4. STRATEGIC ANALYSIS

Today, the United States of America is the world's preeminent superpower, whether military or economic power is used as a measure. The U.S. is also the world's largest consumer of energy and other natural resources, as well as the world's preeminent generator of waste. More municipal solid waste (trash) is produced in the U.S. than the total of the next highest 15 developed countries of the world together.[1]

In negotiating policies for global warming, the United States has attempted all manner of clever data manipulation to hide its rate of consumption of fossil fuels and production of greenhouse gases from the world, but all disguises have failed to conceal the fact that the U.S. is, far and away, the world leader in greenhouse gas pollution, not an admirable achievement (see Table 3-2).

The cartoon in Figure 4-1 really says it all: the fat cat driving the gas hog sits judgmentally over the developing world in "protecting the environment" (cultural illiteracy is also evident). The U.S. still views itself as the good guy trying to do the right thing for the rest of the world—secure peace, ensure a clean environment, and help establish an acceptable quality of life worldwide. People in the rest of the world see the U.S. with less trust, questioning its motivation in helping and supporting them.

This is the context in which the U.S. is searching for a coherent policy and strategy with regard to environmental security. It is critically important to recognize that environmental security is only one component of the larger process of U.S. foreign policy and cannot be separated from the whole. Foreign policy issues are outside the scope of this research, as is much of the detail of how our Department of State should accomplish its environmental security mission. This study limits itself to separating overall requirements into military missions and those governmental actions best accomplished by other agencies.

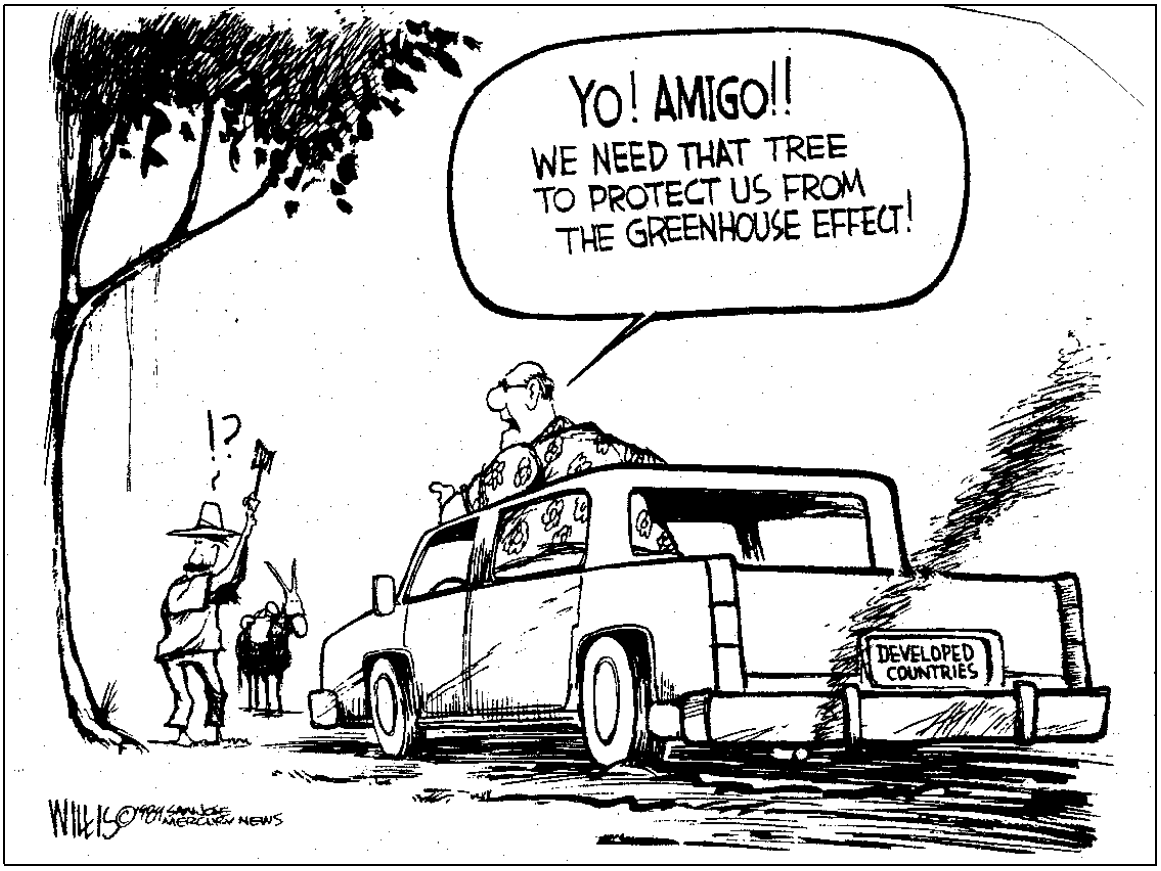
Recalling the opening questions, it is now time to address:

What is the military mission in environmental security
and how should this mission be executed?

[1] Rodney White, *North, South, and the Environmental Crisis* (Toronto: University of Toronto Press, 1993), 148.

FIGURE 4 – 1

Environmental Security, Two Perspectives



SOURCE: Scott Willis, *San Jose Mercury News,* Copley News Service, 1989.

First, it may be useful to recap what has been discussed to this point. Chapter 1 reviewed current discussions and research regarding the political science of environmental security, while Chapter 2 focused on defining the term "environmental security" and proposed a working definition for this study. Chapter 3 presented a scientific overview of critical environmental issues.

Our strategic analysis begins with a notional understanding of the key environmental security issues and how environmental scarcity and environmental degradation could impact security. To avoid making radical assumptions—and recognizing that there are still many uncertainties—we can draw from the generally accepted lessons of the body of environmental security studies in identifying three consensus-based areas of critical concern:

1. Environmental scarcity is impacting human lives in many regions of the world.[2] In an address to the International Conference on Climate change in 1994, Eileen Claussen, the Senior Director of Global Environmental Affairs for the National Security Council, stated: "The four resources most likely to help produce conflict are cropland, water, fish, and forests."[3] As discussed in Chapter 3, scarcity or degradation of these four resources is often the result of human-induced environmental change.

2. Environmental resource scarcity, fostered by a combination of population growth and resource depletion, has already been a cause or a contributing factor in regional conflict.[4] The conflict in the Sahel region of Africa (Chad, Ethiopia, and Sudan), and the Bangladesh-Assam fighting were resource-depletion based, with resource scarcity driving migration which led to ethnic conflict. The Senegal River conflict and, to many, the genocide in Rwanda also had resource scarcity issues as basic causes.

3. The environmental conditions that sparked the conflicts mentioned above are only getting worse—there is less water and arable land, fish resources are being heavily mined, and deforestation continues—while regional populations burgeon.

The useful scholarly debates concerning the cause and effect relationships between conflict and environmental issues will continue, but our task here requires us to pragmatically move past this discussion. It was earlier stated that this study would employ a risk-assessment model in dealing with uncertainty. This approach allows for making the best possible decisions based not on certainty about what will happen, but on the best scientific judgments on the consequences of what is most likely to happen.

Applying risk analysis to the three areas of critical concern listed above, it can be concluded that the risk of destabilizing events or conflict is high today and can be expected to increase. The resulting harm—which is the threat to long-term U.S. security caused by the occurrence of many of the sufficiently likely conflicts—would be significant. Therefore, following a risk model where magnitude of harm multiplied by the probability of occurrence equals risk, a high potential risk would necessitate a security strategy focusing on preventing and responding to the potential threats to environmental security. This is the approach taken in most aspects of U.S. national security strategy planning: employing a risk-based threat analysis as the basis for decisions on future policy and strategy.

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[2] White, *North South, and the Environmental Crisis.*
[3] Eileen Claussen, speech given at the International Conference on Climate Change, Washington, D.C., July 1994.
[4] James Lee, *Inventory of Conflict and Environment* (Atlanta, Ga.: AEPI, 1999).

4.1 Environmental Security Threat Assessment

Analysis of the threat posed by environmental degradation can be simplified into three questions:

What is going to happen?

Where is it going to occur?

When will it start?

What is going to happen was discussed in Chapter 3 and will be summarized in this chapter. ***Where*** these issues are going to occur is the focus of much of the remainder of this chapter, but can be dealt with only on a larger regional scale because of the coarseness of the data available. ***When*** is probably the most difficult of all the issues, because so many variables, natural and human-induced changes, enter into the calculations.

