

Environmental Change, Adaptation, and Security

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Environmental Change, Adaptation, and Security

edited by

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Foreword

The chapters in this volume are edited versions of papers presented at the NATO Advanced Research Workshop on Environmental Change Adaptation and Security held in Budapest, Hungary, from October 16 – 18, 1997. As is evident in this volume, the papers ranged from descriptions of environmental and health issues in Russia and Eastern Europe to models of sustainable land use. This diversity of perspectives on environment and security is indicative of both the breadth of this new area of research as well as the varied background of the researchers involved. The discussions at the NATO workshop were remarkably animated and exciting, not surprising given the interest in the topic. I think this vitality is reflected in the papers in this volume as well.

The main purpose of the NATO ARW is to foster research links among researchers from NATO countries and Central and Eastern European States, Russia, and the Newly Independent States. In editing this volume, a decision was made to keep to the spirit of this purpose and—if at all possible—include all papers prepared for the workshop. This required extensive editing and rewriting of some of the papers (and consequent delays in production). A determination was made early in the process by the workshop steering committee that the value of publishing the entire collection of articles outweighed the advantages of accepting only a limited number. This volume, therefore, stands as a testament to the importance of initiating and facilitating contact between NATO country researchers and those from NATO Cooperating Partner Countries. It also fits well with a previous ARW volume entitled *Conflict and the Environment*, edited by Nils Petter Gleditsch, 1997, and an upcoming one being edited by A. Carius.

I would like to thank those individuals who spent a considerable amount of time working with me on the workshop and this resulting volume. My thanks go out to the NATO Science Committee and to L. Veiga da Cunha, Director of the Priority Area on Environmental Security, in particular, for the initial support of this workshop. The success of the workshop was largely due to the organisational efforts of the workshop Advisory Committee, consisting of Sandor Kerekes, as co-chair (Budapest University of Economic Sciences), Peter Nijkamp (Free University of Amsterdam), Mike Brklacich (Carleton University), and Richard Matthew (University of California, Irvine). In particular, Mike and Richard provided valuable assistance in editing the volume. Most of all, I would like to thank the members of the “editorial team” at the University of Victoria without whom the production of this volume would not have been possible. They spent many (many) hours working on the papers, and the quality of the final volume is as much a result of their efforts as it is mine. The team included Andrea Blower, Kathleen Gabelmann, Denise Pritchard, and Amy Zidulka who worked on the text of the papers; as well as Diane Braithwaite and Ole Heggen for their help (and patience) with the camera ready manuscript.

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Victoria, B.C.

Section I

Environmental Change, Adaptation, and Human Security: Shaping the Debate

Chapter 1

Environmental Security and Competition for the Environment

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This chapter considers the environment, and the policy discourse surrounding it, in terms of competition between different forces at the international level. Instead of regarding environmental change as the backcloth to security issues, including human security, it considers environmental change as the outcome of competition over the environment. The chapter examines the way in which globalisation of economic relations, and especially the development of global markets, create both ideological uniformity in terms of exonic goals and, at the same time, more competition between economic interests to secure these goals. It argues that, within the global economy, private capital has a transformative effect, in seeking to secure market advantages. This makes the “environment” an increasingly contested domain, and one for which different views of “sustainable development” can be obtained. The environment becomes a battlefield on which transnational actors seek to gain market advantage and, in the process, serve to undermine the sustainability of global resources.

1. INTRODUCTION

The way that we understand environmental security is bound up with the way we understand environmental change. The view is often taken that environmental change is a given, and that environmental security is a means through which the social sciences might explain and even seek to restore human powers of adaptation to physical changes.

This chapter takes a rather different perspective. It begins by identifying areas in which the environment and the policy discourse surrounding it are subject to competition, especially at the international level. It regards environmental change as the outcome of competition over the environment, rather than a series of largely physical processes. The chapter examines the way globalisation of economic relations and the development of global markets create uniformity—both ideologically and in terms of economic goals—and, at the same time, create more competition between economic interests who strive to secure these goals. It argues that, in the course of seeking to secure global competitive advantage, private capital transforms the environment into a heavily contested domain, over which different views of sustainable development contend. The environment becomes a battlefield, where the responsibility for environmental processes is transferred from national states to transnational actors.

Central to these contests is the way in which the environment is represented. The global representations of the environment primarily carry the preoccupations of the industrialised (and the rapidly industrialising) countries. This serves to obscure some important issues. For example, materially verifiable data, such as correlations between resource endowments and population pressures, are used as substitutes for an understanding of the essentially social relationships that govern the international conduct of states and economic interests (Becker, 1996). The environment continues to be viewed as if it were a geopolitical “space,” devoid of political content, despite the fact it assumes importance precisely because of political considerations.

This chapter argues that we need to undertake another type of analysis before we can begin to understand the potential of environmental security today. We must begin by examining who has responsibility for the environment within the global market economy and who is responsible for determining present levels of consumption and meeting the functions of a global waste repository. Environmental security can then be understood as a way of placing checks on the untrammelled competition of transnational capital for the environment. To be effective, global environmental security, like global military security, needs to rest on policies that hold geopolitical interests in check and are subject to wider security objectives. Global environmental security requires limitations be placed on the competitive drive to harness and exploit natural resources and sink capacities at the global level. It is these drives that determine the course of economic development at the close of the twentieth century. Competition for the environment does not preclude such a major adjustment in the course of economic development—but it does make it exceedingly difficult.

Presently, global environmental management only exists at the level of rhetoric, while cultural resistance to globalisation and environmental depletion gain sustenance from specific local and regionalised conflicts over the environment. These responses frequently take issue with the goals, as well as the means, of economic globalisation. This chapter raises questions about the failure to develop global environmental management commensurate with the scale and urgency of the problems faced. Underpinning this failure is a tension expressed in the concept of sustainable development itself: the pursuit of economic growth and sustainability usually lead in quite different directions, and our failure to acknowledge this divergence will continue to undermine effective global security.

2. ECONOMIC GROWTH AND SUSTAINABLE RESOURCE USE

In broad terms, there are three views of the relationship between economic growth and sustainability. The first and most common view is held by most governments and conventional economists. This is that sustainability and economic growth are more or

less compatible, provided that we recognise the need for minimal international regulation, and make efforts to protect endangered ecosystems and species. The second view is that they are totally incompatible. As Herman Daly (1992) has expressed it: "sustainable growth is an oxymoron." In this reading, the pursuit of economic growth implies increased throughput of energy and materials in an economy, and this in turn serves to undermine the sustainability of the environment.

The third perspective is somewhat different. It asserts that whether economic growth is compatible with sustainability depends on the prior definition of a number of concepts, notably wealth, economic efficiency, and the interests of future generations. According to its proponents, this third view requires a prioritisation of sustainability as a goal rather than as a set of ex post management tools. A political commitment to considering sustainability as a goal of international politics would necessitate the re-definition of economic growth itself; the reduction of waste and pollution, together with the eradication of world poverty, would constitute an objective of policy. It is a measure of the cynicism that pervades many international policy fora that such sentiments should appear utopian, rather than practical and necessary. But before considering ways of grounding these objectives in practical policy measures, it is worth stepping back to consider the global balance sheet of environmental and resource degradation.

The discussion of climate change has concentrated our attention on shifts in the climate system. Although these shifts are difficult to understand and predict, it is apparent that there are severe problems of pollution, which lie close to home. Indoor pollution, from both the burning of wood and poor ventilation in homes, harms over 400 million people worldwide, and contributes to acute respiratory infections from which four million children die annually. Another global problem that originates in the home is household sewage. Sewage is the major cause of water contamination, and poor sanitation for over one and a half billion people worldwide contributes to even larger numbers of infant deaths. In the developing world, almost 95 per cent of sewage is untreated. The provision of clean drinking water would enable two million fewer children to die from diarrhoea each year; currently thirteen and a half million children die as the result of the combined effects of poor diet and unsanitary conditions (Ekins, 1996).

Perhaps more alarmingly, there is evidence that the number of people without adequate sanitation actually increased during the 1980s. Additionally, measures to mount preventative campaigns are jeopardised by growing water scarcity in many parts of the world. Forty per cent of the global population experiences periodic droughts. That, at the same time, per capita water consumption has risen (by 50 per cent since 1950), has largely been due to the growth in irrigated agriculture at the expense of domestic water provision. In the world's cities, the problem is frequently the quality of the air, as well as the water. Today, almost one and a half billion people live in

cities with air quality below minimum standards set by the World Health Organisation (WHO), producing respiratory and other ailments from which half a million people die prematurely every year (Ekins, 1996).

Even the environmental problems that we usually regard as remote from these problems of primary health and livelihoods, such as the production of industrial wastes and the extinction of species, are inextricably linked not only to levels of consumption (ecological footprints), but also to resource degradation. The losses to our global environment through unsustainable economic growth, in the form of increased pollution and resource degradation, put individual livelihoods at risk throughout the developing world. These are survival issues for the poor, as well as the subject of informed speculation for policy analysis.

Economic globalisation was not the originator of these processes, but it has intensified them. From the dominant neoliberal perspective, global technology and markets provide efficiency gains. Transnational actors, particularly large corporations, pursue their interests even when they conflict with those of the national state or supranational institutions. This now constitutes the natural order; it constitutes the grain of history. The creation of the World Trade Organisation (WTO), for example, marked a departure from the General Agreement on Tariffs and Trade (GATT) in several important respects. The management of trade was expanded to include trade in intellectual property rights, as well as services. There are calls now for the WTO to expand further to consider issues such as labour standards and the environment. According to the prevailing view, global welfare is best served by a liberal economic order, however substantial the evidence of social and ecological dislocation. The intellectual near-hegemony of this consensus has meant that alternative approaches to understanding the relationship between global trade and social or environmental issues have been almost lost by default. Globalisation means more uniformity in economic goals, as well as more competition to achieve them. It carries important implications for international political action and, particularly, for the survival of local, frequently oppositional cultures.

3. CULTURAL CONSTRUCTIONS OF ENVIRONMENTAL PROBLEMS

Some commentators have argued that the autonomy of the globalisation process operates in relative independence of conventionally designated societal and sociocultural processes (Featherstone, 1990, p. 5). This intellectual position can be challenged, not because it is wrong, but because it fails to identify the contribution of global economic and social restructuring to the development of global culture, and the tensions that ensue when cultural changes arrive coincidentally with economic restructuring.

It is also important to emphasise that environmental problems (including global climate change) are not defined in a cultural vacuum. The way that environmental issues are represented reflects social and cultural perspectives. Although most of the mass media may be devoid of explicit environmental messages, they are implicit throughout, and clearly communicate a great deal about the environment. Cinema and television depict environmental values in the form of buried messages about consumption, nature, and the world of goods. The values associated with media messages, however, may not be readily assimilated into existing cultural categories. The tension between Western (primarily Northern) values, and those of traditional Hinduism, or Islam, serve to underline the difficulties posed by globalisation. If clean drinking water is the principal environmental issue for millions of people in the South (and its absence contributes to the premature death of thirteen and a half million children each year), it is hardly surprising that global climate predictions appear even less of a concern than they do in the developed world.

The underlying social commitments and practices of everyday life constitute the filter through which people and their governments perceive *global* environmental problems. In the poorest countries, environmental problems consist of those associated with health, shelter, and food availability. In the newly industrialising countries, discussions about environmental issues are bound up with the short- and medium-term costs, such as high levels of air pollution in cities, of pursuing very rapid economic growth. In the privileged developed world, environmental issues increasingly involve exposure to largely invisible and unforeseen risks, such as levels of radon, or beef contaminated by BSE. In dealing with these problems, issues of equity appear less important than those of freedom of information, or civil rights.

However, when dealing with global environmental changes (GEC), equity issues must be addressed, not only because of measurable differences in the flow of energy and materials, levels of personal consumption, or the difficulty in arriving at international agreements, but for ideological reasons as well. Ideology shapes the discussion of GEC in several important ways. First, as we have seen, the perceptions of environmental issues are subject to ideology, and vary markedly in different societies and cultures. Second, ideological assumptions govern the amount of trust that can be placed in others who are acting to address environmental concerns. One of the most persistent debates within the GEC literature concerns the so-called free rider question: the extent to which countries that do not sign global environmental agreements will be able to benefit from them. Similarly, the loss of sovereignty means quite different things in different contexts. Sovereignty itself is an ideological construct that needs to be investigated in order to establish how rights and responsibilities to the environment vary.

Many of the structural processes at work in the international economic system also have ideological components that we should not ignore. For example, the view taken of environmental regulation (or deregulation), and the value of trade liberalisation and

the market economy (as opposed to command economies or economic protection) are not self-evident or obvious. In addition to disparate economic strengths and weaknesses, the political economy of the environment is governed by opposing ideological precepts. Perhaps the best example of ideological factors influencing the debate is the discussion of sustainable development or Green development, which is often polarised between the respective value of technological transformations (ecological modernisation) and more comprehensive cultural changes (deep Green solutions).

Some writers claim that small-scale societies or earlier civilisations exemplify sustainability. Others argue that sustainable development needs to totally embrace global technology and global means of communications—the internet, satellites, and the media. There are thus two dimensions to international equity: intergenerational (or temporal) and intragenerational (or spatial). The—for the most part, implicit—concern of most commentators in the North has been with future generations of our people, while that of those in the South has been with the current generation. The importance of intragenerational equity, however, is such that, unless we can successfully resolve differences between North and South, the prospects for future generations in the developed world are also bleak. Consequently, the conclusion to this chapter examines the obstacles to a global compact that would regulate *management* of global environmental problems.

4. GLOBALISATION, THE ENVIRONMENT, AND THE POOR

The notion of globalisation, as a means of social and economic ordering within a highly integrated capitalist world economy, has a vital bearing on our understanding of change within the global environment. Taking Giddens' (1990, p. 64) definition of globalisation as the "intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa," it follows that the site of environmental degradation may be far removed from its agent of causation.

It is apparent that such situations result from interdependent patterns of development, involving the mobility of capital and the relocation of industrial processes, that deepen the international division of labour while reflecting comparative advantage and regional patterns of specialisation. The term globalisation simply provides an interpretive device through which environmental change, arising from the use and transformation of sources, sinks, and resources, can be traced and attributed to a set of structured practices and processes guided by the underlying dynamic of material accumulation. This dynamic, Saurin (1996) argues, concentrates wealth in certain locales and amongst certain social groups largely by dispossessing and extracting from other locales and social groups. The environmental consequences thus arise from

employing the biophysical system as a source of materials and as a sink to assimilate wastes and pollution, as well as through the externalisation of the resulting social and environmental costs of this process of accumulation.

It is clear that there are two variants to global environmental problems, each derived from the development decades of the 1950s, 1960s, and 1970s. First, we can identify the diffusion of sources through which wastes and pollution are relocated globally. Examples of this diffusion are the transfer of industrial agriculture to new settings, and its sourcing from new locations. Similarly, the spread of polluting industries and energy and transport technologies, predominantly from the North to the South, are other cases in point. The problems that ensue—such as the dispersal of hazardous waste, and the threat posed by radioactive leakages and fallout—are global in the sense that economic globalisation implies global relocation.

The second form of global environmental problems occurs through the diffusion of impacts. What we observe in this case are the effects of systemic changes in natural resource systems through the mediums of water, soils, and the atmosphere. Many of the problems that are regarded as characteristically global—most of those contained in the texts of international negotiations, such as global warming, ozone depletion, and acid deposition—are of this second variety. The existence of this range of problems reminds us that, far from being autonomous, global environmental problems are a consequence of the development of the global economic system, and are deeply embedded in conventionally designated societal and sociocultural processes. The perilous state of much of the global environment is a direct reflection of our habits of getting and spending.

It is central to our understanding of globalisation that the location of these material sources, the sites where these materials are transformed and where they are consumed, and the location of the waste sinks need not, and increasingly do not, coincide. As the penetration of the market displaces the production of use values by exchange values, the co-evolutionary basis by which local environmental resources and ecological processes provide for rural people is broken (Norgaard, 1994). Incorporation into the world economy effectively diminishes the capacity of local producers to exercise control over their choice of production systems and the way resources are to be managed. Instead, a web of decisions made many miles away, that may involve the imposition of externally derived macroeconomic goals and market incentives, can exert greater influence over production systems and the local environment.

A sector that perfectly illustrates this development is the food industry, which exercises an extraordinary level of influence over land use in the South. The Netherlands, for example, appropriates the production capabilities of 24 million hectares of land, 10 times its own area of cropland, pasture, and forest (Postel, 1994). Part of these ghost acres support cassava production in Thailand and Indonesia, which then enters the feed industry for intensive pig farming in the Netherlands. Indonesia has been

anxious to maintain or even increase its share of the European Union's cassava quota and its vigorous promotion of exports has seen domestic prices rise. Conway and Barbier (1990, p. 76) observe:

In response, farmers are switching from more sustainable and less erosive mixed-cropping and perennial crop-farming systems to mono-cropping cassava. They are even removing terracing and other soil and water conservation structures to increase the area of cassava cultivation. . . . [T]he on-site productivity costs and off-site erosion impacts of the recent price distortions may have already impaired the prospects for secure livelihoods for many upland farmers, and for the sustainable management of upper watersheds as a whole.

This example of the cassava connection shows how a distortionary trading structure, combined with short-term policy objectives, can lead to economically and environmentally unsustainable outcomes with the costs borne in Indonesia, principally by small farmers whose livelihoods are undermined. While many might attribute such unsustainable outcomes to local agents who may be acting out of ignorance or wilful self-interest, a structural analysis informed by the principles of political ecology (Peet & Watts, 1996) serves to challenge the received wisdom based on simplified and inherently localised models of linear causation (Leach & Mearns, 1996). Such challenges are vital to countering tendencies toward global environmental management that would strengthen the hand of transnational and multilateral institutions in the name of the common good.

Buttel and Taylor (1994) have argued that packaging multiple environmental problems and concerns within a common rubric conveys a sense of scientific legitimacy and, consequently, the political rationale for responding urgently. However, using such a strategy for global environmental management can provide the opportunity for the powerful to exert control over the resources of others in the name of planetary health and sustainability (Peet & Watts, 1996). The emergence of a paradigm of global environmental management, with a curative rather than preventative approach to environmental problems, rests upon the rise to dominance during the past 25 years of a discourse in which the metaphor of *Spaceship* or *Planet Earth* has played an important role. Arturo Escobar (1996) argues that the visualisation of Earth as a "fragile ball" offers a narrative for managerialism best exemplified by *Scientific American's* September 1989, Special Issue, "Managing Planet Earth" that asked: "What kind of planet do we want? What kind of planet can we get?" (as quoted in Escobar, 1996, p. 50). While Escobar, in turn, enquires as to the identity of this *we* who knows what is best for the world as a whole, the answer to his question is self-evident. The existing international political economy is managed by a small number of multilateral institutions (principally the World Bank, the International Monetary Fund, and the World Trade

Organisation) whose policies are determined by the richest industrialised countries (the Group of Seven [G7]) who control over 60% of world economic output and over 75% of world trade.

In reflecting on the process of globalisation, then, we can make a number of tentative observations. First, globalisation is often, but not always, territorial in nature. Where globalisation operates territorially it relocates environmental functions, the sourcing of economic growth, and the disposal of waste. Due to both concentration and dispersal, the metabolic imprint of human activity on the global landscape has an increasing spatial dimension. The effects of economic globalisation are very uneven in their impact, both spatially and socially. The diffusion of sources is determined by the process of economic development and its policy mechanisms (e.g., investment, trade). At the same time, the spread of system impacts is more diffuse, usually irreversible, and likely to be passed on to future generations. Most global environmental risks of this kind are low probability/high consequence risks.

At the same time, we should acknowledge that globalisation consists not only of concrete things, but the way we *see* things; it involves representations of the global. This is not because global culture is *autonomous*, in some way disconnected from lived experience, but because cultural change reflects changes in economic and social restructuring; it reflects lived experience, as well as reflecting upon it. The relationship between economic restructuring and global representations is expressed in several policy discourses, including that surrounding climate change (Redclift, 1996).

5. THE OWNERSHIP OF GLOBAL ENVIRONMENTAL PROBLEMS: THE CASE OF CLIMATE CHANGE

Greenhouse gas emissions are, on a per capita basis, so much lower in the South that a dispassionate observer might adopt the view that developing countries should have more room to increase their emissions, while developed countries reduce theirs. At the same time, the technological transition to lower energy intensity (the amount required to produce a dollar of Gross Domestic Product) is not as advanced in the South. Thus, the potential for economic growth through energy saving and technological improvements is greatest in the developing countries. Logically speaking, and from a global perspective, the industrialised countries could therefore optimise their financial assistance to the South by providing incentives to the adoption of cleaner, more efficient technology. This would help the South to effectively leapfrog the stage of dirty, labour intensive industrialisation where it is not yet fully underway.

Unfortunately, this dispassionate analysis holds several serious difficulties. First, calculations of atmospheric emissions based on per capita contributions spell disaster for the global situation, since knowledge that they are not the main contributors to the

problem provides little inducement for the developing countries to pursue more efficient use of energy. Developing countries have little incentive to endorse global objectives above meeting the more immediate needs of their own people.

Second, the transition to cleaner technology in the South is not encouraged by most of the Northern industrialised economies, whose efforts (in so far as they are geared to ecological modernisation) are focused on gaining for themselves the market advantages conferred by higher environmental standards in tradeable products. They have an interest, in other words, in *not* transferring cleaner, more energy-efficient technologies to the South. For most transnational companies, acting in the global environmental interest will be secondary to the pursuit of profit, until such time that profits reflect the internalisation of environmental values.

Third, the labour-displacing effect of high-tech industries recommends them to countries where labour costs are high, but provides fewer obvious advantages for economies where labour costs are low (hence, the celebrated remark of Larry Summers, then a World Bank economist, prior to UNCED in 1992, that it was more efficient to direct pollution to poorer countries). For most developing countries, the incentives to achieve lower energy intensities pale in comparison to the economic benefits of providing dirty (and frequently unsafe, and unhealthy) employment. In addition, the need to reduce levels of some greenhouse gas emissions, such as methane, is confused by the fact that, when goods are traded in the world economy, emission levels are not taken into account.

From the perspective of a developing country, then, the real costs of reducing emission levels, in the global interest, are very high. It is by no means clear that sustainable development should be given precedence over achieving increased economic growth. Environmental gains can even be measured in terms of economic growth foregone, and jobs that would have been created. Posed as a conflict between intragenerational equity and intergenerational equity, most developing countries are more likely to choose to reduce the inequalities in the present global economic system, rather than make sacrifices to achieve gains for future affluent generations in the North.

Much of the discussion of climate change policy has followed a completely different trajectory. Taking the idea of carbon budgets, for example, policy discussion has sought to identify principles for allocating reduced emissions among countries. It begins with what is assumed to be a shared problem and proceeds to allocate national reductions in emissions as measures for resolving it (Krause et al., 1992). Within the international relations community, attention has been given to mechanisms that might ease the differentials (or inequalities) between countries that currently make them unwilling to act for the greater good. International environmental taxes, tradeable permits, and joint implementation are all methods for seeking to overcome current opposition to collective action. Nevertheless, there has been a marked reluctance, even on the part of most of the industrialised countries, to agree to implement these environmental policy measures. This is largely because they place their own short-

term economic advantages above longer term, global benefits. In practical terms, most developed countries are unwilling to endorse the precautionary principle as a guide to resolving the contradictions between equity and efficiency at the international level, or to face the severe political problems which would likely accompany a new world economic order.

As Grubb et al. (1993) have observed, distributive problems lie at the heart of the failure to take global action. First, there are differences over the extent to which historical contributions to climate change should be considered. The problem of anthropogenic global warming is essentially one that the industrialised countries have produced through their own industrialisation. Since developed countries have a larger responsibility for current greenhouse gas concentrations than for current emissions, the question arises as to whether they have a responsibility for their earlier contribution to the problem. Before energy intensities began to decline in the North, emissions were linked to unbridled pollution for which we are all paying the costs.

Second, aggregating emissions is not the same as equating them. Some authors, such as Anil Agarwal and Sunita Narain (1991), have argued that methane emissions from the cultivation of rice paddies or ruminant animals are essentially livelihood emissions, rather than lifestyle emissions, like those of the North that are based on high levels of personal consumption. In addition, methane emissions are extremely difficult to quantify and assess, and the data are very unreliable. Similarly, CFCs, which are overwhelmingly produced in the North, have no known sinks and should not, therefore, be equated with carbon dioxide or methane gases for which sinks exist.

Third, it is not clear that we all share an equal stake in the global commons, whether it is common property or open access resources that are being considered. The global commons are being privatised through the patenting of nature itself. The inconclusive deliberations over the Biodiversity Agreement at UNCED demonstrated that, for most countries in the North, the wish to preserve tropical forests was linked to the preservation of patent rights in nature. The resources of developing countries needed to be preserved, so that they could be discovered or utilised as a laboratory for commercial ends on a first come, first served basis.

The key question, as Martinez-Alier (1993) has suggested, is the economic value we place on the functions of natural ecosystems. At present, the forests and oceans are global sinks, but they do not attract payments to developing countries, even those containing large amounts of forested land, for their global conservation value. Acknowledging this principle would immediately upset the existing consensus surrounding GEC, and serve to undermine the current basis for global environmental management.

It is clear that we cannot begin by agreeing to share emission reserves on an equitable basis without undermining the very nature of the global economic system on which they ultimately depend. If we are all allocated pollution quotas, or carbon budgets, the problems posed by GEC are not resolved, they are merely deepened. Would such quotas still be available if the poor become richer? What would be their price?

Which international institutions would collect the receipts on quotas, and to what ends would they then be applied? It is clear that using the concept of a stake holder to imply that everybody has a stake in the global environment is ambiguous. If the countries of the South are disadvantaged through being unequal stake holders in the global environmental problem, how can they benefit from being stake holders in global environmental solutions?

6. A GLOBALISING WORLD ECONOMY: COMPETITION AND SECURITY

Unfortunately most of the great names of classical social theory offer us very little instruction in how to understand global environmental changes (Goldblatt, 1996). They also offer us no more than a few insights into the relatively new world of global environmental policy making. In seeking to find answers to global problems, we are unlikely to uncover a rich vein in existing social theory. Instead, we might ask: since globalisation is so ubiquitous economically, as well as culturally, what makes global environmental management so difficult to achieve? This may not lead us to a discrete body of theory, but it will help us to identify the criteria against which we should begin to measure our theories. The following observations represent a first exploration in that direction.

First, environmental issues, especially at the global level, are addressed through different and frequently competing policy frameworks, such as market and regulatory instruments. Global problems are approached from within different paradigms. This leads to a number of apparently irresolvable contradictions. For example, economic convergence through global market integration frequently undermines the social and cultural autonomy of distinct groups, a conflict that is intensified by exposure to global culture. Globalised culture tends to be Northern culture, and produces its own antithesis—in Comandante Zero in Chiapas; in the occupation by Peruvian guerrillas of the Japanese Embassy in Lima; in the resurgence of fundamentalist Islam throughout much of North Africa, Asia, and the Middle East. Environmental problems are also contextualised by culture, but globalisation frequently removes them from their context. They become like a cultureless language, an Esperanto of the mind, that speaks to everybody and therefore, ultimately, to nobody.

Second, the opening up of global markets, global consumption, and the penetration of remote ecological systems by global capital, lead to conflict with the real world economics that characterise peoples' everyday lives. There is increasing tension between compliance with neoliberal economic policies and the struggle to establish sustainable, long-term livelihoods, which depend in turn on sustainable environments. This tension can be eased by policies to arrest the degradation of the physical environment. Nevertheless, global environmental management remains elusive, precisely

because it contradicts the integrity of culture and place. It has been argued that attempts to manage the global environment come on the back of global economic restructuring, and are resisted by many people in the South for the same reasons as structural adjustment policies have been resisted. In developing countries, global environmental management is as likely to breed resistance as compliance. It frequently represents a narrowing of policy options and the erosion of local self-determination.

Third, political consequences follow social and environmental dislocation. Addressing global environmental problems requires legitimate political action, and a domestic constituency in support of global environmental management. However, many nation-state governments have been weakened by neoliberal policies, especially in the South, while global institutions, particularly those of the United Nations system, are increasingly beholden to one national government, namely that of the United States (Hurrell & Woods, 1995). Questions are raised in the corridors of power, if not across the negotiating table, about the legitimacy of both environmental conditionality and the coercion used by global institutions seeking to engineer management solutions. Global environmental management is either toothless (and ineffective) or it is coercive (and also ineffective). The moral imperative to ensure the integrity of the biosphere is used to justify the creation of a new regulatory world order, one that is based on poor foundations and unaccountable to local populations.

7. CONCLUSION

In addressing the concept of environmental security this chapter has explored the environment, and the policy discourse surrounding it, as a competitive terrain. In the process, it has questioned the idea of environmental security as human adaptation to environmental change. Instead, this chapter has argued that one cannot consider environmental security without an examination of both the social and environmental consequences of economic globalisation.

Global environmental management is often advocated as a solution to global environmental problems. However, if an environmental problem is defined as one associated with physical phenomena and that lies outside human behaviour, then the problems may not be environmental at all. Rather, they are problems of development and growth that undermine long-term sustainability and represent competing human aspirations. It is also sometimes assumed that human beings need to adapt to environmental changes to enhance environmental security. Again, the adaptation that is required is not one that would bring human behaviour into line with physical processes of environmental change, such as soil erosion, climate change, or loss of biodiversity. The adaptation that is required is of our (currently) unsustainable models of growth and development. It is these models that drive environmental change and undermine the prospect of enhanced environmental security.

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Chapter 2

Social Responses to Environmental Change

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Throughout the world, diverse actors are seeking to identify and implement effective, fair and robust strategies for addressing problems posed by environmental change. This chapter seeks to contribute to these efforts by providing a multifaceted framework for analyzing environmental problems. The framework situates environmental problems in the context of four dynamic and interactive forms of disequilibria evident in the international system: between world views; between rich and poor; between institutions and needs; and between social and ecological systems. The chapter further considers environmental change from an historical perspective. It then presents a repertoire of possible social responses, and concludes that one—innovation—is especially promising today. However, the cumulative impact of the various disequilibria in the international system makes it very difficult to cooperate in designing and implementing effective environmental response strategies. Huge inequalities, for example, contribute to environmental problems that need to be addressed while simultaneously predisposing rich and poor to very different solutions. The chapter concludes that environmental problems must be addressed together with social problems.

1. INTRODUCTION

Since the 1960s, increasing attention has focused on the question of whether and how societies throughout the world can adapt to the diverse impacts of environmental change. Pollution, depletion, and environmental modification are manifest in various ways at local, national, regional, and global levels. According to the United Nations Environment Programme's (UNEP) first *Global Environmental Outlook* report (*GEO-1*), released in 1997, environmental degradation and depletion generally is worsening throughout the world, especially in Africa, Asia-Pacific, and West Asia (see also Brown et al., 1998; Goudie, 1996). Further complicating the problem, the knowledge, capacity, and will to respond vary considerably at each level of social organization.

Given the variability and complexity of environmental change, it is not surprising that researchers and policy makers offer a number of perspectives on the nature of the problem and the appropriate ways to respond. One influential literature focuses on controlling population growth (Ehrlich, 1968), another on promoting sustainable development (WCED, 1987), and yet another on technological innovation and ingenuity (Homer-Dixon, 1994b; *The Liberation of the Environment*, 1996; Simon, 1989). National and international regulation, market forces, technological innovation, and education are among the prominent strategies that have been examined, discussed, and

attempted (Brown et al., 1998; Caldwell, 1990; Porter and Brown, 1991; Stone, 1993; Wells, 1996). Some writers are optimistic, others pessimistic, and many others ambivalent. Significant attention has been devoted to the potential for conflict and violence (Deudney & Matthew, 1998; Gleick, 1993; Homer-Dixon, 1994a; Lipschutz, 1989), as well as to the opportunities for cooperation within states, among states, and between state and nonstate actors (Haas et al., 1993; Levy, 1995; Matthew & Zacher, 1995). Skepticism about the severity of the problem is expressed by some (Bailey, 1995; Kaufman, 1994; Simon & Kahn, 1984); others are convinced it is one of the most urgent challenges facing humankind at the close of the twentieth century (Brown, 1972; Kaplan, 1994; Mathews, 1989; WCED, 1987).

These various perspectives are linked in different ways and are as prevalent in narrowly defined cases as they are in regional and global assessments. Taken as a whole, the literature on environmentalism is not only rich, innovative, and compelling, but also permeated with uncertainties, mixed interests, and controversies.

In this chapter, I argue that responses to environmental change should be (a) guided by a comprehensive view of the sort of world we would like in the next century, and (b) sufficiently robust to succeed in a variety of possible futures. I begin by arguing that it is useful to analyze environmental change in the context of a complex of dynamic and interactive forces that simultaneously generate threats to and opportunities for human security and development. Much evidence, however, suggests the balance may be shifting toward threat and away from opportunity. This context serves as a reasonable framework within which the magnitude of environmental change and the repertoire of possible social responses to it can be described and evaluated.

Since the 1970s, a question raised frequently by the less advantaged members of humankind has been: Will Northern elites, and their Southern allies, simply design and implement solutions to environmental change that preserve and perhaps strengthen their privileged status in the international system? I conclude that, in fact, environmental change is one of several forces exerting considerable pressure on elite members of society to reduce inequality, promote justice, and foster sustainable development. Resistance to this pressure is foolish, although widespread, and could prove highly destructive. A further evolution in thinking is required to overcome this resistance and ensure that the solutions devised today have the best possible chance of succeeding in a future that is uncertain.

2. DYNAMIC DISEQUILIBRIA

The economist Robert Heilbroner (1995) argues that modernity is the construction of three powerful and interactive forces: capitalism, democracy, and technology. Technology creates opportunities and demands for increased participation in political and

economic life; greater participation stimulates technological innovation; innovation generates more opportunities and demands for participation; and so on. Two hundred and fifty years ago, the promise of these forces produced widespread optimism about humankind's unlimited potential for progress—for a future of longer lives, greater numbers, enhanced security, more freedom, and mountains of material comforts (Heilbroner, 1995).

Several major events and discoveries of the twentieth century have unsettled this early modern optimism: world wars costing millions of lives, nuclear arsenals capable of planetary destruction, scientific evidence of human-generated environmental degradation and scarcity, and universal gains in life expectancy diminished by unprecedented inequalities of wealth and power. Today, Heilbroner (1995) contends, we peer into the next century with "apprehension." The concept of progress has not been abandoned; although world utopia is scarcely believable anymore, it lingers on as a vestige of nineteenth century idealism. At the same time, the possibility that mere survival will become our prime directive looms large and real, due in large measure to the ways in which we have ravaged and ransacked our natural environment.

Environmental degradation and scarcity are the unforeseen and unintended consequences of the rapid pace at which we have designed new ways to chop, dig, melt, till, and build—to make the land useful. In the 1960s, observers of these consequences sought a language that would convey their magnitude and importance, and often employed a desperate vocabulary—"silent spring," "the tragedy of the commons," "the population explosion," "the limits to growth" (respectively, Carson, 1962; Hardin, 1968; Ehrlich, 1968; Meadows et al., 1972). Business and industry assumed a more conservative and even skeptical attitude, extolling the virtues of "end of the pipe" solutions. In the late 1980s, the concept of sustainable development emerged, rhetorically powerful enough to capture worldwide attention, and yet sufficiently elastic to support a range of perspectives (WCED, 1987). In this decade, the language has darkened again as environmental change has been linked to acute violence and conflict, piquing the interest of security specialists (Homer-Dixon, 1994a; Matthew, 1997).

Through the efforts of the past 30 years, it is clear that understanding and responding to the impacts of environmental change require a careful reconsideration of the big picture of world politics. From this perspective, I identify four dynamic and interactive forms of disequilibrium: a disequilibrium of world views, a disequilibrium between rich and poor, a disequilibrium between institutions and needs, and a disequilibrium between social and ecological systems. Together they impart a reasonable sense of the challenges facing humankind at the close of the twentieth century, and hence a context for assessing our environmental problems and describing and evaluating social responses to them.

2.1 The Disequilibrium in World Views

Throughout the twentieth century, a lively debate has taken place in the field of international relations between proponents of realism, who focus on the state and the maximization of its power and security in an anarchic world, and the proponents of liberalism, who focus on the individual and the possibilities for economic growth and moral progress in a complex system of mixed interests and associations (Baldwin, 1993; Matthew & Zacher, 1995). The arguments of both sides have been influential in shaping research agendas, influencing policy makers, and promoting powerful perceptions of the basic character of the world we inhabit. At least in the United States, the experience of two world wars followed immediately by intense superpower rivalry was widely regarded as compelling empirical support for the realist position. Yet, throughout this period, the steady growth of international trade, receptivity to the discourse of human rights, and the burgeoning transnational relations enabled by technological innovations, sustained some support for the liberal world view. With the end of the Cold War, bullish writers such as Francis Fukuyama declared a victory for liberalism (1992). In the academic world, efforts intensified to correct the intellectual disequilibrium that had resulted from years of privileging realist scholarship.

