Behind The Headlines

Volume 48, No. 3 Spring 1991

Environmental Change and Human Security

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$3.00 per single issue
$12.00 per year/$10.00 for subscriptions placed direct (Canadian addresses add 7% GST)

Spring 1991
(Date of issue - March 1991)
Second-class mail registration number 2578
ISSN 0005-7983

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As I write this article in late November 199o, I have no idea what the world will look like as you read it in the spring of $1_{99}1$ or later. Will war envelop the Middle East? Will the Soviet Union survive the winter, or will it break apart under the pressure of economic collapse, food riots, and civil strife? How will Poland, Czechoslovakia, Romania, and other East European countries manage as their fuel supplies dwindle, economies stagger, and ancient nationalisms flare? Will South Africa pull back from the brink of inter-tribal fratricide and Afrikaner reaction? Is India on the verge of another round of fierce communal violence?

The current changes in our world are quick, unprecedented, and unpredictable. Long-established norms, principles, and procedures for international conduct are weakening, and new ones have yet to crystalize. A bipolar system of animosity between the superpowers, codified and institutionalized by two mighty military alliances and giving a certain degree of order to international affairs, has been left far behind by events in Europe. As I write, each day's developments can evoke optimism or pessimism: on the one hand, the United Nations has become the vehicle for singular international co-operation to oppose Iraq's invasion of Kuwait; on the other, the General Agreement on Tariffs and Trade may unravel because of a sharp dispute over agricultural subsidies. Human-kind seems poised on a threshold: it must make a fateful choice between various co-operative or conflictual world orders, a choice that will shape international affairs for generations to come.

In today's shifting, unstructured world, it would be easy for events of the moment to consume our attention. But I want to focus here on deeper and perhaps more ominous trends. Over the next fifty years, we will almost certainly see a global population approaching nine billion; a

decrease in rich, adequately irrigated agricultural land; the loss of much of the remaining virgin forests and the abundance of species they sustain; the widespread depletion and degradation of aquifers, rivers, and other water resources; and the decline of many fisheries. We may also see significant climate change and further ozone depletion. These trends may come to dominate all other factors affecting domestic and international security.

While the events of the moment are tremendously important, and we must bring reason and prudence to our choices about the new world order, we must not lose sight of these deeper trends in the relationship between humankind and its natural environment. In fact, we should use the extraordinary opportunity offered by the currently fluid international order to start redefining this relationship by changing existing institutions and building new ones.

What are the principal large-scale environmental changes that may confront us over the next decades? How might these changes affect domestic and international security? How are these changes related to other variables, including levels of technological development, population growth, and institutions and culture? Can our societies mitigate or adapt to these changes in order to prevent or lessen threats to human security?

First, I must define 'security.' With the waning of the immediate external threat to Western societies represented by the Soviet Union, and with increasing evidence within these societies of internal social and environmental decay, many commentators have argued that we should broaden the concept of 'security' to encompass a multitude of non-military threats to national well-being – to health, prosperity, and general quality of life. In this spirit, over the last two years numerous meetings and conferences in North America have tried to clarify the links between environmental change and such a broadened concept of security. Invariably these meetings have been marked by unfocussed, disparate commentaries and very limited progress towards clarifying the links. As a result, a consensus is emerging that to link environmental change to a broad notion of security brings too many issues into the debate.

Instead, some experts seek to bound their research programmes by either jettisoning the concept of 'security' or giving it the more traditional meaning that emphasizes safety from violence and military threats. Here I choose the latter course and will discuss the relationship between environmental change and potentially violent conflict, both international and domestic.

Some experts have suggested that environmental change may shift the balance of power between states either regionally or globally, producing instabilities that could lead to war. Or, as global environmental damage widens the gap between North and South, poor nations may confront rich for a fairer share of the world's wealth. Severe conflict may also arise from frustration with states that impede agreement to protect the global

commons. Warmer temperatures could lead to contention over new ice-free sealanes in the Arctic and over more easily harvested resources in the Antarctic. Bulging populations and land stress may produce waves of environmental refugees, often spilling across borders with destabilizing effects on the recipient's domestic order and on international stability. Countries may fight among themselves because of dwindling supplies of water and the effects of upstream pollution. In developing countries, a sharp drop in food crop production could lead to internal strife along urban-rural and nomadic-sedentary cleavages. Moreover, if environmental degradation makes food supplies increasingly tight, exporters may be tempted to use food as a weapon. And the ultimate consequence of environmental change could be the gradual impoverishment of societies in both North and South, which could aggravate class and ethnic cleavages, undermine liberal regimes, and spawn insurgencies. In general, many scholars sense that environmental degradation will 'ratchet up' the level of stress within national and international society, increasing the likelihood of many different kinds of conflict and impeding the development of co-operative solutions.