Obviously, the answers we seek are not going to be straightforward. This is compounded by the fact that environmental security is very much a contextual issue. For example, assume that two disputes over water rights exist between the U.S. and Mexico on one border and the U.S. and Canada on the other. If the technical details of these two problems are similar, will the nature of the discussions be the same? Experience supported by numerous examples suggests that scarcity of water in the south would make that dispute much more contentious. Further, the prevailing political environment could make the technical details of the issue secondary to the political policy considerations. To reemphasize a previous statement, *environmental security is only one component of the larger process of U.S. foreign policy and cannot be separated from the whole.*

In strategic decision making, politics has primacy over the military and even science. However, environmental studies do offer solid intelligence data to allow the conduct of an environmental security threat assessment. To begin, Table 4-1, "Impacts of Environmental Change," presents a summary of the information developed in Chapter 3 on the possible impacts of the most significant environmental hazards. Drawing on Table 3-4 (potential impacts of deforestation) and Table 3-3, which predicts regional impacts of an enhanced greenhouse effect, Table 4-1 addresses the "What" component of our analysis and, to a small extent, where these impacts may be expected.

Table 4-1 stratifies the impacts into the categories employed by Ms. Claussen (farmland, forest, water, and fish), with the addition of consideration of human impacts. As we

TABLE 4 – 1

Impacts of Environmental Change

Environmental Issue	Global Environmental Concerns				Regional Environmental Concerns			
	Farmland	Forest	Water / Fish	Human	Farmland	Forest	Water / Fish	Human
Global Climate								
- Warming	Inundation of arable lands, drier soils in summer	Change in shape of temperate and tropical forests	Weather changes impact the hydrologic cycle	Natural hazards, property loss, heating & cooling costs	Wetter wet seasons, drier soils in dry season	Shifts in size and location of temperate and tropical forests	Changes in rain patterns, change in temporal and spatial distribution	Increased disease in developing countries
- El Niño	---	----	---	---	Increased erosion	Change in water distribution	Increased winter rains, loss of fish in Pacific	Flooding and other natural hazards
- Ozone depletion	UV damage to many species of plants & animals	UV damage to many species of plants & animals	---	Cancer	UV damage to many species of plants & animals	UV damage to many species of plants & animals		Cancer in Southern Hemisphere
Land Issues								
- Deforestation	---	Greenhouse gases produced, less CO_2 recycled, loss of biodiversity	Reduction of groundwater recharge, siltation of streams	Indigenous tribes endangered, biodiversity lost	Temporary increase in cropland	Net loss, particularly in tropical forests, Biodiversity loss	Decreased groundwater recharge, increased runoff rates	Loss of Indian habitat in rainforest, loss of beneficial species
- Desertification	---	---	---	Displacement herding populace	Loss of productive lands	Encroachment on fragile forests	Reduced soil moisture, can increase runoff & reduce recharge	Migration of African nomads
- Waste disposal	---	---	Contamination of surface & ground water and fish	Toxic exposure	---	---	Poisoning of water supplies & fish	Toxic exposures; contamination of water resources and food chain
Water								
- Quantity	---	---	Freshwater fish lost, reduced productivity in estuaries	Increased migration	Reduced irrigation and grazing	Highly variable impacts by regions	Freshwater fish lost, reduced productivity in estuaries	Increased migration
- Quality	---	---	Toxicity and bioaccumulation of toxics	Increased rates of disease	Salinity reduces productivity	Acid rain damage	Toxicity and bioaccumulation of toxins	Disease increases in developing countries
- Oceans	---	---	Overfishing is endangering stocks	Loss of fish, disease exposure	---	---	Overfishing is endangering stocks	Loss of fish protein; disease

proceed with our analysis it will become evident that, for military considerations, acute human impacts must be included in the assessment.

Table 4-1 further divides impacts into global and regional, a distinction which is of great importance in identifying the appropriate policy and strategy response. Table 3–4 describes impacts of deforestation on tropical and temperate (i.e., outside 20^{o} latitude north or south) regions of the world and then further subdivides these regions in terms of economically developed and developing countries in temperate regions and developing countries in the tropics (because there are no fully economically advanced countries in the tropical belt). These divisions are similar to the North and South approach of Rodney White[5] and others, which defines the rich northern temperate world as one group and the tropical and southern temperate developing countries as a second group. This study attempts to overcome the shortcoming of the North and South approach by including a separate classification for northern temperate developing countries. For environmental security purposes there are important countries in this classification, such as the Balkans and some of the small states of the former Soviet Union.

Considered together, Tables 3-3, 3-4, and 4-1 permit several summary conclusions to be made about the impacts of environmental degradation and change, including, in order of importance:

1. Humans are threatened by loss of water and food and increased incidence of disease. This is a summary finding based on the human and farmland columns of Table 4-1, but it is supported by the information in Table 3-4. Table 3-3 suggests regions where these impacts are likely to occur; temperate and tropical Asia and Africa appear to be the areas of most concern.

2. The greatest overall impacts from cumulative environmental change will occur in the tropical countries, which are all economically developing countries. All current data and analysis suggest this to be true.

3. Global warming with its linkages to deforestation is the issue with the potential to produce the most damage. Table 3-3 predicts large-scale impacts from global warming and Table 3-4 lists some of the devastating effects that reduced carrying capacity could have in some regions.

4. Weather change is likely to produce an increase in the incidence of natural hazards as increased evaporation is counterbalanced by new, more intense

[5] White, *North South, and the Environmental Crisis.*

weather cycles. Because of environmental degradation, many more people will be at risk.

5. A combination of factors presented in Table 4-1 is resulting in a lessened ability to feed the people of the world.

6. Issues related to water are major stress factors on human subsistence and economic development.[6]

Using the summary data available, we can move on to conduct a geographic information systems (GIS) analysis to determine more precisely "Where" environmental security problems and conflicts may occur. The GIS process is a powerful tool for employing spatial data to identify trends and cumulative factors. The GIS process begins by thematically mapping environmental data at a constant scale, recognizing that edge errors may exist because most data are constructed following political boundaries while the actual issues spill across borders. Information is then overlaid or stacked to identify points of conformity between features or values.

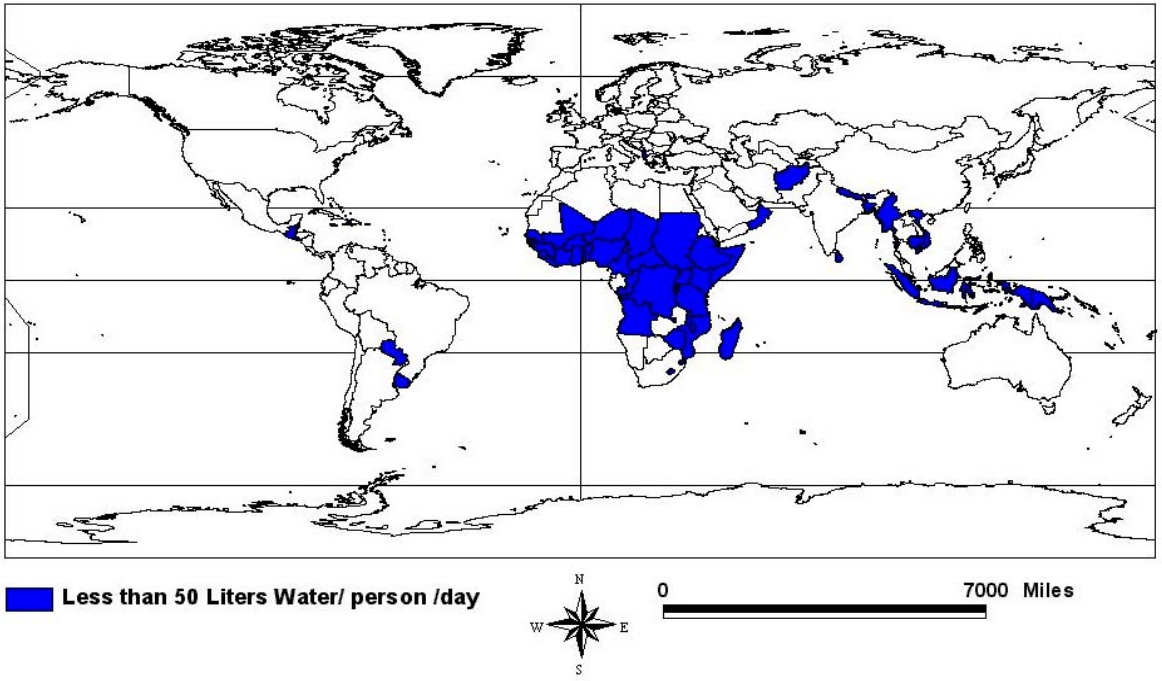
Population density and rate of natural increase[7] are two (of many different) ways of examining population data that will be employed here. In environmental security studies, the only true common ground among researchers is the strong consensus belief that population is a primary variable in understanding all the other issues; therefore, some form of population statistic will always be the base feature.