A simple analysis might suggest that war misled us to attribute more to realist theory than it could deliver. However, the debate expresses a tension in our thinking about politics that has very deep roots. This tension has two dimensions that have divided Western political thought since antiquity.

The first dimension concerns the real character of politics. For Plato and Aristotle, politics was the activity through which a community defined and sought to implement the “good life.” It was the practical expression of ethics. The terms of distinction for this view of politics included virtue, justice, and morality, and collaboration was its preferred form of power. In sharp contrast, Thrasymachus, Thucydides, and others represented politics as an arena of power in which the few coerce and exploit the many, using authority and force that they have acquired through wile and chance. Its terms of distinction were fear, power, glory, and wealth.

The second dimension of intellectual tension also has roots in antiquity—the belief that only one view can be correct. Plato used philosophy as the basis of his claims; Thucydides used empirical evidence to validate his; but the choice of methodology has little relationship to the choice of ontology. Indeed, many writers use both dialogic reasoning and empirical evidence to make their cases. What is remarkable is the insistence that, while the practice of politics may appear to move in both directions, ultimately it must have one objective or the other. One must choose a side in theory, as well as in practice; those who sit on the fence are not to be trusted.

In light of the above, there are four possible ways of representing the debate between realists and liberals:

1. One theory accurately captures the essence of world politics; the other may offer brilliant insights into political phenomena but its fundamental assumptions are flawed.
2. Realism and liberalism are, in fact, two sides of the same coin—Western political thought—and it is the unified discourse that needs to be assessed. Their differences are overstated.
3. Both theories are wrong, and we need an alternative or perhaps hybrid theory to truly understand world politics.
4. Politics is actually a realm of contradiction. Realism and liberalism focus on parts of the whole, and are accurate insofar as those parts are concerned. The whole, however, embodies fundamental contradictions. It is not the case that when the objectives of liberalism clash with those of realism, one side is always or most often victorious.

It would appear that across the range of possibilities, realism has a distinct edge. If it is wrong and we accept it, then we might be obstructing the realization of the good life; but if it is right and we fail to appreciate this, then we might be risking the very things both camps cherish: our lives, property and freedom. But before embracing realism as the prudent position, at least for practitioners, three other global disequilibria need to be considered.

2.2 The Disequilibrium Between Rich and Poor

The statistics of the human condition are well known and shocking. According to the now famous UN claim, women constitute 50% of world population, do two-thirds of the work, and control 10% of the wealth. The world's richest 250 individuals control as much wealth as the world's poorest 2.5 billion. Over a billion people live in absolute poverty (less than a dollar a day); 1.8 billion lack access to health care or safe drinking water; over 2 billion have no sanitation services. And while the global economy has grown faster than world population, the gap between rich and poor continues to increase. In 1960, the richest fifth of the world had 30 times the income of the poorest fifth; today the multiplier is 60.

To speak of an equilibrium is to suggest that some level of inequality is acceptable. The philosopher John Rawls provides a persuasive case for this position, arguing that the possibility of having more of a valued good than others can be a useful way of motivating people to do things beneficial to the whole society that they might not otherwise do. For Rawls, the key is to ensure that "social and economic inequalities are . . . arranged so that they are both (a) reasonably expected to be to everyone's advantage, and (b) attached to positions and offices open to all" (1971, p. 60). This is clearly not the case in the world today. Rather than attempt to define an ideal point of

equilibrium for the unequal distribution of goods on a global scale, the more immediate question is, "How great can social, political, and economic inequalities become before desperation, easy access to arms, and the externalities of poverty (such as environmental degradation, infectious disease, and population movement) demand a concerted effort to change the situation?" At least three scenarios are conceivable:

1. Inequality stabilizes or increases, but absolute gains, displays of force, technological innovations, and cooptive strategies succeed in neutralizing its revolutionary impulses and negative externalities.
2. The world accepts that current concentrations of wealth and power are dangerous and immoral, and designs and implements fair equalization mechanisms.
3. The poor unify to confront the rich with whatever means they can secure.

The scenario one chooses to promote and prepare for depends in some measure upon the position one adopts on the real character of world politics. In particular, realism is constrained in terms of how far it can go in promoting the reduction of inequality—a limitation known as the "relative gains problem" (Grieco, 1988). The great risk, perhaps, is that policies designed to appease both liberals and realists might fall short of effectively promoting either scenario 1 or 2. The shallow liberalism of the past few decades, which has focused on production over distribution, may reflect this problem. This enhances the credibility of scenario 3, although it remains only a possibility (see Connelly & Kennedy, 1994).

2.3 The Disequilibrium Between Institutions and Needs

Within the context of social systems, another sort of disequilibrium, particular to the twentieth century, has been widely discussed (Rosenau, 1990; World Bank, 1997). In the past an equilibrium of power between state and society was sought to ensure that societies remained orderly but governments did not become totalitarian—the so-called "social contract." Today, the balance may be tipping towards anarchy. According to this view, technological innovations have reduced the capacity of existing political institutions to satisfy the needs for which they were designed. The globalization of the economy has made states unduly vulnerable to nonstate actors such as currency speculators, money launderers, and portfolio managers. In consequence, it is difficult for states to stabilize currencies, protect employment, and design and implement long-term economic growth or development plans. Nuclear weapons and the globalization of the arms trade, together with the proliferation of transnational crime, have had a similar impact on the provision of state security (see Matthew & Shambaugh, 1998; World Bank, 1997). To make matters worse, the pace of change may exceed the capacity of existing institutions to adapt or be too quick for new institutions to be designed and established.

International organizations face similar challenges. The United Nations, for example, seeks to fill a need for humanitarian intervention for which it was not designed, and for which it lacks a clear mandate and adequate resources. Its strategy in Bosnia—creating “safe havens” that it could not protect, which actually facilitated ethnic cleansing by providing Serbs with clear targets—exemplifies the growing gap between institutions and needs at the multilateral level.

James Rosenau (1990) has written extensively on the tension between states, which are losing their monopoly of power and authority, and nonstate actors, which are accumulating skills and knowledge along with power and authority. He is unsure whether one group will succeed in gaining control over the other, the two will be reconciled in some way, or conflict between them will escalate. However, Rosenau is sure that world politics has entered a period of turbulence, or what I have termed disequilibrium. The power and authority vested in institutions is being taxed and perhaps overwhelmed by the demands being made on them. They may ultimately be strengthened by this challenge—or they may collapse.

2.4 The Disequilibrium Between Social and Ecological Systems

To be torn between world views at a time when inequality has reached an unprecedented level and existing political institutions may be weakening is itself the basis of a serious intellectual, moral, and practical problem. However, it is not enough to reflect upon the relative virtues and risks of acting to reduce inequality among societies versus trying to protect what we have from the growing numbers of people who have much less, and then design a strategy for realizing one or the other of these ends. Scientific research into environmental change has demonstrated that human behavior is a significant cause of environmental degradation and scarcity, and environmental change often negatively affects human security, welfare, and freedom (Brown et al., 1998; Goudie, 1996; UNEP, 1997). There are, in short, disequilibria between:

- the rate at which we extract and consume environmental goods versus the rate at which they can be replaced;
- the rate at which we load waste materials into ecosystems versus the rate at which they can be absorbed and neutralized; and
- the rate at which our activities displace and endanger other species of life versus the rates at which they can adapt and recover.

It is impossible to specify and quantify all the ways in which human activities adversely affect the environment and all the ways in which environmental change can affect human security and welfare. However, over 30 years of research has shown that in either case the trend is generally of grave concern: social and ecological systems are at odds. Again, it is possible to imagine at least three scenarios for the next century:

1. *Limits prove false.* We discover that nature is more resilient than we had believed, or that human activities are not as destructive as we thought, or that innumerable microlevel adjustments emerge almost spontaneously to restore the balance between nature and civilization. In any case, human society and behavior continue more or less as they exist today.
2. *Peaceful transition.* State and nonstate actors appreciate the importance of environmental rescue and collaborate in various ways to address current environmental problems.
3. *Crisis and conflict.* Social responses prove inadequate to meeting the serious challenge of environmental change. Global warming and ozone depletion validate worst case predictions, biodiversity loss throws ecosystems into turmoil, and humankind faces a barrage of severe weather events, water and food shortages, and drug-resistant microbial invasions. Economic, health, and political systems deteriorate and collapse; violence and misery escalate. The failure of government and business in the face of a cascade of environmental disasters emboldens grassroots movements and strengthens bottom-up approaches to transformation.

It is within this context of multiple and interactive disequilibria that environmental change must be studied and addressed. The challenge, then, is to find effective responses to environmental change in a world in which politics is influenced by competing theories that often demand irreconcilable values and behavior; global inequalities harden the division between realism and liberalism, while intensifying environmental and other problems; and political institutions may in any case be hard pressed to act effectively as nonstate actors swarm through and around them. At the same time, the ways in which the world is mobilizing to address environmental problems provide grounds for optimism.

3. ENVIRONMENTAL CHANGE IN HISTORICAL CONTEXT

Before presenting and evaluating different social responses to the forms of environmental change currently evident, it is useful to consider the work of ecologists, environmental historians, and paleoanthropologists on what has transpired in the past. How serious are the world's environmental problems when viewed in an historical context? How have humans adapted, and when have they failed to adapt? Consulting this body of literature gives us a good sense of the magnitude of our environmental problems, the repertoire of social response mechanisms, the conditions under which they have succeeded or failed in the past, and the extent to which our situation is truly unique.

Anyone reading a recent study of ecology, such as E. O. Wilson's influential *The Diversity of Life* (1992), must marvel at the complexity of nature and the many gaps in our understanding of how nature functions. As Wilson makes clear, we are at a very early phase insofar as understanding the dynamics of ecosystems and the processes of change are concerned. Our analytical tools, while impressive, provide only partial explanations and cannot answer many pressing questions. Within the scientific community, there is significant controversy over the definition of fundamental terms—such as species, ecosystem, evolution, and pollution—and much remains to be learned about how nature works (Wells, 1996; Wilson, 1992). Significant gaps in our database make progress difficult and Wilson emphasizes the importance of improving environmental data sets.

Nonetheless, it is widely accepted that human activities are having a substantial impact on the physical and biotic systems within which humans act and upon which we depend (UNEP, 1997). For example, according to Wilson (1992), human activities have accelerated “natural” rate of species extinction by a factor of 1,000 to 10,000 in biologically rich areas such as tropical rainforests. On five occasions in its history, the planet has experienced comparable, rapid rates of species extinction culminating in biodiversity loss in the order of 95% (Wilson, 1992). These have resulted from climate change which, in turn, has been the aggregate product of several phenomena, especially large asteroid strikes; intense volcanic activity; continental drift pushing land masses closer to the poles; and fluctuations in the amount of solar energy absorbed by the planet due to gradual shifts in the shape of the earth's orbit, its degree of tilt towards the sun, and its proximity to the sun (Ponting, 1991; Wilson, 1992). Over millions of years, climate change has caused relatively rapid declines in biodiversity, declines from which it has taken millions of years to recover (Wilson, 1992).

Wilson contends that human activities cause biodiversity loss at a similar rate—in other words, our environmental problems are comparable to the most severe periods of environmental change in the past. But, even if true, does this really create a problem in the sort of time frame that would be of any value to a society? At Wilson's estimated rate of 27,000 species lost per year, and assuming 100 million species exist, it would take 3,700 years to reach the point of devastation experienced on five earlier occasions (Wilson, 1992). To explain why we must act now, Wilson's argument relies on vague estimates of what is at stake in the short to medium term such as the loss of potential sources of drugs and food stuffs. Other global problems such as climate change suffer from a similar type of uncertainty: when will they matter and how?

Clearly some forms of environmental change do pose obvious and immediate problems—polluted air and water pose serious health risks, for example. But the question remains: Do we face a basket of pressing but specific concerns or a pervasive long-term problem of almost inconceivable proportions, or both? The position

one adopts on this question has important ramifications for subsequent investigation into the potential for social adaptation. For example, if we face a basket of problems, green technologies may resolve them effectively, but if nature is on the verge of collapse, a broader and more transformative set of strategies may be imperative.

Studies such as Wilson's that analyze the events of billions of years make it difficult to assess the urgency of the threat to humankind. If we narrow the time frame considerably to cover only the last 5 million years, the period during which paleo-anthropologists argue that humankind has existed, some of the potential implications of environmental change come into a very different focus. In this time frame, we can isolate three natural forces that have had a dramatic impact on our species (and its ancestors): climate change, continental drift, and evolution (Fagan, 1990; Leakey, 1994; Ponting, 1991). During the period in question the planet has experienced several ice ages, plates of land have collided and separated, and the human species has evolved through perhaps a dozen iterations (Leakey, 1994). The story is only available in fragmentary and disputed formulations, but in any case it can hardly be read as a tragedy. To the contrary, environmental change may well be regarded as the driving force behind the biological and technological achievements that mark our gradual rise from small, primitive hunting and gathering clans to the commodious industrial societies we inhabit today. Propelled by scarcity, and perhaps curiosity, the human species migrated out of Africa, and, over many millennia was able to adapt to virtually every type of ecosystem on the planet: polar, tundra, savannah, desert, and forest (Fagan, 1990).

In comparison to other species, our adaptive mechanisms have been the most remarkable. Faced with colder temperatures or forms of scarcity, the human species has migrated, innovated, competed, cooperated, and evolved in its unrelenting, and successful, effort to survive and flourish (Fagan, 1990). The historical record of our adaptive strategies slowly comes into focus with the emergence of *homo sapiens*, some 100,000-200,000 years ago; it gains significant clarity once our species, *homo sapiens sapiens*, becomes dominant 30,000 years ago; and it is relatively well known after the emergence of agricultural societies in the Middle East, China, and Meso-America some 10,000 years ago (Ponting, 1991). Interpretations vary, of course, but the record is clear on one thing: as our natural environment has changed, in some cases due to our own activities such as overhunting and agriculture, we have found ways to adapt.

At first humans moved, developed crude stone tools and determined ways to cooperate in order to cope with climate change and scarcity. With the advent of agriculture, more elaborate technologies and forms of social cooperation appeared, enabling larger numbers to survive on smaller tracts of land. The industrial age accelerated these trends, and their overall success is demonstrated by the growth spurts in human

population at each stage. Our hunting and gathering world peaked at about 4 million and remained constant for millennia; agricultural societies reached a population of 600 million; and industrial societies have let the human race grow to some 6 billion (Ponting, 1991).

What can we conclude from this? If Wilson is correct, and human behavior has triggered, or is on the verge of triggering, the sort of environmental catastrophe that devastates life and requires millions of years to recover from, and if there are reasons to believe we have managed to compress this into a very short time frame (scores or hundreds versus thousands or millions of years), then our priority is clear. We must do everything possible to halt the processes of destruction we have engendered. On the other hand, if our environmental problems are similar to those that our species has faced before, then it is perhaps feasible to consider response strategies within the context of the dynamic disequilibria outlined in Section 2. In either case, if we fail to act, we may soon find ourselves on the threshold of a future described by Jonathan Schell (1982) in which nature persists, but humankind does not.

Such an outcome is far from implausible. After all, many species have come and gone in the 4 billion year history of our planet. Large, and at the top of the food pyramid, mammals tend to be especially vulnerable to change (Hummel, Pettigrew, & Murray, 1991). The sheer number of humans is at odds with the numbers nature has allowed other large mammals. Like bacteria in a petri dish, the human species might be destined to expand quickly and die even faster. If, as Wilson contends, our behavior is eliminating other species, thinning the ranks of the biodiversity that sustains us, it is plausible that the top of the pyramid will one day crumble into a nutritional abyss.

Backing away from Wilson's estimate of the magnitude of our problem does not put us on very secure ground. Let us assume that our assault on the food pyramid does not destroy the structure itself. Significant fractions of humankind may still be very vulnerable. Humankind's adaptation to environmental change over the millennia was marked by many failures. How many died from cold or starvation before a given adaptation succeeded? Do we resign ourselves to a similar harsh fate today, or do we do what we can to distribute the burden of adaptation equitably?

In short, it is hard to assess the magnitude of human-generated environmental change and its implications for the human species. But it matters whether we believe the human species is at risk, or that some subgroups will disappear while others survive, or that we will continue to adapt and flourish. Each judgement will have a different impact on how we try to respond. Wilson argues that we should assume the worst and act accordingly. Julian Simon (1989), Wallace Kaufman (1994) and Gregg Easterbrook (1995) are skeptical of this approach. I propose examining a middle position: the problems are serious enough to warrant concerted and extensive action. In this case, what can we do?

4. THE REPERTOIRE OF SOCIAL RESPONSES

Based on the above discussion, it is possible to construct a simple typology of possible social responses to environmental change:

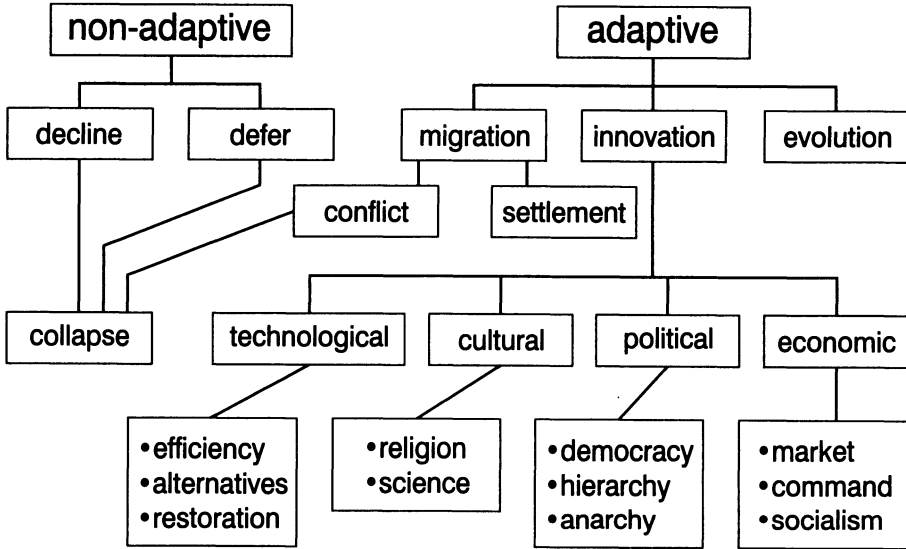


Figure 2.1 Social responses to environmental change

Societies respond to environmental change in a variety of ways. They can ignore the evidence and refuse to change, a strategy likely to lead to decline or collapse if the mainstream estimates of the gravity of the problem are accurate. Or, as Kaplan (1994) argues, societies may lack the capacity to change, to rearticulate their interests, resulting in the same dismal outcomes. Or, finally, they may act to defer the problem, shifting its impacts over time and space, a strategy that must inevitably lead to ruin.

Nonadaptation is a serious possibility. *GEO-1* suggests that, in spite of volumes of scientific evidence, endless meetings and innumerable promises, “from a global perspective the environment has continued to degrade during the past decade” (UNEP, 1997, p. 3). Long-time horizons, uncertainties about cause and effect, mixed interests, a lack of leadership, and the difficulty political and economic institutions have in changing make it difficult for societies to respond to environmental problems. Easter Island may be a model of the future. This depends upon how serious the problems really are, how intransigent the values that guide existing institutions prove to be, and whether we in fact have the capacity to adapt.

History gives us some grounds for optimism: human societies have adapted successfully to environmental change in the past. However, the repertoire of adaptive

mechanisms appears to be dwindling. With the exception of the currently remote possibility of colonizing asteroids or building sea cities, not much fertile land is available to move onto. Migration is declining as a viable strategy—recent population flows have been closely connected to violence (Homer-Dixon, 1994a). Of course, the distribution of humankind could be more efficient, and countries such as Canada and the U.S. might well be able to accommodate larger populations. But humans have occupied most of the ecological niches available, and many societies have developed effective ways of keeping foreigners out of their niches. If environmental change is a real problem, inviting more people to share one's ecological niche will be a hard position to sell. Thus it is hardly surprising that the bulk of population flows occur within the regions of poverty and weak institutions. But moving from Rwanda to Burundi is not likely to be an effective adaptive mechanism.

Evolution is always an option, but the rate of evolutionary change may be too slow to accommodate the rate of environmental change. Of course, genetic engineering might pick up the pace considerably, but today it appears to be guided more by aesthetic values than a desire to adapt to environmental change, and “beautiful” people die as quickly as “ugly” ones. In any case, these options are too uncertain to rely upon. Therefore, we are left with innovation.

4.1 The Principles of Innovation

Figure 2.1 identifies a variety of innovation strategies. Environmental historians and paleoanthropologists often read human history through what might be described as the lens of environmental determinism. From this perspective, environmental change is the real motor driving social innovations. But what exactly does this mean? One can hardly dispute the claim that, as a species, humans have adapted to environmental change. It is therefore valid to state that our social structures represent successful adaptive strategies. But lots of people have succumbed, and continue to succumb, to disease, cold, starvation, and so on. The important questions are the following: What are the conditions that lead to success, and what exactly do we have to do today?

It might appear that there are simple and obvious answers to these questions. All forms of innovation have the potential to contribute to environmentally sustainable practices, which themselves can be characterized as practices that work together to

- *produce more with less*, that is, satisfy human material needs (sustenance, shelter, energy, and so on) more efficiently;
- *close the loop*, that is, reduce the amount of energy lost and waste loaded into ecosystems; and
- *protect ecosystems*, that is, mitigate the impact of human activities on ecosystems at all levels.

However, unless the world unifies around an environmental agenda that trumps all other objectives, these principles are not, themselves, an adequate basis for decision making. Innovation designed to address environmental problems must also take into consideration the other disequilibria in the international system. We need to reduce inequalities, which are closely related to many forms of environmental change. We need to act with institutions that may be losing capacity and authority. And we need to be alert to the concerns of realists who suggest that reducing inequality may be a dangerous strategy.

On this latter point, recall Heilbroner's (1995) argument about technology, capitalism, democracy, and progress. From a realist perspective, if we (in the Western world) devote some of our vast resources to reducing inequality in ways beneficial to the environment, we may stimulate demands for higher levels of equality. Can we satisfy these in environmentally sound ways? If not, are foreign leaders likely to divert additional resources to acquire further military assets rather than improve education, health, and sanitation systems? In this case, our efforts to reduce inequality to save the environment might generate other threats to our security and welfare. Ironically, inequality is simultaneously the basis of security and insecurity for those with wealth and power.

This observation gains some validity from the fact that many technologies have multiple applications. For example, U.S. satellite technology currently produces the best resolution images in the world. These can be used to measure deforestation, track fisheries, and even assess the health of forest cover. They can also be used for military purposes. Today the U.S. intelligence community is considering ways to make its highly sophisticated data gathering and analysis assets and its archived material available for environmental assessment and policy, but it is concerned about the implications of this for national security (Deibert, 1996; Matthew, 1997). Thus, while encouraging the dissemination of technology is advocated as an integral part of environmental rescue, it is an approach that raises red flags for national security specialists. Rejecting the realist world view might simplify matters theoretically, but it is unrealistic to proceed on this basis, knowing that many academics and decision makers are persuaded by this way of thinking.

5. ROUSSEAU ON EASTER ISLAND

5.1 Freedom and Inequality

The French Enlightenment thinker Jean-Jacques Rousseau gave eloquent expression to two ideas that are relevant to understanding our current predicament. The first has to do with human freedom and our relationship to nature. The second concerns the constraints on political action and social change imposed by inequality.

In *The Social Contract*, Rousseau writes, “The passage from the state of nature to the civil state produces a remarkable change in man by substituting justice for instinct in his conduct and giving his acts the morality they previously lacked” (*The Essential Rousseau*, 1974, p. 20). In civil society, people forsake possession and natural freedom, the right to take hold of whatever they can, but they gain ownership and moral freedom, concepts that have no meaning outside of civil society. Rousseau adds,

If the abuses of this new state did not often degrade him below his previous level, he [man] would constantly have reason to bless the happy moment when he was drawn out of the state of nature forever and changed from a stupid, short-sighted animal into an intelligent being and a man.
(*The Essential Rousseau*, 1974, p. 20)

The essence of Rousseau’s claim will be very familiar to students of environmental ethics. Unlike humans, rocks, plants, and animals do not have the capacity to imagine different ends, reason, or make choices. They are, in a way that separates them from us, guided by instinct or determined by the laws of nature, and thus they lack what we call history and culture: the records and expressions of our choices. Of course, the earth has a history, and it affects human history, but it is still somehow different from the history of Judaism or Tibet. The problem arises when, in light of evidence of human-generated environmental change, we search for a new basis for defining the relationship between nature and civilization. It is most explicit when environmentalism is encountered in its virulent Earth First! forms: no compromise in defense of nature. Here environmentalism expresses a type of antihumanism that leaves social systems deflated and disoriented.

The virtue of this extreme position is that it places the human species in the context of the interconnected web of life—a web that preceded us and, arguably, will outlast us. It suggests a locus of value that embodies us but is not exclusive to us. Just as the individual must reconcile self-interest with the interests of others, our species must strive to reconcile its interests with those of nature writ large. But this way of thinking tends to be deeply critical of human aspirations, achievements, culture, and history. In the big picture of nature, it suggests we are akin to an infection that has got out of control. The implication is that we will have to reject many of our beliefs, values, institutions, and practices to recover some sort of harmony with nature. This conclusion is threatening to many and hence practically implausible.

At the other end of the spectrum, the humanist end, the significance of environmental change depends on its impact on human security, welfare, and freedom. At times it is in our interest to adjust our behavior, to reduce toxic emissions or the rate at which we exploit fisheries or rainforests, for example. This seems to be a reasonable direction in which to think. After all, there is no limit to how we can define our interests. In addition to wanting good quality air and water, our interests might include things like

preservation of wilderness for aesthetic reasons, or because of a widely felt sense that nature has an intrinsic value we cannot quite articulate. In this case, we preserve our sense of uniqueness, our belief that the creative expression of our particular form of freedom is valuable, but we also reduce our adverse impact on the environment that sustains us materially and serves as a source of spiritual and aesthetic inspiration.

In theory, a humanist environmentalism has many attractions; in practice, it is compromised by Rousseau's second great insight into modernity. In his "Discourse on Inequality Among Men," Rousseau argues that living in nature, which implies living in accordance with instinct or natural law, keeps people from realizing what is marvelous and distinctive about being human: the capacity to reason and hence to make choices and become moral beings. Society, then, is different from nature in a fundamental and valuable way. The problem is that whereas an "animal . . . cannot depart from the rules laid down for it, even when it would be advantageous to do so . . . man often departs from them to his own disadvantage" (*The Essential Rousseau*, 1974, p. 152). The reason for this, Rousseau argues, is that inequality has become so deeply entrenched in social systems that it now shapes all of our values and behavior. He writes:

If we follow the progression of inequality through [history] . . . we find that the establishment of law and the right of property was its first phase, the institution of magistracy its second, and the transformation of legitimate power into arbitrary power its third and last. The first gave rise to the distinction of rich and poor, the second to that of weak and powerful, and the third to that of master and slave, which is the ultimate degree of inequality and the one to which the others all lead. (The Essential Rousseau, 1974, p. 195)

Rousseau concludes, "it is obviously contrary to the law of nature, however it may be defined . . . for a handful of people to wallow in luxury while the starving multitude lacks the necessities of life" (*The Essential Rousseau*, 1974, p. 201). He wants to suggest that it is also contrary to any worthwhile alternative to the law of nature.

In his writings on "perpetual peace," Rousseau seeks to recommend an interstate organization very similar in design to the United Nations, but he argues that it would not work because of inequality within societies. Leaders maintain their domestic status in part by making sure that the world beyond their borders is as threatening as possible. Eliminate external threat and the internal challenges to inequality, challenges that leaders have no desire to encounter, would become intense. In other words, in a very direct way, the international system is constructed to help maintain profound domestic inequalities. This creates a seemingly inescapable dilemma: to change the international system we have to change the character of its units, but to change the character of its units we need to change the international system. Once it has become pervasive in a social system, inequality will tend to reproduce itself inexorably.

Rousseau's insights into domestic politics fit neatly into the analysis of world politics presented in Section 2. People often make choices to their own disadvantage; inequalities are intensifying; and we may be witnessing an increase in the capacity and magnitude of arbitrary power in the international system. Even if today's international system is better described in the terms once reserved for domestic politics, the problem of inequality is unchanged. Thus, Rousseau's writings suggest another way of characterizing the problem of developing effective social responses to environmental change. The antihumanist variants of environmentalism, which call for radical social transformation, are unpalatable insofar as they tend to discredit the creative freedom we have come to regard as distinctly and preciously human. But the humanist versions of environmentalism risk being constrained, or perhaps distorted, by the pervasive effects of inequality. Can we rise above the cognitive effects of inequality? Or, as Rousseau suggests, are they now irrevocably entrenched in our world views? Can we effectively address environmental problems in the context of inequality? If not, can we reduce inequality enough to make effective responses possible? This at a time when the capacity of our political institutions may be weakening and our repertoire of adaptive mechanisms may be shrinking.

For the Western observer, the extent of global inequality is easy to measure, but difficult to grasp. We are aware that, in our increasingly globalized economy, 1 out of 5 people lives on less than a dollar per day. How can we, in the Western world where incomes average 60 times that amount, over \$20,000 per year, appreciate what this means?

5.2 The United States on Less Than a Dollar a Day

In order to grasp the extent of this inequality, let's imagine life in the U.S. on less than a dollar a day. The scenario is a family or group of six, with a combined annual income of \$2,100 (equal, incidentally, to what Bill Gates earns in approximately four seconds). Housing will be a major expense, but it is conceivable to rent a single room in a depressed part of the country for \$100 a month. The room might be used primarily for sleeping, two people at a time in eight hour shifts. Some artful scavenging produces two old mattresses, a couple of broken chairs, a table, and some dishes. There is no phone, television, lighting, air conditioning, or heating. An industrious shopper can purchase shoes, pants, two shirts, two pairs of underwear, two pairs of socks, and a coat at a Salvation Army store for approximately \$10—\$60, then, to dress the family for a year. Food is another major expense, but again careful shopping might yield 100 pounds of hamburger meat (\$80), 300 pounds of chickpeas (\$150), and 2.5 tons of brown rice (\$440 at the wholesale price). This diet would provide a subsistence amount of approximately 1,570 calories per person per day (40 from the meat, 200 from the chick peas, and 1,330 from the rice). It would, however, fall short of daily requirements for

protein as well as for most vitamins and minerals. The total expenses so far equal \$1,930.00, leaving \$170.00, or fifty-four cents per person per week for food supplements, health care, transportation, and entertainment. I assume water is the beverage of choice, and free, and that no taxes are paid. Thus, even in the U.S., a dollar a day might provide a family of six with shelter, water, clothes and almost 1,600 calories per day. It would be a cold, barren, miserable existence; largely spent outdoors, hungry, tired, and vulnerable to illness. And it would include constant exposure to incredible levels of wealth—of goods and services tantalizingly close but always out of reach. In short, it would be much the same as the lives that over a billion people actually do lead in various parts of the world. Now, imagine a future in which this condition is fixed and virtually inescapable. One might reasonably conclude that one out of five people on the planet cannot possibly care much about global environmental problems. What about their counterparts at the top of the economic pyramid?

5.3 The Easter Island Model

Polynesians arrived on Easter Island in the fifth century: “Against great odds the islanders painstakingly constructed . . . one of the most advanced societies of its type in the world. For a thousand years they sustained a way of life in accordance with an elaborate set of social and religious customs that enabled them not only to survive but to flourish” (Ponting, 1991, p. 6). The rich, intricate, commodious life of the Easter Islanders involved, among other activities, carving huge stone statues that were moved from the quarry to the coast by using trees as rollers. Status among the clans depended on the quantity and quality of statues each produced. Year after year the ruling class, the “hanau eepe,” forced the working class, the “hanau momoko,” to work harder and eat less. Over the course of a millennium, the trees disappeared entirely, stripping the soil of the nutrients essential for agriculture and depriving the islanders of their prime material for fuel, tools, and shelter. Social inequalities worsened; violence increased:

The Easter Islanders, aware that they were almost completely isolated from the rest of the world, must surely have realized that their very existence depended on the limited resources of a small island. After all it was small enough for them to walk round the entire island in a day or so and see for themselves what was happening to the forests. Yet they were unable to devise a system that allowed them to find the right balance with their environment. . . . Indeed, at the very time when the limitations of the island must have become starkly apparent the competition between the clans for the available timber seems to have intensified as more and more statues were carved and moved across the island in an attempt to secure prestige and status. (Ponting, 1991, p. 7)

As the society on Easter Island was collapsing, before it was “discovered” by Europe, thousands of miles away Rousseau wrote in his *Discourse on Inequality*, “public esteem came to be valued. . . . This was the first step toward inequality, and also toward vice” (*The Essential Rousseau*, 1974, p. 178). It would not have surprised him to learn that on Easter Island socially constructed forms of inequality were compelling people to act in ways that ultimately would cause their society to collapse. Insofar as Rousseau is correct in his assessment of the embeddedness of inequality in modern civilization, Easter Island might be an apt metaphor for our late twentieth century world.

There are at least three reasons for taking this possibility seriously. First, environmental thinking in the Western world is generally committed to the belief that it is possible to save the environment and maintain economic growth, leading to a pronounced tendency to try to solve problems through technological innovations that increase efficiency and to discredit alternative approaches. Second, although poverty and related forms of inequality are regarded as a significant and growing source of environmental problems, arguments for redistributing wealth and power have been coldly received. Our disproportionate share of wealth and power are widely perceived as the basis of our security. And third, after three decades of research and practice, the condition of the world’s environment continues to deteriorate.

5.4 Grounds for Optimism

It would be misleading and counterproductive to suggest that the fate of humankind is inextricably linked to a set of beliefs, values, practices, and institutions that simultaneously generate inequalities, which make change impossible, and environmental problems, which make change essential. It is true that, by many accounts, both current inequalities of wealth and power, and the severity of human-generated environmental degradation and scarcity, are unprecedented. It is also true that history might well be read as Rousseau chose to read it: as a steady march towards greater exploitation of people and nature. But there are grounds for optimism:

- The simple and extreme forms of realism and liberalism that sustained and divided the discipline of international relations and the policy community during the Cold War appear to be yielding to a new generation of richer and more complex theories. The realist claim that maximizing power relative to others should be the basic and nonnegotiable goal of the state may be losing favor even among practitioners.
- Much anecdotal evidence suggests that, in both the political and economic arenas, the belief that current inequalities are unsustainable and must be reduced is growing. During the Cold War, development assistance was justified largely in terms of fighting socialism in the Third World. Today, new arguments are being explored to defend the continuation of foreign aid.

- A significant body of research suggests that new forms of global governance, and something akin to a world civic society, are taking shape, nourished by cooperation among states, a thickening web of transnational nonstate actors, and a more aggressive United Nations system.
- Awareness and understanding of environmental problems has grown at a remarkable pace in three decades, and significant efforts are being made at local, national, regional, and global levels to address many of these.

Will the cumulative effect of these optimistic trends, which I have noted in a very cursory and even disputable manner, be sufficient to mobilize support for ecohumanist policy initiatives to reduce inequality, strengthen accountable institutions, and save the environment? It is not my objective here to attempt to answer this question; I seek only to elaborate on a framework for thinking about viable social responses to environmental change.

6. CONCLUSION

In this chapter, I make three arguments. First, I argue that the tension between social systems and ecological systems is in part due to, and must be analyzed in the context of, three other forms of disequilibrium in the late twentieth century world. We are pulled by competing theories of politics: one advises us to protect what we have from the aggressive predation of others on the grounds that politics is about coercion; the other advises us to promote human development and justice on the grounds that politics is about collaboration in pursuit of the good life. We are divided by growing inequalities that have reached a point of absurdity; for example, the founders of Microsoft each earn as much in a year as about 30 million people at the bottom of the economic pyramid, 30 million people who are slowly starving to death. These inequalities shape our values, beliefs, and practices, and may limit our ability to think creatively about the sort of world we need and want. And we are challenged by global problems that our political institutions were not designed to handle, at a time when they may be losing capabilities to nonstate actors.

Second, there are different ways of thinking about the magnitude of our environmental problems. From Wilson's perspective, we are on the verge of destroying life on planet earth. For Ponting and others, environmental change can be severe and destructive, but it also stimulates human creativity and propels us forward. For Bailey and Kaufman, our problems are real but tend to be overstated. In any case, our repertoire of social response mechanisms appears to be shrinking. We must rely heavily on our capacity to innovate to resolve problems regardless of how serious we believe them to be.