Some Major Environmental *Problems*

Before trying to identify the most plausible scenario, I should review briefly the nature of some of the major environmental problems facing humankind. The one receiving the most media attention is greenhouse warming. As is now widely understood, human activities release a number of gases (mainly carbon dioxide, chlorofluorocarbons, methane, and nitrous oxide) that impede the escape of infrared radiation (heat) from the surface of the earth to space. In the crudest terms we can say that (given a certain amount of incoming solar radiation) the more of these gases present in the atmosphere, the higher the mean temperature at the surface of the planet. In fact, if it were not for the greenhouse effect, the current average temperature of the planet would be about 33 degrees Celsius lower than it is now, and the earth would not be able to support most of the life currently present. However, the scientific story is much more complicated, because there are countless ill-understood positive and negative feedbacks that may accentuate or diminish human perturbations of the global heat balance. For instance, scientists are uncertain to what extent increased cloud cover caused by global warming will trap further heat (a positive feedback) or reflect sunlight (a negative feedback).

Over the last few years, though, a consensus has developed among the experts: assuming no major changes in the trend of human emission of greenhouse gases, we will likely see a global warming of 1°C by 2025 and

3° by 2100. This may seem a small increase, but the earth has warmed only about 5° since the coldest period of the last ice age, some 18,000 years ago. Moreover, the predicted rate of increase during the next 100 years will be about o.3° per decade – far faster than rates following the ice age.

At the moment, the three-dimensional computer models of the atmosphere used to predict global warming trends have insufficient resolution to foretell with confidence changes in precipitation patterns, storm frequency, and soil moisture for specific regions. However, we can say that temperature increases in high latitudes will be much greater than the mean, that sea levels will rise about 6 centimeters per decade (principally from thermal expansion of sea water), and that coastal areas will generally receive more precipitation while interiors of continents will become drier. For instance, by 2030 it is predicted that central North America will warm from z to $_4$ degrees in winter and 2 to 3 degrees in summer and experience a 15 to 20 percent decrease in soil moisture. This, of course, could have a major effect on grain production in the United States and Canada.

In considering the social effects of environmental change, especially of climate change, we should be particularly aware of two general principles. First, the most important result of a change in the average value of a variable (temperature, pressure, or humidity) in an environmental system may be the change it induces in the probability of 'extreme' environmental events. Thus, while a 2 to $_3$°C mean global warming might not seem too significant for agricultural production, it may produce a large increase in the probability of crop-devastating droughts, floods, heat waves, and storms. Second, until recently environmental systems, in particular the earth's climate, were regarded as relatively resilient and stable in the face of human insults. But now many scientists believe their behaviour is often unpredictable because these systems have many non-linear relationships between the huge number of variables that describe them. Thus it may be much easier than we thought to push an environmental system from one equilibrium state to a very different one. In 198$_7$, for example, geochemist Wallace Broecker reflected on recent polar ice-core and ocean-sediment data: 'What these records indicate is that Earth's climate does not respond to forcing in a smooth and gradual way. Rather, it responds in sharp jumps which involve large-scale reorganization of Earth's system. ..We must consider the possibility that the main responses of the system to our provocation of the atmosphere will come in jumps whose timing and magnitude are unpredictable.2

This brings us to a second problem: stratospheric ozone depletion. A dramatic example of such non-linear (or 'threshold') effects in complex environmental systems was the discovery of the Antarctic ozone hole in the mid-1980s. Until then scientific models of ozone depletion had, for the most part, assumed a rough linear relationship between chlorofluorocar-

bon (cFc) emissions and ozone depletion. Atmospheric scientists had not even remotely anticipated the ozone-destroying catalytic process that occurs on the surface of stratospheric ice crystals when certain temperature and light conditions interact with particular concentrations of water, nitrogen compounds, and CFCS. We now know that if conditions are right, this destruction can occur at lightning speed, stripping the ozone from multi-kilometre-thick layers of the stratosphere in a matter of clays. The Antarctic ozone hole was startling evidence of the instability of the environmental system in response to human inputs, of our capacity to affect significantly the ecosystem on a global scale, and our inability to predict exactly how the system will change.