The first GIS analysis takes the water scarcity data from Table 3–5 and thematically maps it to produce Figure 4-2. Next, the population density data from Figure 3-2 is overlaid onto Figure 4-2 to create Figure 4-3, which depicts the most populated countries with water shortages. An analysis of this figure suggests that the Ganges River region and island nations in southwest Asia are two areas where water is a growing concern. This is a somewhat surprising finding, since these areas fall within the wet tropics. Further study reveals that many factors in combination are creating these regional water supply problems, but the major factor is that the cost of supplying clean water to a fast growing population is beyond the means of the countries of these regions. In many of the island nations, collecting and moving supplies to populated areas is more of the water problem than total available supplies.

[6] Ambassador Richard Armitage, lecture given at the Naval War College, May 2000.
[7] Rate of natural increase is the crude birth rate minus the crude death rate expressed as a percent value.

FIGURE 4 – 2

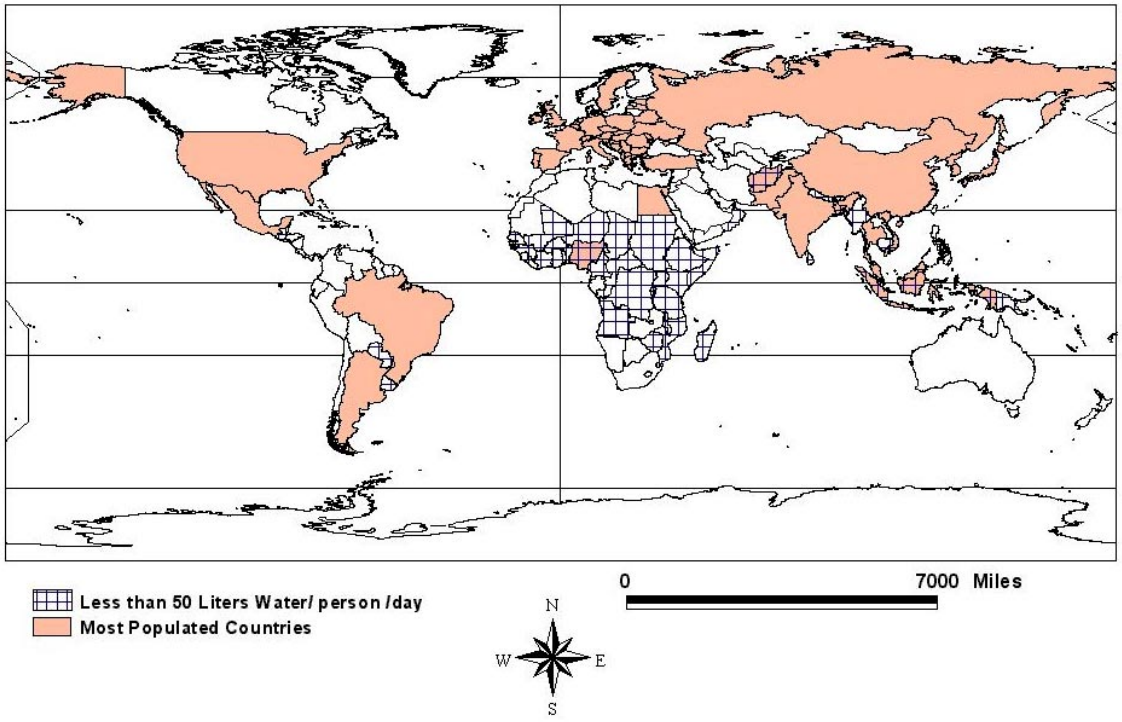
Countries Without Adequate Drinking Water



SOURCE: Peter Gleick, *The World's Water* (Washington, D.C.: Island Press, 1998).

FIGURE 4 – 3

Densely Populated Countries with Water Shortages



SOURCE: Peter Gleick, *The World's Water* (Washington, D.C.: Island Press, 1998); populations from *Goode's World Atlas.*

There is some concern with the analysis depicted in Figure 4-3 because of the lack of correlation between the countries with high population and the countries with water shortages. To address this concern, it was felt that some measure of population growth rate such as rate of natural increase might prove a better metric than population density. To test this theory, the water scarcity data from Figure 4-2 was stacked with the population growth rates data from Figure 3-3 to create Figure 4-4. The result is a much stronger correlation; countries with high growth rates are to a large degree also the countries with drinking water shortage issues. (Doing the same type of analysis with the safe drinking water/adequate sanitation data from Figure 3-17 would further support this finding, but would introduce a separate factor of disease due to the sanitation problems in these same regions.)

We can conclude that population growth rates prove a much better metric than population density in determining the relationship between population and water issues. To further assess the utility of rate of natural increase to predict water scarcity, Figure 4-5 was constructed with only the countries from Figure 4-4 that met both criteria—high population growth rate and water scarcity; *41 of the 50 water-scarce countries also have population growth rates above 2 percent per year.*

Deforestation is another major issue that can be better examined with the help of GIS analysis. Overlaying population growth rates with deforestation rates produces the striking correlation seen in Figure 4-6. *Countries with forests that also have high population growth rates are being deforested at high rates.* The correlation in this case is even stronger than that seen with water. Nearly all of the points of discontinuity can be readily explained. Most are associated with places that have high population growth rates but lack significant forests to cut. Somalia, Ethiopia, and Kenya in Africa and Mongolia in Asia are all examples of this type of situation, as depicted in Figure 4-6. In most of the other cases of discontinuity, the countries had moderate growth and moderate deforestation, with both falling just below the thresholds used in building Figure 4-6.

From a global perspective, our concern becomes the countries in the tropics, Africa in particular, because of the high rates of natural increase. With regard to deforestation, the major concern is with tropical forests because they are the most significant ecological resource. These forests are the most biologically active and thus the most useful in mitigating the enhanced greenhouse effect. In addition, they are 40 times more diverse in species than temperate forests.

The next step in our analysis is to determine which regions of the world will be both water scarce and impacted by deforestation. Figure 4-7 depicts the areas that meet both criteria. The only caution in interpreting these data is that countries already deforested are not