However, thirdly, innovation is guided by our understanding of the character of politics, the inequalities that shape our values and needs, and the capacity of our institutions to act. There are many reasons to be concerned that we will not be able to develop and implement the innovative solutions that our problems, unless they are fairly trivial, need. However, there are also grounds for optimism.

I conclude by suggesting that Rousseau was correct: inequality is the most deeply embedded and pernicious characteristic of modern society. It teaches the few that they can do anything, except put their privileged status at risk. It persuades the many that the only alternative to their misery is to become like the few. It thus places virtually insurmountable constraints on perception and behavior. Environmental change, however, suggests that the status quo is dangerous and unsustainable: it asks us to challenge and overcome socially constructed constraints. But the impulse, at least of the few, is to creatively interpret evidence of environmental change in ways that do not really require significant change to the status quo. This is a potentially dangerous strategy: as the example of Easter Island demonstrates, inequality can blind people to the need for change, and lead to decline and collapse.

What, then, is required to bend the future away from this trajectory? One might hope that environmental problems prove less severe than our science claims, but if this hope turns out to be unfounded, humankind will come to revile our century. What is required, I think, is to encourage a renaissance of critical thinking and creative endeavor that focuses human energies on attacking inequality and developing or recovering ways of making life valuable that do not depend on exploitation. We need to solve environmental problems by solving social problems.

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Chapter 3

Strategies for Enhancing Human Security in the Face of Global Change

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This chapter takes as its starting point the proposition that the concept of security should not be limited exclusively to the geopolitical and military contexts, but should also recognize threats to human welfare associated with environmental change. The environmental threats that humanity faces differ in fundamental ways, such as immediacy, probability, predictability, and geographical scale, which have implications for the challenges they pose to policy makers. Four types of responses to environmental threats are distinguished: (a) prevention or limiting of environmental change; (b) avoidance of impacts; (c) defense against impacts; and (d) reaction to impacts. Key issues that arise in deciding upon response strategies are identified; these include economic costs, relative priorities, the possibility of exacerbating threats, impacts on other countries, responsibilities of industrial countries in assisting developing nations, cross-national differences in the perception of threats, and the role of nonstate actors.

1. INTRODUCTION

The end of the Cold War triggered widespread reflection on the meaning of the term security. For nearly half a century, security was primarily associated with the geopolitical and military security of nations. In recent years, disagreement has arisen about whether the term should be used more expansively to also encompass threats to basic human welfare in realms such as economics, energy, resources, food, and the environment. Furthermore, the question arises whether or not the concept is applicable to political and social units other than nation-states, ranging from the individual to global levels of human organization. I have argued elsewhere for liberating the term security from the traditional confines of national security studies to stimulate thought concerning the larger array of threats that confront human societies and the strategies that can be employed to further human security. In doing so, I define security as the assurance people have that they will continue to enjoy those things that are fundamental to their survival and well-being, such as life itself, health, food, economic sustenance, and freedom from violence (Soroos, 1995).

In thinking about human security and how it can be enhanced, it is useful to reflect on its negation, namely what constitutes an insecurity. An insecurity arises when there

is a combination of a threat and a vulnerability. A *threat* is present when there is the possibility of a development or a turn of events that could seriously harm humans if it materializes. A *vulnerability* exists when humans lack the means to avoid or cope with the detrimental effects of a threatening event (Soroos, 1995). To begin this chapter, I briefly discuss the diversity of environmental threats that human populations face with the approach of the 21st century; I then suggest four basic strategies for dealing with these threats—prevention, avoidance, protection, and adaptation. Lastly, I highlight several larger issues that arise as efforts are made to enhance human security in the face of environmental changes.

2. DIVERSITY OF ENVIRONMENTAL THREATS

The natural environment not only provides the habitat and resources that sustain human populations, it is also the source of many of the threats they face, such as earthquakes, volcanoes, storms, droughts, pestilence, and diseases. For example, there is the seemingly remote possibility that a large meteorite might crash to the Earth's surface with resulting devastating environmental consequences. Such an event, scientists widely believe, was the cause of mass extinctions of dinosaurs during the Cretaceous period 65 million years ago. In modern times, human activities such as the increased burning of fossil fuels, mining and smelting, chemical production, extensive land clearing, and intensive fishing contribute to additional environmental threats that jeopardize human welfare. It is important to reflect upon the broad diversity of such environmental threats, because the characteristics of each have significant implications for the response strategies that will be effective, and even possible. This section considers several of the more important ways in which environmental threats differ from one another.

2.1 Potential for Human Mitigation

Humans are powerless to eliminate or significantly diminish many types of environmental threats, especially some of the naturally occurring events such as volcanoes and earthquakes, which are triggered by powerful forces in the earth system. Other threats may be mitigated by human interventions, including the prevalence of certain diseases, such as the smallpox virus, which has been virtually eliminated among human populations. Preserving the habitat of endangered species can slow loss of biodiversity. Policies that curb air pollution may reduce the acidity of precipitation, preserve the ozone layer, and limit the amount of climate change that takes place. Nuclear defense systems could conceivably be adapted to the task of intercepting or destroying meteorites before they reach the planet.

2.2 Pace and Immediacy

Some environmental threats arise in a gradual and almost imperceptible way; in contrast, others may be sudden and have dramatic impacts. Sea-level rise attributable to global warming is an example of the former, while a storm surge or tidal wave that smashes into low-lying areas is illustrative of the latter. The pace of environmental change may accelerate suddenly once a critical threshold is reached or other factors come into play, as when gradually rising rates of acidity in the environment exceed the tolerance of species of trees and aquatic life. More rapidly unfolding changes such as the appearance of the “ozone hole” over Antarctica or the dramatic spread of forest death syndrome (*Waldsterben*) in central Europe in the early 1980s are more likely to provoke a decisive human response than those changes that are almost imperceptible in the short run, but over time may have immense consequences.

Some threats are much more immediate than others. The impacts of some—such as the damage to forests and aquatic life observed for decades in Europe and North America, and which is attributed to acidification—are already manifest. By contrast, it is projected that the gradual thinning of the ozone layer will have few readily observable impacts until well into the 21st century, when it will be too late to reverse the trend and avoid catastrophic impacts on the global environment. Conventional wisdom suggests that human communities are likely to address immediate environmental dangers, while discounting the importance of trends that pose even graver threats for the more distant future.

2.3 Probability and Predictability

Some environmental changes and their impacts are highly *probable* in the sense that they are likely to occur. Two examples of these are the loss of certain endangered species if their habitat is altered, and a higher incidence of respiratory illnesses with a rise in the concentrations of certain air pollutants. The shrinking of the Aral Sea was an inevitable outcome of the diversion of waters from the rivers that feed it. The materialization of other threats, such as the cracking and sliding of the West Antarctic ice sheet into the ocean due to global warming, is substantially less certain (although the breaking off of large chunks of ice shelves and the appearance of deep fissures in the sheet suggest that such an event may be more likely than previously believed).

The probability of environmental changes should not be confused with their *predictability*. Certain natural occurrences such as earthquakes, volcanoes, or hurricanes are quite probable over a given period of time, but where and when they will take place may be difficult if not impossible to anticipate very long before they occur. Scientists in fields such as seismology and vulcanology are, however, making substantial progress

in developing techniques for timely prediction of these natural events. Other factors being equal, threats that are probable and predictable would seem more likely to elicit a human response in the form of an anticipatory action than those that are far less certain and foreseeable.

2.4 The State of Scientific Knowledge

Environmental dangers such as the thinning of the ozone layer are often brought to light by science, initially as a tentative theory which is subsequently subjected to extensive scientific investigations. Scientific research involves both systematic observations, including monitoring of key trends, and research aimed at understanding the dynamics of ecosystems and the factors contributing to changes. Organized assessments of the state of scientific knowledge on a specific problem, such as those conducted by the Intergovernmental Panel on Climate Change, are critical for informing policy makers of the nature and severity of environmental threats and the options available for responding to them.

Lingering scientific uncertainties or disagreements among scientists pertaining to an environmental threat and its probable consequences are sometimes cited to justify delaying responses to environmental threats, even though waiting for conclusive scientific evidence may necessitate more drastic and costly action in the future. Language designed to combat this tendency was inserted into several recent international documents; for example, the 1992 Rio Declaration on Environment and Development provides that “where there are threats of adverse or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

2.5 Anticipated Severity of Consequences

Some environmental changes are potentially far more severe or destructive than others are. The loss of a single, localized species in a tropical rain forest is unlikely to have grave consequences in the larger scheme of things. Alternatively, a substantial thinning of the stratospheric ozone layer has serious implications for human health and, more importantly, could cause serious disruption to the biosphere if vulnerable species near the base of the food chain succumb to increased doses of UV radiation. Global warming portends potentially disastrous impacts such as the flooding of low-lying regions where much of the world’s population resides and a weakening of major ocean currents that moderate the weather of some regions, including heavily populated northern Europe. The more severe the consequences of environmental changes are anticipated to be, the greater the likelihood that there will be action taken to mitigate or prepare for them.

2.6 Geographical Scale

A toxic waste dump, a forest clear-cut, or urban air pollution may have largely localized consequences. Other threats are regional in geographical scope, as in the case of climate changes and the wind blown silt caused by the shrinking of the Aral Sea, or the transboundary movement of air pollutants responsible for acid deposition in North America, Europe, and east Asia. Other environmental changes, such as the depletion of the ozone layer and climate change, occur on a global scale. Effective responses to these problems must involve the participation of governing units that encompass the geographical extent of the environmental change. Global negotiations that are necessary to devising frameworks for addressing planetary problems, such as curbing global warming, may be ill-suited for responding to regional threats.

2.7 Differential Impacts

Some environmental threats will have a similar impact on all nations, at least in the sense of being unanimously perceived as negative; this would be the case with a substantial thinning of the ozone layer. Addressing change poses a more complicated challenge when various nations are affected in markedly different ways. What may be a threat with potentially catastrophic implications for some countries, such as the threat of sea-level rise and more frequent and intense tropical storms for small island states resulting from global warming, may be viewed by other nations to be of little consequence or perhaps even beneficial. The calls by seriously threatened nations for international cooperation to address environmental changes are likely to be frustrated by the indifference of those countries anticipating much less of an impact.

2.8 Differential Degrees of Responsibility

Responsibility for human-induced environmental changes is rarely shared equally. With numerous global problems such as ozone depletion and climate change, developed countries have contributed a disproportionate share of the pollutants causing the problem, and significant differences even exist among the highly developed countries. For other environmental threats, such as acidification from transboundary pollution, some countries may be largely responsible for a problem that has far greater impacts on countries other than themselves. While there is broad sentiment for abstract principles, such as "polluter pays," which put the burden of response strategies on the responsible parties, applying them into actual practice in the international context is often diplomatically complicated if not impossible. A case in point is the United States' persistent opposition of a binding schedule for reducing greenhouse gas emissions. In most cases, strong and effective measures for addressing an environmental threat are

unlikely unless the costs of implementing them are distributed in a way that reflects, at least roughly, responsibility for the problem.

Each environmental threat has a unique configuration of the above variables, as well as other traits that have a bearing not only on the response strategies that are theoretically possible, but also on the likelihood that the populations that are subjected to the threats will adopt each of them. Moreover, the nature of the threats has implications for whether states will pursue environmental security on their own or in cooperation with others that have similar insecurities.

3. RESPONSE STRATEGIES TO THREATENING ENVIRONMENTAL CHANGES

This section considers four basic approaches that can be taken to enhance human security in the face of threatening environmental changes. The first is fundamentally a preventive strategy oriented toward minimizing, if not entirely averting, the environmental changes that threaten human security. The other three approaches presume that threatening environmental changes will materialize, and thus are designed to reduce the vulnerability of human communities to them by avoiding the impacts of the changes, by creating defenses against the impacts, or by simply adapting to the changes.

These four approaches—prevention, avoidance, defense, and adaptation—can be illustrated by reference to the example of how humans try to cope with the threats that diseases pose to their health. First, the threat might be eliminated or substantially reduced by preventing the spread of the diseases. This could be accomplished by eliminating the media that transmit the disease, such as using pesticides to control mosquitoes that bear the parasites that spread malaria. Second, humans may try to avoid the threat by staying away from areas where the disease is endemic, such as the habitat of the tsetse fly that spreads sleeping sickness on the African continent. Third, a defensive strategy might involve developing and administering vaccinations that enhance the human body's resistance to certain diseases such as smallpox, even when it comes into contact with the organisms that carry the disease. Finally, an adaptation strategy may be adopted by design or default in which steps are taken to cope with the disease once it is present in the human body. Such steps could include drinking fluids, resting, and taking antibiotics. Let us now explore these four options more fully in the context of environmental changes that threaten human security.

3.1 Preventing or Limiting Environmental Changes

Ideally, the first strategy would be to completely prevent the development of threatening environmental changes. If the attainment of such a goal were to prove impossible, the goal would then be to limit the amount of change that would take place. It may

be impossible to modify threatening environmental circumstances, especially if they are naturally occurring phenomena such as earthquakes or volcanoes that are generated by geological or atmospheric forces which humans are powerless to alter. Human-induced environmental changes are generally more amenable to interventions, although they too may have proceeded to a point where changes are irreversible, as would be the case with the extinction of species.

There are numerous examples of strategies designed to minimize threatening environmental changes. The prospect of a significant thinning of the stratospheric ozone layer evoked a preventive strategy intended to stem the production and use of the substances linked to ozone loss. Likewise, much has been done in Europe and North America to reduce emissions of sulfur and nitrogen oxides that are responsible for acid deposition. A preventive strategy for preserving biodiversity might entail curbing the clearing of tropical forests, especially in species-rich regions. In a more basic way, limiting the rate of population growth, either in specific areas or globally, can contribute to the lessening of a broad variety of human-induced environmental threats.

Preventing or substantially limiting threatening changes requires the cooperation of all groups that contribute significantly to the problem. Small island nations acting on their own are powerless to prevent sea level rises associated with global climate change since they are responsible for only a minute share of world emissions of greenhouse gases. Achieving the required level of cooperation among sovereign states can be a very complicated and time-consuming process. This is especially the case when key states have contrasting priorities and when some will experience impacts considerably more than others will, as was demonstrated with negotiations on climate change. The successes in concluding a series of agreements to protect the ozone layer were possible because the problem could be mitigated at reasonably low costs and none of the other potential responses—avoidance, defense, or adaptation—held significant promise for addressing the problem.

In an abstract sense, preventing or limiting human-induced threats, assuming it is possible, is the preferred strategy for enhancing environmental security, especially among environmental activists in the developed world. This is particularly the case when the potential consequences of the changes are foreboding or are difficult to anticipate given the complex interrelationships within ecosystems. In other cases, however, it may appear that preventing or minimizing threats would be far more costly or disruptive than dealing with vulnerabilities through avoidance, defense, or adaptation.

3.2 Avoidance of Impacts

The second response strategy seeks to avoid being in a position where one is exposed to environmental threats should they materialize. For example, not locating a home on the slopes of a potentially active volcano, near a fault line prone to earthquakes, in the floodplain of a river, or on sea coasts susceptible to tropical storms avoids such

potential impacts. The harmful effects on human health from increased doses of UV radiation resulting from the thinning of the ozone layer might be avoided by heeding the advice of dermatologists to avoid exposure to intense midday sun. Impact avoidance presumes that the environmental threats can be anticipated and opportunities exist for avoiding exposure to them if they materialize. Environmental threats can be anticipated readily where there is a history of naturally occurring events such as earthquakes or flooding. Some of the threats associated with human-induced global changes, such as global climate change, may be more difficult to forecast, although science has done much to identify what they may be. Even when a threat is foreseen, avoidance may not be an option for those who would be impacted most directly. Many people are aware they are living in places that are vulnerable to natural or human-induced catastrophes; they simply lack the means or the opportunity to locate elsewhere. This was the case for many of those people dwelling in slums located dangerously close to the Union Carbide Plant in Bhopal, India, when it leaked deadly gases in 1984, killing thousands. As population densities grow throughout the world, and increasing numbers of people are subjected to serious environmental threats, the strategy of impact avoidance through relocation becomes less feasible, especially for the poorer segments of the world's population. There are also many people who could avoid exposure to environment threats, but choose not to and thus assume risks, such as determined sunbathers and those who build vacation homes on barrier islands.

3.3 Defense Against Impacts

The third strategy of a defensive response seeks to reduce vulnerability to environmental threats not by avoiding them, but by taking measures that protect populations against adverse impacts. Through the ages, defensive measures, in the form of castles, walled cities, and armed borders, have been the principal approach to military security. Defensive responses can sometimes be used in the environmental realm; for example, sunscreen and sunglasses offer some protection from UV radiation, levees can prevent rivers from flooding cities and farmland, and quake-resistant buildings provide protection from seismic activity. Quarantines can be imposed on agricultural products transported from countries where diseases or pests are present, as was the case with the EU embargo on British exports of beef when incidents of "mad cow disease" came to light. Strong containment structures around nuclear power plants can provide a defense against releases of radioactive contamination of the type that occurred at Chernobyl in 1986.

As with the avoidance strategy, protection against adverse environmental impacts is of limited applicability. It assumes also that the nature of threats and their consequences can be anticipated and there exists the means to establish the defenses, many of which may only be affordable to the more wealthy societies. Moreover, for some

environmental threats, there are no feasible defenses. For example, there is no practical way for a country to protect its forests from the effects of acid deposition resulting from the influx of pollutants from beyond its borders. Nothing can be done to protect species such as phytoplankton, which are especially vulnerable to increased doses of UV radiation.

3.4 Adaptation to Impacts

The final strategy is to adapt, or react, to environmental changes once they take place. In the aftermath of abrupt events such as floods, hurricanes, or earthquakes, people do what they can to salvage what remains of their homes and to rebuild their lives. Populations might migrate from areas that have become uninhabitable due to drought and the spread of deserts, thus becoming what are known as “environmental refugees.” Air conditioners may be purchased to cope with warmer conditions in urban areas. Farmers may alter their crops in response to changing weather conditions, or shift to other forms of employment that are not impacted. In Sweden, lime has been spread on lakes to neutralize the increasing acidity.

Adaptation may be undertaken in an ad hoc manner once the adverse environmental conditions materialize, often with results so unfavourable that the welfare of those affected is significantly diminished. In ill-prepared countries, public order may break down as people desperately pursue their own survival in the face of deteriorating conditions. Alternatively, advance planning involving emergency preparedness and disaster relief can facilitate the process of adaptation. Many types of group insurance programs are designed to provide relief to those who are most affected by environmental change.

Adaptation, especially in an ad hoc way, would not seem to be the preferred strategy for coping with most environmental threats, but for a variety of reasons it is often the default strategy. It may simply be that none of the other strategies—prevention, avoidance, or defense—are technically feasible, or that the threatened populations lack the capacity to do anything else. Alternatively, the threat may be viewed as so improbable that it may not be taken seriously, or the possible impacts are deemed to be not so costly that they could not be absorbed, even in a worst case scenario. There is also the belief in some circles that human societies throughout history proved themselves to be highly adaptable and resourceful, and thus can be counted upon to cope with whatever challenges arise in the future. There are, of course, numerous examples of civilizations that declined or disappeared because of failure to adjust to markedly changing circumstances.

It is possible that societies will implement a combination of these response strategies, either by design, or more likely in an uncoordinated way. In some cases, a combination strategy may be a rational course of action. Steps may be taken, for example,

to minimize climate change, but it may still be necessary to organize adaptive responses to changes that cannot be prevented. In other situations, a more favourable outcome may be achieved by concentrating limited resources on a single response strategy, such as preventing threats from arising, thus obviating the need for the other approaches.

4. UNDERLYING ISSUES IN THE PURSUIT OF HUMAN SECURITY

In this section I raise several major crosscutting questions that arise in the consideration of strategies for enhancing human security in the face of threatening environmental changes. Some are of a practical nature, such as unplanned or unintended impacts and relative costs; others raise philosophical issues, such as human rights and international responsibilities.

4.1 What are the relative economic costs of alternative strategies for responding to environmental threats?

Numerous efforts have been made to calculate the economic costs of various responses to environmental threats, even highly complex ones such as climate change (e.g., Fankhauser, 1995). Would it cost more to prevent an environmental threat from materializing than to endure or adapt to its consequences? For example, from a purely economic standpoint, would it be more expensive to invest heavily in strategies to prevent climate change to keep small island states from being inundated, as opposed to relocating their relatively small numbers of residents and compensating them for their losses? Calculating such costs is a notoriously imperfect science that leads to widely discrepant estimates based on contested assumptions, and questions of whether a price can be placed on such values as a degraded environment and loss of human life. Focusing on economic issues raises the long-standing debate between environmental preservationists, who aim at minimizing changes by retaining as much as possible of the pristine qualities of nature regardless of cost, and resource conservationists, who seek to make use of natural resources up to sustainable levels in the pursuit of economic ends.

4.2 What proportion of a society's resources should be invested in pursuing environmental forms of human security as opposed to other priorities?

Most human aspirations can be placed in one of two broad categories of human values—*development* or *security*. *Development* goals involve improving the conditions of human society, whereas *security* goals entail retaining or maintaining those things that

humans already enjoy, including life itself. Individuals and societies must decide what proportion of their limited resources to invest in order to augment security as opposed to development ends. Nation-states have long displayed a proclivity for investing heavily in military security, even to the point of great excess as did the superpowers in assembling arsenals of nuclear weapons capable of destroying human civilization many times over. An overly cautious approach weighted heavily toward environmental security may leave few resources for development programs that would lessen the widespread incidence of poverty and hunger in much of the world. Alternatively, a lack of attention to securing what is important to human societies, including the qualities of the environment that sustain human life and civilizations, can undermine and render ineffective major efforts devoted to development.

4.3 To what extent do the various response strategies to environmental threats exacerbate the same threat or contribute to others?

Arms races triggered by defensive motivations have not only heightened military insecurities for the countries involved, but also have jeopardized their economies and environments. The same possibility exists with efforts to cope with environmental insecurities. Strategies for adapting to climate change that entail increased consumption of energy generated from fossil fuels, such as more intensive use of air conditioning, add further to concentrations of atmospheric carbon. Widespread use of chemical agents in agriculture can result in the evolution of pesticide resistant strains of organisms that further threaten crops, as well as threaten other desirable species. Large dams built to provide irrigation water often submerge large areas of fertile farmland and force the relocation of large numbers of people, thereby drastically diminishing their sense of personal security. This question can also be looked upon as an issue of intergenerational equity. Are current generations looking for stop-gap responses to environmental threats that address their relatively short-term security needs, while compounding the environmental problems that will confront future generations and closing off options that would otherwise be available to them (see Weiss, 1989)?

4.4 To what extent do the response strategies adopted by one state add to the environmental insecurities of other states?

In the military realm, the stockpiling of arms to enhance the national security of one country often has the effect of diminishing the sense of security of others. Likewise, countries often try to diminish trade imbalances by devaluing their currencies and restricting imports; this aggravates the balance of payments of other countries, and is thus referred to as a “beggar-thy-neighbor” strategy. What one country or society does to address its own environmental vulnerabilities will quite possibly affect the

insecurities of others. For example, building a levee along a river may protect the city or farmland directly behind it from high waters, but subject other land along the river that is not similarly defended to even more flooding. Large dams constructed by upstream states to enhance their water security pose a major threat to downstream neighbours; an example is Turkey's massive Southeast Anatolia project on the Tigris and Euphrates Rivers that jeopardizes the security of Syria and Iraq. The phenomenon of acid deposition from long-range transboundary air pollution in Europe and North America became a serious problem when tall smokestacks were erected to disperse more widely the pollutants that were threatening the health of people living in nearby industrial zones.

4.5 Is environmental security a fundamental human right?

Do human beings have a basic right or entitlement to be secure, and in particular environmentally secure, or is freedom from environmental insecurities merely to be treated as a goal or aspiration? Human rights are weightier principles, generally regarded as absolutes. To put it another way, human rights are conditions of life to which humans are entitled that are not to be compromised for other considerations such as economic costs. Historically, Western conceptions of human rights emphasized political and civil rights, but in recent decades there has been a growing acknowledgment that people are entitled to the fulfillment of their basic economic and social needs, such as food, education, health care, clean water and sanitation facilities, and an income that affords them a life of human dignity. Some international legal scholars have argued the existence of human rights of an environmental nature, in part on grounds that a contaminated and degraded environment jeopardizes human health and ultimately human survival (see Trindade, 1992). In the context of concerns over global change, do people have the right not to be exposed to higher levels of UV radiation, or to the maintenance of climates that have sustained them? If there are human rights in the environmental realm, are people entitled to expect that serious environmental threats will be prevented from materializing, or should they be content with the means to avoid, defend against, or adapt to the adverse consequences of environmental changes?

4.6 What responsibilities do states or societies have to assist others to cope with environmental threats?

The United States and other developed countries have been reluctant to acknowledge a broader range of human rights, such as a right to development proposed by representatives of Third World countries in recent international forums, partly out of concern that they may stimulate expectations for significant additional international assistance.

Similar reservations will inevitably arise should environmental security also be aggressively promoted as a human right. The case for international assistance, or compensation, is more compelling if it is apparent that certain states are primarily responsible for environmental changes that undermine the security of other states. For example, do the residents of small island countries seriously jeopardized by storms and rising sea levels have a right to expect assistance from the highly developed countries largely responsible for the advanced greenhouse effect? While the widely cited Article 21 of the 1972 Stockholm Declaration (Declaration on the Human Environment, 1972) provides that states have a “responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction,” governments rarely own up to such responsibilities, frequently citing ambiguities in the relationship between cause and effect as a rationale for their lack of response.

4.7 Under what circumstances are states likely to opt for international cooperation as opposed to self-reliance in the pursuit of environmental security?

In most cases, the preferred strategy for seeking environmental security would seem to be international cooperation designed to prevent or minimize environmental threats, as was accomplished in the 1987 Montreal Protocol and subsequent adjustments which required all parties to phase out the chemicals largely responsible for ozone depletion. There are strong temptations, however, for states to opt for other types of response strategies that can be implemented unilaterally. This is due partly to their reluctance to rely on complicated and often frustrating international negotiations. Politically, governments may be more successful in marshalling public support to invest in projects that will benefit their populations directly and exclusively, such as dikes to ward off rising seas, than to contribute to the creation of an international or global public good, such as lessened climate change, which all countries enjoy regardless of whether they contribute to its creation. The international agreements to preserve the ozone layer can at least partly be explained by the lack of any practical unilateral alternative to avoiding vulnerability to UV radiation due to a diminished ozone layer.

4.8 To what extent are there cross-national differences in the ways in which environmental security is perceived?

Environmental security may be viewed very differently from one country to the next, especially at contrasting levels of economic development. Such differences may reflect divergent assessments of the relative importance of various types of environmental threats, or of environmental insecurities relative to other types of insecurities

or aspirations. In the transitional societies of Eastern Europe, local and regional environmental problems such as urban air pollution and water contamination pose more immediate threats than global ones such as ozone depletion and climate change that are of more concern in the highly developed countries. For Third World countries, economic development aimed at fulfilling basic human needs will continue to take precedence over addressing environmental concerns, except to the extent that environment and development are clearly linked as in the case of desertification.

4.9 What are the roles nonstate actors, such as nongovernmental organizations and corporations, can be expected to play in advancing environmental security?

Despite numerous pronouncements of the demise of the territorial state, national governments continue to play a predominant role in advancing the human security of their citizens in the face of military, economic, environmental, and other types of threats. It is governments that are empowered to make and enforce policies and regulations that reign over those who would undermine environmental stability in the pursuit of their individual self-interests. Likewise, it is national governments that enter into negotiations with other countries on binding forms of international environmental cooperation. Civil society in the form of nongovernmental organizations has important roles to play in calling attention to environmental threats, mobilizing public opinion, prodding governments to adopt laws and policies, and monitoring their implementation. Profit-oriented corporations can be expected to engage in environmentally destructive ways unless they are forced to do otherwise by government regulations or induced by incentives that make it profitable to operate in an environmentally responsible manner.

5. CONCLUSIONS

Traditional definitions of security that focus on geopolitical and military threats to nations are giving way to the more expansive concept of human security that acknowledges a wider array of important threats to the welfare of human populations, including environmental ones associated with the terminology of global change. In this chapter I have pointed to the variety of forms that environmental threats take, possible response strategies, and which of these can be effective. Four major approaches that can be adopted by human communities to respond to environmental threats were discussed: prevention, avoidance, defense, and adaptation. While preventive strategies aimed at eliminating or *minimizing* environmental threats would seem to be the more prudent strategy for dealing with most environmental threats, humans have, thus far, indicated

a tendency to opt for one of the other three strategies either by design or default. Finally, the pursuit of environmental forms of human security raises numerous larger questions, several of which are highlighted in the final section of this chapter. They are likely to continue provoking discussion and debate among academics and policy makers.

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Chapter 4

Adapting to Environmental Insecurities: A Conceptual Model

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How do states tackle inevitable uncertainties and prepare for dimly foreseen threats? This question is especially acute in the context of insecurities stemming from environmental degradation and growing resource scarcities. This chapter argues that the question of adaptation can be approached as the resultant of strategies that are intended both to reduce uncertainty and maintain autonomy. Two types of adaptive strategies are identified and discussed. Through coping strategies, states seek to reduce vulnerabilities and protect themselves from the consequences of ill-defined environmental change, or try to change their behaviour in order to take uncertainty into account. Alternatively, transforming strategies are intended to eliminate or mitigate the threat either through direct action aimed at the source of the threat or, indirectly, by shaping the conditions that have given rise to it. Finally, two complementary sets of hypotheses about the choice of particular strategies are suggested. The first set includes hypotheses that may determine the range of possible options, whereas the second set focuses on factors that may affect the preferences of decision makers themselves.

1. INTRODUCTION

In the late 1970s, problems of national governance were defined in terms of “overload.” Increasing demands coupled with reduced resources meant that states experienced growing difficulties responding to the expectations of their citizenry. Twenty years later, the problem remains, but it has acquired new dimensions. It is no longer simply a question of matching resources with demands, but one of devising policies in an environment that is both more complex and less predictable. These two dimensions are well illustrated by the nature of environmental problems that arise in an international system itself characterized, especially since the collapse of Soviet power, as particularly turbulent. From an environmental perspective, the need for a state to adapt can stem from a variety of circumstances:

- The inability to gain access to external resources essential to the maintenance or to the pursuit of fundamental objectives, among which survival, welfare, or stability are the most important. Problems with access to shared (water, oil) or to common (fisheries) resources are illustrative of this classic concern.
- The degradation of the internal socioeconomic situation of the country, which may or may not proceed from the former. An example is the case of scarcities induced by degraded agro-ecosystems.

- The evolution of norms and values that lead to new expectations and prescribe new behaviours or responsibilities, such as the embracing of global environmental values and concepts like deep ecology.
- Changes in internal forces such as population growth (or decline) that create new scarcities and vulnerabilities.
- Actions from a foreign entity, usually another state (for example, transboundary pollution). Or
- A change in the balance of power among nations or groups affected by the differential impact of environmental change (such as climate change).

Adaptation to environmental changes presents acute difficulties because of the multiple uncertainties that accompany such problems. Many political controversies surrounding environmental change revolve around the choice of the most appropriate form of adaptation to such change. For example, should governments try to cope with a given possible change, that is accept it as inevitable and minimize its impacts on national societies? Or, should they try to mitigate, or even prevent it? Recall, for example, the attitude of the United States toward climate change; it had decided the cost of coping would not be great (especially compared with the costs of prevention), and thus drastic measures were not in order. This attitude is contrary to the position of the Alliance of Small Island States (AOSIS) or that of the European Union (Paterson, 1996).

How should one approach adaptation? How does one tackle inevitable uncertainties and prepare for dimly foreseen threats? And what factors may influence the choice of the selected strategies? Although this chapter will focus largely on the responses of states to foreign environmental threats, much of its argument applies to internal environmental change as well.

2. CONCEPTUALIZING ADAPTATION TO ENVIRONMENTAL INSECURITIES

2.1 From Change to Uncertainty to Insecurity

Environmental change becomes a threat when it creates or exacerbates insecurities that may impinge on the ability of the state to pursue its fundamental goals. These insecurities originate in various types of uncertainties. These four types of uncertainty can be labeled analytical uncertainty, effect uncertainty, actor uncertainty, and response uncertainty (Iida, 1993; Milliken, 1987; see also Haas, 1976). Although actor uncertainty has always characterized international relations, the three other types recently have acquired new salience, making it more difficult for states to calculate their interests. First, the nature and extent of environmental change may, in itself, be uncertain; that is,

one may not be able to assess the probability distribution of future events. Fundamentally, analytical uncertainty is uncertainty about how the system works (Iida, 1993). Second, there may be uncertainty as to how environmental change will impact a given actor; effect uncertainty reflects a basic lack of information about causal relations. These two types of uncertainties affect the actor's ability to determine the availability of resources it needs to pursue its fundamental goals. Third, the behaviour of other actors with respect to a shared resource or their response to environmental constraints may be uncertain. In other words, there may be uncertainty about the preference set or preferred strategies of other actors. Fourth, uncertainty may be caused by the inability to predict accurately what the consequences of other actors' decisions might be.

Change *per se* does not create uncertainties; unpredictable change does. Slow change is not the problem; neither is risk. Societies are constantly adapting to slow change, and communities are always making decisions in the face of known risks. Whereas risk characterizes a situation where it is possible to assign probabilities to the occurrence of specific outcomes, uncertainty characterizes a situation where the determination of the possible outcomes is incomplete or impossible, and where, consequently, assigning probabilities to known possible outcomes is impossible. Knowledge of risks enables the calculation of interests. Or, as Knight (1957) expresses it, a risky situation is characterized by the completeness of the set of available alternatives, whereas uncertain situations are characterized by its incompleteness (Dosi & Egidi, 1988). When facing risk, one can use cost-benefit tools of decision making; in the face of uncertainty, a no-regrets approach and the precautionary principle have been advocated.

In the early phases of addressing environmental issues, uncertainties are high while risks are undetermined. Thus, problem definition and agenda building often mean transforming uncertainties into risks. In the case of climate change, for example, uncertainties (as to causes, impacts, and costs of actions) are high, whereas risks are unclear. Indeed, the political debate is precisely over whether we are dealing with uncertainties or risks. The political process, therefore, aims to identify various outcomes and assign probabilities to them (through the Intergovernmental Panel on Climate Change [IPCC], for example). Information gathering thus becomes the main adaptive strategy. In the case of the ozone layer, as in that of shared resources and transborder pollution, uncertainties are low and risks high. Adaptation to these perceived risks (insecurities) is what matters.

The concept of adaptation is itself ambiguous because it can refer both to a process and to an outcome. As a process, it refers to strategies that are used to reduce various uncertainties, notably regarding access to key resources. As an outcome, it refers to the result of these strategies. Too often, these two aspects are conflated. Confusion increases when adaptation refers to a particular set of strategies among a larger possible set (here called coping strategies), as well as to the positively valued result of these strategies.

Using adaptation normatively, as Haas (1990) tends to do, creates several problems, notably when one is trying to gauge the extent to which a particular society or group has adapted to environmental stress, or when one attempts to predict the nature of this adaptation. One cannot assume *a priori* that there is an optimal way to adapt to a given environmental change. The difficulty increases when learning becomes the ultimate form of adaptation.¹ In order to avoid ambiguities, this chapter approaches adaptation as a result of strategies that seek to reduce the basic uncertainties that actors face, rather than as a set of particular coping strategies. States do not choose a form of adaptation; they select strategies first.

2.2 Two Basic Types of Adaptive Strategies²

“There are two types of people,” the French philosopher Alain once said, “those who get used to the noise and those who try to force people to quiet down.” Decision makers also face the choice between two basic sets of adaptive strategies.

Through coping strategies, the actor can either reduce vulnerabilities and protect itself from the consequences of ill-defined environmental change, or change its behaviour to account for this uncertainty. The objective is to maintain essential goals, regime values, and structures³ by reducing future vulnerabilities. This set of strategies of adaptation affects the potential target of the environmental disruption.