The Antarctic hole contributes to the general depletion of ozone over a wide area of the southern hemisphere. Each southern spring, the hole forms inside a circular pattern of wind called the 'circumpolar vortex'; as summer approaches the vortex breaks up, and ozone-depleted air moves northward from Antarctica. Although Antarctica's pattern of chemical and atmospheric events is not exactly replicated over the Arctic, during the last three years scientists have found very disturbing evidence that rapid depletion may soon appear there too. While the polar situation is perhaps the most urgent, stratospheric ozone depletion is occurring around the planet as CFCS move into the upper atmosphere. In 1988, for example, the United States National Aeronautics and Space Administration found that up to 3 percent of the northern hemisphere's ozone layer had been lost in the last twenty years.

Humankind has already released immense quantities of CFCS into the atmosphere. It takes on average seven years for a CFC molecule to migrate to the upper stratosphere. Once there, sunlight breaks these molecules down, and the liberated chlorine catalyzes the destruction of ozone molecules for many years before precipitating back into the lower atmosphere. Thus, with the CFCS released to date, we have already committed ourselves to a dramatic thinning of the ozone layer over the coming decades. Experts estimate that a one percent decrease in stratospheric ozone produces about a 2 percent increase in the incidence of ultraviolet radiation on the surface of the earth, which in turn produces about a 3 to 4 percent increase in skin cancer rates. But that should perhaps be the least of our worries: the deleterious effects of increased UV radiation on crops, forests, ocean phytoplankton (at the bottom of the ocean foodchain), and human and livestock health may be severe. Research results on these effects are still preliminary.

While greenhouse warming and ozone depletion have caught the public's attention, certain terrestrial and aquatic environmental problems - deforestation, soil degradation, and depletion and degradation of water resources - deserve equal consideration. Such problems may, in fact, interact with and multiply the effects of atmospheric change; and

they merit immediate concern because they already seriously threaten the well-being and cohesion of many societies.

The estimates of deforestation vary widely, since it is often very difficult to determine its exact extent in any region. There are different kinds and degrees of forest degradation, and it is often unclear whether a particular hectare qualifies as 'deforested.' Satellite images are not as precise as often thought in allowing researchers to determine the extent of forest damage and usually have to be supplemented with detailed ground inspections. Despite these difficulties, recent estimates by the World Resources Institute (WRI) suggest there has been a sharp increase in the rate of tropical forest depletion since the 1_{97}0s. Whereas the United Nations Food and Agriculture Organization estimated in 198o that the world was losing $11._4$ million hectares of tropical forest annually, the WRI study sets the figure as high as $20._4$ million hectares. Particularly affected are the forests of Brazil, Costa Rica, India, Myanmar, the Philippines, and Vietnam.

A closer look at the Philippines reveals the speed and extent of the damage. As recently as the Second World War, about half the area of the Filipino archipelago was forested. Since then, logging and the encroachment of farms has reduced the virgin and second-growth forest from about 16 million hectares to between 6.8 and 7.6 million hectares. At the turn of the century, the Philippines had about 10 million hectares of virgin forest; less that a million hectares remain, and it seems certain that most will be gone by early in the next century. The logging industry boomed in the 196os and 19705, and, following the declaration of martial law in 1972, President Ferdinand Marcos handed out concessions to huge tracts of land to his cronies and senior military officials. Pressured to make payments on the foreign debt, the government encouraged log exports to the voracious Japanese market. The numerous companies set up with exclusive opportunities to exploit forest resources rarely undertook reforestation. Despite the change in regime and the more aggressive concern for the environment of the Aquino government, the WRI figures suggest the rate of deforestation remains very high.

Soil degradation from inappropriate or overly intensive agricultural practices is another worldwide environmental problem that deserves much closer media attention. Currently, total global cropland amounts to about 1.5 billion hectares. Optimistic estimates of potentially arable land range from 3.2 to $_{3 \cdot 4}$ billion hectares, but nearly all the best land has already been exploited. What is left is either less fertile, not sufficiently rainfed or easily irrigable, infested with pests, or harder to clear and work. Experts generally describe a country as 'land scarce' when 7o percent or more of the potentially arable land is under production. In Asia about 82 percent of potential cropland is cultivated. While the percentages are lower in Africa and Latin America, the poor quality of the remaining land

and its inequitable distribution suggest that the previously high rates of cropland expansion cannot be maintained.