FIGURE 4 – 4

Correlation of Population Growth Rates with Water Scarcity

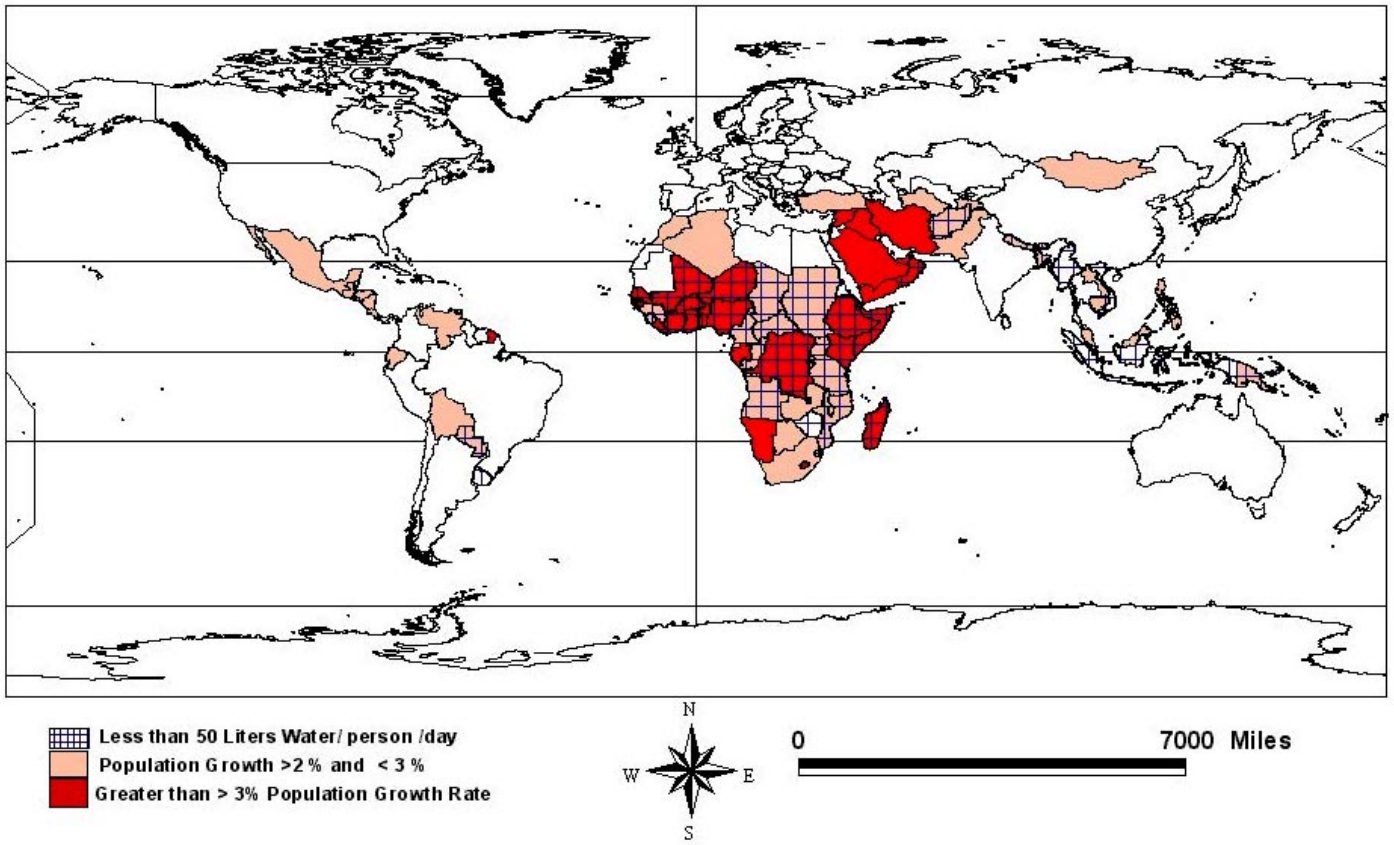


FIGURE 4 – 5

Countries with High Population Growth Rates and Water Scarcity

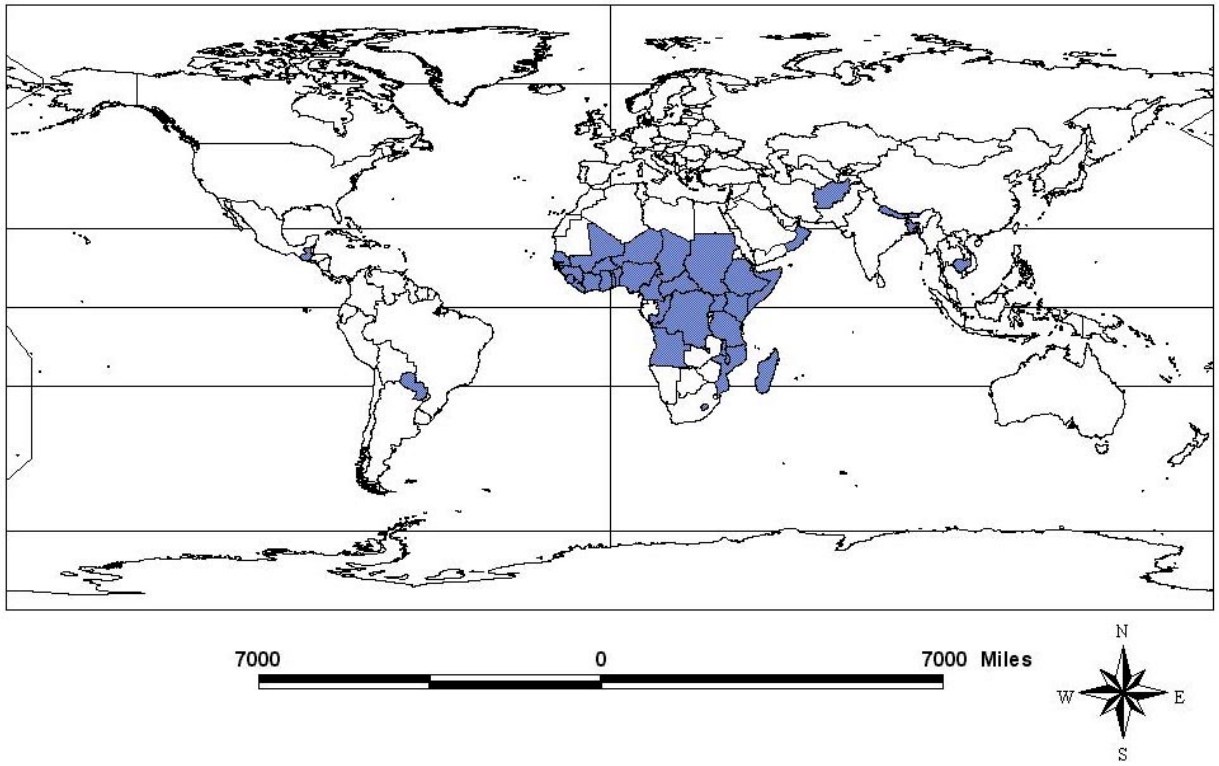


FIGURE 4 – 6

Correlation of High Population Growth Rates with High Deforestation Rates

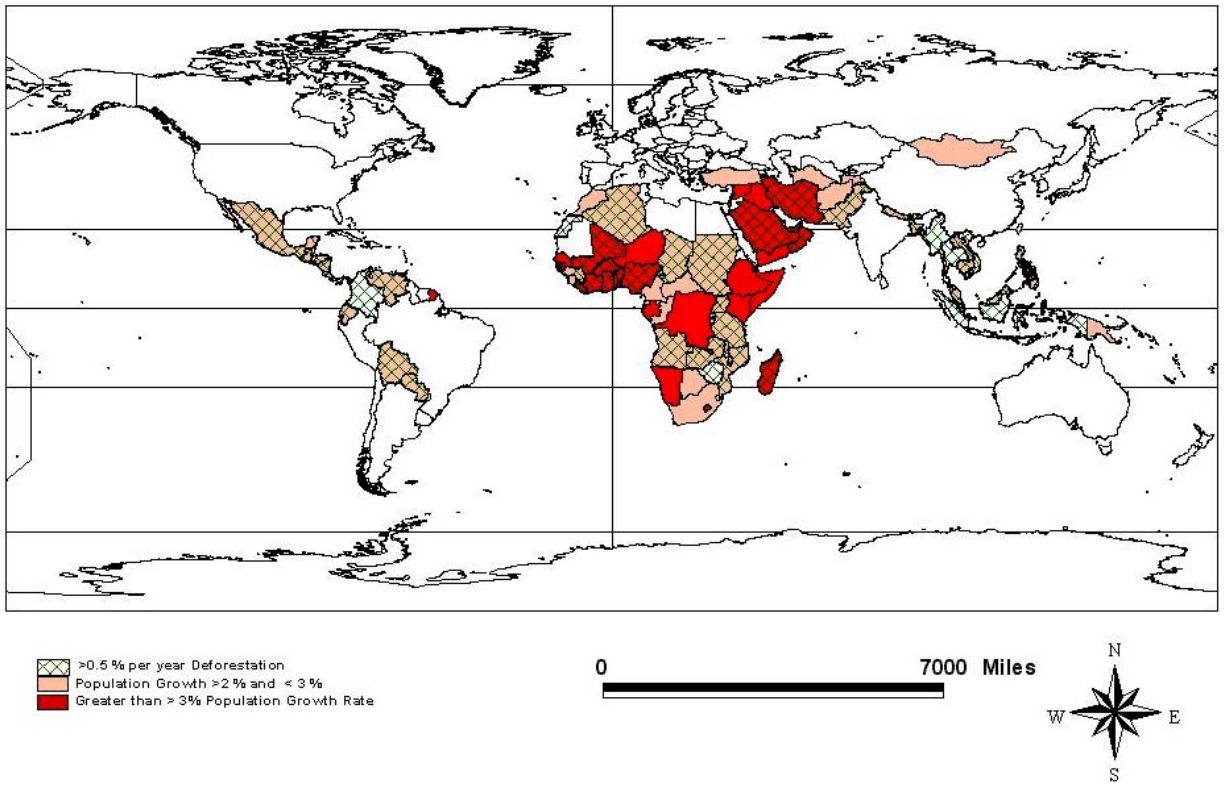
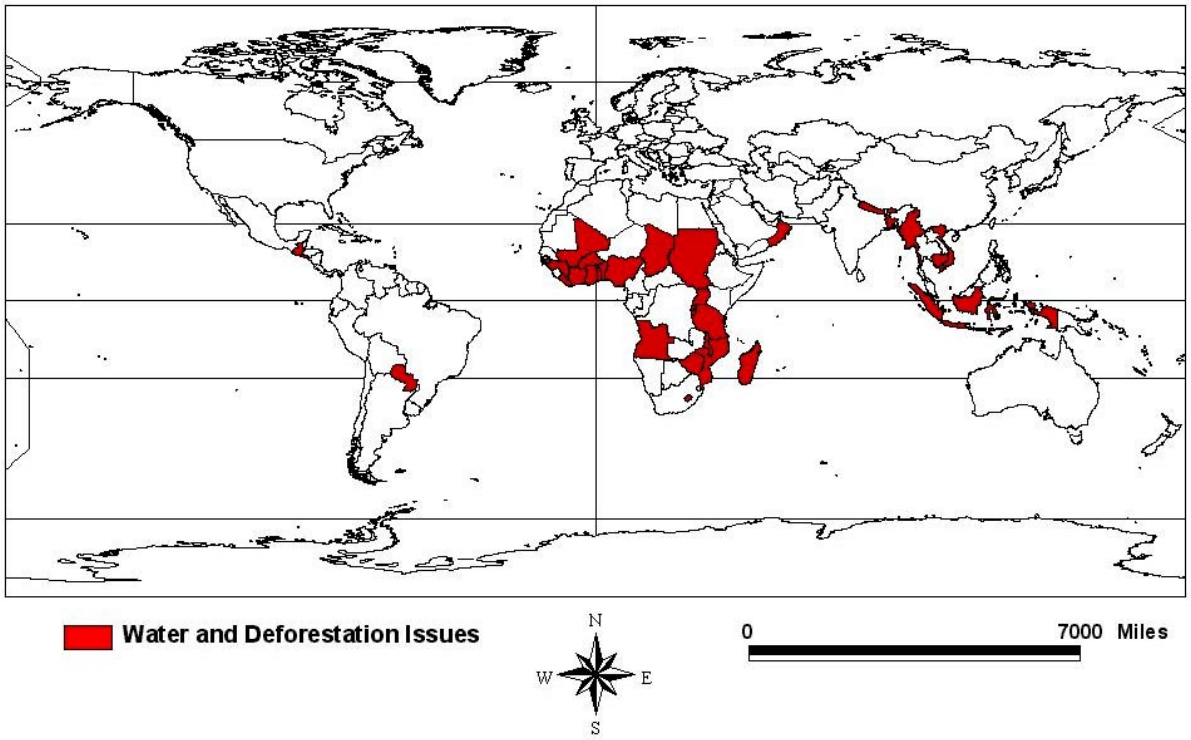