Transforming strategies, on the other hand, affect the source of the environmental disruption. The aim of this set of adaptive strategies is to eliminate or mitigate the threat either through direct influence on the source of the threat or, indirectly, by shaping the conditions that have given rise to it. One has in mind, for example, President Bush’s remark when Treasury Secretary Brady began explaining how the U.S. might adapt to expected higher oil prices. The President then interjected, “Let’s be clear about one thing: we are not here to talk about adapting [i.e., coping].... We are not going to plan how to live with this.”⁴

These strategies are themselves responses to two basic and often contradictory needs: reducing uncertainty and maintaining autonomy. Reducing uncertainty and strengthening the conditions for the maintenance of essential structure and goals, although the most important impetus in favour of adaptation, is only one side of the equation. The security problem in foreign and domestic politics also stems from the perceived need to maintain or increase autonomy, which is defined as the fear of losing control over a domain of action, or as freedom of decision making. As is well known, this concern often lies at the root of bureaucracies’ responses to proposed international environmental action.⁵

An actor’s capacity to maintain its essential structures and pursue its essential goals depends on minimizing uncertainties, but without autonomy there cannot be purposeful adaptation. Certain strategies of adaptation entail a loss of autonomy or reduce

future options. Here lies the adaptation dilemma.⁶ Adapting to environmental threats, therefore, means minimizing the trade-off between reducing uncertainty and maintaining autonomy. Some actors emphasize uncertainty reduction, others autonomy; most attempt a delicate balance between the two and many mix strategies.⁷

The questions that now arise are, “Which strategies can be and have been used?” and “Under what conditions will states select one strategy (or combination of strategies) over another and with what consequences?”

3. STRATEGIES OF ADAPTATION TO ENVIRONMENTAL UNCERTAINTIES

The aim of this section is merely to identify the types of very general strategies that actors—especially states—have used or can use in dealing with uncertainties. Inaction is rarely an option. In fact, what is often called inaction is more often the result of the choice of particular strategies. Actors cannot ignore a state of uncertainty for long because their own needs to reduce future risks to goal-attainment result in systemic and internal pressures to act.⁸

3.1 Coping Strategies

One can identify at least six coping strategies (see Table 4.1) that are delineated in the following section.

3.1.1. Information Collection

This strategy seeks to improve knowledge regarding the nature and dimensions of analytical uncertainty, that is, to increase the ability to predict fluctuations or the evolution of environmental change, as well as the consequences of change. It is the most basic strategy and often the first used, since it keeps other options open and its immediate costs are known. This strategy has a neutral impact on autonomy and aims at increasing the capacities of the threatened actor. Although it is relevant to all types of environmental problems, it is particularly important in the early phases of environmental insecurities that pit many groups against one another. Examples of such strategies abound, starting with the U.S. National Security Directive of November 15, 1991, that sought to reshape intelligence-gathering capabilities in dealing with shortages of natural resources, health problems, and other issues.⁹

Of course, the greater the reliance on information collection, the greater the probability of internal conflicts pertaining to the nature, interpretation and use of that information. Hence, decisions become more complex, increasing the risk of conflicts which tend to transnationalize the debate, thereby reducing decision-making autonomy.

Table 4.1 Coping strategies

<i>Strategy</i>	<i>Relevant type of uncertainty</i>	<i>Impact on autonomy</i>	<i>Lowers risks or increases capacities?</i>	<i>Impact on probability of conflict</i>	<i>Relevant environmental problem¹</i>	<i>Selection theory</i>
information collection	state, actor effect	negative	capacities	moderate	all	rational
shielding	actor, effect	positive	both	moderate	non commons	social-psych pluralism
coalition	actor, effect response	negative	capacities	low	all	alliance
specialization	actor, state effect	negative	unclear	low	non commons	evolutionary ecology
diversification	actor, state effect	positive	risks	moderate	shared resources	evolutionary ecology
rationalization	state response	negative	unclear	low	all	constructivism

3.1.2. *Shielding*

As its label indicates, this strategy seeks to enhance the actor's capacity to protect itself against the effects of unexpected environmental change. In the economic realm, protectionism best illustrates this strategy. In the environmental field, shielding can take various forms, such as erecting barriers to the impact of change (e.g., sea walls) or stocking up on resources (oil and food reserves). There are several reasons why shielding is often a preferred strategy:

- its costs, relative to those of other strategies, are low;
- it keeps other options open (one can switch easily to another strategy later if the costs of using this strategy remain minimal);
- it emphasizes the maintenance of decision-making autonomy; and, in doing so,
- it can enhance the future bargaining position of the actor should a more cooperative strategy be preferred.

Obviously, this strategy very much depends on the nature of the environmental threat, on the resources available to the actor, on the distribution of domestic preferences, and on the impact that such a strategy may have on the actor's overall political status.

3.1.3. Coalition

Through this strategy, actors pool their resources in order to reduce uncertainties and increase their access to key resources. As a reflection of actor uncertainty, coalition is as common in the environmental field as it is in international relations in general. In confronting climate change, coalition has been the strategy of the Organization of Arab Petroleum Exporting Countries (OAPEC) and AOSIS. The strategic alliance between Zimbabwe and South Africa regarding the elephant regime instituted by the Convention on International Trade in Endangered Species (CITES) and Australia's alliance with France and ASOC (Antarctica and Southern Ocean Coalition) in opposing the 1988 mining protocol also illustrate this approach. Joint attempts to reduce analytical uncertainty, however, are less common. One reason may be the preference for regional solutions over global ones.

3.1.4. Specialization

Specialization denotes the attempt to increase the actor's capacity to use existing resources better and thus reduce the impact of change. The actor becomes able to ignore the threat or to absorb the costs. Examples are energy-saving strategies or France's development of its nuclear electrical capacity in the 1970s and 1980s. One of the problems associated with this strategy is that it considerably reduces future options. The actor acquires short-term stability (in the provision of the resource) and efficiency, but in the long term is more vulnerable to sudden changes.

3.1.5 Diversification

This strategy is the reverse of the preceding one. The actor seeks to reduce dependence on a single resource by enlarging the types of resources that can fulfill a given need. This increases future options even though it may lead to more conflicts in times of resource scarcity since the actor is competing with more actors. It was used by European countries to deal with energy supplies and suppliers after the 1973 oil embargo.

3.1.6 Rationalization

As a coping strategy, the goal of rationalization is to change the actor's essential values and behaviour in order to harmonize them with the expectations of the external environment. This is similar to how Haas (1990) conceptualized learning. The aim is to reconcile internal values to external ones. Accordingly, the actor will evolve a new definition of its interests. The OECD's "polluter pays" principle and the norms governing exploitation of wildlife fall in this category. Understandably, this strategy is one of the last ones to be adopted. The North-South environmental debate, or controversies over whaling and the ivory trade, illustrate the value clashes that often lie at the heart of environmental disputes and make these disputes more difficult to solve.

3.2 Transforming Strategies

Here again, six basic strategies (see Table 4.2) are delineated.

Table 4.2 Transforming strategies

<i>Strategy</i>	<i>Relevant uncertainty</i>	<i>Impact on autonomy</i>	<i>Lowers risks or increases capacities?</i>	<i>Impact on probability of conflict</i>	<i>Relevant environmental problem¹</i>	<i>Selection theory</i>
bargaining	all types	negative	risks	moderate	transboundary shared resources	game theory
institutionalization	all types	negative	capacities risks	low	commons transboundary	game theory regime
coercion	state, actor	unclear	risks	high	shared resources	prospect theory
inducements	state, actor	unclear	risks	low	commons shared resources transboundary	pluralism realism
education	state, actor, response	neutral	risks	low	commons	constructivist approaches
systemic change	state, actor	unclear	risks	moderate	all	ideology neo-realism

3.2.1 Bargaining

Bargaining refers to cooperation in reducing uncertainties without any party losing autonomy. This is a strategy that, not surprisingly, will be used when one of the parties has accepted a given probability distribution of outcomes and calculated the costs and benefits attached to specific choices. Although it is primarily concerned with reducing risks, it also can apply to uncertainty. For example, Finland's close proximity to two of the world's most unsafe nuclear power plants (at St. Petersburg and Kola) prompted it to pursue environmental cooperation with Russia (Löfstedt & Sjöstedt, 1996).

3.2.2. Institutionalization

With institutionalization, on the other hand, parties build up international institutions, notably regimes, and give up autonomy for the sake of reducing analytical and response

uncertainties. The aim is to shape the systemic environment in order to harmonize domestic and international demands, actions and expectations. For major powers, institutionalization serves to extend domestic constraints or minimize potential competitive distortions. For smaller powers, it helps enmesh greater powers into a web of constraints that will give the former a greater voice and, above all, renders the latter's behaviour more predictable.

Regime-building is widely used and studied as a strategy to reduce environmental uncertainties, as shown by the U.S. and Canada's promotion of the Montreal Protocol, Scandinavia's lead on acid rain, Germany's lead on climate change, or Australia's on Antarctica. This was the dominant strategy of the U.S. towards Europe after the Cold War (Nye & Keohane, 1993), but it is also favoured by small countries. Likewise, in 1991, after the collapse of the Soviet empire, the Czechs initiated the creation of a Europe-wide environmental agency (on the basis of the EC agency) to work toward a European Environmental Protection and Restoration System (Vavrousek, 1993).

In the larger realm of international relations, some believe regions will become intermediaries between the demands of the international system and domestic politics (because of the importance of economic, historical, and cultural variables), whereas others, such as Nye (1993) and Keohane (1993), emphasize that strengthened, or new, multilateral institutions at the global level will be needed to assist governments in navigating through international turbulence. In either case, institutions will "shape an actor's expectations on probabilities of outcomes" (Haftendorn & Tuschhoff, 1993, p. 5).

3.2.3. Coercion

A strategy of coercion increases the actor's capacities or willingness to intervene directly to minimize the source of environmental insecurities arising from the actions of another actor. For example, some have not hesitated to propose a new policing role for the navies of the developed world. Admiral Sir Julian Oswald, as First Sea Lord of the United Kingdom, has proposed setting up a UN maritime guard operation "with a remit of policing fishing limits, enforcing pollution limits and controlling dumping at sea" (Oswald, 1993, p. 129).

As students of interdependence have pointed out, coercion is not a usable strategy in many cases involving global environmental issues (such as climate change). On the other hand, it has often been used to impose behaviour in cases of shared resources or transboundary pollution. The U.S., in particular, has often resorted to it regarding ocean pollution or the protection of dolphins (and U.S. fishermen's interests) against Mexico. In 1995, Canada used it dramatically in the so-called "Turbot War." Indirectly, this strategy can take the form of playing actors against one another. For example, Syria has supported the PKK in Turkey in response to the perceived Turkish threat toward Syria's water supply (Güner, 1996, qtd. in Kilgour, 1997).¹⁰

3.2.4. Inducements

This well-known strategy seeks to modify the behaviour of other actors through positive incentives, that is, by rewarding them. This is the standard strategy of aid agencies. In this regard, the Global Environment Facility (GEF) has proven a potent instrument in inducing changes in policies affecting the environment. Likewise, in 1992, Sweden set up a climate change fund to support its and other Baltic states' efforts to reduce carbon dioxide emissions (Löfstedt & Sjöstedt, 1996). Although attractive in many ways, this strategy can, at best, only help reduce state and actor uncertainty. Its value may lie in facilitating the effectiveness of other strategies.

3.2.5. Education

Education is often thought of as the strategy of the weak. It refers to the imposition through persuasion, or in association with nearly all other strategies, of norms that will guide actors' actions in relation to an environmental problem. Often, it will entail increasing the illegitimacy of the behaviour that causes the uncertainty or threat, along with the legitimacy of preferred responses. The actor who controls the norms that govern the process of resolution of environmental conflicts or problems is better able to advance its own capacity to pursue its basic goals.

One can point out, for example, the conflict between sustainable development and animal or natural ethicists—that is, between those who believe that what can be exploited in a sustainable manner should be allowed to be exploited (e.g., supporters of whaling in Norway, or elephant hunting in Zambia), and those who believe that humans do not have the right to take what they want from nature simply because it can be done. This strategy is especially relevant in responding to analytical, effect, and response uncertainties. When actors are unable to identify those policies that promise to minimize costs or maximize benefits, they will try to protect their relative positions. In such a situation, value-based strategies, such as education, are especially important (Young, 1989).

3.2.6. Systemic change

This final strategy aims to change the environment in which another actor's decisions takes place or which has given rise to the environmental threat in the first place; it can also reduce the uncertainty attached to another actor's responses. Like education and unlike institutionalization, it alters the relations among external actors, not the relations between the target and its environment. For example, some strategies advocated by liberals, such as promoting pluralist values and supporting domestic environmental non-governmental organizations (ENGOS), seek to strengthen the domestic conditions that would make governments more responsive to the environmental wishes of their citizenry. Systemic change also takes the form of improving the capacities of actors to act, thus

minimizing response uncertainty through institution-building. In short, it helps others calculate their own interests and is thus a precursor for effective regime-building and compliance. Actors may also use this strategy to limit the freedom of other actors to select adaptation strategies that may be detrimental to the former's autonomy. For example, Turkey has an interest in promoting conflicts between Syria and Iraq, so as to minimize an alliance between the latter two over access to water from the Euphrates.

4. THE SELECTION PROBLEMATIQUE

Given the wide number of strategies that actors can use to minimize environmental insecurities or uncertainties, what factors will determine the choice of particular strategies? This question naturally deserves extended study. The aim, here, is merely to offer some directions that one could explore when approaching this topic.

Predicting strategic choice is more fruitful than attempting to predict adaptation. First, decision makers are victims of their past decisions, that is, of past strategies of adaptation. Cultural, technical, and political inertia mean that adaptation will always lag, so the uncertainties of environmental change make short-term predictions impossible and long-term ones hazardous. Second, although adaptation eventually may work to improve the fit between a society and its environment, various factors dictate *which* features of the society (e.g., technology, institutions, values, or politics) will be emphasized in order to promote this fit. On what basis will choices be made? Third, in order to take full advantage of a particular strategy, one must learn how to cope with its side effects; the most optimal political strategy may not be the most acceptable. As students of international relations know well, the search for security itself entails new risks. For example, an increase in food production may rest on a greater use of pesticides; securing access to water resources because of increasing internal demand (scarcity) may entail a reallocation of the existing distribution of the resource and increase the probability of conflicts. Thus, which potentially useful strategy is selected depends on the particular characteristics of the actor.

In order to generate useful hypotheses, one could approach this question from three different perspectives; taken together, they help make up a set of necessary and sufficient conditions or constitute a layered funnel leading to useful theories.

First, one could reflect on the preconditions that will shape the universe of subsequent options. For example, the choice of strategies may well depend on three factors:

1. *The type of uncertainty (analytical, actor, effect, response) one is facing.* This factor has two dimensions:
 - certain strategies are better suited for particular types of uncertainties (see Tables 4.1 and 4.2 for illustrative speculations); and

- different types of uncertainties may encourage the emergence of different sets of forces (such as domestic factors) that impinge on the actor's choice of adaptation strategies.

For example, since decision makers may tend to imitate the strategies of others, response uncertainty may favour coalition (Milliken, 1987); but if the stakes and the costs are high, then prudence might be in order. Analytical uncertainty means that actors are unable to identify those policies that promise to minimize costs or maximize benefits; they will therefore seek to protect their relative positions and adopt strategies that promise fair outcomes. One could hypothesize that—all other things being equal—if the perceived threat or uncertainty is great, a variety of strategies will be used, rather than a commitment made to any specific strategy. As analytical uncertainty diminishes, specific strategies can assume more importance because states are better able to define their interests.

2. *The range of policy instruments available to the actor.* Thus, those strategies that seek to increase capacities may be preferred by an actor that perceives itself as being weak. Wealthy states, by definition, have a greater capacity both to cope with environmental uncertainties or threats, and to transform the system, whereas poorer states have low capabilities to do either. Thus, the latter favour a transformation of the system but cannot effect it by itself, whereas the former have a choice of strategies.
3. *The nature of the environmental problem.* Indeed, the very phrase “environmental problem” is a semantic grab bag that hides profoundly different phenomena and dynamics. Following Oran Young (1994), one can distinguish among four categories under which environmental problems can be categorized, each, by its very nature, implying a different adaptational strategy:
 - Problems originating outside any one state's jurisdiction. Examples of such problems are those relating to the Antarctica, the ozone layer, deep sea mineral resources, or space. The difficulty in such cases is how to improve or ensure conservation while minimizing relative gains and the following strategies are often favoured: information, coalition, rationalization, inducements, education, systemic change.
 - Problems relating to common pool resources, such as renewable and nonrenewable shared resources, migratory species, and water.
 - Problems that are linked to transborder externalities, that is, to activities that originate within the territory of another state, but which affect the well-being of populations that live outside that territory. Acid rain, radioactive pollution, and threats to cultural artifacts are all examples that would fall under this category. In cases such as these, states can coerce—through intervention or sanctions, financial and technical aid, or institution-building in developing countries—or support domestic social conditions that will promote change, such as strengthening civil society.

- Problems that are composed of interdependent issues; that is, situations where the resolution of environmental problems have reciprocal impact on other regimes. This is the case in the relationship between environmental and trade regimes. Institutionalization may then be the preferred strategy.

A second approach would use the actors' preferences as its starting point. Below are four examples of principles that could be used to guide calculations aimed at predicting states' strategic selections:

- In general, states will seek to preserve autonomy; however small states will happily relinquish it if doing so also ties down more powerful states.
- Related to the above, in the case of conflicting strategies, more powerful states will emphasize increasing autonomy, while less powerful states will emphasize uncertainty reduction.
- Unless a long-term solution to the problem is guaranteed, states will select strategies that also keep future options open.
- Just as learning to fear is a highly adaptive behaviour on the part of animals, states will try to define evils to be avoided rather than goods to be pursued.

If strategic choices are shaped first by the identification of what is unacceptable, the question becomes, what determines the identification of the fears? Several sets of hypotheses can be constructed to explain both the assessment of the danger and the selection of strategies. The number of relevant theoretical approaches is very large; therefore, only a few broad categories of variables will be mentioned:

- *Psychological variables*, particularly those linked to prospect theory (Levy, 1992).¹¹ It remains unclear, though, to what extent psychological approaches can be applied to the decisions of states as opposed to those of individuals. Another useful approach would be to look at the role that beliefs and images play in strategic choice. For example, Spiegel (1984) has underscored the importance of shared beliefs and history in explaining U.S. policy towards the Middle East.
- *Cultural and historical variables*. The historical context is relevant because of the weight past decisions may have on future strategic choices; that is, even in the absence of positive data linking a given strategy and an observed result, actors may continue resorting to a specific adaptive behaviour unless strong negative consequences have been observed. Moreover, past successful adaptation poses new constraints insofar as it limits future options. In some cases, it may hinder alternative paths when the environment changes. Finally, history proves to be an influence if and when states learn from past mistakes; it may determine when they adopt more cooperative strategies in order to minimize the political costs of past opposition (such as was the case with Japan and the ozone issues). Cultural variables may come into play in various ways. One of the more intriguing aspects of this point is

the link between adaptive strategies and identity (or self-image). That is, a country may define its environmental role mainly on the basis of concerns with identity rather than status.

- *Domestic variables.* These variables may be especially important for great powers. For Paul Kennedy (1987), who is concerned with economic decline leading to political decline and systemic instability, the problem actually lies in the cultural and ideological prejudices that make adaptation difficult, and in the power of established interests that encourage forsaking investments for the sake of consumption and defence. In this case, the main adaptation problem is internal.

Domestic variables are important insofar as uncertainties surrounding environmental change or insecurities affect the distribution of power among domestic actors. The choice of strategies is affected by the specific actor and by the decision-making process that is encouraged by the nature of the insecurity or uncertainty. Change may favour some groups or organizations and hurt the relative position of others. Major dam constructions have provided us with some of the best known examples of the dynamics that can precipitate conflict.

In general, the greater the perceived threat or uncertainty, the greater the involvement of NGOs and the importance of public opinion. Bureaucratic politics also impedes adaptation (or favours particular strategies such as shielding and specialization) when segments of the administration fear losing authority or autonomy with respect to a particular activity. For example, during the negotiations over the 1972 London Convention on Ocean Dumping, the U.S. Commerce Department was concerned with possible impacts on trade, the Atomic Energy Commission about losing jurisdiction over nuclear disposal, the Department of Defence about freedom of action for the navy and its aircraft, and the U.S. Army Corps of Engineers over losing control over dredging permits to the Environmental Protection Agency (Barkdull, 1997).

Moreover, the existence of a consensus, or the desire to forge one, makes it difficult for the state to take advantage of changes in the environment. This is the consensus paradox identified by Jervis. This desire, as we know, leads to reliance on the lowest common denominator, such as a strategy of information collection. It may also, if the desire for consensus is strong, make it more difficult to reach one since the expected payoffs for hold-outs are larger.

- *Systemic variables.* For illustrative purposes, at least two types of systemic variables can be identified: status and transnational actors. Certain states tend to emphasize status-related variables in the definition of their national role. That is, the strategy that they will select will be linked to their perception of their status in the international system. Some states (e.g., Scandinavia and Canada) have used environmental issues to gain prestige; others feel bound to seek cooperative solutions; still others have the resources to use coercion.

Another noteworthy systemic variable is the degree of power held by transnational actors. Keohane and Nye (1971) point out that new powerful and dynamic transnational actors are capable of influencing adaptation in order to shape

the world to their interests. Thus, national adaptation would, at a minimum, be constrained or enabled by these actors. See, for example, the role of industry in the negotiations of the Montreal Protocol, or that of insurance and oil companies in climate change issues.

It is difficult, amidst the proliferation of relevant theories, to find a basis for selecting a specific set without extensive case studies that control for the types of uncertainty and environmental problems, and the specific characteristics of each state. Rosenau (1980) has hypothesized that the adaptation of a large, rich, and democratic state would be influenced—in order of importance—by societal, governmental, systemic, and individual variables. The time factor also plays an important role in the selection of strategies since lack of time will favour routine behaviour, simplistic decision making, and inertia.

5. CONCLUSION

This chapter has argued that adaptation is best approached as the result of coping and transforming strategies designed to reduce the uncertainty arising from environmental change while minimizing the negative trade-offs with respect to autonomy. Externally, adaptation means enacting foreign policy roles. Internally, adaptation involves reconciling the state's interests with societal aspirations. A set of possible strategies have been identified and some of their dimensions have been explored. Finally, factors that possibly would influence the choice of particular strategies have been hypothesized.

Much remains to be done. First, one must assess which strategies seem more prevalent than others and explain why some are selected over others. Section 3 has already offered several hypotheses in that regard. Second, one must reflect on the impact of any strategic choice on access to essential resources, and interstate or civil conflict.

Hostility and conflict are well-known by-products of adaptational crises, especially when there is no clear strategy that should or could be chosen. Adaptation strategies are important to study because they, rather than environmental change itself, may be linked to conflicts. Accordingly, Tables 4.1 and 4.2 each contain a column that makes speculative attempts at correlating these strategies to the probability of conflict.

All strategies may potentially heighten or lower the risks of disputes. The question becomes, "What types of states under what conditions are likely to resort to strategies that hold a higher risk of generating interstate conflict?" Thus, we are back to the preceding queries regarding the selection of specific strategies. More than transforming capacities, however, it may be reduced coping capacities that matter. Indeed, when even strong states have diminishing capacities to cope, or when they perceive environmental scarcities as new sources of power, conflict is more likely.

The risks of conflicts grow more acute as the South progressively becomes more included in a global environmental strategy. Efforts by developing countries to achieve living standards based on the same levels of consumption as industrialized countries could lead to environmental catastrophe. Studying strategies of adaptation and their interactions may be a useful first step towards a better understanding of the future dynamics of international disputes over environmental change.

6. ENDNOTES

- ¹ Learning is itself a special kind of adaptation. One can approach it in three ways: (a) simply as institutionalized error correction (learning by experience); (b) as the capacity to integrate new knowledge into behaviour, or to respond more quickly to new demands and to new information, which becomes crucial as the policy environment becomes more uncertain; or (c) following Haas (1990), as a fundamental change in the nature of the consensual knowledge of the actor; in other words, a change in the norms built into theory-in-use accompanied by a change in the organization's model of the world (Haas, 1990). Or as Bennet (1990) put it, "A State which [copes with] the environment will behave the same way under identical conditions at different times, whereas a State which learns will behave differently under identical conditions at different times (cited in Levy, 1992a: 4). Thus, when learning has taken place in response to some environmental change, the return to the status quo ante may not entail a return to previous policies.
- ² Since these strategies are generic, they can refer to policies such as compliance, which pursue other aims besides uncertainty or risk management.
- ³ These essential structures relate to the political sphere (concerning, for example, intra-elite conflicts and conflicts over political arrangements), the social sphere (concerning, for example, domestic violence), the economic sphere (which is linked to domestic welfare and human security), and the physical sphere (the resilience of ecosystems).
- ⁴ *The New York Times*, March 3, 1991, p. 18.
- ⁵ This was also Machiavelli's prime concern, which helped define his notion of the national interest.
- ⁶ The security dilemma, on the other hand, lies in negotiating between the lowering of risks and the increasing of capacities.
- ⁷ For example, France, faced with greater uncertainty regarding oil supplies in the 1970s and later, emphasized the development of nuclear energy, adopted a more pro-active and conciliatory policy toward Arab States, and encouraged French multinational corporations' involvement in other oil producing states.
- ⁸ From this perspective, adaptation is not a problem of cooperation; rather, cooperation is but one form of adaptation.
- ⁹ See *The New York Times*, December 22, 1991, p. 9.

- ¹⁰ On the other hand, Turkey viewed its control of the flow of Euphrates' waters as a way to force Syria to cut off aid to the PKK.
- ¹¹ According to prospect theory, individuals tend to overweight losses with respect to comparable gains, are generally risk-averse with respect to gains and risk-acceptant with respect to losses, and are heavily influenced in their choices and behaviour by the nature of the reference point around which they frame a problem (see Levy, 1992).

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Section II

Resources and Human Security

Chapter 5

Transportation's Oil Dependence and Energy Security in the 21st Century

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The continuing dependence of the world's growing transport sector on petroleum presents a threat to world economic security. This threat must be understood in the context of global efforts to solve environmental problems associated with petroleum use. The nature of the oil dependence problem is explained and the role of the technological change in its solution is highlighted.

1. INTRODUCTION

The persistent and, in many parts of the world, rapid motorization of transport is intensifying global dependence on petroleum. Transportation's global oil dependence poses real energy security risks for the first few decades of the 21st century, at least. At the same time, the world economy is in no danger of running out of oil during the next century. In this chapter, I will attempt to explain this paradox of oil scarcity and its implications for energy security in an increasingly motorized world. The scarcity that immediately threatens world energy security today is an economic, rather than a physical or geologic, scarcity. Economic scarcity does depend on geology, but, more to the point, it can be created by anticompetitive (monopolistic) behavior or may temporarily result from any of a variety of shocks to which the world's oil producing regions are subject. The inability of oil markets to adjust rapidly to sudden changes in supply enables supply shocks, whether deliberate or inadvertent, to produce enormous increases in oil prices and, consequently, immense profits for oil producers together with massive losses for oil consumers.

The adequacy of fossil energy resources is an important issue from the perspective of the sustainability of human society, as are the consequences of its use. While there appear to be more than enough fossil energy resources to last 100 years, conventional use of this resource would produce cumulative carbon emissions six to seven times the current atmospheric carbon content of 760 GtC (World Energy Council and International Institute for Applied Systems Analysis, 1995). Thus, the immediate oil dependence problem must be understood in the context of global efforts to address associated

problems of urban air pollution, greenhouse gas emissions, and, above all, the sustainability of modern society. Each one of these motivations to transform transportation's oil dependence arises from a kind of market failure. Urban air pollution and greenhouse gas emissions are environmental externalities. The failure of market systems to adequately consider the long-run sustainability of society is yet a different kind of market failure that is at present still being defined (Pearce & Warford, 1993). At the heart of the oil security problem is the potential for market power to be exploited in imperfectly competitive energy markets. All of these transportation energy problems appear to share a common solution: the transformation of transportation technologies to better achieve society's environmental and economic goals.

2. BACKGROUND

Over the past 25 years, the Organization of Petroleum Exporting Countries (OPEC) cartel has used its market power to create or capitalize on oil market disruptions. In October 1973, the Arab members of OPEC announced an oil boycott against countries that aided Israel during the October War between Israel and neighboring Arab states. From September to December 1973, they reduced their crude oil production by 4.2 million barrels per day (mmbd), about 7 percent of the 1972 world oil supply (U.S. Department of Energy, Energy Information Administration, 1997b, Table 4.4). World oil prices doubled. Again in 1979-80, the loss of 5.4 mmbd of production from warring Iran and Iraq, about 8 percent of world supply, produced another doubling in the price of oil. Following both shocks, OPEC members restrained their oil output, with the expressed intent of maintaining the new, higher price of oil. From May to December of 1990, total oil output from Kuwait and Iraq fell by 4.8 mmbd, about 7.6 percent of world production. From the second to the fourth quarter of 1990, oil prices jumped from \$18.50 to \$34.50 per barrel (1995 US\$). In contrast to previous price shocks, this one was short lived, as OPEC members, especially Saudi Arabia, responded by increasing output by more than 3 mmbd to replace most of the shortfall (Tatom, 1993, p. 138).

The oil market machinations of the 1970s and 1980s were very costly to oil consumers and very profitable for oil producers. The price shocks and subsequent higher price levels of the 1970s and 1980s cost the economies of oil importing nations trillions of dollars (U.S. Department of Energy, 1988, p. 6). Greene and Leiby (1993) estimate the costs from 1972 to 1991 to the U.S. economy alone at over \$4 trillion dollars, 80 percent as large as the nation's total expenditures on national defense over the same period.¹ At the same time, many OPEC states were transformed from developing economy status to being among the richest nations on earth. In 1972, OPEC revenues amounted to \$24 billion per annum. After the 1979-80 oil price shock, OPEC collected

\$287 billion from oil consumers. Today, after 10 years of cheaper and plentiful oil supplies, we seem to think that the oil problems of the past are behind us. But are they?

After the first oil crisis in 1973-74, many believed that oil resources had suddenly become permanently, physically scarce, and that oil prices would inexorably continue to rise in the future. This view turned out to be wrong. High oil prices, sustained by OPEC's continuing efforts to restrain production, depressed oil demand and stimulated supply from non-OPEC producers. World oil demand, which had been growing at nearly 8 percent per annum since 1960 until just before the 1973-74 price shock, slowed to an average annual rate of 0.4 percent per annum from 1973 to 1985 (U.S. Department of Energy, Energy Information Administration, 1997d, Table 11.9). OPEC oil production, which had been increasing at an annual rate in excess of 10 percent since 1960, actually fell at the rate of 5 percent per year from 1973 to 1985. Oil production by non-OPEC countries, which had been increasing at 5.5 percent annually prior to the first oil price shock, grew at 3.5 percent per annum from 1973 to 1985 (U.S. Department of Energy, Energy Information Administration, 1996, Table 11.5). As a consequence, OPEC's share of the world oil market shrank from 55 percent in 1973 to 30 percent in 1985. As will be explained below, loss of market share means loss of market power for a cartel. Finally, unable to continue to maintain high oil prices by means of further production cuts, OPEC members began increasing production. Just as suddenly as they had risen, oil prices collapsed from \$34.43 per barrel in 1985 to \$17.37 in 1986 (1992 US\$) (U.S. Department of Energy, Energy Information Administration, 1996, Table 5.19).

The oil price collapse of 1986 dispelled the myth of oil's physical scarcity. OPEC, it seemed, had been vanquished by the relentless force of the marketplace. Unfortunately, the reports of OPEC's death were greatly exaggerated. Since 1986, oil production by non-OPEC nations has declined by 0.5 percent per year, while OPEC's output has increased at the modest rate of 1 percent per year. As a result, OPEC's share of the world crude oil market has grown from 30 percent to 42 percent.

It is tempting to look back at 15 years of lower oil prices, slower growth in petroleum demand, especially in the economies of Western Europe, Japan, the U.S., and countries of the former Soviet Union, as well as the recent successes in non-OPEC oil production, and conclude that oil dependence is no longer a serious security problem. But this would be shortsighted. World petroleum consumption is becoming increasingly concentrated in the transport sector, a sector that remains nearly totally dependent on oil. In the U.S., past technology-based improvements in transportation energy efficiency appear to have run their course (U.S. Department of Transportation, Bureau of Transportation Statistics, 1997, Chapter 5), promising a faster rate of growth in demand in the future. In the rest of the world, transport's energy demand is growing faster as it becomes increasingly motorized. In 1950, 90 percent of the world's 50 million cars and trucks could be found in North America or Europe. Today, the world

motor vehicle fleet stands at 650 million and is expected to exceed 800 million by 2010 (World Resources Institute, 1996). Motorization and motor fuel demand are growing fastest outside of the U.S. For two decades following the 1973-74 oil price shock, U.S. transport energy demand grew at about 1 percent per year, while demand in the rest of the OECD and in formerly communist countries grew at 2 percent per year (Greene, 1996, p. 2). In the past few years, the rate of growth of U.S. transport energy demand has accelerated to nearly 2 percent per year. Outside of the OECD, transport energy use has been growing at more than 4 percent per year.

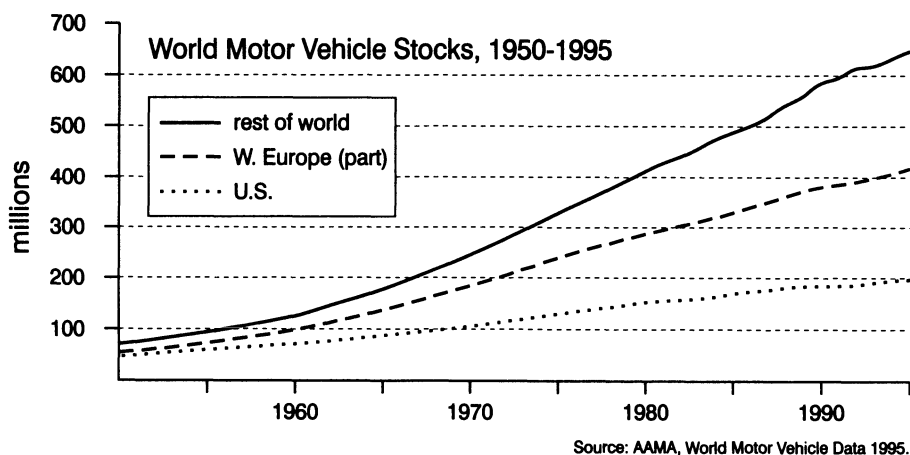


Figure 5.1 World motor vehicle stocks are expanding rapidly

Whether in the future oil producers will be able to manipulate the economic scarcity of oil to their benefit and at the cost of oil consumers depends on the fundamental factors that permit an oil cartel to wield market power and, also, how the noncompetitive pricing of oil and especially oil price shocks harm an economy. These factors are key to understanding whether similar oil price shocks could happen again, whether the world's economy remains vulnerable, and what, if anything, can be done about it.

3. MARKET POWER AND THE ECONOMIC SCARCITY OF OIL

From the perspective of energy markets, oil is not an exhaustible resource. This once heretical view is now widely accepted among resource economists (Adelman, 1990; Banks, 1986; Gordon, 1994) for two reasons. First, until 1973, more oil had always been discovered and developed, and without any increase in its real price. Imagine a world in which more oil can be found, just by looking for it; in which one can, with extra effort, squeeze more oil from already depleted fields; a world in which things that

are not oil can be changed into oil, and in which the same amount of work can be done with much less oil than previously required. Of course, this is the real world. It is the world of the fixed, finite stock of oil that will someday be used up that is make-believe.

The second reason that markets do not treat oil as if it were exhaustible is that the world's endowment of oil and oil-like resources is known to be large relative to current rates of consumption. How large the world's oil resources are depends on how one defines resources, and how one defines oil. This is not merely a flippant remark, because technology defines both of these terms, and technology is ever changing. If we use the concept of proven reserves, oil that is known to exist and can be produced economically at prevailing prices using current technology, the world has approximately 1 trillion barrels. The world presently produces about 24 billion barrels per year (U.S. Department of Energy, Energy Information Administration, 1997a, Table 10.1b). This gives a reserve-to-production ratio (R/P, a measure of size more than a prediction of lifetime) of 42 years (Table 5.1). The U.S. Geological Survey estimates that the world's ultimate resources of conventional oil (discovered and undiscovered) amount to 1.7 trillion barrels, raising R/P to 71 years (Masters et al., 1994). But current methods of oil extraction recover only 34 percent of the oil in the ground. The American Petroleum Institute estimates that if the technology of oil recovery improves as it has in the past, 2.8 trillion barrels of oil eventually could be produced (Porter, 1995) for an R/P of 117 years. If known reserves of unconventional, heavy and extra-heavy oil could be economically refined, oil resources would expand to 3.4 trillion barrels (R/P = 142 years). Beyond this, there are an estimated 14 trillion barrels of oil equivalent in oil shale and tar sands that could be used—if technology and economics permitted, and if the world were willing to suffer the environmental consequences. When will the world run out of oil? Never.