For developing countries in general, during the 1980s cropland grew at just 0.26 percent a year, less than half the rate of the 1970s. More importantly, arable land per capita dropped by 1.9 percent a year. In the absence of a major increase in the amount of arable land in developing countries, experts anticipate that the world average of 0.28 hectares of cropland per capita will decline to o.17 hectares by the year 2025, given the current rate of world population growth. Large tracts of land are being lost each year to a combination of urban encroachment, erosion, nutrient depletion, salinization, waterlogging, acidification, and compacting. The geographer Vaclav Smil, who is generally conservative in his assessments of environmental damage, estimates that two to three million hectares of cropland are lost annually to erosion, with perhaps twice as much land going to urbanization and at least one million hectares abandoned because of excessive salinity. In addition, about one-fifth of the world's cropland is affected by desertification. Taken together, he concluded that the planet would lose about ioo million hectares of arable land between 1985 and 2000.

Smil gives a particularly startling account of the situation in China, which lost 33.33 million hectares of farmland (30 percent of its 1957 total) between 1957 and 1977 and added 21.2 million hectares of largely marginal land. He notes that 'the net loss of 12 million hectares during a single generation when the country's population grew by about 300 million people means that per capita availability of arable land dropped by 4o percent and that China's farmland is now no more abundant than Bangladesh's – a mere one-tenth of a hectare per capita!' About 15 percent of the country's territory is affected by erosion. Severe erosion on the Loess Plateau 'makes the region the area with the lowest grain yields and the poorest standard of life,' while the Huanghe River annually carries 1.6 billion tonnes of silt to the sea.'

Turning to another environmental problem, experts now recognize that the scarcity and degradation of fresh water supplies will he one of the chief resource issues of the 21st century. At the moment, humans withdraw about 3,500 cubic kilometers of freshwater a year from various sources (mainly rivers) and return about 1,400 cubic kilometers, often in a polluted condition. This consumption is growing at a rate of 2 to 3 percent per year. Total river resources at any one time amount to about 2,00o cubic kilometers, but because of the constant cycling of water between the atmosphere and surface of the earth, the annual quantity available from rivers is probably closer to 40,00o cubic kilometers. But while these aggregate figures might seem to indicate abundance, there are great differences in water availability between regions, and many areas – including much of Europe, large parts of the United States, the Ganges

basin in India, and the northwestern provinces of China - are using virtually all their locally generated river runoff. In many arid developing countries, quick population growth threatens to reduce per-capita water availability to levels below those required to meet minimum household, industrial, and agricultural needs. If greenhouse-induced climate change causes large shifts in precipitation patterns, some of these regions may no longer face water shortages while others may suffer ruinous drought.

In Africa and the Middle East, where populations are expanding rapidly, many areas have endured repeated drought, and water has long been a source of contention between certain groups and societies. Scholars have closely studied the implications of the overuse of the Nile river, which runs through nine countries. Downstream nations - Egypt and Sudan, for example - are particularly vulnerable to upstream pollution or water diversion because of their dry climates and dependence on irrigated agriculture. Egypt and Sudan engaged in a military confrontation in 1959 over Nile waters. Other African rivers shared by several countries deserve close attention, including the Zambezi and the Niger, which flow through eight and ten countries respectively, and the Senegal, which has been at the centre of a recent serious dispute between Mauritania and Senegal. Water conflicts may also arise over aquifers. Both Egypt and Libya, for instance, see the Nubian aquifer as a vital future source of water for huge agricultural zones. In the Middle East, there is a simmering dispute between Syria and Turkey over Euphrates water, and some experts contend that the desire to secure the waters of the Jordan, Litani, Orontes, and Yarmuk rivers was a principal cause of the 1967 Arab-Israeli war. Access to limited underground water resources is an extra stress in the Israeli conflict with the Palestinians over the future of the West Bank.

Can Our *Societies Respond : Effectively?*

The environmental problems described above might seem overwhelming. They are large-scale, long-term, and ill-understood. They strike directly at our most intimate link to the biosphere: our ability to produce the food and water we need for survival and social stability. But we must avoid slipping into simple-minded environmental determinism: the causal linkages between environmental change and, for example, decreased agricultural production are neither tight nor inescapable. There are numerous intervening factors - physical, technological, economic, and social - that often permit great resilience, variability, and adaptability in human-environmental systems.