FIGURE 4 – 7

Countries with High Population Growth Rate, Water Scarcity, and Deforestation



shown. Ethiopia, for example, has lost nearly all of its forests over the last 50 years, and therefore is not shown in red in the figure. The Sahel region of Africa (see Figure 3-9, page 41), the Ganges River basin, and the tropical islands of Southeast Asia are the areas of the world most impacted by these resource scarcities and high population growth rates.

Constructing GIS maps for the impacts of global warming is, in the view of this researcher, too problematic to be useful. However, it is possible to identify concerns in a generic way. The most important issue related to global warming is the problem of sea level rise, because most of the world's population lives close to or on a coast. Any loss of land is certain to displace people, in numbers depending on the magnitude of sea rise. Particularly sensitive are the low-lying delta regions around the world that support large populations, such as the Ganges and Nile River area. A small sea rise in these areas will produce measurable to catastrophic harm.

Changes in weather and regional climate are the toughest to predict, temporally or spatially. If Houghton's predictions of climate change shown in Figure 3-9 are considered with the data presented in Figures 4-5, 4-6, and 4-7, there is some basis for discussion, but the information is too inexact to allow for useful predictive models. Nevertheless, the northern belt of the sub-Sahara is clearly the area of greatest concern. It fails to provide basic requirements for a population growing at high rates. The region encompassing east India and Bangladesh is another very resource-limited area where adverse weather and/or sea rise could produce traumatic impacts. Existing monsoon conditions already make catastrophic death from flooding almost routine in this area. Caution should be applied in conducting any sort of analysis based on climate modeling, yet it can be assumed with relative certainty that adverse impacts will be better ameliorated in the developed-temperate north than in the tropical and southern temperate countries.

The data does support making several observations about the environmental security impacts of other issues discussed in Chapter 3, specifically desertification, hazardous wastes, and oceans. As is evident in Table 4-1, most of these environmental issues are more regional than global in their impacts.

Desertification impacts occur in the regions on the margins of existing deserts. These impacts, while extreme for the populations affected, tend to occur in the less populated areas of the world because of the already low carrying capacity of deserts. Waste disposal is of concern primarily because of localized secondary impacts on water quality, but there are regions of the world where environmental exposures to hazardous wastes are producing acute and chronic illness. Parts of the former Soviet eastern block have particularly severe environmental health problems. The world's oceans are being affected by overfish-

ing; a reduction of fish production has been a secondary response to anthropogenic damage to the world's estuaries as a result of water pollution.

In this section we have summarized the impacts of environmental degradation. Since many of the impacts are regionally specific while the data consist of broad, global observations, the methodology presented here is as important as the reported results. The hope is that this type of methodology can be used by regional Commanders in Chief (CINCs) in collecting and applying detailed data from their areas of operation to develop their specific plans.

4.2 Strategic Assessment of Environmental Security as a Military Mission

The fundamental tenet of military power is summed up in the introduction to the National Military Strategy: "The military is a complementary element of national power that stands with the other instruments wielded by our government."[8] The Chairman of the Joint Chiefs of Staff more powerfully expressed the same thought when he stated, "The military is a great hammer, but not every problem is a nail."[9] Since this is the fundamental principle to which we will adhere in conducting our strategic military assessment, is is important to differentiate between the military and non-military environmental security missions of the National Security Strategy.

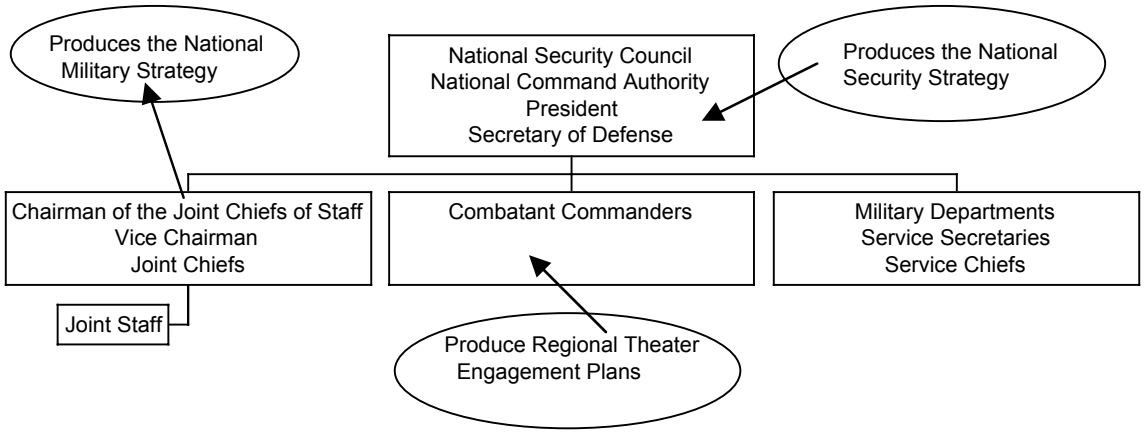
The current framework for developing and implementing U.S. national security policy is represented in Figure 4-8. The National Security Strategy (NSS) is the primary document promulgated by the National Security Council. The National Military Strategy (NMS) is the accompanying policy document promulgated by the Chairman of the Joint Chiefs of Staff.

