural resources</i>	<i>45.5</i>	<i>40.9</i>	<i>13.6</i>
Military installations to local municipalities to manage	57.1	42.9	0.0

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

Action	1 or 2	3	4 or 5
Develop cheap sensors for after-effects of bio, etc. pollution	4.3	43.5	52.2
<i>Military provision of medical care for those who are already affected</i>	<i>13.0</i>	<i>39.1</i>	<i>47.8</i>
Off switch" in nanotech replicators to render them harmless	13.6	50.0	36.4
A self-destruct in bioweapons to render them harmless	22.7	40.9	36.4
Mechanisms to comply with treaties that define responsibilities	22.7	50.0	27.3
Safe emergency dumps for mass disaster cleanups	22.7	54.5	22.7

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

Action	1 or 2	3	4 or 5
<i>Rules of engagement that avoid environmental damage</i>	<i>34.8</i>	<i>26.1</i>	<i>39.1</i>
<i>New relationships between military and the ps for post-conflict cleanup</i>	<i>21.7</i>	<i>43.5</i>	<i>34.8</i>
<i>Ordnance that has a zero "dud" rate and/or self-destruct features</i>	<i>23.8</i>	<i>42.9</i>	<i>33.3</i>
Battlefield rapid remediation to lessen subsequent restoration	18.2	50.0	31.8
<i>Development of non-toxic explosives</i>	<i>22.7</i>	<i>45.5</i>	<i>31.8</i>
<i>New models to measure impact of military operations</i>	<i>22.7</i>	<i>45.5</i>	<i>31.8</i>
<i>Cheap sensors to allow for stand-off detection of pollution</i>	<i>36.4</i>	<i>36.4</i>	<i>27.3</i>

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

Action	1 or 2	3	4 or 5
Training of soldiers for environmental missions	13.6	36.4	50.0
UN doctrine for environmental security operations	<i>26.1</i>	<i>34.8</i>	<i>39.1</i>
New military equipment for environmental missions	13.6	50.0	36.4
<i>Simulation can replace field training of armed forces</i>	<i>35.0</i>	<i>35.0</i>	<i>30.0</i>

8. Future conflicts will be driven by rogue states and terrorists, changing the nature of environmental challenges facing military forces.

Action	1 or 2	3	4 or 5
R&D for defense against such asymmetric attacks	0.0	36.4	63.6
Doctrine for military responses to attacks on the environment	0.0	39.1	60.9
Use of military forces to isolate 'Rogue' states	13.6	27.3	59.1

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