Some of these factors are identified in Figure 1. It shows that the total

effect of human activity on the environment in a particular ecological region is a function of two main variables: first, the product of total population and of physical activity per capita and, second, the vulnerability of the ecosystem to those particular activities. Per capita activity, in turn, is a function of available physical resources (renewable and ecological resources such as water, forests, and agricultural land and nonrenewable resources such as minerals) and 'ideational' factors (institutions, social relations, preferences, and beliefs). The figure also shows how environmental effects might cause certain types of social effect that in turn could lead to particular kinds of conflict. For example, the degradation of agricultural land might lead to large-scale migration which could create ethnic conflicts as migratory groups clash with indigenous populations. There are important feedback loops from social effects and conflict to the ideational factors and thence back to activity per capita and population. Again, ethnic clashes arising from population displacement could alter the functioning of a society's markets and thereby its economic productivity.

The ideational factors at the top of the diagram are particularly important. This social and psychological context is immensely complex: it includes patterns of land distribution; the social distribution of wealth; the economic, political, and legal incentives to consume and produce material goods (including the system of property rights and markets); family and community structures; perceptions of the probability of long-run political and economic stability; historically rooted patterns of trade and interaction with other societies; the distribution of coercive power within and among nations; and metaphysical beliefs about the relationship between humans and nature.'

Without a full understanding of these factors we cannot begin to grasp the true nature of the relationships between human activity, environmental change, social disruption, and conflict. Recognition of the important role of these factors distinguishes simplistic environmental determinism from sophisticated understandings of the nature of the environmental threat posed to humankind. And it is principally these factors that determine the *vulnerability* and *adaptability* of a society when faced with environmental stresses. There is historical evidence that certain societies have technological, institutional, or cultural characteristics that make them very resilient in the face of such pressures. Not only do we need to identify the thresholds beyond which given societies cannot adapt when confronted with a particular set of environmental stresses; we also need to determine which will adapt better and why. This research should help us identify key 'intervention points' where policy-makers may be able to alter the causal processes linking human activity, environmental degradation, and conflict.

Environmental Change and **: the Developing World**

Developing countries, by definition, do not have the financial, material, or intellectual resources of the developed world; furthermore, their social and political institutions tend to be fragile and riven with discord, which hinders their ability to develop co-ordinated responses to environmentally induced scarcity and dislocation. It is probable, therefore, that developing societies will be less able to apprehend, mitigate, or adapt to environmental disruption.

Many developing countries will soon confront a broad range of environmental problems. An agricultural region may, for example, be simultaneously affected by degraded soil, greenhouse-induced precipitation changes, and increased ultraviolet radiation. As more environmental problems and scarcities appear, and their interactions and synergies become more complex and unpredictable, policy-makers in developing countries will need greater and greater *social* ingenuity to design, implement, and maintain the social mechanisms (such as effectively operating markets) that could unleash the *technical* ingenuity required to address these problems. Simply put, these policy-makers will have to be increasingly clever as 'social engineers' just to sustain the current output of agricultural and other necessary goods.

Unfortunately, these environmental problems and scarcities will be simultaneously generating social stresses and disruption. Degraded land will weaken village communities, encouraging the men to work far away in cities and factories; economic dislocations induced by environmental

change may undermine corporate and financial institutions; and mass migration of people into the cities may disrupt labour markets, shift class relations, and upset the traditional balance of economic and political authority between ethnic groups. The ability of policy-makers to be good social engineers - for example, to construct effective markets and to mobilize factors of production, including capital and technical ingenuity - will go *down as* social stresses increase. Progressive environmental degradation will thus trap developing countries in a vice: as the need for social ingenuity increases, policy-makers will be less able to deliver it.

In most cases, the main impetus to the complex processes of environmental degradation and scarcity in developing countries is population growth. But it is not the sole cause: it must join with other social, structural, and technological factors, in particular the inequitable distribution of wealth and land and inappropriate agricultural modernization. In combination with certain social structures and technologies, population growth has no negative effect on the environment; and if a society's social and technical engineers are very clever, population growth might even alleviate environmental problems. But in most developing countries population growth is the 'forcing factor' behind environmental degradation; that is, referring again to Figure 1, total population is the causal variable changing most rapidly and ominously in the environmental-social system.