In the view of this author, the process depicted in Figure 4-8 works well for NSS policy and strategies that relate to wholly military functions, but is inadequate for policy and strategies relating to broad-based, comprehensive issues, such as the nation's environmental security mission. Accomplishing the total environmental security mission requires actions from many departments and offices outside the Department of Defense (DOD), with the bulk of the requirements falling outside the military sphere. Because the requirements for international environmental security are not primarily military, but fundamentally a policy matter

[8] Chairman of the Joint Chiefs of Staff, *National Military Strategy* (Washington, D.C., 1997), 1.
[9] GEN Hugh Shelton, lecture given at the Naval War College, May 2000.

FIGURE 4 – 8

National Security Structure



SOURCE: National Security Decision Making Department, Naval War College, 1999.

for the Department of State, the DOD should play a supporting role in developing a strategy and executing the environmental security plan.

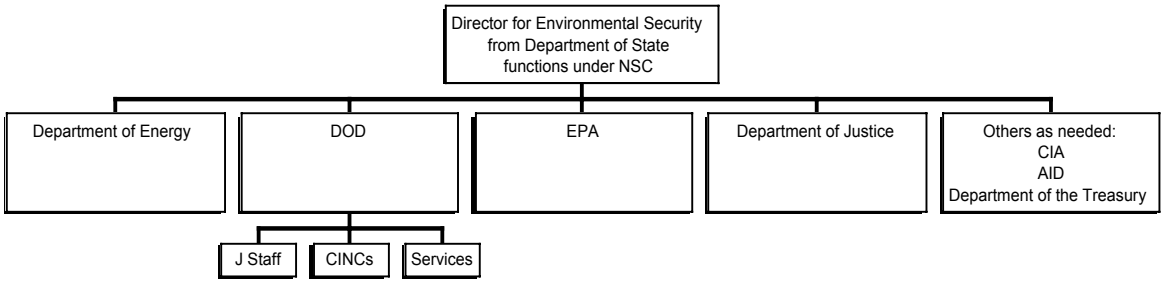
Figure 4-9 diagrams a proposed governmental structure for environmental security. The structure involves a variety of organizations, indicating both recognition of environmental security as a component of their mission and an existing capability to support this mission. It is evident that no one organization contains all the capability required for developing and implementing a coherent international environmental security strategy. It is equally clear that someone must be in charge, and the nature of the problem suggests this should be the Department of State. Establishment by the Department of State of several regional Environmental Hubs throughout the world shows some recognition of this fact.

Details on the operational requirements of a scheme such as that depicted in Figure 4-9 are well beyond the scope of this study, which remains focused on the DOD activities and functions. This research did not examine State Department activities in support of environmental security, but an interview with Mr. Gary Vest, the Principal Under Secretary of Defense for Environmental Security, indicated that no real plan has been developed by the Department of State, nor has it assumed leadership and management for an overall program.[10]

[10] Gary Vest, interview conducted by author 31 March 2000, at the Pentagon.

FIGURE 4 – 9

A Proposed Environmental Security Organizational Structure



- The Director is a senior official from the Department of State, working as part of the National Security Council staff
- Each subordinate organization has a member on the Environmental Security Planning and Review Board

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In the scheme proposed here, it appears logical that any issues primarily of global focus must be managed from the top of the structure, by the Department of State. Global warming, greenhouse gas reduction, and ozone depletion are examples of issues falling into this category. Based on both the data in Table 4-1 and the technical explanations presented in Chapter 3, these are issues that must be addressed with the tools of diplomacy such as international/bilateral agreements and economic diplomacy. The international effort to control ozone-depleting substances is a good example of the effectiveness of this process. As noted earlier, chlorine in the atmosphere is being reduced, directly because of the international cooperation achieved through the Montreal Protocol of 1987.

Protection of the oceans is also primarily a matter of diplomacy, but one which could be aided by supporting uses of the military, particularly the Navy and the Coast Guard. Waste disposal is another primarily diplomatic and legal activity requiring little military support, although the Army Corps of Engineers possesses technical expertise that could aid developing countries in civil works activities.

Land use and surface water issues are the areas where the military can have the greatest utility in a supporting role. The next section of this report will examine some of the ways in which military capability can forward the cause of security in a preventive defense manner.

4.3 Strategic Military Environmental Security Planning

The military approach to accomplishing the National Security Strategy is reflected in the National Military Strategy as "Shape, Respond, Prepare Now.

- "Shape" involves promoting regional stability and preventing/reducing conflict and threats, primarily through actions that can prevent or, as much as possible, mitigate adverse impacts of environmental change. *This is the primary focus of environmental security as it is defined in this paper.*

- In terms of international environmental security, "Respond" entails smaller scale contingency operations where it has been determined that military capabilities are necessary to respond to an environmental security emergency; U.S. actions in Rwanda and Hurricane Mitch are examples of this type of response action. Military response is appropriate when it expedites reestablishment of peace and security in a region or is essential to reduce human suffering.

- "Prepare Now" involves manning, equipping, and resourcing for the missions of the future.

The final issue to be raised in this analysis has to do with the emerging environmental security mission. What should this mission be? The DOD has an office to manage its environmental security program, but this office functions in the context of the program-oriented definition of environmental security found in the DOD directive (see section 2.1), and thus is limited in the attention devoted to the aspects of international environmental security as it is defined in this work. Further, this analysis has shown that most environmental security issues that could involve the military occur at the regional level; this means that primary activities will fall under the purview of the regional CINCs. "Shape" will be addressed in the CINC theater engagement planning (TEP) process and "Respond" will be part of CINC operational contingency planning. It is hoped that CINCs will use the concepts in this document to refine these components of their mission planning and execution.

The Army Center for Strategic Leadership has been a focal point for analysis of environmental security issues as they relate to the DOD and has assisted CINCs in developing environmental security components of their theater engagement plans.[11] "Prepare Now" must begin at the national policy level with a plan that can then be supported by the DOD through

[11] A number of documents from the Strategic Studies Institute, Army War College, many authored by Dr. Kent Butts, are included in the bibliography as general references that enhanced this research.

a structure such as that proposed in Figure 4-9. Until that overarching plan is developed, the DOD does not have the guidance it needs to begin carrying out its supporting roles.

This leads us to the question that drives right to the heart of the matter of environmental security within the DOD: what actions can be taken by the military to help secure peace? Table 4-2 presents a list of ideas compiled from the literature and gathering of information from those with practical experience.

All of the regional CINCs currently conduct military-to-military exchanges. TEP environmental security activities are based on the limited data available to the CINCs, the existing capabilities within the control of the CINCs, and financial constraints. Costs relating to environmental security activities are not identified as separate budget items but receive funding only as part of the general military-to-military engagement strategy intended to "win friends and influence people."

New plans relating to "Shape" should focus on the kinds of functions listed in Table 4-2, with regional analysis refining the priorities for each particular CINC. National resources, such as Corps of Engineers water resource managers, should be made available to aid regional CINCs. Non-DOD experts in critical skills should also be made available through the general environmental security project office. Military-unique issues such as weapons disposal and "green" training should be areas of special DOD attention and effort because they offer an opportunity for both environmental security actions and building cooperative relationships with other militaries.

With regard to "Respond," the sequence of events following a man-made or natural disaster is predictable and, therefore, can be planned for. The overall planning process needs to take place at the DOD level to reduce duplication of effort and ensure optimal use of resources, while execution must be planned at the CINC level. There is now an extensive database from several response actions taken over the last ten years that can serve as a foundation for developing future plans. Personal experience and review of the most recent deployments suggest that the DOD continues to struggle with the same start-up problems and repetitive mistakes. Findings reported by this author in 1994 after the Rwanda mission were similar to reports from Central America after the most recent hurricanes.

"Prepare Now" requires an impetus from the highest levels of government. A mission based on the risks described in this work and substantiated by many others, including the current Vice President, must be developed and resourced. A national level policy and strategy must be developed before military planning can proceed. The process needs to begin with collecting intelligence on issues and areas of concern. This research finds that monitoring of the rate of natural population increase in countries may forecast the potential for environmental

TABLE 4 – 2

Military Environmental Security Missions

In the format of the National Security Strategy of 1997:

Shape:

- Military to military exchanges
  - ◊ Land use planning
  - ◊ Green training
  - ◊ Green use of troops
    - Construction of water and sanitation facilities
    - Construction of solid waste disposal systems
    - Preventive medicine and disease control
  - ◊ Educational programs
- Water Resource Management (Army Corps of Engineers)
- Environmental security intelligence gathering
- Disease surveillance
- Military-unique environmental protection measures
  - ◊ Chemical weapons disposal
  - ◊ Demining
  - ◊ Explosive waste management
  - ◊ Training lands management
  - ◊ Green training

Respond:

- Response-planning standing Tiger Teams formed
- Operational planning for refugee response actions
- Planning for natural environmental disasters
- Enforcement of international environmental laws
- Operational planning for eco-terrorism

Prepare Now:

- Participation in the development of a national environmental security strategy
- Development of DOD policy and strategy for environmental security to complement the national strategy
- Preparation of risk assessment for critical environmental degradation and scarcity issues.

degradation; such data are currently readily available. It is worth noting that the trouble areas predicted on the basis of this model are very much the same as the hot zones identified by James Lee in *Inventory of Conflict and Environment*.[12]

Given a clear mission, and with the other elements of "Prepare Now" listed in Table 4-2 in place, the military can effectively accomplish what should be the military component of an overall environmental security program for the United States.