Table 5.1 World oil resource estimates

<i>Category of Resource</i>	<i>Amount</i>	<i>R/P "Life" of Resource Base at 1995</i>	<i>R/P "Life" at 3% Annual Growth</i>
Proven Reserves	1 trillion barrels	42 years	27 years
USGS Identified Reserves	1.1 trillion bbls.	46 years	29 years
USGS Ultimate Resources	1.7 trillion bbls.	71 years	38 years
With Enhanced Oil Recovery	2.8 trillion bbls.	117 years	50 years
With USGS Heavy and Extra Heavy Oil	3.4 trillion bbls.	142 years	55 years
With Oil Shale and Tar Sands	17.4 trillion bbls.	725 years	104 years

The problem is not that the world is about to run out of oil.² Rather, it is that the world's conventional oil resources are concentrated in relatively few countries. These countries are therefore able to manipulate the economic scarcity of oil to their advantage, and have done so in the past. The best estimates of the world's conventional oil resources indicate that OPEC owns more than half. Credible estimates of OPEC's share range from a low of 55 percent (Masters et al., 1994) to a high of 64 percent (OPEC Secretariat, 1995).³ The difference is due to greater optimism on the part of analysts at the U.S. Geological Survey about the petroleum resources in the former Soviet Union (Ulmishek & Masters, 1993) and, to a lesser extent, the U.S., Canada, Mexico, and China.

Because OPEC members are drawing down their reserves at half the rate of the rest of the world's oil producers, it seems almost inevitable that OPEC's share of the world oil market will grow (Masters et al., 1994). For example, the U.S. Energy Information Administration predicts that OPEC's share of the world oil market will rise from its current level of 42 percent to reach 48 percent by 2005, and will climb to 52 percent by 2010 (U.S. Department of Energy, Energy Information Administration, 1996, Tables 10 & 11).⁴

4. THE DETERMINANTS OF OPEC MARKET POWER

Objective conditions, namely the distribution of world oil resources, the size and structure of oil consuming economies, and the technologies of oil production and consumption, determine the potential market power of the OPEC cartel. Given information about these factors, economic theory can predict what OPEC could do, and even what would be most profitable for OPEC to do. But it cannot predict what OPEC will do. This would require predicting the behavior of a confederation of sovereign states, a task that is largely outside the domain of economic analysis. Yet, by revealing what power the OPEC cartel could exert on energy markets, and what would be in its economic interest, economic analysis provides valuable insights into how world oil markets are likely to behave in the future.

A fundamental conclusion of the theory of competitive markets is that production of a commodity will expand until the cost of the last unit produced (C) equals the market price (P). For a competitive market to exist, no one producer (or colluding group of producers) can be able to affect the market price. All must be price takers. A producer with market power, on the other hand, finds that, by restricting production, it can cause prices to increase. The price that a monopolist should charge to make the greatest profit is given by a simple formula (see Figure 5.2) that depends on the extent to which demand responds to changes in price (i.e., the price elasticity of demand, which is the percentage change in the quantity demanded for a 1 percent change in

price). Referring to Figure 5.2, if the price elasticity of demand is -2 (a 1 percent price increase will cause demand to fall by 2 percent), the ratio P/C will equal $1/(1/2) = 2$, implying that the price that maximizes the monopolist's profits will be twice the competitive market price.⁵

$$\frac{P}{C} = \frac{1}{\left(1 + \frac{1}{\beta}\right)}$$

SIMPLE MONOPOLY

P = price

C = cost of production

β = price elasticity of oil demand

$$\frac{P}{C} = \frac{1}{\left(1 + \left[\frac{1}{\beta} \sigma (\delta + 1)\right]\right)}$$

STACKELBERG MONOPOLY

σ = cartel's market share

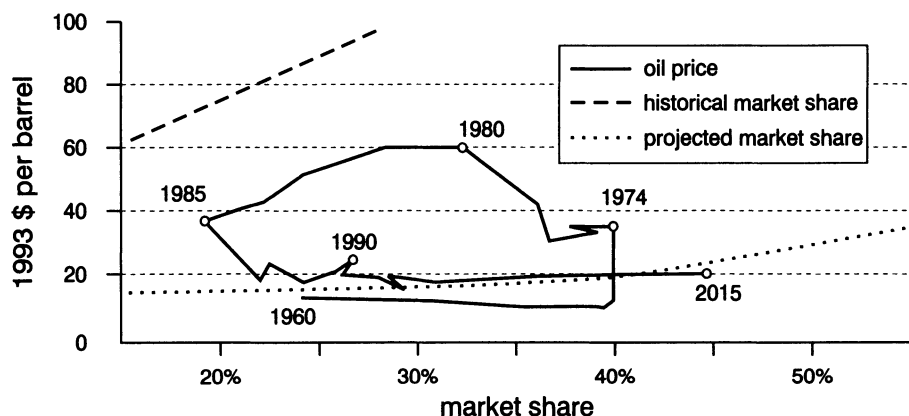
δ = rest of world's supply response

Figure 5.2 Noncompetitive pricing

When a producer does not control the entire market, its market power is limited by the ability of other producers to respond to its pricing and production decisions. This is the position in which OPEC finds itself. Whereas OPEC can coordinate (albeit imperfectly) its production decisions and influence market prices, the rest of the world's producers behave competitively (as price takers) (Dahl & Yücel, 1991; Griffen, 1985; Jones, 1990). In economic jargon, OPEC is an imperfect monopolistic cartel of the von Stackelberg type (Mabro, 1992). For a von Stackelberg monopolist, the profit-maximizing price depends not only on the price elasticity of demand, but on its own share of the market, and on the supply response of the rest of the world (Figure 5.2). The rest-of-world supply response is defined as the number of barrels the rest of the world will supply, at constant market price, in response to a one barrel reduction in supply from OPEC. If the supply response equals -1, then a 1 barrel reduction in supply by OPEC will be met by a 1 barrel increase in supply by the rest of the world's producers; the market price remaining unchanged. If this were the case, OPEC would have no market power (i.e., its profits would be maximized when $P/C = 1$).

Over a short period of time, the ability of producers and consumers to respond to a change in the price of oil is far more limited than it is in the long run. It takes time to

discover, develop, and bring new oil resources to market. It takes even longer to replace the capital stocks of oil-using automobiles, airplanes, and industrial plants. Typically, the long-run response to changes in oil prices is in the order of 10 times the response that can be accomplished in one year. This fundamental fact has enormously important implications for the world oil market. It means that the price that yields OPEC the greatest profits in the short run cannot be sustained over the long run. By substituting into the von Stackelberg formula first short-run and then long-run values for the price elasticity of oil demand and the rest-of-world supply response, one can draw two curves, showing the short-run and long-run maximum profit prices for OPEC as a function of its market share (Figure 5.3). If one assumes a competitive price (C in the formulas in Figure 5.2) of \$10.30 per barrel (the 1972 price of oil in 1995 \$), then the ratio P/C can be translated into the market price of oil, as in Figure 5.3.



Source: U.S. DOE/MER March 1997, table 10.1, AEO 1997, table A21; Oil Econo

Figure 5.3 Oil prices and core OPEC market share, historical and projected

The upper curve in Figure 5.3 shows the prices that would give OPEC maximum profit for a single year, but which could not be sustained for more than one year. The lower curve shows prices that could be sustained indefinitely in a static market. When world oil demand is growing, however, prices above the lower, long-run curve can be sustained indefinitely. Because knowledge of price elasticity and supply response parameters is never perfect, these curves should be considered indicative rather than precise. Nonetheless, they are useful for illustrating several important points.

Plotting historical world oil prices and the market share of OPEC core nations⁶ in Figure 5.3 reveals why oil prices collapsed in 1986 and why OPEC's influence on world oil markets faded. Prior to 1973, with oil prices below even the long-run price curve, OPEC's market share grew rapidly as world oil demand increased at the rate of

about 8 percent per year. In 1973 and 1974, OPEC members restricted output, causing the first oil price shock, but also halting the growth of their market share. In a static market, OPEC would have had to sacrifice market share in order to cause prices to rise. The price shocks of 1979 and 1980 were accompanied by just such a loss of market share. At this point, OPEC consciously decided to defend the higher price level by cutting back on production (Al-Fathi, 1990, pp. 2-3). But reducing production means giving up market share, and giving up market share means giving up market power. This inevitably led to a downward spiral of OPEC revenues, from \$287 billion in 1980 to \$131 billion in 1985. As the untenability of the situation became clear, OPEC cohesiveness cracked, with Iraq first jumping ship and increasing production in 1985. When Saudi Arabia abandoned the defense of higher prices in 1986, oil prices collapsed. Even so, prices did not collapse to pre-1972 levels, but rather to levels closer to the long-run, sustainable monopoly price curve.

Since 1985, when world oil demand began increasing once again, OPEC has gradually regained market share. The U.S. Department of Energy's 1996 oil price and OPEC output projections (also shown in Figure 5.3) reflect the seemingly inevitable recapturing of market share by OPEC, which holds the majority of the world's oil resources, the overwhelming majority of the world's low-cost reserves, and which is drawing down its reserves at half the rate of the rest of the world.

5. COSTS OF OIL DEPENDENCE

Opportunistic use of market power generated fabulous profits for OPEC members during the 1970s and 1980s, but also caused enormous losses to oil consuming economies. Oil price shocks and noncompetitive oil pricing inflict three types of costs on oil consumers: (1) wealth is transferred from oil consumers to producers; (2) the economy's overall ability to produce is diminished by oil's greater economic scarcity; and (3) when price movements are sudden and drastic, inflation and unemployment cause additional losses of output. These three components are distinct and additive. They do harm to all economies that import and use significant amounts of oil.

Transfer of wealth is the most straightforward component of the costs of oil dependence. When prices rise above normal competitive market levels, wealth is transferred from oil importing economies to oil exporting economies. The quantity of wealth transfer is equal to the quantity of oil imported, times the difference between the actual market price and the normal competitive market price. For instance, in 1980 the United States imported 2.3 billion barrels of oil at an average price of \$56 per barrel. If the price of oil in a competitive market would have been \$10 per barrel, as some energy economists believe (Adelman, 1989; Berg et al., 1997, p. 502; Brown, 1987; Griffen & Vielhaber, 1994; Morison, 1987), then the transfer of wealth from the U.S. economy

to oil producers that year amounted to \$114 billion (1995 \$). Over the period 1972 to 1996, noncompetitive oil pricing cost the U.S. economy approximately \$1.4 trillion (1996 \$) in transferred wealth. Vulnerability to transfer of wealth is directly proportional to the quantity of oil imported.

When oil prices rise, they signal that oil has become more scarce. It matters little whether the price rise is due to physical scarcity or the use of market power. A world in which oil is more scarce is a world in which it is harder to make a living. In other words, there is a loss of the potential to produce economic output. The size of the loss depends on how much oil an economy consumes, and how readily it can substitute other factors of production for oil. Whether prices rise suddenly or gradually, there is still a loss of potential GDP.

When prices rise suddenly and drastically, an economy cannot adjust immediately to the change. The new oil price regime requires accompanying adjustments in wages and interest rates, and changes the relative amounts of capital, labor, energy, and materials needed to produce most efficiently. But labor and capital markets need time to adjust, and the technology embodied in capital equipment cannot be instantaneously transformed. The result is less than full employment of the factors of production, and further losses of GDP. Such macroeconomic adjustment losses cause GDP to fall below the full employment GDP, which has already been reduced by the impact of higher oil prices on the economy's potential GDP.

While there are a great many estimates of the combined effect of the two kinds of GDP losses, much less is known about the relative sizes of the components. Numerous empirical and simulation studies in the U.S. over the past 20 years suggest that a doubling of oil prices reduces U.S. GDP by about 5 percent for several years (for a brief review, see Greene et al., 1995, pp. 21-25). The size of the impact in any given year is related to total expenditures on oil as a percent of GDP. That is, all else being equal, the larger the share of expenditures that goes to oil, the more damaging an oil price shock will be to the economy.

6. IS OPEC DEAD?

The collapse of oil prices in 1986 and the ensuing decade of lower oil prices have convinced some that OPEC will never regain control of world oil markets. The creation of strategic petroleum reserves, deregulation of energy markets, establishment of an oil futures market, improving relations in the Middle East, the U.S. military presence in Saudi Arabia, and downstream investments by OPEC have all been cited as reasons why the oil dependence issue is no longer relevant. None of these objections, however, affects the fundamental determinants of OPEC market power, as shown in Figure 5.2.

Certainly, there have been some changes for the better. Since 1985, world oil demand has been growing at an average rate of 1.8 percent per annum, far less than the 8 percent rate that preceded the first oil price shock. Since 1994, however, oil demand has grown at a 2.5 percent annual rate and may be accelerating. At 42 percent of the world's crude oil supply, OPEC's market share remains below 50 percent. There is evidence that technological advances, such as 3-D seismic imaging, horizontal drilling, and advances in off-shore drilling methods have reduced the cost of finding and developing oil resources outside of OPEC (Ismail, 1994). It is possible that such changes have increased the rest-of-world supply response, thereby weakening OPEC's market power. Some are clearly convinced that this is the case (U.S. Department of Energy, Energy Information Administration, 1997c) but others (Salameh, 1995) are skeptical. The greater concentration of oil use in the transportation sector may have decreased the price elasticity of demand, which would strengthen OPEC's market power (Dargay & Gately, 1994; Gately & Rappaport, 1988).

7. MOTIVE AND OPPORTUNITY

Simulations of possible future oil-supply reductions by OPEC suggest that the cartel will have both the opportunity and the motive to create price shocks and profit from them. Suranovic (1994), confirming an earlier analysis by Wirl (1985), demonstrates that successive oil price shocks produced the maximum profit for OPEC producers. The U.S. Department of Energy/ Energy Information Administration (1994, p. 22) shows that the equivalent of a 5.25 million barrel per day supply shortfall, even as soon as the year 2000, would likely cause oil prices to rise to \$55 per barrel. Greene et al. (1995) simulate a 2-year OPEC supply curtailment in the year 2005 similar in size to those of 1973-74 and 1979-80, followed by very gradual increase in OPEC output through 2010. They conclude that the shock would boost OPEC revenues by about \$600 billion, while the U.S. economy would lose a half trillion dollars as a result. These simulations take into account the now slower growth of oil demand, but do not explicitly address changes in the technology of oil supply.

Both Suranovic (1994) and Greene et al. (1995) assessed the ability of strategic petroleum reserves to defend against a major, sustained supply curtailment, and concluded that they would be of little help. This may surprise some, but it is relatively easy to understand. The total world oil supply shortfall in the Greene et al. simulations amounts to 19 billion barrels. Even the entire strategic reserves of all OECD countries could cover only 5 percent of the total shortfall. Strategic reserves can work well for smaller supply disruptions and do have some beneficial effect even in the event of a protracted supply curtailment. However, they are not a panacea for energy security.

Creating economic scarcity through the use of market power is beneficial to oil producers and harmful to oil consumers. The opportunity to do so can arise in any of a number of ways. We have already seen oil market disruptions triggered by a boycott by Arab OPEC members of nations that supported Israel in the 1973 October War, a bloody war between Iran and Iraq in 1979-80, and the invasion of Kuwait by Iraq in 1990-91. Future price shocks could be caused by deliberate action to curtail supplies, wars, insurrections, terrorism, or natural disasters. Depending on the circumstances, OPEC could choose to capitalize on the opportunity and make enormous profits or elect to increase production and mitigate the price increase, as Saudi Arabia chose to do in 1991. It seems reasonable to assume that the more money there is to be made, the more likely it is that an opportunity to profit from an oil market disruption will be found.

8. TECHNOLOGY AND PRICE ELASTICITY

Oil dependence has been a serious economic problem in the past, and there is reason to believe it may be again in the future, but is there anything that can be done about it? Just as the von Stackelberg equation helps us understand the problem, it also points toward the solution. If short- and long-run price elasticities of demand and supply can be increased significantly, the market power of the cartel can be greatly reduced. The price elasticity of demand depends on consumer preferences but more importantly on the technology of energy use. Because the transport sector accounts for the majority of world petroleum consumption and an even greater percentage of the high-value products that drive the oil market, it is the technology of energy use in the transport sector that matters most.

Technology affects the price elasticity of oil demand in two main ways: (1) through the efficiency of transport vehicles; and (2) through the transport sector's ability to use alternative, nonpetroleum energy.

As an example of how the efficiency of vehicles affects the price elasticity of oil demand, consider light-duty vehicles, which account for more than half of all transportation energy use.⁷ Fuel (F) or energy use by light duty vehicles is identically equal to miles traveled (M) divided by the average efficiency (e) of travel (in miles per gallon). Application of the calculus leads to Equation 1, which states that the price elasticity of fuel demand ($\beta_{f,p} < 0$) depends on the fuel cost per mile (fuel price divided by mpg) elasticity of travel ($\beta_{m,c} < 0$) and the fuel price elasticity of efficiency ($\beta_{e,p} > 0$).

$$\beta_{fp} = [\beta_{mc} \times (1 - \beta_{ep})] - \beta_{ep} \quad (1)$$

Whatever increases the fuel price elasticity of fuel economy will make the price elasticity of fuel use more elastic (larger in absolute value). We assume for the sake of simplicity that technology does not affect the fuel price elasticity of vehicle travel.

Reasonable values of $\beta_{m,c}$ and $\beta_{e,p}$, based on the extant literature (U.S. Department of Energy, Office of Policy and International Affairs, 1996, Chapter 5) are approximately -0.2 and 0.2. Only about half of the elasticity of efficiency is due to technological changes, the rest (about 0.1) being due to consumer choice of size classes, makes and models, and configurations (e.g., engines and transmissions). These are long-run elasticities. In the short run, the elasticity of travel is about the same and the elasticity of efficiency is perhaps one-tenth as large. Thus, a reasonable long-run value for $\beta_{f,p}$ would be -0.38, and a reasonable short-run value would be about -0.22.

Increasing the fuel price elasticity of efficiency ($e = 1/\text{mpg}$) is accomplished by reducing the cost of increasing vehicle fuel economy. As an example of how technology can do just that, we draw on a recent study of the potential for advanced automotive technologies, such as those being developed by the government/industry Partnership for a New Generation of Vehicles (PNGV) program (U.S. Congress, Office of Technology Assessment, 1995). These technologies range from lightweight materials, to hybrid vehicle technology, batteries, lean nitrogen oxides catalysts, and fuel cells. Figure 5.4 shows the estimated costs of increasing passenger car fuel economy using today's technology according to a recent study by the National Research Council (NRC, 1992), and using advanced technology in the years 2005 and 2015 according to a study by the Office of Technology Assessment (U.S. Congress, OTA, 1995). Smooth quadratic functions have been fitted to the NRC and OTA data. The advanced technology curves are based on the OTA's most optimistic assessment of the potential for technological advances. The curves in Figure 5.4 represent total costs, whereas the supply curve for fuel economy represents marginal costs, the derivative of total costs, which in this case will be a straight line.

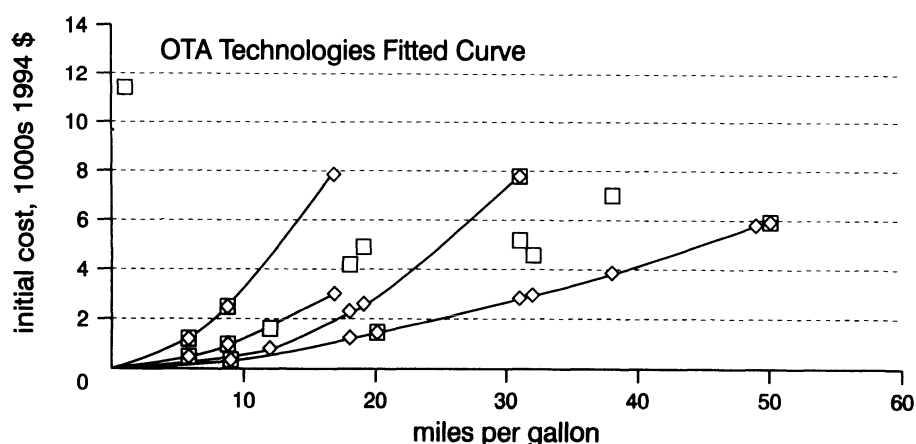


Figure 5.4 Estimated costs of passenger car fuel economy improvement using advanced technologies, today to 2015

The fuel price elasticity of fuel economy also depends on the demand for fuel economy. Demand curves can be derived based on motorists' willingness to pay for fuel savings. Here we assume that willingness to pay equals the discounted present value of future fuel savings, a straightforward calculation given a few key parameters (an effective discount rate of 15 percent, including the depreciation rate of capital invested in the vehicle, annual miles driven of 14,000 per year when new declining at 4 percent per year, and fuel prices of \$1.21 and \$1.52 per gallon). Changing the price of fuel shifts the demand curve for fuel economy upward. By solving for market equilibrium fuel economies at the two fuel price levels, arc elasticities can be readily computed for the different fuel economy supply curves, and these are shown in Table 5.2. Advancing technology from today's level to the optimistic 2015 curve more than triples the price elasticity of new vehicle fuel economy. With a flatter fuel economy cost curve, a given upward shift in the demand curve produces a large increase in mpg. In the long run, the PNGV technology increases the price elasticity of gasoline demand by almost 50 percent. In the short run, however, the effect is certain to be much smaller. Indeed, because of the time required to implement design changes in vehicles, in the first year there may be no effect of technological changes on mpg. On the other hand, the effect of consumer choice could be greater if the advanced technology caused a wider array of high efficiency models to be available to choose from. A more detailed analysis than we have been able to do thus far would be necessary to meaningfully analyze this question.

Table 5.2 Effect of the cost of fuel economy on the elasticity of gasoline demand

<i>Supply Curve</i>	<i>Initial mpg</i>	<i>Final mpg</i>	<i>Long-run $\beta_{e,p}$</i>	<i>Long-run $\beta_{t,p}$</i>
NRC High Cost	28.5	29.0	+0.077	-0.341
NRC Low Cost	31.1	32.0	+0.126	-0.380
PNGV: OTA Study	37.3	39.7	+0.274	-0.500

Note: The values of $\beta_{e,p}$ shown in Table 2 are the technology component. To get the full value including salesmix shifts, 0.1 is added. The full value is used in computing values for $\beta_{t,p}$.

Another principal means of increasing the price elasticity of petroleum demand is to make it cheaper and easier to introduce nonpetroleum energy sources. Nonpetroleum energy sources can be introduced in two different ways: (1) by blending with conventional fuels (e.g., blending ethanol with gasoline to produce gasohol), and (2) by direct use of neat or near-neat alternative fuels by alternative fuel vehicles. Alternative fuel vehicles may be dedicated (able to run only on the alternative fuel) or fuel flexible. Fuel flexible vehicles are especially interesting because of their ability to instantly

switch from one fuel to another. But, the effect of flex-fuel vehicles on price elasticity is likely to be constrained by the ability to expand fuel supply. For this reason, alternative fuels that are already ubiquitous (such as electricity or natural gas) would seem to be especially attractive. An electric hybrid vehicle capable of drawing electricity from the grid to recharge its batteries or of running solely on gasoline or diesel is one example.

Evaluating the potential effects of the wide array of alternative fuel options is well beyond the scope of this paper. Instead, a general example of fuel substitution is used to illustrate the principle that alternative fuel technology can directly affect the price elasticity of oil demand. The demand for petroleum fuels (g) is identically equal to the demand for total motor fuels (f) times the market share of petroleum fuels (s_p). By application of calculus, it is easy to show that the price elasticity of demand for petroleum fuels (β_g) equals the product of the price elasticity of demand for all fuels (β_f) and the cost share of petroleum fuels (ω_g), plus the price elasticity of the market share of petroleum fuels (γ_g). This simple relationship is shown in Equation 2.

$$\beta_g = \beta_f \omega_g + \gamma_g \quad (2)$$

If we further assume that each fuel's share is a multinomial logit (MNL) function of the price (P) of the fuel (Train, 1986), by choosing a reasonable value for the coefficient of price in the MNL model, we can simulate the effect on the price elasticity of gasoline of improving the alternative fuel and thereby increasing its market share. Certainly other attributes of the fuel (e.g., range, effect on horsepower, availability, etc.) distinguish the fuel from gasoline but one can think of translating those attributes into price equivalents and capturing them in a measure of generalized cost. Using survey data concerning the effect of fuel availability on the choice between two otherwise identical alternative fuels, Greene (1997) estimates a price coefficient of about -10 for such an MNL model with prices measured in 1996 dollars. Since alternative fuels are actually somewhat different, a realistic price coefficient would be smaller in absolute value.

In this simple illustration, the effect of improving alternative fuel technology on gasoline price elasticity appears to be quite dramatic. Assuming that gasoline costs \$1.25 per gallon, and that the price elasticity of fuel demand is -0.4 , the price elasticity of gasoline demand with the alternative fuel priced at \$2 per gallon would be -0.407 , and the market share of the alternative fuel would be 0.1 percent (Figure 5.5). As the price is decreased toward \$1.50 per gallon, market share increases to 12 percent, and the price elasticity of gasoline demand more than quadruples to -1.8 . If one thinks of the price of the alternative fuel as a generalized cost incorporating negative aspects of the alternative fuel and the alternative fuel vehicle that uses it, the effect of decreasing price can be an analogy for improving the technology of alternative fuels and vehicles. Of course, this is a simple illustration that ignores very important aspects of real world

markets, such as the time required to expand alternative fuel production and distribution infrastructure. Nonetheless, it suggests that alternative fuels and vehicles technology could potentially have a dramatic impact on the price elasticity of oil demand.

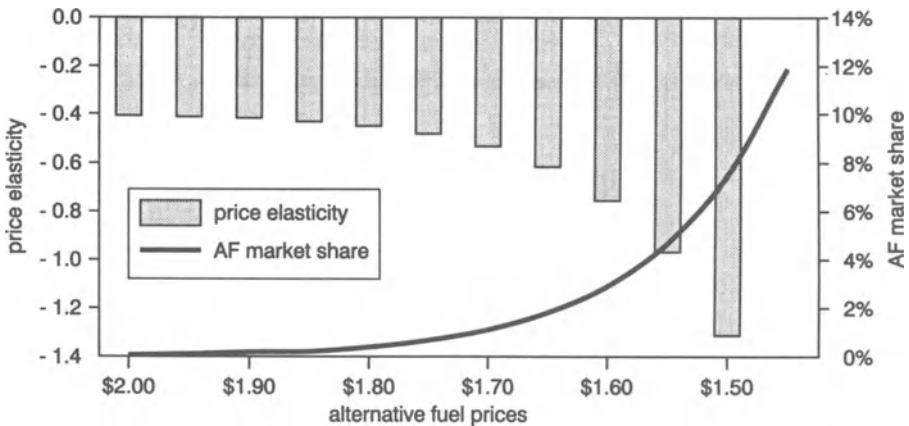


Figure 5.5 As the price of an alternative fuel converges on the price of gasoline, both market share and elasticity increase

Technology can also profoundly affect the price elasticity of oil supply. It appears likely that improvements in oil supply technology, such as 3-D seismic imaging and horizontal drilling, have had an impact on world oil supply elasticities (Fagan, 1997; Salameh, 1995) but the size of that impact has yet to be measured. Improvements in technologies for converting natural gas into liquid fuels (such as the Fischer-Tropsch processes for producing synthetic gasoline and diesel), plus a greater willingness to pay for cleaner transport fuels, all offer the potential to increase the elasticity of petroleum product supply. There appears to be a growing consensus among energy forecasters that technological advances will permit greater oil supply from non-OPEC sources than previously thought and that this will slow the rate of growth of OPEC's market share over the next 20 years (U.S. Department of Energy, Energy Information Administration, 1997c; World Energy Council & International Institute for Applied Systems Analysis, 1995).

9. SUMMARY AND CONCLUSIONS

Oil dependence has cost the U.S. economy dearly in the past and is likely to continue to do so in the future, unless the fundamental parameters of oil supply and demand change. Technology plays a major role in determining these parameters. It has been

demonstrated that major changes in the energy efficiency and alternative fuel technologies can, in theory at least, have a major impact on the elasticity of oil demand in the transport sector. To some extent, we can rely on the marketplace to develop the needed technologies. Some of the costs of oil dependence are born directly by producers and consumers, and, to the extent that oil prices signal scarcity and the market anticipates future price shocks, these costs will be internal to market decisions. But much of the cost of oil dependence is a societal cost that markets will ignore (Broadman, 1986), and there are other important social costs of oil use that result from other market failures, such as environmental pollution and the sustainability of our current energy system (Martin et al., 1996). Because of this, oil dependence is an important public policy issue, one that we have virtually ignored for the past decade. It is now past time to give it the serious attention it deserves.

10. ENDNOTES

- ¹ Subsequently, Greene and Leiby discovered an error in their calculations that resulted in an overestimate of the transfer of wealth component of oil costs by approximately 20 percent, with the result that total costs were overestimated by about 5 percent.
- ² More importantly, from the perspective of sustainability, 50 or even 150 years is not a very long time, considering that energy for an essential economic activity hangs in the balance.
- ³ Similar estimates have recently been produced by Petroconsultants (1996), Campbell (1995), and Miramadi and Ismail (1993).
- ⁴ The most recent DOE/EIA projections are more optimistic, foreseeing OPEC's market share at only 42 percent in 2005 and 45 percent by 2015. World oil demand is projected to grow at only 2 percent per year, while non-OPEC oil production increases at 3 percent per year. (U.S. Department of Energy, Energy Information Administration, 1996, Table A47).
- ⁵ The formulas in Figure 5.2 cannot admit any and all values of price elasticities and other parameters. In particular, the monopolist's pricing equation is undefined for price elasticities between -1 and 0, inclusive. Intuitively, if demand is too unresponsive to price, the monopolist could charge any price it wished (this might occur, for example, if a firm had the monopoly on food, water, or air). In most cases where demand is inelastic, however, price elasticities do not stay constant but tend to increase with increasing price, so that a solution is ultimately reached.
- ⁶ This reflects the theory that a core group of OPEC members comprise the functional cartel. These core members are Saudi Arabia, Kuwait, Iraq, Iran, the United Arab Emirates, and Libya.
- ⁷ Note that the elasticity of oil demand with respect to the price of oil is equal to the sum over all petroleum products of the elasticity of demand for each product with respect to its own price, times the elasticity of its price with respect to the price of oil, times the product's share of total oil use. Thus, increasing the own price elasticity of demand for all products by 10 percent would increase the elasticity of oil demand with respect to the price of oil by 10 percent.

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Chapter 6

Food Security Concepts

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Food security concepts have evolved over the past three decades from initial concerns focusing on the adequacy of global food supplies to include concerns about accessibility to food and human livelihood. These changes have underscored the need to address food security at scales ranging from global through to community levels, and the need to integrate quantitative and qualitative research methods.

1. INTRODUCTION

1.1 The Context

Food is unique as a natural resource. Like other human accessories such as air and water, it is essential for existence. Yet, unlike the air and—to a lesser extent—the water, food is not ubiquitous; that is, it cannot be produced in the same quantity or within the same quality at all geographic locations. Wallerstein (1980, p. xv)

Amid increasing reports of worldwide poverty, human malnutrition, and hunger, Wallerstein's (1980) observation reflects the spatial variation of natural resources, and acknowledges that food production is affected by the interplay of biophysical and socioeconomic factors. Today, there are some 800 million people in the developing world who are food insecure, and malnutrition and hunger are enmeshed with poverty. About 10% of the world's population that are food insecure are in the Caribbean and Latin America, 15% are in East Asia, 19% in Sub-Saharan Africa, and 50% are in Southern Asia (Pinstrup-Andersen & Pandya-Lorch, 1996). Without question, food insecurity and human poverty are intertwined and exhibit distinctive national and regional patterns.

1.2 Purpose and Organization

The overall purpose of this paper is to lay the groundwork for conceptual and analytical frameworks for estimating food security. Section 2 chronicles the recent evolution of the concept of food security. Section 3 explores the potential for forging links

between food security research and the broader field of environmental change and human security. The paper concludes with suggestions to advance the food security concepts established in Sections 2 and 3.

2. THE EVOLUTION OF FOOD SECURITY CONCEPTS

Over the past three decades, food security research has been shaped by a growing awareness that further expansion of global food supplies can no longer rely on bringing more land into agricultural production. Lands which might be brought into agricultural production in the future are either remote from markets or environmentally marginal, and the utilization of these lands for agriculture would, in all likelihood, entail unacceptable economic and environmental costs (Pierce, 1989). As a result, food security in the future will undoubtedly rely on a more intensive use of existing agricultural lands rather than an expansion of the resource base (Cassman & Harwood, 1995).

In addition, the meaning of food security has changed dramatically since the World Food Conference in 1974. A quick scan of the literature reveals multiple food security definitions have been proposed since the early 1970s (Smith et al., 1992). Early definitions of food security tended to focus on single dimensions of food production systems. More recently, it has been acknowledged that "understanding food security requires recognition of [its] complexity and diversity" (Maxwell, 1996b, p. 156). Overall, there have been notable shifts in how food security issues have been framed and in the methods employed to address these concerns.

2.1 The Threat of Food Shortages

Throughout much of the 1970s, food security research was driven to a large extent by the fear of food shortages on a global scale (Table 1). The *Limits to Growth* report (Meadows et al., 1972) and the 1972 grain harvest failure in former USSR provided compelling evidence that the world's food supply was at risk and that even wealthy nations could become victims of food shortages (Foster, 1992). At the time of the grain harvest failure, other major wheat-producing nations benefited by exporting unprecedented amounts of grain to the former USSR. The negative consequences included severe reductions in world grain reserves and sharp increases in food prices. Widespread concern that world food systems might collapse was one of the motivating factors for the World Food Conference in 1974.

Responses to the threat of periodic food shortages on a global scale and sharp fluctuations in food prices dominated the agricultural agenda in the early 1970s. Food security was, at this time, addressed by calls for global stabilization of agricultural

production and, when necessary, the provision of short-term support to assist nations in overcoming sudden requirements for food imports. A reliable global supply of basic food products was seen to be a foundation for offsetting periodic and damaging fluctuations in agricultural production and food prices (UN, 1975).

In response to these concerns, many food security studies focused on the extent to which future food production increases might be able to keep pace with rapid global population growth and on mechanisms to enhance food self-sufficiency at the national level (Higgins et al., 1982). This does not imply that microscale studies focusing on community level food supplies or on food preferences were absent during this period, but it does highlight that the dominant themes researched under the aegis of food security were characterized by quantitative, macroscale studies which employed nations or world regions as the basic unit of analysis. Overall, institutions and programs such as the World Food Council and the Food and Agriculture Organization's (FAO) Committee on Food Security were established in the context of protecting international and national security; less attention was given to understanding food security dynamics at the local or community level (Maxwell, 1996b).

2.2 Hunger Amidst Abundant Food

By the 1980s, global food supplies had increased and the risk of international food shortages had subsided considerably (Foster, 1992). Technological advances had enhanced agricultural production to such an extent that food was abundant at the international and national scales. Increases in food production outpaced population increases in most of Asia and Latin America, although per capita food production declined in some parts of Africa (Grigg, 1993). Global food supplies and reserves had been enhanced and fluctuations in agricultural production and food prices were reduced, but hunger and malnutrition had deepened (Barraclough, 1996).

Hunger amidst abundant food (Parikh & Tims, 1986) revealed that food security was multidimensional and considerably more complex than assuring an adequate global food supply and the dampening of production and price fluctuations. It became apparent that agricultural production increases derived from technological advances could not overcome the deeply-rooted economic, social, and political forces that ultimately controlled the distribution of food products at the sub-national through community levels.

It was in this context that food security concepts began to be transformed and issues relating to the accessibility of food came to the forefront (Table 6.1). Sen (1981 and 1996), building upon the work of nutritionists, is often "credited with initiating the paradigm shift that moved this issue of access to food to centre stage...and access to food [became] the defining characteristic of food security" (Maxwell, 1996b, p. 156-157).

Table 6.1 Evolution of food security concepts

	<i>1970s: Threat of food shortages</i>	<i>1980s: Abundant food & hunger</i>	<i>1990s: Linking food security & livelihood</i>
<i>Driving forces</i>	<ul style="list-style-type: none"> • Limits to Growth • USSR crop failures 	<ul style="list-style-type: none"> • Abundant global food supply and hunger occur simultaneously 	<ul style="list-style-type: none"> • Regional & local disparities exacerbate food insecurity
<i>Political-economic context</i>	<ul style="list-style-type: none"> • Depleted world grain reserves • Food prices increase 	<ul style="list-style-type: none"> • Technology limits • Food entitlement 	<ul style="list-style-type: none"> • Individual-household security coupled with food security
<i>Framing food security issues</i>	<ul style="list-style-type: none"> • Food supply & market stabilization 	<ul style="list-style-type: none"> • Access to food • Nutritional adequacy 	<ul style="list-style-type: none"> • Food choice vs. food needs • Coping mechanisms
<i>Dominant research perspectives</i>	<ul style="list-style-type: none"> • Global population vs. food supply • National food self-sufficiency 	<ul style="list-style-type: none"> • National to sub-national scale • Objective measures of food sufficiency 	<ul style="list-style-type: none"> • Livelihood security/household viability • Subjective measures
<i>Subdominant research perspectives</i>	<ul style="list-style-type: none"> • Cultural/community preferences 	<ul style="list-style-type: none"> • Intrahousehold food distribution 	<ul style="list-style-type: none"> • Coupling macro-micro & objective-subjective measures

Derived from Beaudry (1996), Marchione (1996), Maxwell (1996a, 1996b), Sen (1981, 1996), and Wallerstein (1980).