As a consequence, many developing countries are locked into a race between population growth (and the climbing consumption and environmental damage it entails, given the prevailing technology and social structure) and social and technical ingenuity (to reform the social structure and change technologies, reduce population growth, get markets working right, and otherwise lessen or compensate for environmental damage). In the end, it seems, ingenuity will lose this race.

The grim reality is that the population growth rates of many of the world's most populous countries - including India and China - have stopped declining. Dramatic improvements during the 1970s and early 198os saw family size dropped from 6 or $_{7}$ children to 3 or 4. But demographers and family planners have discovered that it is much more difficult to convince mothers to forgo another 1 or z children to bring family size down to replacement rate. India's population growth rate has levelled off at around 2.1 percent (1_{7}.9 million people) per year, while China's has levelled off at 1.3 percent (1_{4}.8 million) per year. These developments have recently led the United Nations to revise upwards its medium estimate of the globe's population when it stabilizes (predicted towards the end of the 21st century) from 10.2 to 11 billion.

Thus the race between ingenuity and consumption and environmental degradation is likely to be longer than anticipated just ten years ago, when population growth rates were falling dramatically. The world will have to

keep increasing its agricultural production, for example, by nearly z percent per year well into the next century. However, as the benefits of green-revolution technology are fully exploited, we are unlikely to see compensating gains in production from new agricultural technologies. Although biotechnology may eventually help scientists develop nitrogen-fixing, salinity-resistant, and drought-resistant grains, the widespread use of such crops in developing countries is undoubtedly decades in the future. In the interim, developing countries must rely upon standard practices to increase yields per hectare (principally increased fertilizer and pesticide use) and expansion of farmland through clearing and wider irrigation. But chemical inputs have already skyrocketed, and there is reduced scope for further increases in many agricultural areas. Moreover, as indicated above, little good land remains uncultivated, and' much of current agricultural land is suffering serious degradation (often as a result of intensive farming practices). While in the past benefits from new grain varieties and chemical inputs far exceeded this lost agricultural potential, its effects are likely to become much more evident as the marginal gain from capital and technological inputs declines and land degradation becomes more severe.

Although we must be careful not to slip into environmental determinism, when it comes to the poorest countries on this planet we should not invest too much faith in the potential of human ingenuity to respond to multiple and interacting environmental problems once they have become severe. As population, consumption, and environmental stresses grow, the capacity of policy-makers to intervene as good social and technical engineers able to chart a sustainable development path – and to prevent severe social disruption – will decrease. Developing countries, in concert with the North, must, therefore, act now to address the forces behind environmental degradation.

Environmental Change and Conflict

From the foregoing discussion, we can assume that conflicts arising from environmental changes will appear sooner and be more severe in developing countries. But what kinds of conflict might we expect? To answer this question, we must identify three principal social effects of environmental degradation (as indicated in Figure 1). First, as suggested above, environmental degradation in developing countries might, over time, significantly reduce agricultural production. Obviously, direct degradation of the land might be a key cause of decline, but there are countless scenarios. For instance, across the Filipino archipelago, especially on the island of Luzon, logging and land-clearing have greatly accelerated erosion and

decreased the land's ability to retain water during rainy periods. The resulting flash floods have damaged irrigation works and filled reservoirs and irrigation channels with silt. There are indications this will seriously affect crop production. One study suggests that about 36,000 hectares of low-lying farmland on the island of Palawan will need irrigation by the year 2005; but the hydrological effect of decreased forest cover is expected to permit only about half of this land to be irrigated.

Second, environmental changes, not least because of their effects on agricultural output, may reduce the overall economic productivity of developing countries. The causal story here is, once again, complex, involving natural phenomena, social and institutional structures, and government policy. For instance, logging may produce short-term economic gain for the elite, but the resulting deforestation can undermine the country's long-term productivity. It changes local precipitation patterns, which may affect food production; it leads to faster runoff, which can damage roads, dams, and other valuable infrastructure; and the extra silt may reduce the transport capacity of rivers and their usefulness for generating hydroelectric power. In addition, as forests are destroyed, wood becomes scarcer and more expensive, and thus absorbs an increasing share of the household budget of the poor who use it as fuel for cooking.