[12] Lee, 110-111.

5. CONCLUSIONS AND RECOMMENDATIONS

As a career Army officer with 28 years of service and an environmental scientist/engineer now teaching at the United States Military Academy, I chose to research the military implications of environmental security because I felt I could bring to the study a joint military/scientific perspective. It is from this perspective that I present the following observations and recommendations.

At the beginning of this paper it was stated that, because of the destabilizing potential that environmental problems represent in the world, environmental security must be a component of U.S. national security strategy. Among the reasons given for U.S. involvement were the moral obligation this country has incurred because of its high demand for resources and the fact that environmental protection is part of the American ethos. A clean, well-sustained natural environment is one component of the heritage we Americans enjoy and should preserve in perpetuity. However, isolationism in environmental protection is not achievable; it is not possible to separate our air from theirs, our water from theirs, or our health from "their diseases." Unfettered human activities can damage our environment on a global scale. This has been demonstrated as environmental issues have evolved from potential risks to damage control. The depletion of stratospheric ozone is a case in point.

Ozone depletion is used as an example here because it represents hope as well as concern. Once the problem was recognized, science was brought to bear in developing alternatives for fluorinated hydrocarbons. The international community was able to reach agreements for phasing out the use of these compounds. As discussed earlier in this paper, a turnaround in the concentrations of atmospheric chlorine has been achieved and a full recovery of the ozone layer can be predicted.

I remain hopeful that we can, as a country, lead the rest of the world into fruitful discussions on protecting the environment and then set a positive example by practicing what we preach in sustainable development. As a military officer and as a scientist, I see this as the most important element in preventive defense that we can pursue.

International environmental security, as defined in this research, is fundamentally concerned with avoiding conflict. Most who study the causes of conflict agree that conflict requires a set of conditions where people lack or perceive a lack of fundamental requirements to sustain their way of life. In the most basic form, this may be a lack of water, food, shelter,

health, or a sense of security. Only after such basic requirements are in place can cultural and political factors come into play to affect security.

Even lacking these "basic requirements," however, people do not always engage in conflict. Usually some initiating event is required to foment conflict. In the context of this study, the driving force may be natural or human-induced environmental disasters, migration of environmental refugees, or any number of other environmental degradation events threatening basic human health. Let us look at some concrete examples.

Consider Ethiopia, Eritrea, and particularly Somalia, and their continuing state of human suffering and war. The data show that this region has one of the higher rates of population natural increase in the world, has deforested until its fuel wood is almost gone, and is not able to provide sufficient safe water to its people. Although there are cultural conflicts in the region, it is clear that a lack of basic human necessities is a major source of regional insecurity. In pragmatic terms, occasional shipments of food, water, and medicine into this region will never resolve the situation, because these band-aids fail to address the root problem of the regional carrying capacity being outstripped by the population demands.

One other example that is much closer to home is Haiti. U.S. intervention was necessitated by political unrest in that country, but many knowledgeable people have identified the root causes of conflict in Haiti as environmental scarcity and degradation issues. Haiti has limited water supplies and can provide only 30 liters of water per person per day. It is completely deforested, has poor sanitation, and is a densely populated country with a moderate rate of natural population increase. There is no worse set of environmental scarcity and degradation conditions anywhere in the world. The U.S. military entered Haiti to restore security, an impossible task in a country suffering under such environmental conditions. The result was that U.S. had to struggle to extract its military from the continuing chaos.

To this author, the only unknown in the cause-effect relationship of conflict and environmental issues is the size of initiating charge required to set off the time bomb. In a 1999 report entitled *Environmental Conditions, Resources, and Conflicts*, the United Nations listed 20 locations it sees as having the potential for "international conflicts over water."[1] If we look at Sierra Leone, Nigeria, East Timor, Ethiopia/Eritrea, and most of the other areas experiencing conflict in the world today, we find primary or secondary environmental scarcity issues inexorably linked to each conflict. In summary, common sense, natural science, and political science rarely come together so closely as they do in the conclusion that environmental security is a topic of critical importance to the well-being and security of the U.S.

[1] Daniel Schwartz and Ashbindu Singh, *Environmental Conditions, Resources, and Conflicts* (United Nations Environmental Program, 1999), 11.

5.1 Where Have We Been?

This paper began by presenting an overview of the political science of environmental security. Analysis of the reasons for U.S. involvement was followed by a brief discussion of National Security Strategy and National Military Strategy.

Chapter 2 addressed the problem of defining "environmental security" and proposed the following definition for the term as used in this paper: Environmental security is a process for responding, as part of the U.S. National Security Strategy, to those environmental issues having the potential to affect U.S. national security.

One of the goals of this work was to provide an environmental security primer. This was accomplished in Chapter 3, where the scientific basis for key environmental issues was discussed in lay terms. Chapter 4 presented a strategic analysis of these issues, followed by a discussion of the environmental security mission and of the military's role in that mission.

The list of environmental pollution and degradation issues presented in Chapter 3 is not exhaustive; there are also many other environmental problems facing the world today. Commanders in Chief (CINCs) may find that one of the issues not addressed here is a threat to security in their area of responsibility. The analytic methodology applied in Chapter 4 can be used as a model for collecting and analyzing data and assessing their significance to regional security and stability. With this information, CINCs can draw conclusions as to what specific military action can be taken to support a national strategy for environmental security.

5.2 What Have We Learned?

Having considered the two key questions—

What is environmental security?

What is the military mission in environmental security and how should the mission be executed?

—we can at this point summarize certain observations with regard to the national security implications of environmental issues:

- Environmental security is an ill-defined term that means different things to different groups of people. The Department of Defense (DOD) definition found in DOD Directive 4715.1, which is primarily a broad list of environmentally related programs, is the least precise of all definitions examined. If the military is ever going to address the real security issues caused by environmental change, the DOD directive must be changed to add focus and clarity.

- International environmental security is primarily a diplomatic and political function of the Department of State.

- There is at present no governmental structure for addressing the environmental security requirements of the National Security Strategy (NSS).

- The military environmental security mission, as described in the National Military Strategy (NMS), is to support the NSS and complement the national environmental security strategy.

- The fundamental environmental security issues are environmental resource scarcity and degradation. Critical resources are croplands, forests, water, and fish.

- Population is the controlling independent variable for all environmental security issues. Rate of natural increase is a good measure for correlating environmental impacts and areas of concern.

- The DOD can undertake meaningful international environmental security missions in support of overall U.S. environmental security strategy.

- Geographic areas of greatest concern in terms of environmental security are: the Sahel and central regions of Africa; the island nations of the western Pacific; the East India/Bangladesh region; and the more isolated areas of Central and South America. These regions are highlighted in Figure 5-1, which depicts CINC areas of responsibility.