With this radical altering of food security concepts, it was no longer sufficient to think in terms of a global scale food supply problem and, as a result, inquiries into food security in the 1980s typically emphasized the importance of entitlement and access to food. This shift in focus from adequate supply to accessibility was accompanied by a scale change for food security research. Sub-national through community level studies became more prevalent while less emphasis was placed on the national through international levels. However, quantitative methods analysis continued to dominate. A typical assessment would employ minimum average daily caloric intake standards as a proxy indicator for overall nutrition, and then accessibility was estimated as the proportion of the population with food consumption levels sufficient to meet the daily caloric requirements. Overall, adequate human nutrition became an aggregate indicator of food security (Grigg, 1993). This perspective on food security has continued to be important. Rights to food and nutrition remain on the agenda at major international symposia on development, and have been incorporated into international agreements, including the Convention on the Rights of Children (Marchione, 1996).

2.3 Food Security and Human Livelihood

With the persistence of hunger and malnutrition in many developing countries throughout the latter half of the 1980s and into the 1990s, it became apparent that food security concepts had to be broadened beyond the objective measures of nutritional adequacy and production stability. Studies into the food distribution at the household scale (Beaudry, 1996) have revealed that “access to food by individuals in a household is pervasively linked to the control they have over household resources and the access they have to household income” (Maxwell, 1996b, p. 157). These studies contributed to another refocusing of food security concepts, and a significant characteristic of the most recent food security research is the coupling of food security with the broader concerns relating to individual livelihood, and more generally, human security (Table 6.1). As a result, food security is now concerned with the quality as well as the quantity of food entitlements (Maxwell, 1996b). Factors such as cultural acceptability of agricultural products are now seen to be part of “accessibility.” It is now recognized that estimates of nutritional adequacy at the community scale provide only a partial estimate of accessibility to food supplies.

This most recent refocusing of food security has also prompted notable changes in the research agenda. The research scale has been reduced to the level of households and individuals in households, and there has been a substantial movement towards the use of subjective methods of inquiry and qualitative assessments. The capacity of conventional social science to uncover the root causes of food insecurity within households has been questioned and participatory research methods are increasingly being employed to gain insight into the fundamentals which govern intrahousehold decision making (Beaudry, 1996).

2.4 Combining the Perspectives

Food security concepts will continue to evolve. Definitions and concepts that were developed in the early part of the 1970s have been transformed several times. The global scale of inquiry and efforts to provide quantitative measures of food security have, to a large extent, given way to research that focuses on the household and relies heavily on subjective assessments. It would be easy to conclude that there are few, if any, common threads linking contemporary food security concepts and research methods with efforts from the early 1970s, and that the early work was simply misguided and is of little relevance today. Similarly, the perspectives summarized in this section could be perceived merely as opposing views that have fleeting currency.

An alternative interpretation (and the one favoured here) is that food security is not and should not be framed in the context of a single perspective and scale, but rather that there are a series of related concerns which have relevance at scales ranging from

the individual up to the global. Clearly, a stable and abundant food supply at national and international levels is not sufficient to guarantee food security for entire populations. Even within the context of the wealthier nations, many individuals and households are food insecure (Uvin, 1994). However, it is also difficult to conceive of food security as being an issue that can be defined and addressed adequately if it is confined solely to the household or individual scale. A recent study by Bohle et al. (1994) illustrates one approach for aggregating macroscale proxy measures of food supply, entitlement, and human livelihood to obtain national indices of food security. There is a need to expand upon this sort of approach and to develop analytical frameworks for meso-scale and microscale assessments, and to develop linkages among the various scales of inquiry.

3. LINKING FOOD SECURITY TO ENVIRONMENTAL CHANGE AND HUMAN SECURITY

Since the end of the Cold War, nonconventional threats to national security as well as broader notions of comprehensive human security have been discussed. While this ongoing discussion about national and human security has occurred at the same time as that of food security, it appears that there have been few links between the two themes. Gottlieb and Fisher (1996) have also noted that discussions regarding community food security have been isolated from the broader debate on environmental concerns. This section summarizes recent discussions on environmental change and human security, and explores potential links between food security and concerns relating to environmental change and human security.

3.1 Contemporary Views of Environmental Change and Human Security

Conventional views of security developed after World War II have focused primarily on protecting the sovereignty of nation-states from external military threats (Dabelko & Dabelko, 1995). The end of the Cold War sparked a reexamination of national security, and at least three alternative perspectives on security have emerged.

- *Alternative 1:* A logical post-Cold War extension of conventional security assessments is based on the consideration of non-military threats to security (Chase et al., 1996; Ullman, 1983). Similarities between this extension and conventional assessments of national security include the use of competitive models of state behaviour, maintenance of sovereignty as the overall goal, and violent conflict as the major destabilizing force. The major deviation from conventional assessments of national security is the perception of environmental scarcities, rather than military force, as the source of security threats (for example, see Gizewski & Homer-

Dixon, 1996; Percival & Homer-Dixon, 1995). This shift in defining the nature of a security threat represents a fundamental change from previous studies, and linkages between environmental degradation and violent conflict continue to be debated.

- *Alternative 2:* A larger deviation from Cold War perspectives on security involves replacing the narrowly defined concept of national security with comprehensive human security (Matthews, 1989). This redefinition broadens the security context to include economic security, health security, personal security and other aspects of human well-being (Lonergan, 1997; Myers, 1993). Furthermore, the human security perspective requires investigations be conducted at the community through individual levels, and not just at the level of the nation-state. This reduction in scale to local and community based research has spawned a growing interest in coping and adaptation strategies, and assessments of the extent to which different communities might be vulnerable to various forms of environmental change. This scale change has also prompted interest in methods based on research partnerships with and direct participation by local communities as part of the research process (Canadian Global Change Program, 1996).
- *Alternative 3:* The broadening of the security debate to include non-military threats has also contributed to new participants entering the security field. For example, environmental scientists, rather than international relations experts, have led the way in developing a biocentric security perspective. This biocentric perspective focuses on securing the functions and services provided by the natural environment, and on the impacts that human activities have on basic life support systems, losses in biodiversity, global climatic change, and so on (Canadian Global Change Program, 1996). Deep ecologists involved in this perspective discount the importance of human well-being and regard maintenance of ecological systems as paramount to all other objectives. Other contributors stress the importance of ensuring human activities do not result in unacceptable declines in ecological functions. Another difference between the biocentric-environmental security and the other two alternatives summarized in this paper is the use of bioregions as the basic spatial unit for assessment, rather than nations that are employed in conventional security assessments or communities that represent the basis for assessing human security.

3.2 Forging Links

Several common themes linking contemporary research into food security specifically (Sections 2.1, 2.2, and 2.3) to environmental change and human security generally (Section 3) can be identified. One common theme is the adoption of a human livelihood or well-being perspective. This signals that both fields now recognize that future advances hinge partially upon a broadening rather than a narrowing of the research scope. The broader issues of human livelihood and well-being are now seen

as a foundation for the various forms of security, including food security. Overall, this suggests that communities and individuals should form the foundation of security studies, and that meso- through macroscale assessments should follow from the microscale studies.

The transformation from a global-national scale of inquiry to the community-individual level is evident in food security as well as environmental change-human security research. This focus on communities and individuals stems from the recognition that security is effectively a subset of human livelihood. Without livelihood security, it is difficult, perhaps impossible, to achieve food security. Another shared characteristic is the growing importance attached to developing and applying subjective research methods and qualitative information. This trend can be viewed as part of a larger debate in the social sciences. Conventional social science methods have and should continue to be part of the food security and more general human security research, but it is also important to complement this base with other approaches including participatory research.

4. THE NEXT STEPS FOR FOOD SECURITY

4.1 Closer Ties with Environmental Change-Human Security Research

As was noted earlier, the evolution of food security concepts has occurred at the same time, but to a large extent in isolation from, the environmental change and human security debate. There is sufficient common ground between these two fields to warrant closer ties as a means to avoid duplication and to expedite scholarly development within each field. Some of the areas of overlap for the two fields include:

- an increasing emphasis on basic research at the community to intrahousehold level;
- expanding the security context to include the livelihood of individuals and communities;
- closer involvement between researchers and communities;
- explicit consideration of differential vulnerabilities across communities and individuals; and
- enhancing our understanding of coping and adaptation strategies.

4.2 Participatory Research

The couching of food security within human security suggests that the basic unit of analysis for food (and human) security should be communities and households (see Section 2.4). This, in turn, demands that future research engage local communities to

a greater extent than has been the case in the past. Participatory research methods, based upon a sharing of research responsibilities between the community and the researcher, provide an opportunity for better understanding the dynamics amongst food, environmental, social, political and economic systems in a local context.

4.3 Food Security Indicators

With food security established as a subset of human livelihood or human security, it will be useful to disaggregate indicators into these two broad categories. Food system indicators would need to be tracked over time and linked to changes in the availability and quality of the agricultural resource base, agricultural production, food distribution and accessibility, and so on. The linkage to human livelihood-security indicators will be critical in order to avoid treating entire communities as undifferentiated populations with equal access to food. It is this linkage between food and human security indicators which will eventually provide clearer insight into issues relating to food entitlements and accessibility.

4.4 Differential Vulnerabilities, Coping and Adaptation

Although food security policy has not been the focus of this paper, there is clearly a direct interest in food security policy and programs at the community through to national-international levels. The use of food security indicators to identify and understand differential vulnerabilities across communities and regions, and to gain insight into the extent to which coping and adaptation strategies might be used to support or reinforce vulnerable communities represents a policy issue which needs to be investigated. Furthermore, the development of analytical systems that are aimed at gauging differential vulnerabilities would provide a basis for both directing assistance to the most vulnerable and identifying potential communities and regions where food security might be at risk in the future.

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Chapter 7

Water Resource Distribution and Security in the Jordan-Israel-Palestinian Peace Process

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This chapter addresses the questions of control and management of water resources in the Middle East as a problem of unequal ecological exchange and of environmental (in)security. The term ecological distribution refers to the noncommodity environment as a source of human well-being. It turns the focus of political economy to the social, spatial, and temporal asymmetries or inequalities in the nonmarketed use by humans of environmental resources and services (energy, water, wild and agricultural biodiversity, and so on), and to the burdens suffered, such as pollution. The opportunity costs of water resource degradation are now being discussed as one of the key axes of geopolitical conflict and environmental degradation for the 21st century, and nowhere are these tensions as plainly expressed as in Jordan, Israel, and the Palestinian Territories.

In sections 1 and 2, some background is given to the place of shared and/or scarce water in the Middle East conflicts and the current peace negotiations. In section 3, the approach to environmental security as a problem of unequal ecological distribution is outlined, and illustrated with reference to tensions at all scales of activity over water use in the region (notably the Jordan River basin and the Gaza Strip). In section 4, some general preconditions are outlined for a "durable peace," which much be regarded as the co-condition for sustainable development in the region. While propositions for cooperation are inevitably optimistic, some suggestions are given for institutional arrangements such as a Regional Agency for integrated management of water resources that could improve the chance of cooperation.

1. AN OVERVIEW OF THE JORDAN-ISRAEL-PALESTINE WATER RESOURCE MATRIX

Water is a complex and fragile medium, not only a natural resource to be exploited, but also the intimate sustaining substance of all life. Access to safe water for drinking, washing, bathing, and to larger quantities for transportation and industrial uses is a decisive factor in the arrangement of rural and urban communities and the rise and decline of civilizations. In the Middle East, as in most parts of the world, much attention has traditionally been paid to the security of water sources. There is inevitably also the problem, linked to public health and hygiene, of wastewater disposal. More recently, systematic attention has turned to the problems of water resource degradation due to pollution and overexploitation. In all these respects, scarcity of and threats to the quality of water tend to reinforce each other, and, as we see in the Middle East, the quality and quantity problems are aggravated by highly unequal conditions of access and use.²

Reviewing the per capita availability of fresh water in each political unit aids in illustrating the quantitative disparities in water access in this part of the world (see Table 7.1). Please note that these figures are not definitive; they may vary depending on the methods used to estimate reserves, or on how shared or transboundary resources are categorized. Furthermore, fluctuating political realities must also be taken into account. However, even if one allows for a substantial margin of error, the magnitude of the discrepancy in the amount of water available to inhabitants of the different regions allows certain conclusions to be drawn.

Table 7.1 Water availability for selected Middle East Countries

	<i>1990s</i> (m ³ /year/inhabitant)	<i>Forecast 2025</i> (m ³ /year/inhabitant)
Lebanon	1500 - 4000	1000
West Bank	400 - 600	150
Israel	300 - 1000	200
Jordan	230 - 300	50
Gaza	70	35

If the water stress level is assumed to be 1000 cubic metres per capita per year, the West Bank, Israel, and Jordan exist in a state of penury; in Jordan, in particular, the situation is quickly worsening (see, for example, the detailed documentation in Salameh, 1996, and in the 1994-1997 reports of the Water Quality Improvement and Conservation Project undertaken by DAI/USAID). In Gaza, the situation is near-catastrophic, and is already specified as a priority for emergency measures within the current Israeli-Palestinian peace agreements (see Office International de l'Eau, 1995, and the 1995 reports by ANTEA et al.). According to most forecasts for the countries listed, only Lebanon looks likely to be in a manageable situation in 2025.

Seriously contaminated water is as bad as—or worse than—no water at all. A satisfactory management of water resources is thus a good biophysical indicator of, and a strong metaphor for, public health and economic viability as a whole. In any situation of war or political conflict, water is one of the most vulnerable and, for this reason, most sacred of a people's resources.

As Golda Meir stated in 1967, any country that seeks to divert the Jordan River was not playing just with water but with fire. Attempts to control the Jordan River basin and other Middle East water resources—the catchment areas, the river flows, and the aquifers—have, historically, been linked to conflict. It has been postulated that the 1967 Israeli occupation of the Palestinian Territories of the West Bank, and of the

Golan Heights, bordering Syria, was due in part to the strategic importance of these regions for the water supply. Finding a resilient agreement for the sharing of water resources is thus an essential part of the current Middle East peace process. A report from a recent Israeli/Palestinian cooperative research project, *Joint Management of Shared Aquifers* explains:

Israelis and Palestinians share several aquifers. These serve as long-term water storage to both sides. Given the high level of hydrological interdependence between the two sides and the susceptibility of the aquifers to pollution and salinization, there is a need to manage the shared aquifers jointly in order to reach optimal results. Otherwise, crucial storage capacity and quality levels may be lost, to the detriment of future generations of both Israelis and Palestinians.

(Feitelson & Haddad, 1995)

The intention of this chapter is not to review the regional water resource situation in the Middle East. Rather, we wish to illustrate some of the fundamental political, economic, and symbolic dimensions of conflict resolution needed to ensure water access security.

Water quantity and water quality issues are intermeshed. As the citation above intimates, two main sources of water degradation are recognized. The first is salinization of ground water which occurs when over-exploitation leads to the contamination of the underground fresh water by adjacent salt waters. Of particular concern are the intrusions of sea water into aquifers on the Mediterranean coastal zones (notably Gaza), and of salty underground water into freshwater aquifers in Jordan. The second source of water degradation is watercourse and groundwater pollution from agricultural, domestic, or industrial activities. Moving roughly from northeast (Lebanon, Syria, and northern Jordan), through the Jordan River Basin, to the Gaza Strip in the southwest, the following examples provide some insight into the complexity of this problem, for the most part due to the intricacies of quality-quantity interdependence and the transboundary problem:

- Much of the fresh water used in Israel and Jordan originates in the north, in watersheds shared with Syria and Lebanon.
- Much of the lower Jordan River flowing from Lake Tiberias (also known as the Sea of Galilee and as Lake Kinneret) to the Dead Sea marks the frontier between Israel and Jordan. This portion of the river has been contaminated by the diversion of saltwater springs from the lake and by pollution from uncontrolled runoff from agricultural, household and industrial zones of activity.
- Amman, the capital of Jordan and a city of about 1 million inhabitants, receives substantial quantities of relatively clean water from outside the immediate region,

and discharges large quantities of waste water, much of which ponds in the reservoir of the King Talal Dam on the lower Zarka River. This dammed water, which flows back into the Jordan River, is potentially available for irrigation; however it is contaminated (see discussion below). This prompts the complaint: “*Amman takes clean water and gives it back dirty*”— an unequal exchange in both real and symbolic terms.

- As a result of the dramatically diminished annual water inflow from the Jordan, the Dead Sea is evaporating faster than it is being replenished, and the water level has dropped many metres over the past 30 years, reducing visitor access and causing dramatic changes to the sea’s ecology and appearance (Watzman, 1997).
- On the western side of the Jordan River, between Lake Tiberias and the Dead Sea, the land rises into hills, before falling again as it moves westward to the Mediterranean Sea. Much of this region is part of the West Bank, and the Mountain Aquifer (actually three separate aquifers), a rain-renewed groundwater resource of vital importance to Israelis and Palestinians, is also found here.
- For its water, the arid Gaza Strip depends mainly on the exploitation of a rain-fed aquifer that runs from the hilly country of central Israel to the Mediterranean Sea. This aquifer is currently being exploited much faster than the rate of replenishment from rain, and the groundwater quality is seriously threatened by the underground suctioning of salt water from the Mediterranean, and by pollution from the surface.

Water management in this region thus enters many dimensions. There are urgent considerations, such as the provision of drinkable water to the Gaza Strip. There is the longer term but still urgent issue of possible irreversible aquifer salinization in Gaza, and also for underground water in Jordan. In the case of groundwater mining, there is the possibility of irreversible breakdown of the aquifer structure. There are also problems of resource degradation through contamination by human-produced wastes.

2. WATER AND THE JORDAN-ISRAEL-PALESTINE PEACE PROCESS

As part of the Middle East peace process, the Middle East Multilateral Working Group on Water Resources (WWG), chaired by the United States with participation by a large number of Middle Eastern, Mediterranean, and other countries, has been established. The WWG first convened in Vienna (May 1992), and has met several times since. Much of the WWG energy has been focused on the preparation of the Middle East Water Data Banks Implementation Plan (see, *inter alia*, Office International de l’Eau, 1995) which sets guidelines for cooperative research:

Each party will operate compatible water data collection and dissemination programs, adhere to agreed-upon regional standards for

equipment, accuracy, and operations, and share and exchange relevant water data and information necessary for water management within the region.

This Implementation Plan is managed and coordinated by an ad hoc committee, the Executive Action Team (EXACT) which, according to the Terms of Reference laid down in January 1995, is to meet at least twice a year and is made up of a maximum of 14 members: two representatives each from Israel, Jordan, and the Palestinian National Authority on the one hand, and the US, EU, Canada, and France on the other.

Together, the WWG and EXACT make up one of the principal current structures for international cooperation on water and peace issues within the Middle East. It is well recognized that the setting up of water resource information systems and what the EXACT Terms of Reference refer to as “the regional sharing and exchange of relevant water information” must be developed against the backdrop of negotiations for security in water resources access: the problem of sharing and exchanging information is a metaphor for the problem of sharing and exchanging water itself.

While the Middle East’s regional water issues encompass many countries (Egypt, Syria, Lebanon, Turkey, and even Iraq and Saudi Arabia), we focus here on the Jordan-Israel-Palestinian axes. All the parties are vulnerable:

- For Israel, the occupation of the Gaza Strip, the West Bank, and the Golan Heights has assured secure access to substantially greater water resources than for the Israel of pre-1967 boundaries. In this context, relinquishing the Golan Heights would mean losing control over a major watershed source of agricultural water; and granting limited autonomy or full independence to Palestinians in the West Bank and Gaza areas would mean (partly) relinquishing the control the Israelis currently exercise over the aquifer waters of these areas.
- For the Palestinians in the West Bank as in Gaza, to be entirely at the mercy of strategic Israeli water supply and resource development decisions under conditions of penury and tension, is simply evidence of “occupied territory” status which cannot be the basis of a durable peace.
- For Jordan, seeing their internal water quality situation continually worsen while the historically important sources of the Yarmouk River, the Jordan River between the Yarmouk and the Dead Sea, and the upstream sources of the Jordan and Yarmouk, are subject to increasing predations and pollutions by Syria and Israel (as well as by the Jordanians themselves), is in contradiction with national economic development and regional security aspirations.

Regional tensions are compounded by internal management stresses, notably those fundamental differences concerning the priority to be accorded to water use in agriculture—in the short and in the longer term—and how to assure water quality requirements in water reuse (such as wastewater use in agriculture).

3. ENVIRONMENTAL SECURITY AS A DIMENSION OF ECOLOGICAL DISTRIBUTION

Water in the Middle East can be addressed purely as a problem of conflict resolution. However, in keeping with the new interest in the ecological dimensions of development ideology and conflict, it is also worthwhile to consider how management of this resource can be approached from an ecological perspective. Environmental security is one of the many terms that connotes the extension and adaptation of traditional themes of political studies, political economy, and welfare economics to the new preoccupation with the environment (see Kok, 1996). Our purpose in this section is to summarize current perspectives on environmental security as an aspect of ecological distribution conflicts. This allows us to link water security analysis with the themes of justice, land, and labour that are constitutive of traditional political economics. As suggested in Figure 7.1, we adopt here an ecological economics perspective (cf. Faucheux & O'Connor, 1997; Hueting, 1980), from which point of view economic resource management must fulfill two complementary functions:

- the creation of an ecological welfare base through assuring the maintenance of critical environmental functions and amenities (lower portion of the diagram); and
- the creation of an economic welfare base through the production of economic goods and services (upper portion of the diagram).

In public economics and public policy analysis, especially since the Second World War, distribution refers to the requirement of resolving competing claims in society by different persons/groups on available or potentially available goods/services or money. Distribution is, therefore, always to some degree a matter of social tension and conflict. This view is inherent in the Marxist perspectives on political economy. By extension, we may also speak of ecological distribution to mean the social, spatial, and temporal patterns of access to the benefits obtainable from natural resources and from the environment as a life-support system, and of exposure to the dangers and harms from adverse environmental conditions (see Boyce, 1994, 1996; Martinez-Alier & O'Connor, 1996; O'Connor & Martinez-Alier, 1997; Rees, 1996; Rees & Wackernagel, 1994; Wackernagel & Rees, 1995).

Many of the determinants of ecological distribution (for example, climate, topography, land quality, minerals, and rainfall patterns) are clearly natural; others are products of social, political, and technological factors. The new prominence of environmental issues in the public policy domain signals the need to resolve not only economic distribution conflicts (those concerning income and marketable property), but also conflicts over ecological distribution.

The industrialization of the developed societies of the North has, in part, been made possible by European colonial exploitation of raw materials and productive labour from distant domains. Currently, the global dominance of the commodity society and

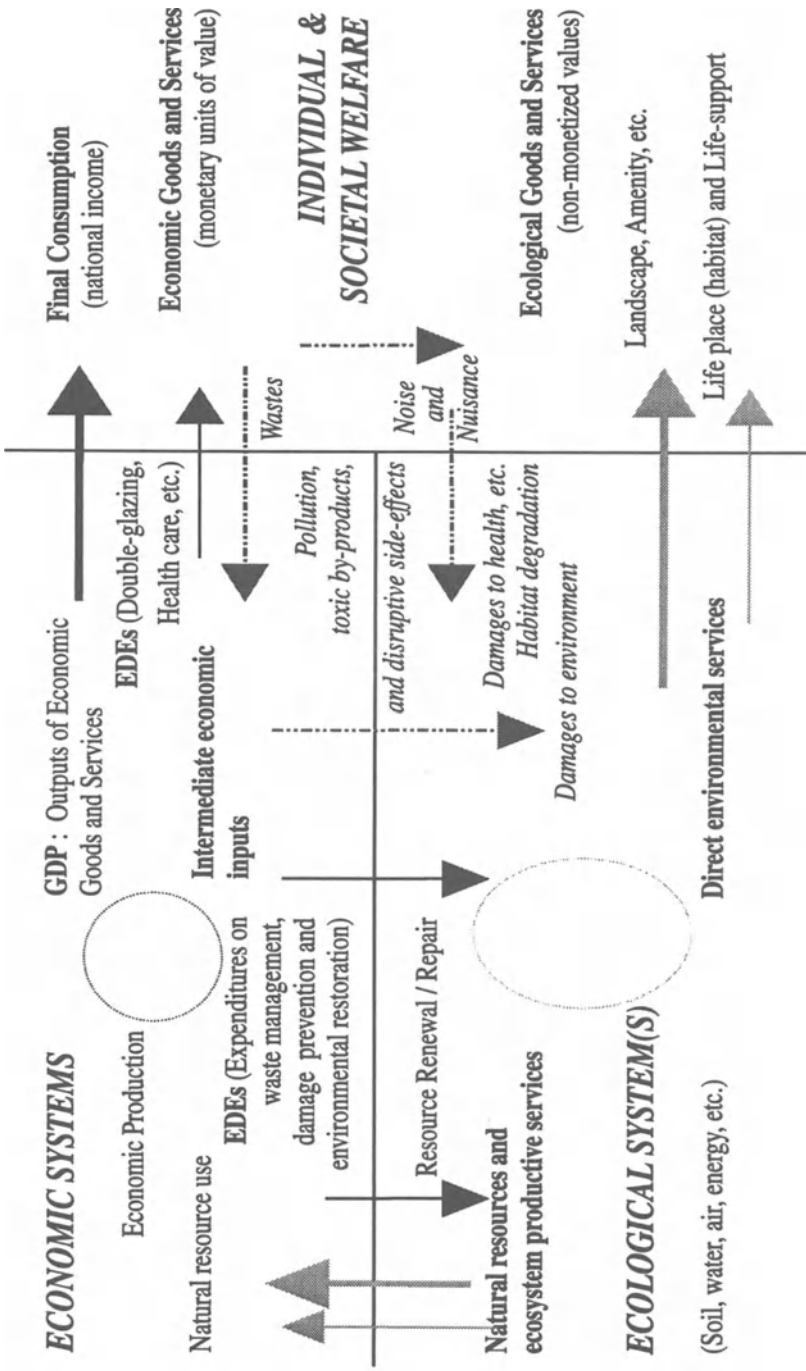


Figure 7.1 Interaction between economic systems, ecological system(s), and individual and societal welfare (Source: Brouwer & O'Connor, 1997)

the market economy—with the Third World countries still striving to catch up—means that there are no longer external domains for conquest. Since World War II, economic growth has been a heavily emphasized development goal of almost all sovereign states. This preoccupation with output growth and, in the case of strategic water resources, with the security of input supply, has historically been accompanied by neglect of the environment (Huetting, 1980; Kapp, 1983). Locally and more recently at a global scale, the absolute and per capita expansion of produced economic capital stocks has meant the depletion of stocks of natural wealth (including fish and forests as well as water, energy and mineral reserves) and the disruption of the biological life-support systems of the planet. As the finitude of the global ecosystem—and of regional water resources—becomes felt in new ways, the asymmetries of the development and conquest processes themselves become more plain (see Latouche, 1989; J. O'Connor, 1994; M. O'Connor, 1993a, 1993b; Sachs, 1993).

In what Kenneth Boulding and others have called the spaceship earth condition, the conflicts necessarily take the form of internal battles over access to environmental assets and benefits. One example is the social conflict that arises between local populations and outside interests over the destruction of the communal fabric of economic infrastructure caused by large-scale dam and irrigation projects. Another good example can be found in the setting of local communities and peasants against international agro-food and commercial biotechnology interests in the vying for the rights to steward ecosystems and exploit their genetic diversity and agricultural production potential (Faber, 1993; Gadjil & Guha, 1995; Gedicks, 1993; Goldman, 1993; Guha & Gadjil, 1992; Leff, 1986; Martinez-Alier, 1989, 1995; Sachs, 1993).

Most environmental resources and services are not marketable and never will be. Although water that is supplied through pipes or canals can be marketed, the ecological conditions of water quality and quantity production—and degradation—cannot be wholly commodified. We use the term *ecological distribution* to refer to the environment specifically as a source of human well being and to highlight its noncommodifiable nature. The term refers to the social, spatial, and temporal asymmetries or inequalities in the nonmarketed use of environmental resources and services. In these terms, we can ask the following types of questions:

- How is the distribution of benefits of natural resource and environmental exploitation currently patterned?
- What mechanisms of capital flow, institutional power, and technological change determine these patterns over time?
- Who carries the burdens of the unwanted side effects of resource exploitation and waste disposal?
- Which social groups benefit most, and which suffer most from the impairment of life-support functions and from the loss of environmental amenities resulting from environmental degradation?

- How are these benefits and burdens distributed across societies, space, and time?
How are these asymmetries valued (or devalued)?

In terms of water resources, the hydrological cycles and water management systems in question are complex, and the ecological distribution issues are, therefore, also complex. Especially in water-scarce regions, water does not only run downhill, there are also complicated recyclings and reuses and intersections between successive water uses and degradations. We will present two illustrative cases: the problems of water quality associated with Jordan's King Talal Dam and the emergency of water security in the Gaza Strip.

3.1 The King Talal Dam

Jordan is a mostly arid country that undergoes extremes of weather and highly seasonal rainfall. For example, according to Salameh (1996, p.10), only 3% of the territory receives annual precipitation of 300 mm or more, the minimum needed for the dry farming of wheat. High evaporation rates often result in seasonal droughts and salinization of both ground and dam-stored water. The Yarmouk River, which is on the northern frontier bordering Syria and discharges into the Jordan just below Lake Tiberias, and the Zarka River (sometimes spelled Zerka), which discharges from the Amman region into the Jordan, are the country's two most important watersheds, supplying water for both agricultural and town use. As mentioned previously, the capital city, Amman, now receives substantial quantities of relatively clean water from outside the immediate region. The used water is discharged through sewerage systems and through uncontrolled leakages and seepages. Much of the collected waste water eventually ponds in the large reservoir of the King Talal Dam on the lower Zarka River. This dammed water could potentially be valuable for irrigation; however, it is quite poisonous.

Dr. Raja Gedeon (1996), Director of the Laboratories and Water Quality Control section of the Water Authority of Jordan (WAJ), states:

Many aspects of the current practices of wastewater handling, use and disposal give rise to groundwater recharge and thus to significant risk of aquifer pollution. Additionally, wastewater use for agricultural irrigation involves major health risks. These practices are directly responsible for many of the endemic diseases associated with pathogenic bacteria and viruses. The risk is directly to agricultural laborers and indirectly to the general public consuming their products.

It arises primarily as a result of possible propagation of waterborne intestinal pathogenic bacteria, viruses and parasitic organisms, which are currently endemic in certain sectors of the population (11-6 Helminth eggs in influents).

The other long-term hazard is the potential build-up of toxic elements (notably lead, cadmium, arsenic and zinc and possibly also boron) in agricultural soils.

Although Gedeon makes explicit some basic principles of quality management, their realization is subject to compromise by circumstance. Gedeon continues:

In Jordan, wastewater treatment and crop restriction have been most widely adopted in controlled reuse practices... . A quality objective for treated wastewater, in terms of allowable permissible organisms, is therefore required for each reuse scheme... . Most municipal wastewater effluents may contain a number of toxic elements [and so] attention should be paid to these minor heavy metals when using sewage effluents of combined domestic and industrial origins for irrigation. (p. 3)

Currently in Jordan, the use of wastewater for agricultural irrigation often does not occur directly following treatment but, rather, after water has flowed through surface watercourses, whose flow in populated areas of the arid and semi-arid regions characteristic of Jordan is, in the dry season, often made up largely of a wastewater effluent-dominant stream. This is particularly true of the Zarka River base flow. The King Talal Dam, with a storage capacity greater than 1 year's inflow, has become a monster wastewater holding tank—with subsequent uncontrolled discharge. Salameh (1996) observes:

At present, the domestic and industrial waste water contributions to the inflows of the [Zarka] river [on which the King Talal Dam is situated] are estimated at 50% of its discharge. The water quality of the river changes dramatically between summer and winter. In winter, flood water constitutes most of the river discharge, and though it contains domestic refuse and waste water, the quality remains acceptable for most uses. (pp. 16-18)

Gedeon (1996) summarizes the situation from a different angle:

An effluent storage facility has resulted in improved water quality. The King Talal Dam Reservoir (storage capacity about 80 MCM) is the recipient body of the main stream emanating from a wastewater stabilization plant (discharge > 40 MCM/year). The blend of wastewater effluents with water base flow along the route to the reservoir during the wet season, in addition to impounded water, has provided additional treatment. The reduction of oxygen demand, suspended solids, ammonia and micro-organisms has been clearly observed... . Depending on the characteristic of reservoir water, some persistent heavy metals have been selectively diminished in the [King Talal Dam] effluent. (p. 5)

It is not clear that the King Talal Dam, which was completed in 1977 and made higher in 1989 (see Salameh, 1996, p.17), was originally meant to be an effluent storage facility. At any rate, the heavy metal stabilization is ambiguous. The figures given by Gedeon (1996) show the King Talal Dam mean annual effluent concentrations for 1996 to be lower than influent concentrations for the metals iron, copper, chromium, cadmium, and lead. However, mean annual effluent concentrations for 1996 exceeded influent concentrations for the metals magnesium, zinc, and nickel.

The containment of heavy metals in the King Talal Dam reservoir is likely to be unstable at best, as any net capture will necessarily accumulate in dam water or sludge, thus posing present and future problems of toxic buildup. Already, the King Talal Dam water is dangerous for agriculture. According to figures given by Salameh (1996, pp. 86-87), there are steady trends of increasing salinity and increasing chemical pollution. He concludes:

Early in 1991 the salinity of the water in [King Talal Dam] reached a value of 2900 μ S/cm. The water flowing out of the dam was heavily loaded with organic matter, contained relatively high concentrations of trace elements and was depleted of oxygen. Upon using that water in the Jordan Valley for irrigation via a pressurized pipe system, 6 thousand hectares of crops were damaged with an estimated loss of 30-60 million JD.

The lesson learned is that a combination of salinity, hypertrophic conditions, depletion of oxygen, richness in organic matter and trace elements with H_2S and CO_2 gases may lead to crop losses, especially if the water is transported in a closed system to the farms, using drip irrigation techniques. (pp. 86-87)

On the receiving end of all this, the water actually flowing into the Jordan River is virtually unusable for domestic or agricultural purposes. Chemical and industrial wastes including heavy metals and domestic effluents, which themselves include bacterially contaminated sewage, are one part of the water quality problem. Increasing salinization, due to maximal exploitation and consequent reduced in-stream and groundwater flows, is another part. But agriculture is not only a victim, it is also a culprit. Water pollutants from agriculture, including nitrates and phosphates from fertilizer applications, as well as pesticides, merge with ground water, natural stream flows, and other used water flows to produce an uncontrolled cocktail.

At the conclusion of a seminar held in Amman, the water resources problem was summarized as follows:

Population and development have overwhelmed traditional agricultural water management practices making new management approaches and new strategies necessary... . Attention to water quality degradation as it passes through the agricultural use portion of the water cycle is important. As water-scarce regions reuse water more times, its quality will deteriorate and has the potential to degrade soil resources. Today is not the time to repeat mistakes made by our predecessors. (CEC et al., 1994)

3.2 The Gaza Strip

The Gaza Strip, with nearly 1.1 million inhabitants and a population density of close to 4000 persons per square kilometre, is in a particularly fragile water situation. The Palestinian population has long been dependent on the coastal aquifer, which is their

only significant water source. Although exploitation of the water is, in principle, subject to administrative controls, there is a large amount of uncontrolled pumping which could soon result in disastrous consequences.

Salinity of the aquifer water is steadily getting higher. World Health Organization (WHO) figures indicate that 70% of the underground water has salinity exceeding 500 mg/litre (compared with the WHO upper recommended threshold of 250 mg/litre) and the salinity is rising by an average of 15-20 mg/litre per year. The intrusion of sea water, induced by the high rate of pumping, is putting the entire aquifer at risk. In simple terms, the aquifer water is presently stratified, with a layer of fresh water (fed by rain falling inland) on top of deeper salt water. There is also a top layer of water contaminated by fertilizers, pesticides, and household wastes which have entered through surface seepage, abandoned wells, and runoff. If the three layers significantly mix, disaster will result.