A third potential and important social effect of environmental change is population displacement. Many researchers have suggested that environmental degradation may generate vast numbers of 'environmental refugees.' The term is somewhat misleading because it implies that the environmental disruption will be a clear, deterministic cause of certain refugee flows. Usually, however, environmental change will be only one of a large number of interacting physical and social variables (including agricultural and economic decline) that may ultimately force people from their homelands.

The West Bengal-Bangladesh-Assam region in South Asia may provide an important example of environmentally induced population displacement. It deserves close study. Over the last two decades, there has been large-scale migration from Bangladesh to Assam. While detailed data are hard to come by (the Bangladeshi government is reluctant to provide information on the causes of emigration), many specialists believe this movement is a result, at least in part, of a rapidly growing population, unsustainable agricultural practices, and consequent shortages of adequately fertile land. In the future, people may be driven from the region by other environmental problems, including rising sea-levels coupled with extreme weather (both induced by climate change), and by flooding arising from deforestation in watersheds upstream on the Ganges and Brahmaputra rivers.

What types of conflict will develop if agricultural production drops, if

developing societies slide further into poverty, and if large numbers of people are forced from their homelands? We can hazard some preliminary answers. Countries may fight over scarce supplies of essential natural resources, such as agriculturally productive land or water. We might call these 'simple scarcity' conflicts, and, while they have been common throughout history, we may now be seeing, with respect to water in the Middle East and Africa, the early manifestations of a new wave of such conflicts.

As *people* are displaced, we can also expect clashes as different ethnic, cultural, and national groups are propelled together under circumstances of deprivation and stress. We can call these disputes 'group identity' conflicts, since they arise in part from the sense of community or 'we-ness' of the groups involved. The situation in the Assam-Bangladesh region may be a good example of this kind of conflict: over the last decade, emigration from Bangladesh has catalyzed Assam's often brutal ethnic strife.

Finally, the decline in economic productivity in developing societies may produce severe internal strife, including coups d'etat and revolutions. According to Jessica Mathews: 'Environmental decline occasionally leads directly to conflict, especially when scarce water resources must be shared. Generally, however, its impact on nations' security is felt in the downward pull on economic performance and, therefore, on political stability.'[5] If environmental degradation and population growth are not checked, 'the resulting economic decline leads to frustration, resentment, domestic unrest or even civil war.' We might call these disputes 'relative deprivation' conflicts because they are motivated by the widening gap that individuals and groups in a society perceive between the level of economic satisfaction they have achieved and the level they believe they deserve. In other words, they see themselves as deprived *relative to* some subjective standard of equity or fairness.

We can usefully apply this theoretical perspective to the Philippines where the population growth rate of 2.5 percent is among the highest in Southeast Asia. This growth, combined with the expansion of large-scale lowland agriculture for the export market, has displaced many traditional farmers and swelled the number of landless agricultural labourers (in a process similar to that in numerous other countries, including Indonesia, Honduras, and El Salvador). Many have migrated to the steep and ecologically vulnerable uplands where they have cleared land or established plots on previously logged land. This has set in motion a cycle of erosion, falling food production, and further land clearing. In the uplands even marginally fertile land is becoming hard to find, and economic conditions are often dire for the peasants.

It is in these peripheral areas, largely beyond the effective control of the central government, that civil dissent is rampant. Although the Philippines has suffered from serious internal strife for decades, resource

stresses and environmental degradation appear to he increasingly powerful forces driving local discontent. The communist-led insurgency is motivated by the relative deprivation of the landless agricultural labourers and poor farmers displaced into the uplands, where they try to eke a living from the failing land; it exploits political opportunities in the hinterland provided by the crumbling of the central government's authority; and it is facilitated by the creative leadership of the cadres of the New People's Army (NPA) and the National Democratic Front. During the 1980s, these groups found upland peasants receptive to revolutionary ideology, especially where coercive practices by landlords and local governments left them little choice but to rebel or starve. Gregg Jones vividly highlights the connection between deforestation, land degradation, and civil unrest:

`The magnitude of the land problem can be summed up here,' the Communist Party official said, gesturing around us toward the bare, rocky mountains where *haingeros* (slash-and-burn farmers) were losing their fight to scrape a living from the tired soil. 'Look at these people, trying to cultivate this rocky hillside. They have no other place to go.'