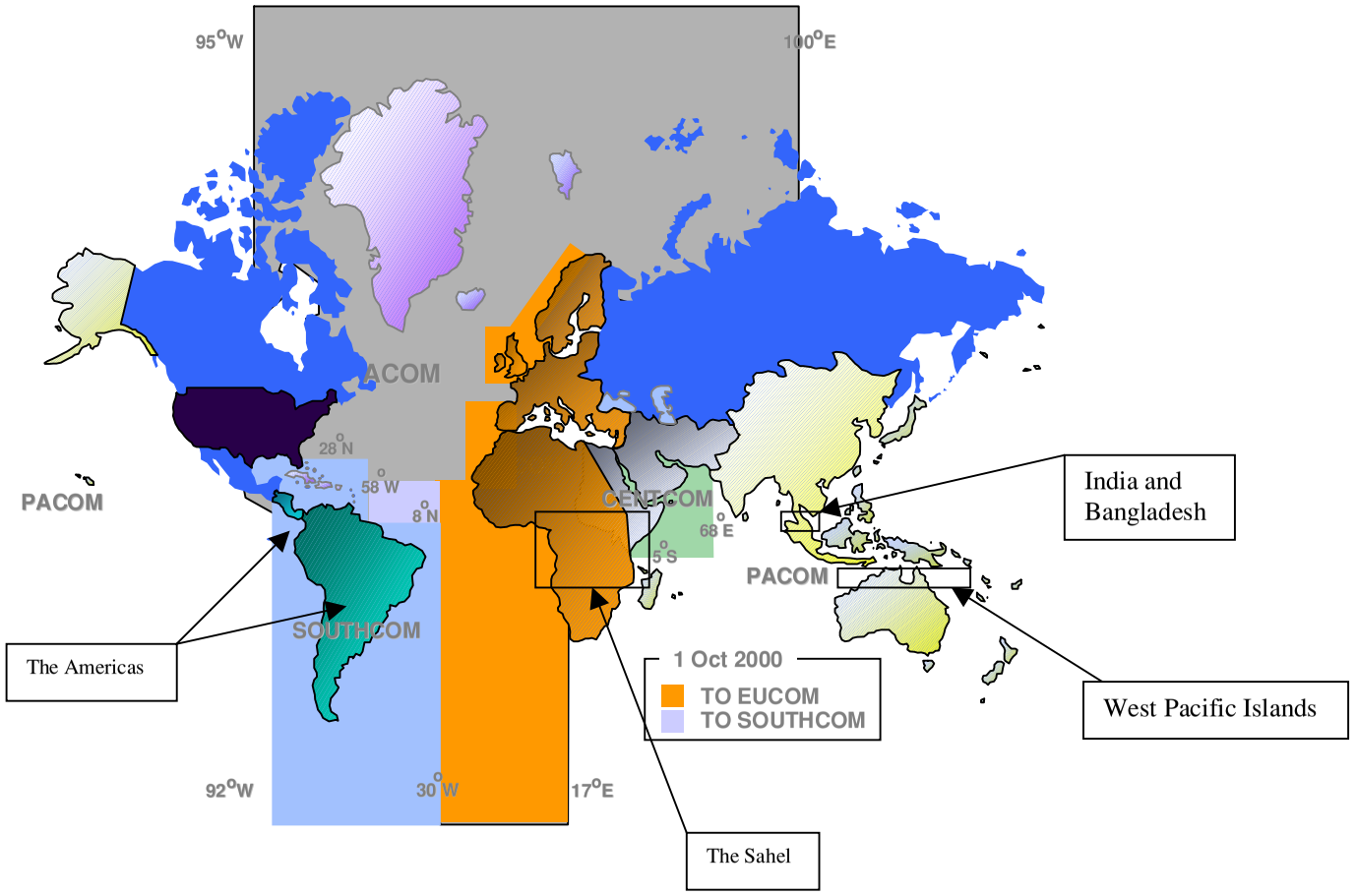
5.3 What Should We Do?

- A national environmental security strategic policy and strategy must be in place before real progress can occur.

FIGURE 5 – 1

CINC Areas of Responsibility

(effective 1 October 2000)



- A governmental structure supported by adequate resources must be set up to develop and implement the goals of U.S. environmental security.

- Existing environmental expertise throughout the government needs to be better utilized. There is tremendous untapped technical power within the Departments of Energy, the Interior, Health, and Defense that could be brought to bear on environmental security matters in a productive and cost effective way.

- DOD Directive 4715.1 needs to be rewritten to define environmental security more precisely. This definition, while having some relation to non-DOD definitions of the term, should serve as a foundation for developing military policy and strategy to meet the NMS missions of environmental security.

- Within the DOD, the environmental security mission must compete for resources. A risk-based analysis that identifies and quantifies the value added by the environmental security program should be conducted.

- The Theater Engagement Plan (TEP) process is the appropriate vehicle for carrying out the military international environmental security program. The Manual for Theater Engagement Planning[2] should be updated to reflect the fact that regional environmental security is a mission component. A program to support the geographic CINCs in developing and implementing the environmental security aspects of the TEP is also needed. The Army War College has made a great start in providing this type of support, but a DOD-wide program needs to be formally instituted. The analytical model used in this research and employed in global analysis provides a useful starting point for detailed regional environmental security assessments.

[2] Chairman of the Joint Chiefs of Staff, Manual (CJCSM 3113.01), Theater Engagement Planning, 1998.

5.4 Final Questions

Does national security policy require any environmental response actions that should become new missions for our military forces?

Certainly there are areas in which the unique capabilities of the military suggest such missions. The gathering of intelligence information through the use of remote sensing technologies is just one example. Although civilian research into data gathering for environmental applications is a fast-developing field, the fact that network centric battlefield information systems could collect valuable environmental data suggests that the military should consider this as a new mission. Such a mission would require additional resources, because environmental security activities should not replace existing military intelligence collection activities. The monitoring of critical environmental resources and agreements is an example of an area in which the current policy of maintaining a forward presence in critical regions could be combined with new missions in international environmental security. Other examples of new missions may emerge as policy and strategy take shape.

Finally, it is appropriate to end this study with probably the most intriguing question for environmental security,

What in the world (environment) is worth (America) fighting for?

Are the Amazon rainforests with their biodiversity and ability to mitigate global climate change worth the use of military power to protect? What about threats to the world's critical water resources? Or threats to the supplies of oil we need to fuel our economy—even at the cost of affecting the global climate?

Today, these and many other questions remain in the "too hard" category of our strategic national policies—too hard because of a lack of certainty, of definite numbers to quantify future impacts of environmental change on U.S. security.

I remain both an optimist and a realist on this subject. We human beings, with our powerful technology, have the capability to irreversibly change the nature of the entire planet, for better or worse. The optimist remains convinced that science and technology will provide the data needed to further our understanding of the earth's processes and with this information we will decide to act to achieve a sustainable environment. The realist recognizes that change will be necessary, that significant costs will have to be paid,

but that these costs will be cheaper than the costs of not addressing environmental security, soon.

We have the technological power to do great harm or great good in the world. Only by proactively pursuing actions to achieve great good will we be able to avoid great harm.

APPENDIX A

Inside the Numbers

Unit of Measure	English Units	Metric Units	Example Areas
Acre	43,560 sq. feet	0.405 hectares	About one foot-ball field
Hectare	2.47 acres	10,000 sq. meters	About two soccer fields
Square mile	640 acres (1 section)	2.59 sq. kilometers	A farm
Square kilometer	247 acres	100 hectares	A small farm
Cubic meter	264 gallons	1,000 liters	A big box
Cubic kilometer	2.64×10^{11} gallons	1×10^{9} M^3	100 days of water for New York City

APPENDIX B

Terms and Abbreviations

TERM	DEFINITION
AAEE	American Academy of Environmental Engineers
AEPI	Army Environmental Policy Institute
^{o}C	Temperature measured on the Centigrade
Carrying capacity	Total population that the resources of an area can support over an indefinite period of time
Centimeter	One hundredth of a meter
CFCs	Chlorinated fluorocarbons
CO	Carbon monoxide
CO_2	Carbon dioxide
DOD	Department of Defense
DOE	Department of Energy
DOS	Department of State
CINC	Commander in Chief
FAO	Food and Agriculture Organization of the United Nations
FGS	Federal Governing Standards
GHG	Greenhouse gases (carbon dioxide, ozone, CFCs, nitrous oxide)
Gigatonne	One billion metric tonnes (a tonne = 2,200 English pounds)
GIS	Geographic Information Systems
IDLH	Immediately Dangerous to Life and Health
Infrared	Long wavelength energy, heat
IPCC	Intergovernmental Panel on Climate Change
km^3	Cubic kilometers
Liter/per/d	Liters per person per day

TERM	DEFINITION
M^3	Cubic meters
mg	Milligrams, one thousandth of a gram
Micrometer	One millionth part of a meter
MMTCE	Million metric tons carbon emissions
NATO	North Atlantic Treaty Organization
NIOSH	National Institute of Occupational Safety and Health
NMS	National Military Strategy document
NSS	National Security Strategy document
PCBs	Polychlorinated biphenyls
PPM	Parts per million, in volume for gases and by weight for solids
TEP	Theater engagement plan
UV	Ultraviolet (shorthort wavelength energy) light
USEPA	United States Environmental Protection Agency
Wavelength	Length of the spacing between peaks of an energy wave
WHO	World Health Organization

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