The situation is known to be dangerous. Poor infrastructure, often-dilapidated equipment, historically rooted anxieties, and lack of know-how are contributing factors to wasteful practices. Also, the absence of stabilized administrative resources means that many unauthorized water uses go unchecked. Scientific and engineering measures to improve both knowledge of aquifer recharge rates and flow dynamics, and monitoring of water quality changes are one part of urgent multilateral assistance measures being negotiated for the Palestinian authorities in Gaza. Education and technical assistance for improved water use in agriculture and urban zones, in particular for improved control of wastes, are also high priorities.

However, technical and administrative considerations must be set in the context of underlying social inequalities and insecurities. For example, there are some fundamental differences of perspective between Palestinian and Israeli authorities as to how to alleviate the Gaza water supply constraints:

- The Israelis have suggested that a desalination plant be constructed in order to supply Gaza with drinking water; the quality standards for aquifer groundwater and wastewater control would therefore relate solely to the needs of agriculture. The Palestinian authorities, in contrast, see the aquifer as their primary resource, and adhere to the objective of maintaining drinking-quality water from aquifer sources. They are mistrustful of becoming dependant on expensive and perhaps strategically vulnerable technological solutions.
- A similar debate has arisen in relation to infrastructure provision for a proposed Gaza Industrial Estate (GIE) intended to benefit regional development through the establishment of a free trade zone which would encourage Israeli as well as international capital investments. In view of the current over-exploitation of the Gaza aquifer, development assistance consultants had proposed that GIE water be provided by drilling on-site brackish water wells for industrial water and constructing a reverse-osmosis plant for drinking water. In early 1997 discussions, the Israeli side proposed that all water requirements could be provided by Mekerot, the Israeli

state water supply company. In contrast, the Palestinian Water Authority position was that, even if the Mekerot supply was accepted on a commercial basis, the brackish water wells and reverse-osmosis plant were essential to ensuring the GIE's viability and independence under all political circumstances.

Parallels between the management issues of water resources and those of the electricity supply (and other strategic infrastructure needs) could easily be developed. For example, despite an elevated unit cost, Palestinian planners' lean towards the construction of power stations within Palestinian territories as a way of reducing direct dependence on the Israelis. This strategic security preoccupation may, however, detract from the potential for improving the energy situation through more efficient use of existing power sources.

4. TOWARDS COOPERATIVE WATER MANAGEMENT IN THE PEACE PROCESS

Future management of water resources in the region is required to respond to a great number of conditions which are not easily reconciled. Water is held sacred in Jewish as well as Islamic religious traditions. Israeli legislation makes water the property of the state, while according to the Charia, water, as God's gift, should not be considered anyone's property. Under the Helsinki Accord of March 17, 1992, the parties in water disputes agree to develop principles for reasonable and equitable water use, and to manage transfrontier water resources in such a way as to not compromise the interests of future generations. Despite the obvious elements of hostility, it is increasingly common to see references to a community of interest and to the transfrontier waters as having to be considered as an integrated management unit in a cooperative process. In the Israeli/Palestinian study, *Joint Management of Shared Aquifers*, which we cited earlier, it is argued:

Previous experience with regard to transboundary river basin management has shown that in practice joint management evolves over time as the parties build up confidence and experience. As there is no inherent difference between surface and ground water in this respect, it seems advisable also in the case of aquifers to concentrate not only on the end-state of the JWM [joint water management] structures but also on the processes that may lead there. (Feitelson & Haddad, 1995, p.8)

Views concerning appropriate solutions for Gaza water security and Jordan Valley water resource management are inseparable from broader regional concerns. There are deep issues of "balance" to be resolved—including the geographical and physical dimensions of (in)security and sufficiency on the one hand, and the historical-symbolic sentiments of (in)justice and (lack of) good will on the other. If we were to

speak of a joint solution based on reciprocity and exchange, it is clear that we are in a much more complex terrain than that of the creation of property rights for market exchange.

In order to understand the multiple dimensions of environmental security with regard to the water problem, we provide the following examples of this complex terrain:

- There are striking lifestyle differences, standard-of-living inequalities, and politically constructed asymmetries in water access and water use. For example, average water use per person is much lower for Palestinians in the autonomous territories than for Israelis living in enclaves or adjacent areas. On the West Bank, an average domestic use per person per day is about 70 litres for a Palestinian, compared with 260 litres for an Israeli. The irritation felt by Palestinians may be not so much the desire to “catch up” with a high water-consumption way of living, as anguish to see a precious present and future resource being squandered in front of their eyes under conditions of antagonism.
- The same sort of inequality is evident in agriculture. Since the 1967 occupation of the Golan Heights and the West Bank, Israel has commanded the headwaters and the entire western side of the Jordan River Basin watershed. On the West Bank, both Israelis and Palestinians have historically used the Mountain Aquifer water. But since 1967 it has been monitored and controlled by Israeli authorities, leaving the Palestinian population with very fragmented and incomplete knowledge of the aquifer. Some 90% of West Bank Mountain Aquifer water extraction is, at present, designated to Israeli use—mostly for irrigation as well as, very significantly from a symbolic point of view, new housing implantations (initiated at a great rate after the provisional accords on Palestinian autonomy).
- For a variety of reasons, some related to the circumstances of the Israeli occupation, Palestinians have achieved much lower agricultural water-use efficiency than Israelis.
- Given that current exploitation of aquifers in the Palestinian territories is already close to (in the case of the Mountain Aquifer) or well beyond (in the case of Gaza) the levels that are sustainable in the long term, the Israeli control of water resource information and access in the autonomous/occupied territories is an extremely sensitive issue.
- For Palestinians, the right to a substantial share of the West Bank water resource and control over its use is a moral issue. Seen from this point of view, the appropriation by Israel of West Bank water could, in part, be compensated by an Israeli agreement to furnish additional water to the Gaza Strip. This provides one example of how a “regional” basis for cooperation over aquifer water is being sought where reciprocity has to bridge over mutual mistrust.
- The Jordan Basin can be understood as a matrix of inextricable interdependencies from north to south. From the Jordan point of view, the keynotes are mastery of water quality in the cascade of uses/re-uses, and sufficiency of inflows. The Israeli

preoccupations are similar, with the added complication of disputed Golan Heights and West Bank water sources. The two parties' preoccupations strongly interact in the Lake Tiberias district, where the Yarmouk River joins the lower Jordan. Up until now, each of the two parties has, essentially, acted alone, leaving the Jordan River as a no-man's-land between them. Transfers in both directions between the two parties are envisaged based on seasonal flow variations, improved storage capacities, and possibly desalination or brackish spring water purification plants. Successful implementation will depend on effective joint monitoring and a sentiment that, in terms of water quality and quantity "exchange," justice has been done.

- Irrespective of the Jordan River inflow volumes, salinities, and sovereignty contingencies (from which the Litani River watershed in Lebanon and even Turkish water should not be excluded), the foreseeable trend is to further reduce the lower Jordan River stream flow. The hydrological face of the Middle East is being irreversibly changed. What might be the long-term effects of continued drop in Dead Sea level (noting, *inter alia*, that the Dead Sea is the "attractor" basin for many of the aquifers in the region, ANTEA et al., 1995)? If the reduction in waters flowing from the Jordan Basin into the Dead Sea can (as talks have envisaged), potentially, be compensated by a Red Sea or Mediterranean Sea canal, what will the new hydro-system architecture imply for the cultural meanings of the Jordan and the Dead Sea?

The hope of finding new (partial? regional?) equilibria depends partly on achieving quantified balances of water volumes and quality between the parties. In this regard, the EXACT programme for establishing regional water resources data banks, with arrangements for common monitoring and information sharing, is indispensable. It would also seem constructive to establish some sort of multiparty water commission that could represent the various perspectives on water resource use within the Middle East region. We have already seen that a durable peace between Jordanians, Israelis, and Palestinians depends on assuring a secure and sufficient water supply to each area.

Some experts within the region have suggested that such a commission would have its own capital, provided by the core parties and support from outside countries, and would act to manage the seasonal variations in water resource availability. This commission would oversee a network of reservoirs, canals, hydro-electric dams, and so on, which might be nourished through access to water from Turkey and Lebanon.

Marwan Haddad, a Palestinian water expert, has proposed the creation of a regional water bank that would be financed by revenues received for water supply. The fees charged would take into account the local supply costs and investments in the regional infrastructure. He suggests the establishment of a regional water community comprised of Jordan, the Palestinian Territories, and Israel, with plans for enlargement to include Turkey, Syria, Lebanon, and Egypt. The bank would be called the Near East Regional Water Agency and it would derive its goals from Article 10 of the Helsinki Accord, which specifies fair and reasonable sharing of water within international watersheds, and from the Bellagio Treaty principles, which emphasize the integrated

management of transfrontier aquifers based on concertation within the community of interest and preservation of the quality of the resource.

In effect, the idea is to give force to the principles of economic solidarity—for example, rationalization of water resource allocations, establishment of sustainable use levels in order to avoid irreversible aquifer damage, and sharing of expertise on wastewater management, irrigation techniques, etc.—in situations where, up until now, the exploitation of the resource has been dictated by the political and strategic anxieties of each individual territory. Initial establishment of such an agency could be approached as a multilateral initiative (sponsored by the United Nations, for example). The objective would be to establish an integrated management capability bringing together representatives of the political units concerned along with representatives of water resource stakeholders—water users and distribution agents (such as municipalities and water companies), environmental protection agencies, and water research and technology development experts.

5. CONCLUSION

Even under the most optimistic of scenarios, the future of the Middle East will be marked by serious religious, cultural, and political-economic tensions. Within this matrix, the management of scarce water resources and water quality will remain critical. Many authors have suggested that an important part of the solution for effective water management is to make water users more accountable for the costs of the water supplied. This is probably true. However, this is a far more complex affair than establishing property rights and prices for water supply. The costs of water must be defined in relation to the overall objectives of water resource management. These objectives include the following (nonexhaustively):

- sustainability in renewable resource exploitation;
- avoidance of irreversible contamination;
- public health;
- promotion of regional peace through resource sharing that is judged fair and reasonable; and
- economically efficient water use for economic development consistent with the parameters for regional water sharing.

Just as it is common to speak of duties as the complement of rights, it is useful to consider commitments as the other face of costs. Access constraints and economic costs will be viewed negatively by the affected parties unless they identify with the purposes served by these constraints and resource commitments. We can see that the

principal challenge for regional water security in the Middle East is therefore to achieve a transformation in the agreed purposes of water management. Suspicion and hostility must, progressively and where possible, be supplemented by efforts at cooperation.

It is interesting, in this context, to reflect on the significance of the *environmental* dimensions of water as a strategic resource or security problem. In the history of human conflicts, environmental security, usually referring to food and water access, has always been a critical consideration. Today, in the Middle East as elsewhere, there is a heightened concern with the risk of irreversible loss of water resource quality, which threatens future economic prospects in the region for all parties.

One of the requirements of the new regime of regional water management is to provide for sustainability. On the one hand, this entails direct costs such as investments in complementary supply (e.g., desalination plants) and infrastructure (e.g., canals, new pipes, leak control), research and monitoring, waste management, and water treatment plants. It also entails lost-opportunity costs (foregoing exploitation beyond thresholds of safety for quality and quantity sustainability, especially in the case of the rain-fed aquifers). On the other hand, it includes collective commitments in the sense of the Brundtland principle—that is, providing for present needs while not compromising the interests of future generations.

A critical question becomes, *Whose present (and whose future) needs?* It is easy to understand why the Palestinians and Jordanians find it difficult to agree to principles of restraint in water use while their margins for manoeuvre are being cut to zero by what is perceived as grossly disproportionate use of water for Israeli irrigation. On the other hand, Israel defends its actions in terms of the necessity to sustain Israeli economic and political prospects for the future. One important step is, thus, to reframe the obligation of restraint as a responsibility of all parties for sustainable resource use. This can help to identify a shared objective—in particular in reference to a future common interest—so that not all water issues are defined simply by conflicts of interest. Yet, this can become credible only from the point of view of an agreed coexistence, and only if each party can see that the other is making an effort not only to protect its own interests, but also the broader community or regional interests.

The *symbolic* dimension of agreements to exchange water and share information is thus even more important than the economic costs and advantages that might ensue. Cooperation means mutual vulnerability. While each party, understandably, wants to ensure the security of a core water provision under its own exclusive control, cooperation must be seen as the positive side of interdependence. In this respect, there is much to be achieved through gestures of cooperation in domains that are, in themselves, noncritical. Such activities can be demonstrations of good faith. It is crucial to note that the exchanges in question are not, for the most part, transactions involving water, nor do they involve agreeing upon prices of water. Rather, they are gestures communicating human engagements and passions.

6. ENDNOTES

¹ The C3ED is an economics research centre at the Université de Versailles–Saint Quentin en Yvelines in France with expertise in interdisciplinary development and environmental analyses. Samir Allal specializes in development, environment, and energy resource studies in the Mediterranean region. Martin O'Connor specializes in ecological economics and political epistemology studies. Both have been recently involved in providing expertise in support of French contributions to multilateral programmes for improved water management and peace in the Middle East. We thank our colleagues at the C3ED, and we appreciate also the helpful comments from Aaron Wolf and other participants at the NATO Advanced Workshop on Environmental Security held on 9-12 October, 1997 in Budapest. Responsibility for any errors of fact, and for the opinions expressed in this paper, is the authors' alone.

² There is a substantial amount written on this subject and it is not our purpose to review. However, we would like to provide the following non-exhaustive list of English and French language publications: Al Tamimi, 1992; Cans, 1994; Chesnot, 1993; Dinar & Wolf, 1994; Klot, 1994; Lonergan and Brooks, 1994; Lowi, 1993, 1995; Naff & Matson, 1984; Picard, 1992; Wolf, 1995.

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Chapter 8

Sustainable Development and Environmental Security: A Pragmatic Approach for Hungary

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Despite the demand for sustainable development and improved environmental security, the environmental performance of some Eastern European nations leaves much to be desired. In Hungary, the transition to a market economy has been accompanied by a decrease in economic output. This decline is partly the result of economic restructuring and better enforcement of environmental laws. As high polluting industries are closed, Hungary's environmental performance has increased (albeit with a loss of jobs). To improve its position and gain acceptance to the European Union, the country's environmental performance must continue to increase, along with an increase in economic growth. This will require more stringent environmental standards and improved efficiency in existing firms. This chapter reviews the situation in Hungary, and calls for better appreciation of the multidimensional nature of the environmental risks facing the country.

1. INTRODUCTION

Since its publication in 1987, the report from the World Commission on Environment and Development, *Our Common Future*, has been the Bible of environmentalists. The report's most important message is that the desire for growth will result in the collapse of the biosphere and that traditional economic development is no longer appropriate. Many people consider sustainable development to be the solution. Environmentalists have long recognized that the theory of sustainable development does not require a change of paradigm. It is compatible with traditional economic theories and definitely does not require going beyond Pigou's theory on externalities. Sustainable development does not require imposing limits on our needs, but urges the satisfaction of these needs with less material and energy throughput. It is not difficult to understand why developed countries welcomed this framework almost immediately; it mitigates a bad conscience due to high levels of consumption per capita, and implicates the developing countries as major threats to the environment. In the name of justice, researchers from the developing countries are arguing for lower levels of energy use and low levels of raw material use from developed countries, while the latter blame developing countries for wasting natural resources. Regardless of who is at fault, the desire of citizens of developing countries to reach the consumption structure existing in the developed world is a mistake. However, if the less developed part of the world is to

steer away from the development path of the industrialized countries, then industrialized countries must make more of an effort to limit emissions. Instead of promoting efficiency, the focus should be on stabilizing consumption per capita. But, in practice, it is difficult to accept or gain acceptance for this principle. Despite the elaborate environmental programs, governments of the developed North fail to recognize that *thinking* about rationalization of use is insufficient; instead, consumption must be reduced in energy intensive societies.

Undoubtedly, the theory of sustainable development has significantly affected the economy by stimulating the dissemination of clean technology, introducing environmentally friendly consumption patterns, re-evaluating the significance of renewable resources, and defining growth not by quantity but by quality.

Development and the Environment (World Bank, 1992) discusses environmental protection as a determinant factor in development. Without protecting the environment, there is no development, and without development, the investments needed for environmental protection cannot be provided. Ehrlich and Ehrlich's (1990) well-known equation states that environmental impact is a function of both scale of economy and the efficiency of the economy:

$$I=PAT$$

where I = environmental impact
 P = population
 A = level of affluence
 T = impact of technology

Over time, the focus has been shifting from one factor to the other. When *The Limits to Growth* (Meadows et al., 1972) was published, the first two variables (population and the economic output) were the most important. In recent years, there has been increasing focus on the third function (efficiency). Terms such as sustainable growth have become buzzwords. The so-called super industrial breakthrough of technology is the foundation for the modernist answer to the environmental challenge. With huge improvements in efficiency, the environmental impacts of technology may be manageable in the next 30-40 years. With appropriate innovations, estimates suggest that the environmental impact per income unit can be reduced to as much as one-tenth of the 1995 level. This is a positive challenge for the research and development sector and for business as a whole. Cleaner production and reduced consumption patterns are having a positive impact on the environment and have won some breathing space for the world business community.

Academics and practitioners agree that the economic impacts of the worldwide movement toward environmental protection and management may soon become comparable with those of the industrial revolution. Often, however, business and academic observers see the results differently. Academics emphasize the strong business

opportunities inherent in the growing concern with environmental protection and management while business executives often see the threats of diminishing market opportunities, decreasing competitiveness, increasing costs, legal challenges, and uncertainties.

2. ENVIRONMENTAL MANAGEMENT IN HUNGARY

In Hungary, a general drop in economic production has accompanied the transition to a market economy, with only the last two years showing a growth in GDP. While emissions reduction is mainly due to the economic downturn, it can also be attributed to economic restructuring and better enforcement of environmental laws. These factors are responsible for the future feasibility of multilateral agreements, (e.g., on CO₂ and SO₂).

Hungarian industry has been privatized over the last 7 years. Today, more than 80 percent of business is in private hands. Some industries, such as metallurgy, have lost their former market share, while new industries, such as car manufacturing, have been established. The orientation of exports is changing rapidly. In 1996, more than 60 percent of Hungarian exports went to the European Union countries (see Table 8.1).

Table 8.1. The regional orientation (in percent) of Hungarian foreign trade¹

<i>Country</i>	<i>1928</i>	<i>1938</i>	<i>1978</i>	<i>1990</i>	<i>1994</i>
Germany	11.9	27.4	16.8	20.0	28.2
Austria	34.0	18.3	3.3	7.5	10.9
12 EU members	25.0	49.7	27.8	32.2	51.0
Romania	5.3	4.0	2.7	1.8	1.9
Soviet Union	0.4	0.1	30.5	20.2	11.6

Companies with obsolete technologies have folded because of bankruptcy due to the long recession. Although few, new investments made by multinationals, such as GE, Suzuki, and others, in the production sector have been, for the most part, environmentally sound. Hopefully, this new economic growth will be environmentally sound as well. The number and the share of small- and medium-sized enterprises have been growing rapidly. Initially, the environmental challenge appears as a threat. However, because they are mainly new investments, these enterprises can meet environmental requirements by incorporating clean technologies. From the environmental point of view, this is a benefit of the transition.

The principle objective of the Hungarian environmental policy, and other sectoral policies, is the transition to sustainable development, as advocated by the 1992 UN Conference for Environment and Development. Adapting cleaner production and technologies in sectors such as transport, industry, trade, and services is crucial for the transition to sustainable development. The reinforcement of preventive strategies is also a key objective of environmental policy in Hungary. This strategic and technological research area will continue in the coming years through particular emphasis on implementation processes.

Due to these developments, the National Hungarian Environmental Plan (draft) states that reinforcement of cleaner production is of strategic importance and should be supported by appropriate measures of infrastructure. In recent years, cleaner production has become the leading strategy of environmental protection in Western companies. This strategy has also become more significant in the field of environmental policy, economy, and technology through well-aimed organizational and budget measures.

Taking into account the principles of good management, economy, and expediency, the realization of cleaner production guarantees an immediate reduction in environmental pollution. This can be seen through reducing emissions and waste minimization, as well as through increased efficiency in industrial production. In addition, the use of cleaner technologies, strengthening of competitiveness, and ensuring sites for the long term through innovation are good pollution reduction strategies, as opposed to end-of-pipe measures. Widespread use of clean technologies and strategies is part of the harmonization of the Hungarian economy with European Union requirements and standards. It is also a precondition for possible closer, and more widespread, economic relationships with European markets.

Hungary has undergone many changes in its transition toward a market economy. The final aim is, of course, accession to the European Union. In order to achieve this aim, it is not enough to simply approximate the legal system. Change is also needed in the area of environmental management, including more widespread use of self-regulatory instruments, such as environmental management standards (EMS).

There has been a tremendous development in the field of EMS in the last few years. In many cases, the implementation of International Standards Organization (ISO) 14,000 follows the implementation of the quality management standard, ISO 9,000. In 1992, only ISO 9,000 was known in Hungary and not more than 5 to 10 companies were certified. By 1996, the number of ISO 9,000 certified companies exceeded 500 and the first steps were being taken for ISO 14,000 certification. There are also a small number of companies that are already certified for British Standard of environmental Management (BS 7,750) or ISO 14,001.

While these are good signals, the result of a small survey of executives shows that, from an environmental point of view, their environmental priorities are not well understood (see Table 8.2).

Table 8.2. How familiar are your employees with the environmental aims of your corporation?²

	<i>Very Familiar (%)</i>
Senior Management	76
Management	66
Workers	29

Furthermore, executives ranked the importance of various groups when making environmental decisions as follows: (a) consumers; (b) authorities; (c) shareholders; (d) employees; (e) citizens; (f) the next generation. More and more, individual executives are being held legally responsible for the environmental damage caused by their companies. Until now, this has occurred mainly in the United States and Canada, but as the concern with environmental issues spreads, governments in other countries are also beginning to hold managers legally liable. This generally results in defensive reactions from managers, who either demand changes in legal requirements or seek stronger personal protection against the potential consequences of the activities of their company.

The first step in designing an appropriate environmental management strategy is assessing the company's ability to manage its environmental risks, where risk is determined according to the probability of causing environmental damage and the seriousness of that damage. A company's environmental risk depends not only on its own activities, but also on external factors—the context (physical, legal, cultural, etc.) in which the company exists. Similarly, in determining broad environmental consequences, not only the physical environment, but also the social environment in which the company operates must be considered. Public reaction to environmental damage is often shaped not so much by facts as by perceptions of facts; this discrepancy accounts for much of the debate between managers and engineers and the rest of the population after environmentally damaging incidents. Experts and the public often perceive and evaluate the same facts differently because their knowledge of the facts, perceptions of damage, and social environments differ.

In assessing a company's environmental risks, two dimensions should be analyzed. First, endogenous environmental risks include risks incurred due to the internal operations of the company, including the materials, technologies, and human resources used in the manufacturing process. Second, exogenous environmental risks are determined by assessing the company's external world: its location, the ecological characteristics (biodiversity, winds, etc.) of the physical environment in which it operates, the demographics (population density, age, education level, income distribution, etc.),

infrastructure (roads, weather treatment system, waste management, hazard handling systems, telecommunication networks, media, etc.), and popular attitudes toward environmental hazards. Political institutions play an especially important role in exogenous environmental risks.

Any corporation facing environmental management challenges must also deal with two questions: First, what level of environmental standards is appropriate for the company to strive to achieve and what strategy should be used to achieve it; and, second, at what level of the organization should environmental issues be addressed? If the business opportunities offered by increasing demands for environmental protection are overestimated, a company may initiate projects that do not produce revenues. However, if a company does not spend enough to comply with regulations, it may be unable to meet new or stricter requirements in the future. This could result in catastrophic costs, fines, penalties, or other legal liabilities that may threaten competitiveness, profitability, or survival.

Generally, environmental challenges define the external conditions under which companies must operate. Management can either consider them as a given and try to *react* to them or try to be *proactive*, forecast future changes, and adapt to them in advance. A company's management may also pursue an *offensive strategy* and decide to set new trends and develop new "green" products and technologies.

Because of Hungary's application for European Union membership, Hungarian legislation and environmental performance has been examined from a European perspective. The International Institute for Management Development (IMD) publishes a yearly competitiveness report (1996), in which they evaluate a country's performance in a variety of ways. We extracted some figures to evaluate how the environmental and overall performance has changed between 1992 and 1996. Based on the rankings, clusters can be created according the difference between the overall and the environmental performance. There are five groups of European countries:

- Among countries in the first group, such as Sweden, Austria, and Switzerland, overall performance is good and environmental performance is excellent. In these countries, not only is ecoefficiency high, but environmental assets, such as arable land per capita and the urbanization levels, are high. They therefore have ample environmental assets.
- Among countries in the second group, such as Denmark, France, Germany, and Italy, overall performance is in harmony with the environmental performance. In these countries, the favorable natural environment is combined with a relatively lower level (in European terms) of population density and urbanization.
- The third group contains countries such as Hungary, Spain, and Poland where the environmental performance is much better than the overall performance. This is due to the benefits of underdevelopment and favorable natural circumstances (fertile soil, low urbanization level, etc.).

- The fourth group contains countries with relatively good overall performance but weaker environmental performance, such as Norway, UK, Belgium, Netherlands, and Ireland. In this group, the problem is not weak environmental management, but is, in most cases, high population density and/or the necessarily overgrown economy (high per capita energy consumption).
- The fifth group of countries exhibits both low overall performance and low environmental performance. In cases such as Greece or the Czech Republic, the environmental infrastructure is weaker.

Although it would be a mistake to overevaluate the reliability of the above mentioned data, some correlation can be seen (see Table 8.3).

Table 8.3. European countries ranked according to their environmental infrastructures and their overall performance

<i>Country</i>	<i>Environment</i> ³		<i>Overall performance</i> ⁴		
	1992	1996	1992	1996	OP _% -E _%
Hungary	35	16	39	39	23
Sweden	4	2	10	14	12
Austria	5	5	12	16	11
Switzerland	3	1	7	9	8
Spain	25	22	30	29	7
Poland		36		43	7
Finland	11	12	21	15	3
Denmark	10	4	6	5	1
France	15	19	16	20	1
Germany	9	11	5	10	-1
Italy	22	29	27	28	-1
Portugal	29	38	31	36	-2
Netherlands	7	10	8	7	-3
Luxembourg		13		8	-5
Greece	44	45	41	40	-5
Czech Republic		40	39 ⁵	34	-6
Norway	31	14	22	6	-8
United Kingdom	26	31	15	19	-12
Belgium	34	30	13	17	-13
Ireland	42	43	24	22	-21

3. CONCLUSION

Hungary faces significant environmental challenges as it prepares to enter the twenty-first century. Despite the clamor for sustainable development and improved environmental management, most of Hungary's improvements in the environmental area are the result of the closure of polluting industries and the subsequent loss of jobs, as well as lower levels of GDP growth. To be competitive in the world market, and to be acceptable as a future member of the European Union, the environmental standards of Hungarian firms must be improved. Increasingly, higher standards are being applied and new firms locating in Hungary have brought with them improved efficiency. This should continue to move Hungary towards a more sustainable future.

4. ENDNOTES

- ¹ Europai tuekoer, 1996. Integracios Strategiai Munkacsoport, 3.
- ² BUES Department of Environmental Economics and Technology, 1996. A survey for environmental management. Budapest, Hungary.
- ³ This ranking is based mainly on the following factors: glass recycling rate, waste-water treatment plants, greenhouse index, carbon dioxide emission, arable area, and urbanization.
- ⁴ This ranking is based on eight factors: domestic economy, internationalization, government, finance, infrastructure, management, science and technology, and people.
- ⁵ 1994.

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Section III

Regional Perspectives on Environment and Human Security

Chapter 9

Islands in the Midst: Environmental Change, Vulnerability, and Security in the Pacific

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Popular imaginations of the Pacific are of unspoiled islands. However, in both the colonial and postcolonial periods, economic and social transformations have led to widespread environmental and resource degradation. Weak economies and limited social capital raises questions about the internal capacity of the Island nations to cope with environmental variability and change. The analysis draws on concepts of *vulnerability*, specifically the notion of vulnerability as a “hazard of place,” which integrates both biophysical and social considerations in defining vulnerabilities in a particular place. For the Pacific Islands, vulnerability is analysed with reference to resource exploitation, threats from toxic substances, and climate variability and change. Since the concept of vulnerability of place encapsulates social and institutional capacities to cope (*social vulnerability*), there is reference also to institutional responses to environmental degradation and change.

1. INTRODUCTION

Seeing these volcanic islands and coral atolls, and wandering, above all, through this cycad forest on Rota, has given me an intimate feeling of the antiquity of the earth, and the slow, continuous processes by which different forms of life evolve and come into being. Standing here in the jungle, I feel part of a larger, calmer identity; I feel a profound sense of being at home, a sort of companionship with the earth (Sacks, 1996, p. 225).

Sacks evokes a common image of the islands of the Pacific—peaceful, unaffected by the wider world, steeped in natural splendour, and evolving gradually along a path defined more by nature than by people. It is the imagery of films and tourist brochures. It would be wrong to suggest that these images of the Pacific are entirely misleading, but they do obscure another reality. Indeed, earlier in the same book Sacks recounts his arrival at Johnston Atoll, a small island that has been exploited by the United States for its resources since the late 1800s and that, more recently, has been used by that country as a nuclear test site and a dumping ground for dangerous chemical wastes.

After almost a thousand miles, we at last saw land—a tiny, exquisite atoll on the horizon. Johnston Island! I had seen it as a dot on the map, and thought, ‘What an idyllic place, thousands of miles from anywhere.’ As we descended it looked less exquisite: a huge runway bisected the island, and to either side of this were storage bins, chimneys, and towers: eyeless buildings, all enveloped in an orange-red haze... my idyll, my little paradise, looked like a realm of hell (Sacks, 1996).

Colonel Jim Nielsen of the U.S. Pacific Army said of Johnston Atoll: “Feared by some as a toxic wasteland contaminated by scattered plutonium and spilled dioxin, remote Johnston Atoll sits at the center of the Pacific, and of Pacific nations’ concerns over global environmental issues” (Nielsen, 1992). The vulnerability of the people of the Pacific arises from things far more numerous than the threats of contamination by the toxic chemical soup of Johnston, however.

My objective in this chapter is to assess the vulnerability of the Pacific Islands to environmental change and to reflect briefly on aspects of the institutional responses in that region to environmental change. The analysis of vulnerability and adaptation is underpinned by the following propositions:

- Vulnerability in the region is the product of both internal tensions and the pursuit of political and economic agendas by agents based outside the region.
- Environmental degradation is an outcome of political and economic agendas, which suggests that the relationships between environment and security must be assessed with reference to the wider political economy of the Pacific. For example, resource and environmental ‘imperialism’ is a significant feature of the region.
- Vulnerability and the implications for security need to be assessed with reference to the effects of external agents on cultural norms and customary practice, which have been undermined by forms of social and economic organization that are different from those traditionally observed in the region.
- Environmental change is a cumulative process in the sense that it is the product of many different processes and activities operating at a range of spatial scales.
- Prescriptions for institutional adaptation to environmental change have often been founded in models applied to developed Western economies, without adequate thought as to the implications of their transfer to Pacific Island nations.
- The Pacific Islands provide a good example of the benefits of regional cooperation as a method of institutional adaptation to threats to security, even though the foundations of the alliance are not entirely stable.

The next section deals with the question of vulnerability, which is assessed not only in terms of direct environmental threats, but also in terms of the economic and political processes that give rise to these threats. The response of the Pacific Island states to environmental change is considered primarily from an institutional perspective.

2. VULNERABILITY

Concepts of vulnerability have long been employed in the natural hazards field, where they have referred, in general terms, to the “potential for loss” (Cutter, 1996). However, in a recent analysis of the concept of vulnerability, Cutter draws out some important distinctions in the way in which the term has been used. She defines *biophysical vulnerability* as the potential for loss from natural hazards or disasters, which necessarily requires an explicit consideration of the social relationships with the environment in a particular location (i.e., nature of human occupancy) as well as the physical dimensions of the hazard itself (e.g., magnitude, duration, frequency, etc.). *Social vulnerability* refers to the social and institutional capacity that defines both susceptibility and the ability to cope with hazards. Cutter indicates that much of the work in this tradition has been concerned with chronic disturbances, including climate and environmental change, droughts, and famine. In addition, “this perspective highlights the social construction of vulnerability, a condition rooted in historical, cultural, social and economic processes that impinge on the individual’s or society’s ability to cope with disasters and adequately respond to them” (Cutter, 1996). More recent contributions to the hazards literature have provided perspectives that integrate the biophysical and the social dimensions, offering analyses of vulnerability in specific geographic locations or in “social space,” thus addressing the issue of *who* is vulnerable. Cutter has referred to these more recent traditions as “vulnerability as a hazard of place.”

This framework is a useful one in which to structure an analysis of vulnerability of the Pacific island nations to environmental change. The primary aim is an assessment of vulnerability of place, the important elements of which are considered under the headings of resource exploitation and degradation, testing and toxins, and climate change/sea level rise.

2.1 Resource Exploitation and Environmental Degradation

Anthony (1990) suggests that, because of their geographic location, the islands of the Pacific have two resources that are particularly significant: their climates and their marine resources. While, from a regional perspective, this is true, the land-based resources of countries like New Caledonia, Papua New Guinea (PNG), and the Solomons include significant mineral wealth, forest resources, and agricultural productivity. Both in the past and today, all of these resources have been the focus of competition and conflict, leading Anthony to claim that “the history of the Pacific Islands is in no small measure a history of conflict over natural resources.” He suggests that the conflict has previously been centred on land-based resources, but that the rediscovery of the Pacific has expanded the domain of conflict to include the region’s valuable marine resources. As Anthony also mentions, the Pacific Islands’ equable climate and attractive natural

environments have helped establish them as internationally renowned tourist destinations; tourism can be seen as another contemporary cause of resource exploitation and its associated environmental degradation.

Vulnerability of Pacific Island communities can be expressed in terms of levels of resource depletion and the extent of environmental degradation, but the explanation of this vulnerability demands an understanding of the political economy of the region and its constituent nations. The most significant single characteristic of the region's political economy has been its colonization and, latterly, a new resource 'imperialism.' Colonization by European countries began in the early 16th century and continued more or less uninterrupted up until the mid-20th century, by which time the region had been widely exposed to capitalist economics, Western religions, new diseases, and immigration. Mackensen and Hinrichsen (1984) suggest that the early colonization of the region was driven more by political than economic imperatives:

Most of the Pacific was transformed into colonies not because of its significance to Europe and North America, but rather due to "power politics" and economic rivalry among Britain, France, Spain and Germany (and later the U.S.). During the 18th century in particular it was fashionable to have a colony or two in the Pacific. It confirmed world power status.

In the period after World War II, most nations of the region achieved independence, while, at the same time, the region became strategically much more important to the U.S. The influence of European nations declined, although some, particularly France, have maintained a significant presence. According to Mackensen and Hinrichsen (1984), the importance of the region to the U.S. and the persisting European nations lay in the access to transport lanes, seabed resources, fishery resources, and the strategic significance of the region vis à vis the Soviet Union. In most cases, the move to independence was peaceful and uneventful, particularly when compared to the struggles of Africa, Asia, and elsewhere, but as Robie (1989) notes, the reluctance of France to relinquish its interests in Vanuatu led to the Santo rebellion, which was the first of several violent political struggles in the region. Wars of independence have been fought elsewhere and continue in Kanaky/New Caledonia, East Timor, and West Papua/Irian Jaya.

While most of the island nations have secured independence from their colonial masters, the postcolonial period is just as marked by high levels of economic, military, and political incursion. And, while many of the nations traditionally represented in the region remain (e.g., the U.S., France, etc.), the influence of Japan and the newly industrializing nations of Southeast Asia is rapidly expanding.

A recent Food and Agriculture Organization (FAO) report (1996) profiles the weak condition of the island economies, which is a key factor in explaining contemporary

patterns of resource control and exploitation, as well as the future vulnerability of the region in economic, social, political and environmental terms. In the report it is noted, for example, that economic growth has been outpaced by population growth, which is at rates that are amongst the highest in the world, with the result that real per capita incomes have not improved. In addition, in recent years, the prices of exports relative to imports have shifted. Moreover, "exports are...vulnerable to external disturbances, including recession in trading partner countries, the effect of weather on export supplies, and strong competition from larger low-cost countries of the region having greater comparative advantage" (FAO, 1996). An important contributing factor to the trade imbalances are the rising demands of Pacific Islanders for imports, including non-traditional foods. The report explains, "Such a high degree of dependence on imports for basic food supplies lays open the economies to threat from disruptions in international markets, such as the current high cereals prices, with potentially serious consequences for SPSIDS (South Pacific Small Island Developing States) which already have severe balance of payments difficulties." In *The Pacific Way*, the 1992 report to the UN Conference on Environment and Development (UNCED) from the 14 member countries of the South Pacific Regional Environment Program (SPREP), the rapid growth in demand for imported goods, together with the weak domestic economic bases, is similarly noted and is interpreted as responsible for the fact that "bureaucracy, aid, social services, and remittances from citizens abroad play the dominant economic roles in many Pacific island economies." There are social costs as well, including dietary diseases (e.g., anaemia, obesity, diabetes) and poor child nutrition, as well as food insecurity, which is the consequence of an increasing reliance on imported food products (FAO, 1996).