We were sitting in an NPA camp in the Cordillera Mountains of Nueva Vizcaya province in 1988 with a bird's-eye view of the desperate plight of Filipino peasants in this rugged corner of the northern Philippines. In all directions, the mountains had been almost entirely stripped of trees by logging companies owned by powerful politicians. Erosion was cutting deep grooves into the severe slopes and carrying away the thin remaining layer of precious topsoil. By night, the mountainsides twinkled with the orange glow of fires set by haingeros as they prepared plots wrested from the hardscrabble for June planting. By day, an acrid pall of smoke and haze hung above the treeless hills, which shimmered like a desert mirage in the baking tropical sun.'

Although relative deprivation conflicts will tend to be domestic, we should not underestimate their potentially severe international repercussions. While revolutionary regimes have only mixed success in achieving their internal economic and political aims, they are very good at mobilizing their citizens and their resources for military preparation and external aggression. Furthermore, the types of conflict outlined in this article, and the environmental stresses leading to them, will reduce the likelihood of success of democratic regimes. As governmental structures in developing societies are weakened, they are likely to experience a loss of territorial control, particularly over the hinterland. The regimes that do succeed to power in these territorial fragments will probably be extremist, authoritarian, and abusive of human rights. Moreover, the already short time horizons of regimes in developing countries will be further shortened.

These political factors will seriously undermine global efforts to mitigate and adapt to environmental change. As the biggest contributors to global environmental problems, developing countries can be expected to become more belligerent, less willing to compromise with other states, and less capable of controlling their territories in order to implement measures to reduce environmental damage. Furthermore, they may be heavily armed, as the continued proliferation of nuclear and chemical weapons and ballistic missiles suggests. If many developing countries evolve in this direction, the interests of the developed world may often be directly threatened.

Conclusions

Obviously, there are many questions that need to be answered as we study the security implications of environmental change. We must, in particular, examine the multitude of intervening variables (including institutions, technologies, and market mechanisms) that humankind might influence in order to alter the course of the planet's environmental-social systems. Our hope for avoiding widespread conflict (beginning in the developing world) may rest with such variables. Unfortunately, there are many reasons to doubt that humankind will take advantage of these opportunities. The environmental problems we face are caused by basic human activities – such as common agricultural practices and the combustion of fossil fuels – that are highly resistant to significant change. They are characterized by great uncertainty and require global collective action for significant mitigation. In addition, modern human society does not seem inclined to absorb high costs to protect the wellbeing of future generations. All this means that humankind will probably not begin to take significant steps until these problems are perceived as very severe. But by then we may have committed the planet to massive and irreversible damage.

As noted above, when we finally recognize that urgent and substantial action is necessary, our *capacity to* respond will likely have been lessened by the very same environmental and population stresses: environmental and resource degradation may leave us with fewer economic resources to contain these problems or effectively adapt to them. Moreover, our national and international societies may be so stressed by the accumulated burden of these problems that our social and political capacity to respond may be lessened also. We may be forced to invest our diminished economic and political capacity in emergency adaptation and crisis management, rather than in long-range mitigation of environmental damage or in prudent and deliberate changes to our institutions and technologies.

Notes

1 Portions of this article have appeared elsewhere: in 'Environmental change and acute conflict,' for Global Environmental Change Committee, Social Science Research Council, New York; 'Global change and international security: a preliminary analysis,' conference on 'Emerging Trends in Global Security,' Montebello, Quebec, October 199o; and 'Environmental change and economic decline in developing countries,' International *Studies Notes,* spring 1991.

2 Wallace Broecker, 'Unpleasant surprises in the greenhouse?' Nature, 328 (9 July 1987), 123-6.

3 Vaclav Smil, *Energy, Food,* Environment: *Realities,* Myths, *Options* (Oxford 1987), 231-7.

4 The level and type of technological development is not explicitly mentioned in Figure 1, although this too is a crucial intervening variable. A society's prevailing technology is a function of two components of the diagram: certain of the 'ideational' factors at the top (most importantly, beliefs about the nature of physical reality held in the society) and available physical resources.

5 Jessica Tuchman Mathews, 'Redefining security,' *Foreign Affairs,* 68:2 (spring 1989), 166, 167-8.

6 Gregg Jones, Red *Revolution: Inside the Philippine Guerrilla Movement* (Boulder co 1989), 175.

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The publication of this pamphlet has

been assisted by a grant from the

Themadel Foundation.

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