The economic vulnerability of many of these nations is also a result of the relatively narrow resource bases. The FAO notes that:

Agricultural, forestry and fisheries in the region are practically everywhere under threat from over-exploitation and in need of urgent measures to preserve and regenerate them, while ensuring their rational exploitation for the present generation. Productivity of both crops and livestock is low and pests and diseases pose serious problems. (1996)

The FAO report also identifies the widespread incidence of resource degradation that is accompanying the increasing levels of resource exploitation. These effects include erosion, flooding, water pollution, and loss of genetic resources as a consequence of forestry. Mining and agriculture have similarly caused widespread and extensive environmental damage. A recent UN Environment Programme (UNEP) report predicted that, in the period to the end of the millennium, forest cover will continue to decline, and that soil erosion, flooding, soil salinity, and species extinction will increase (Hay et al., 1994).

The FAO report is largely silent on the underlying causes of and the matter of responsibility for the resource exploitation and degradation, although the following statement hints at these issues:

Natural resources tend to be seen by modern society as goods to be exploited in order to draw maximum economic benefit from them. Local people often view such resources in other ways, attributing cultural, religious or simply recreational value to them. (1996)

Others have been more direct on this score. In a commentary on resource exploitation in Papua-New Guinea, for example, Murphy-Dunning and Moriarty (n.d.) of the Rainforest Action Network highlight the involvement of multinational corporations, lack of government resources to monitor and regulate resource exploitation, and rampant internal corruption, which has led to “widespread tax evasion, violation of environmental regulations, and, most particularly, non-payment of royalties to landowners and the national government.”

Murphy-Dunning and Moriarty (n.d.) also echo the popular theme that the problems of resource exploitation and the associated environmental degradation are a consequence of a conjunction of the resource imperialism of other countries and multinational companies and the pursuit of economic opportunity by Pacific Island governments, which has often been accompanied by corruption. Environmental problems associated with resource exploitation thus derive from the region’s colonial past, the contemporary economic and strategic interests of other nations and corporate capital, weak domestic economies, as well as the inherently fragile nature of the islands’ environments. Anthony (1990), for example, suggests that the dominance of foreign interests in the commercial fisheries of the Pacific has come about partly because the island nations lack the necessary capital, technical expertise, and access to international markets. Pacific Island governments have therefore entered into licensing and joint venture agreements with Taiwan, Japan, the USSR, and South Korea. What is significant from the perspective of resource sustainability is that these agreements often do not specify limits on the size of catch, but only on the number of vessels operating (Anthony, 1990).

The effects of resource exploitation are apparent not only in terms of increased environmental vulnerability, but also social dislocation. Ghee and Valencia (1990), for example, observe that “just as industrialization changed the equilibrium between humankind and resources in the West, colonialism weakened indigenous cultures in Southeast Asia and the Pacific, and introduced new approaches towards the environment and natural resources.” These new approaches emphasize the acquisition of material wealth, the commodification of natural resources, and the emergence of social stratification. This is in marked contrast to traditional societies that emphasized “aesthetic, cultural and spiritual aspects of life,” and in which communal systems of property rights prevailed. According to Ghee and Valencia, the social and economic transformation of

Pacific Island nations as a consequence of colonialism and the penetration of capitalism has led to the intensification of conflict over the control and use of resources, conflicts that are likely to worsen as feelings of nationalism consolidate. Their sobering prognosis was that:

these resources (e.g., minerals, metals, fuels) are already deeply imbedded in regional and international political rivalry, and conflict over them appears likely to intensify.....At the local level, conflict over natural resources among competing groups of users, including tribal communities, peasants, fishermen, miners, loggers, and corporations, has not only continued unabated but threatens to worsen in the coming years. (Ghee & Valencia, 1990)

The issue of social transformation is addressed also by Wesley-Smith and Ogan (1992) in their analysis of the Bougainville crisis. Their argument is that the Australian mining operations introduced social stratification to a society that had previously been based on more egalitarian social relations. The commodification of land and labour and the emergence of a group who benefited from their interaction with the giant CRA mine fundamentally changed social relations on the island. For example, the society had traditionally been matriarchal, but "key positions in the mine, cooperative societies, and private businesses were invariably occupied by men" (Wesley-Smith & Ogan, 1992). Also, younger men, and particularly those with some education, profited more from the presence of the mine than their elders did. Thus,

in general, the combination of widely varying compensation payments, royalties, wage employment connected with the mine and related enterprises, and differential success in cash cropping produced extraordinary variation in income in an area that had previously been characterised by a relative egalitarianism. (Wesley-Smith & Ogan)

Wesley-Smith and Ogan also suggest that the emergence of a more pronounced social stratification was a significant contributing factor to the violent conflict that has raged since the late 1980s. In part, the conflict can be linked to a clash of cultures, since the history of colonialism and the more recent introduction of capitalist relations has not eliminated traditional forms of social organization; for example, some Bougainvilleans do not acknowledge claims on land (see also Viner, 1984), and women have continued to assert their position within society despite the economic inequalities between the sexes that have emerged recently.

The same root causes of the Bougainville crisis have been identified by Powes Parkop, a PNG lawyer. Like Wesley-Smith and Ogan, Parkop (1992) focuses on the social and cultural implications of development by international capital as a major contributing cause to the conflict over the Panguna mine:

This development model, while initially granting several years of substantial economic growth from mining, cash crops and logging, has in the long run proven to be destructive for most people. While there was economic growth, distribution of benefits was highly unequal. Mining, logging, and plantation industries had little local participation in equity, management control and benefits. On the other hand, cultures were disrupted and changed. The environment was destroyed, disrupting the life support system it provided, with disease and poverty the only reward for many people. (Parkop, 1992)

The social, cultural, economic, and environmental dislocations associated with large-scale resource development projects is not, of course, limited to the high profile Bougainville war; in PNG alone, the Japanese Honshu Paper Corporation (GANT) operations in the Gogol-Naru valley, which have resulted in the clearance of more than 37,000 hectares of tropical forest, and other mining projects such as those at Ok Tedi, Porgera, and Misima have brought about similar dislocations (Emberson-Bain, 1993; Murphy-Dunning & Moriarity, n.d.; Seddon, 1984; Viner, 1984). Moreover, "It is one of the ironies of mining 'development' that it has tended to consolidate rather than reduce economic dependence for Pacific countries and that in the process it has caused a decline rather than improvement in quality of life for its supposed beneficiaries" (Emberson-Bain, 1993).

Resource exploitation and its associated environmental effects is part of a global dynamic. While there is a tendency in some quarters to represent acute conflicts such as the one in Bougainville as a battle over resource ownership, or to construct resource degradation as a result of poor resource management practices (including sometimes blaming traditional patterns of land ownership!), the root causes of resource decline and environmental degradation lie in historical and current patterns of political and economic power. In short, most Pacific Island economies are weak, which is a result of their narrow production bases, lack of investment capital, vulnerability to international shifts in consumption patterns and prices, and deteriorating trade balances as a result of rising demand for imported food and other consumer products. Over their colonial histories, different forms of social and economic organization have been introduced, the results of which have included an increased measure of social stratification and inequality, commodification of resources, and cultural dislocation. While most nations have now achieved political independence, the postcolonial period is marked by a high level of strategic, political, and economic investment by other countries and multinational companies. In view of their economic plight, Pacific Island governments have typically welcomed these incursions. However, the obvious conclusion is that, in social, economic, and environmental terms, contemporary patterns of resource development and exploitation have only tended to increase the vulnerability of Pacific islanders. In some cases, such as Bougainville, the insecurity has contributed to acute conflict.

2.2 Testing and Toxins

The disposal of wastes, including those that are classified as hazardous or toxic, is both a domestic problem of many Pacific Island nations and one imposed upon the region as a consequence of the strategies pursued by other countries. However, the region's use as a site for the detonation of nuclear weapons, on the other hand, is entirely an imported problem. In *The Pacific Way*, the report to UNCED by the member nations of SPREP, it is observed that "the physiological characteristics of some Pacific Islands, their isolation and oceanic location, and their dependence on a marine and limited terrestrial resource base make them vulnerable to contamination by hazardous wastes and radioactive materials" (SPREP, 1992). In terms of the physical vulnerability of the islands, Brodie and Morrison (1984) indicate that the low-lying atolls have limited areas of land, low natural soil fertility, and groundwater systems that are susceptible to contamination; the high islands, such as Fiji, the Solomons and New Caledonia are subject to erosion and water contamination.

The problems of waste disposal are primarily a consequence of economic and social transformations, including industrial development, modern agricultural systems, and urbanization. Brodie and Morrison (1984) refer specifically to problems posed by pesticides (including some, such as DDT, which are now banned in developed countries), wood preservation chemicals, industrial effluents (e.g., metals, high BOD wastes, cyanide, acids and alkalines), urban garbage, and sewage. The problems are accentuated by an absence of adequate monitoring of environmental effects, inadequate regulations governing the use and disposal of chemicals, a lack of control over imports of chemicals or wastes, and a widespread lack of knowledge about the correct use and disposal of chemicals and other waste products. In the report to UNCED it is observed:

The history of waste disposal in the region has led to a growing awareness of the danger to the Pacific environment and the health of its people. The region has no capacity for monitoring pollution from toxic or hazardous substances. Controls of the importation, storage, sale, safe use and disposal of biocides are necessary. The fundamental need for labels to be printed in the local language is rarely met. (SPREP, 1992)

Just as the patterns of resource exploitation are a consequence of colonialism and the influence of outside agents in the post-colonial era, so are these domestic problems of waste disposal. In most island states, altered patterns of production and consumption that are an outcome of exposure to the ideals and the trappings of Western capitalism are inescapably the foundation of problems of environmental contamination.

The problem is not just one arising out of the transition of domestic economies, however; part of the problem of hazardous wastes in the region is due to dumping by other countries. Johnston Atoll stands as a landmark to this predatory practice. Its history of exploitation by the U.S. extends back to the 1800s when it was mined for

guano (Nielson, 1992). In the 1930s, the U.S. Navy carried out a programme of construction to facilitate the servicing of planes, ships and submarines, which involved destruction of coral reefs, land reclamation and dredging. During the post-War period, the U.S. used the atoll as a staging point for nuclear tests and, in the 1970s, chemical munitions, including Agent Orange, were dumped at Johnston. An accident involving nuclear-tipped missiles in 1962 led to plutonium contamination of soils. Summarizing the atoll's toxic past, Nielsen says:

Today, the legacy of earlier contamination still exists, and the careless storage of the dioxin-laden herbicide, disruption of the reef, and the destruction of thermonuclear weapons on and above the atoll have damaged the environment. Recovery programs, now just beginning, will require millions of dollars and many years to complete.

However, as Branch (1984) notes, Johnston has not been the only dumping site in the region. He cites the accidental discharge of nuclear wastes onto reefs at Moruroa by the French in 1981, the deliberate dumping of 31 containers of nuclear waste by the University of Hawaii off Honolulu between 1956 and 1970, and dumping of nuclear waste off the coast of California between 1946 and 1970. The attitude that the region is a convenient disposal site for the unwanted and potentially hazardous outputs of other countries was also expressed in the 1980s when Japan announced what proved to be a controversial plan to dump thousands of drums of nuclear waste north of the Mariana Islands (Branch, 1984).

What have undoubtedly attracted the most attention internationally, though, are the nuclear testing programmes of Britain, the United States, and France. The testing of thermonuclear weapons in the region began in 1946 and, in the 12 years to 1958, the U.S. detonated 66 bombs on the islands of Bikini and Eniwetok (Danielsson, 1984). Britain detonated bombs at Christmas Island beginning in 1957 and the U.S. also carried out detonations there in 1962 during what Danielsson describes as the most concentrated series of tests in the region (25 detonations over a 4 month period). Testing in the vicinity of Johnston Atoll was conducted in 1958 and again in 1962. All of these tests preceded the ban on atmospheric testing under the 1963 Partial Test Ban Treaty. The French testing programme at Moruroa began in 1966, with the first series of tests involving detonations above ground. Testing of nuclear weapons by France at Moruroa has continued more or less uninterrupted until 1995, when France declared a cessation.

The French testing programme has been extremely controversial and has incited overwhelming resistance throughout the region. This resistance to France and the testing programmes of other nations has been a significant source of international tension. For example, the U.S. Ambassador to Fiji commented in 1982 that "the most potentially disruptive development for U.S. relations with the South Pacific is the growing antinuclear movement in the region. The U.S. government must do everything possible to counter this movement" (cited in Robie, 1989). It was France, however,

that most distinguished itself in this regard: the French government perpetuated an act of terrorism against the people of New Zealand when the French military bombed a Greenpeace vessel in Auckland harbour, killing one person.

The actual extent of environmental damage done and the potential for radioactive contamination in the future remain uncertain, however. A report of the SPREP Technical Group on Radioactivity observes

that exposure to artificial radionuclides, mainly the radionuclides formed during past nuclear weapons tests in the atmosphere, is on the average lower, perhaps two or three times lower, in the South Pacific region than it is for the world as a wholeIn general, the contribution to total radiation exposure due to artificial radionuclides is small and is much less than the variability that exists in exposure to natural sources of radiation. (Bacon et al., 1985)

At the same time, however, the Technical Group comments that certain islands do record unusually high exposure to radiation. The affected islands include Nuie, Guam, and the Marshall Islands, and the higher than normal exposure is attributed to weapons testing (Bacon et al.).

With France maintaining an effective blockade on independent scientific inquiry into the extent of contamination at Moruroa, it is impossible to determine with any confidence what the existing levels of pollution are or what the future risks might be. The official line remains that environmental contamination is low and the risk of leaks in the future from underground blast sites is negligible. This position was supported by the report of SPREP committee in 1985:

Overall the Technical Group concluded that the present nuclear weapons testing and the proposed low-level waste disposal involve only a small, quite possibly a non-existent risk to human health and the environment in the South Pacific Region. The group found little scientific basis for judging these activities to be unacceptable (Bacon et al., 1985).

Irrespective of the actual environmental and health risks, however, it is indisputable that the unwelcome intrusion of Britain, the U.S., and France in the form of nuclear weapons testing has given rise to a sense of vulnerability amongst the people of the Pacific, which has undermined their security. Aside from the environmental damage and risks, the nuclear testing programmes represent yet another example of imperialism in the region, along with a flagrant disregard for the welfare and values of the people. Robie (1989) cites this statement from the preamble to the *People's Charter for a Nuclear Free and Independent Pacific*:

We, the people of the Pacific, have been victimised too long by foreign powers...Alien colonial, political, and military domination persists as an evil cancer in some of our native territories, such as Tahiti-Poly-

nesia, Kanaky, Australia and Aotearoa (New Zealand). Our environment continues to be despoiled by foreign powers developing nuclear weapons for a strategy of warfare that has no winners, no liberators and imperils the survival of all mankind....

While less emotive, the SPREP Technical Group qualified their conclusion as to the absence of scientific evidence for environmental damage and risks by saying, "this conclusion does not in any way deny that important legal, political, and moral principles might very well be involved in, and dominate the evaluation of them" (Bacon et al., 1985).

2.3 Climate Change and Sea level Rise

Global warming and sea level rise are the most serious environmental threats to the Pacific region. Island countries are particularly vulnerable because they include many hundreds of low-lying islands and atolls, house most of their populations and many important economic activities in their coastal zones, depend on scarce supplies of potable groundwater, have limited areas of arable soils, and are at great risk from natural events. (SPREP, 1992)

There is a perception that the most significant implication for Pacific Island nations of a systematic change in the climatic regime will be a rise in sea level. As well as the actual drowning of some low-lying islands and atolls, the possible effects of a rise in sea level include accelerated coastal erosion, salt water intrusion of fresh water reservoirs, and an increased landward reach of storm waves (McLean, 1992). Scientific evidence suggests, however, that this risk is overstated and that there are other environmental consequences of climate change which might be more significant. Hay (1997), for example, commented that "the most significant and more immediate consequences are likely to be related to changes in rainfall regimes and soil moisture budgets, prevailing winds (both speed and direction) and in short-term variations in regional and local sea levels and patterns of wave action."

McLean (1992) has shown through an analysis of the recent (Quaternary) historical record that there have long been large absolute and relative variations in mean sea level in the Pacific region. These variations correlate with a variety of climatic and oceanographic parameters, which can reasonably be expected to prevail in the future. McLean also notes that insufficient recognition has been given to the fact that there will be regional and local variations in the actual extent of sea level rise, and he points out that the historical record of global sea levels shows considerable variability at any particular time. He also points out that projections of sea level rise have been revised downward and "in so doing are tending to converge closer to estimates based simply on extrapolation of observed sea level rise during the last century." Based on these

observations and the evidence in the historical record, McLean suggests that any rise in sea level as a result of global warming is likely to be overshadowed by “seasonal, inter-annual, and other short term climatically determined variations.” He concludes:

Climate models now predict that global mean sea level will reach about 48 cm above present level in 110 years time. In the interim, the peoples of the Pacific Islands will have to plan for and cope with regular fluctuations in mean sea level in the order of 20-40 cm, as well as the episodic extremes resulting from storm surges, hurricanes, and tsunamis.

In spite of this and other scientific evidence, it remains that climate change and predictions of an associated systematic rise in sea level are represented, and have been widely accepted, as critical threats to the environmental security of the region. In *The Pacific Way* (SPREP, 1992), for example, the vulnerability of the environment was expressed in terms of coastal erosion, loss of mangrove forests, destruction of agricultural and forest resources, coral mortality, threats to inshore fisheries, contamination of fresh water lenses, and loss of sea grass beds. It was also posited that the prospect of sea level rise represents a threat to foreign investment.

For the island nations of the Pacific, two characteristics of the sea level question contribute to its gravity. One is the uncertainty about the extent and character of any systematic change in sea level. Hay (1997) notes, for example, that the global climate models cannot provide reliable information at a scale that is relevant to Pacific Island countries. He also suggests that the assessments of possible effects of climate change are unhelpful:

For Pacific island countries, the development of responses to global warming is further impeded by the fact that many regional and national vulnerability assessments have been undertaken using methodologies which are, at best, poorly harmonised with local conditions. Local applicability of methods is frequently in conflict with the legitimate desire to undertake studies using comparable methods that facilitate global intercomparisons and global assessments.

The second dimension of concern is the powerlessness of Pacific Island nations in the face of an environmental problem almost entirely not of their own making and over which they have only limited control.

The perceived threat of sea level rise to the Pacific islands and other small island states has been successfully imbedded into the international negotiations over climate change, due largely to the concerted efforts of groups like SPREP and the Alliance of Small Island States (AOSIS). For example, the Langkawi Declaration on Environment, which was an outcome of the 1989 Heads of Government of the Commonwealth, acknowledges the vulnerability of coastal and island states to sea level rise and is a declaration of support for the efforts to protect these countries from the perceived

threat. Similarly, a resolution of the UN General Assembly in 1989 (UNGA Resolution 44/206, 22 December, 1989) encouraged all states to assist those countries most at risk and recommended that the issue be considered by both the Intergovernmental Panel on Climate Change (IPCC) and at the planned 1992 UNCED meeting (UNEP, 1993). AOSIS was formed at the 1990 Second World Climate Conference and immediately embarked upon a lobbying campaign to highlight the vulnerability of the member nations to sea level rise. A measure of success was achieved in that the 1992 UN Framework Convention on Climate Change does give explicit recognition to the concerns of small island states and (under Article 4, paragraph 8) puts it upon all parties to consider the circumstances of island nations when fulfilling their obligations under the convention (UNEP, 1993). Thus, whatever the real character of climate change-induced sea level rise will be, the vulnerability of small island nations has been effectively constructed as one of the main lines of discourse in international negotiations.

3. RESPONDING TO ENVIRONMENTAL CHANGE

In reference to the possible threats posed by climate change and an associated change in sea level, Hay (1997) notes that the potential for most Pacific island states to have any tangible role in mitigating the environmental effects is negligible. This means that the main response strategy must revolve primarily around adaptation. As far as the climate change issue is concerned, Hay suggests that, having always had to deal with marked environmental variability may have imparted a degree of resilience on Pacific Islanders. At the same time, however, he recommends a regional action strategy, to include:

- regional cooperation;
- a policy of “owning” the climate change issue;
- identifying ways to maximize the benefits of climate change;
- improved factual understanding of climate change;
- mainstreaming responses to climate change in national planning;
- enhancing the capacity to respond to the consequences of climate change; and
- a policy to improve regional security.

While there is an obvious truth in Hay’s (1997) observation that small island states can not have very much direct influence in terms of mitigating the effects of climate change, there is the already realized capability to exert meaningful pressure on other countries, as AOSIS and SPREP have done. While these regional consortia might be seen as an adaptive institutional response to environmental change, they have, through

lobbying and negotiation, the potential to compel powerful players to employ strategies of mitigation.

The theme of regional cooperation as a form of governance through which to mediate the outcomes of global environmental changes has emerged quite strongly (e.g., Gupta, 1996; Porter & Brown, 1991; Schrijver, 1996; Vogler & Imber, 1996) and the experience of the Pacific Islands has been reflected on positively. Palmer (1992), for example, refers to the Convention for the Protection of the Natural Resources and Environment of the South Pacific, which he says contains a "comprehensive legal framework to implement a plan for managing the natural resources and environment of the area." Another success was the role of the South Pacific Forum in its campaign to ban driftnet fishing, which led to the Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific. According to Palmer,

Although regional issues are the paradigmatic case for regional organizations, such organizations can also be useful in dealing with global issues such as the destruction of the ozone layer and global warming. Consensus-building at the regional level often expedites the progress of further meetings held at the global level.

The experience of the small island states in international climate change fora bears testimony to this.

Despite the obvious success that the Pacific island nations have had in terms of establishing and participating in regional governance, which has undoubtedly led to better protection for the resources and environments, as well as highlighting the vulnerability of these nations to climate change induced effects, both the regional alliances and the environments which they seek to protect are exposed and fragile. In the wider context of global affairs, Dalby (1992) has suggested that the workings of international capitalism, which keep resource-based commodity prices low and which maintain income discrepancies, will only tend to perpetuate the economic (and thence social and environmental) insecurity of the lesser developed nations. With reference to the Pacific, Ghee and Valencia (1990) make a similar point in their analysis of regional agreements dealing with marine resources:

Reliance on some glamorous slogan like 'the Pacific way' as a means of solving problems may be illusory when the interests of outside powers are threatened and large amounts of money are at stake. In a generation or two, what now appears to be a comfortable consensus may turn out to be paper-thin and brittle indeed.

Later on, with respect to resources in general, they comment, "As pressures and enticements increase to develop both land-based and marine resources, there will be a temptation for some anxious governments to short-circuit whatever exists in the corpus of environmental law in the interests of securing contracts from prospective developers."

The fact is that the economic disadvantages that are the experience of most of the Pacific Island states are going to persist for some time to come, if not indefinitely, while, at the same time, other nations and agents will continue to exploit the resources of the region for profit and gain. In the face of pressure to improve their economic lot, national governments, which continue to be locked into an ethos of the nation-state and sovereignty, might be tempted to sideline regional priorities in favour of localized economic benefits, particularly if these can be realized in the short term. According to Ghee and Valencia, the collective approach has so far worked well in terms of formulating regional approaches to resource management, but the challenge will lie in mediating tensions and conflicts within, particularly as the institutional, political, and economic context in which they are operating becomes increasingly complex.

One of the key impediments to maintaining an effective regional system of governance, though, will be the lack of capacity of state governments, as well as the dominance of elite national powers, many of which are corrupt. While the leak of the Australian government's background papers on Pacific Island leaders in 1997 was undoubtedly a serious diplomatic blunder, there can be little doubt that the accusations of corruption and incompetence contained a fair measure of truth. On more or less the same issue, Ghee and Valencia (1990) pose the rhetorical question:

When the Pacific Century is over, will it be said that islanders slept through it all while those who controlled the mechanisms of power in island states, with few exceptions, danced late into the long and weary night, celebrating plunder disguised as development?

In terms of institutional responses to the threats to regional and national security in the Pacific, it is worth reflecting briefly on prescriptions for administrative and economic reform. Consider, for example, the following suggestions of the FAO (1996):

The public sector remains very strong in most countries of the region and there is scope for considerable privatization which normally should lead to more efficiency. Investors will be all the more willing to take over as macro-economic reforms, accompanied by measures to increase productivity and labour are taken.... Governments will retain a role, alongside the private sector, to define national policy goals, correct market failures and ensure environmental sustainability and social well-being and equity.

A recommendation to impose the ideology and the framework of the neo-liberal restructuring agenda that has dominated many Western nations over approximately the last decade must be a matter of concern. Goodman and Redclift (1991) argue against the imposition of "Northern" environmental managerialism, suggesting, "It can be argued, indeed, that attempts to manage the environment in developing countries, in as much as they are predicated on Northern experience, are not merely unworkable, they are also frequently prejudicial to the interests of the poor." Suggestions, such as that

from the FAO quoted above, would seem, with respect to the role of governments in the Pacific, susceptible to this very accusation. Indeed, later in the FAO report there is an oblique acknowledgment that 'modernization' is undermining traditional attitudes and decision making structures, a consequence of which is weakened capacity to deal with resource and environmental issues.

Rather than imposing a contemporary Western-style administrative and economic restructuring regime upon Pacific Island nations, what might be more effective would be building upon and adapting the more traditional approaches to decision making. Certainly, the postcolonial experience with Western politics has not been an entirely happy one and the way forward may not be to reform within this structure, but to contemplate systems of governance (both nation-state and regional) that are more strongly rooted in local values and mores.

4. CONCLUSIONS

There is no question that threats to the security of the Pacific islands are posed by environmental change. Resource exploitation and the associated degradation of the physical environment, widespread contamination of terrestrial and marine environments, and the possible effects of climate change are the three main causes for concern. Vulnerability to these threats, though, can only be understood with reference to the political, economic, cultural, social and environmental contexts in which they are imbedded. The history of resource and environmental exploitation by outside interests, for example, is a central theme. Colonialism brought about social, cultural, and economic transformation, as well as pervasive environmental change. Little has changed in the postcolonial period, partly because Pacific Island countries are in a desperate struggle to achieve a measure of economic security and, in so doing, are inevitably engaged in an internationalized economic system, which is at least as exploitive of the resources of the region as the former colonial states. Economic pressures, the erosion of traditional forms of social and political organization, and the widespread corruption of the ruling elite class all conspire against effective protection and management of the region's environment and resources. These problems are exacerbated by the fact that some of the problems that loom largest (e.g., the perceived threat from climate change) lie far outside the direct influence of the region's nations.

The vulnerability of the Pacific, then, is both cumulative and globalized in its character. It arises out of historical and geographic circumstances, and is inextricably linked to the contemporary economic, social, and political context. Ongoing resource exploitation and environmental degradation are manifestations of this vulnerability, and the effects upon the resource base and the environment, in turn, contribute to the insecurity of the region and its people.

In terms of responding to environmental change, much of what is required is capacity building: better information, a wider spread understanding of environmental change, improved economies, and improved systems of administration and governance. In terms of institutional adaptation, there is a popular view that regional cooperation in the Pacific has been quite successful thus far. The South Pacific Regional Environment Programme and the participation of Pacific island states in AOSIS have contributed measurably to environmental management in the region, as well as to highlighting the vulnerability of these nations in international fora. The very same political and economic conditions that underpin the vulnerability of the region, though, have the potential to destabilize these regional alliances. Since regional cooperation is an important part of the response to global change, a key priority must be to consolidate and strengthen systems and structures of regional governance. There will be a measure of conflict with the ideals of sovereignty, particularly when, for most countries, the shackles of colonialism have only recently been shed, and domestic politics and economics will, in some cases, be countervailing forces. Yet, based on the demonstrated successes of regionalism thus far, there is foundation for optimism.

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Chapter 10

Institutional Adaptation to Global Environmental Change and Human Security in Central and Eastern Europe

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This chapter attempts to assess the capability of the countries of Central and Eastern Europe (CEE) to adapt to environmental change and the effect possible scenarios of adaptation may have on the security of the people and societies living in the region. It argues the following: (1) The fall of Communism left the CEE vulnerable to environmental turbulence, a situation that can be attributed to a negative environmental legacy; an indifference to environmental threats among leaders; a low rate of technological change; societal alienation and anomie; and a political and economic legacy that inhibited the development of communication links between all levels of government. (2) The importation of Western institutions and technology into the region during the transition period is forcing the countries to undertake fundamental institutional restructuring as long-held values and societal behaviour patterns confront and adapt to the imports. In most countries, the import process is in its incipient phase, and it is still unclear whether institutional transformation will increase these societies' capacity to prevent or correct environmental turbulence. (3) Currently, the main goal of institutional and technological change in the CEE is to meet the criteria for membership in the European Union (EU) and possibly NATO. However, this goal fails at both the national and regional levels to promote serious, constructive discussion aimed at finding coping and preventive strategies for handling potential ecological problems. The chapter concludes with an evaluation of several alternative institutional mechanisms available to the CEE for enhancing regional and national security in the face of environmental change.

1. INTRODUCTION

Environmental problems contribute to human insecurity along three basic dimensions (see Figure 10.1). Vertically, every environmental problem is *nested* in a set of problems that may start at the local level, move to the subnational level, and then to the national, regional, and finally the global levels, or any combination of these. It may skip levels, or start at any of the intermediate levels of social organization. Our understanding of the typology of nestedness is still rudimentary, and this lack of understanding constitutes a major lacuna in our approach to environmental security. On the horizontal dimension, environmental problems interact across the whole spectrum of human security issues: economic, food, health, personal, community, and political. The pattern of interdependence is as yet insufficiently understood to permit accurate prediction. Finally, there is the temporal dimension. Human actions that initially seem

beneficial to society become major environmental threats as the action assumes institutional form. The unintended consequences of the sustained development and application of technologies, such as the automobile, are examples. Another temporal aspect is our continuing inability to predict accurately natural environmental turbulence. While our knowledge of earthquakes, hurricanes, and volcanoes has grown substantially in the years since the introduction of the computer, we are not yet at the point where we can say with certainty that *this* environmental event will occur at *this* time with *this* intensity and *this* effect. The whole politics of global warming derives from the uncertainty of science regarding the cause, progress, and outcome of a given event.

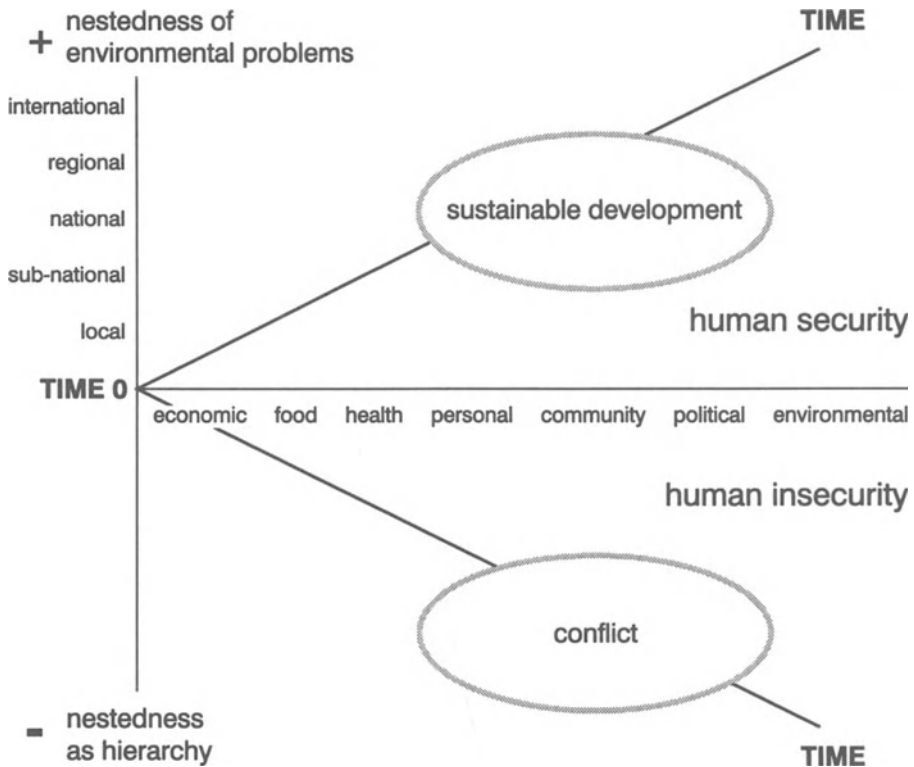


Figure 10.1 The dimensions of environmental security

Why should the international community care about the CEE? The core economic reason is the West's concern for the energy resources in Central Asia and the Caspian. Ethnic conflict, political instability, limited managerial skills, and a low level of economic development have contributed to placing at risk the exploitation of the oil and

gas fields, as well as the pipelines that would transport the oil and gas to the West. A second reason is rooted in the environmental threat posed by the pollution and exploitation of the regional seas and inland waterways. Third, there is an environmental threat posed by the outbreak of conflict. The ravages of war make once arable land unusable, causing populations to flee to countries that appear safer, richer, and more comfortable. Finally, there are the tangible global threats of another Chernobyl somewhere in the area, and the contributions to global warming by the CEE through their continued reliance on coal as a primary source of energy.

2. THE LEGACY OF COMMUNISM IN THE TRANSITION

2.1 The Geophysical Factor¹

The fall of Communism revealed the extent of environmental destruction caused by the pursuit of rapid economic development. Virtually all this environmental degradation transcends national borders, engendering severe secondary social problems, contaminated food, undrinkable water, and the return of bacterial diseases. The CEE's environmental problems are not, nor can they be, contained within the borders of one East European country. The relatively small size of the countries, the multiple borders, and the disintegration of previous political entities compound the problems. These factors make transboundary pollution a crucial issue in the environment/security linkage.

No one state acting unilaterally can solve any of these problems, nor can that state compel neighbouring polluting states to take action. Most often, several states are joint polluters. In some cases, such as the Nagymoros litigation and the controversies surrounding the use of nuclear energy, countries view attempts to limit or prohibit access to a natural resource or energy source as a threat to national independence or domestic well-being. In terms of energy security, the problems faced by small countries in handling transboundary pollution, generated largely by the use of coal as the principal energy source, are evident in the decline of the forests of Krkenose National Park, which is situated on the border of Poland, the Czech Republic, and Germany. The radioactive fallout from Chernobyl, threatening food and water supplies, provides the most sinister evidence of the region's vulnerability to crossboundary pollution. Few waterways lie wholly within one East European country and conflicting national demands upon the use of these waterways has increased pollution. The regional seas suffer from the same problem. Security is particularly at risk in the Black and Caspian Seas with their large oil and gas reserves. Having a marine coastline already involves the coastal state in international issues, in which otherwise it might have little interest; where key energy reserves are concerned, the coastal state partakes in direct and on-going relations with the interested countries.

The geophysical aspect of environmental problems demands all CEE states develop efficient institutions at the regional level that can effectively work with the member states as well as with the international community.

2.2 The Democratic Deficit

Since the end of Communist rule, and in all successor regimes, there has been fierce jockeying for power between the political and economic interest groups that had acquired positions of influence during the Communist period. These groups include the upper and middle level bureaucratic elite; the scientific, professional, and technical elite; and the workers and peasants. The most critical issue in decommunization has been the transfer of natural resources and human-made industrial assets into private hands. Perhaps the most salient characteristic of the transition period has been the ability and tenacity of the Communist bureaucracy to hold on to the instruments of power. In all countries, the nomenklatura distinguished itself by the speed and rapacity with which it acquired the newly privatized factories and enterprises, and by the ability of its members to transform themselves from party apparatchik to economic moguls. Elections in the region reflect the political path of the nomenklatura as it developed its efforts to maintain its influence and control. In Rumania and Bulgaria the old leadership elite held on until 1996. In Poland, the voters see-sawed between Solidarity and the former Communists. Presidential elections in Estonia followed the same pattern.

Today, the new democratic governments have coopted the scientific and professional elite to assist in developing the capabilities necessary for promoting rapid economic growth. This cooptation effectively deflected attention from environmental remediation to doing whatever is necessary to join the international community, specifically the EU and/or NATO. The middle level administrators have sought to keep or extend their control over the economic resources formerly under their jurisdiction but which, through privatization, threatened to pass into the hands of the top level elite. This latter group promotes their country's economic enterprises and natural resources as investment opportunities for foreign capital. The struggle over ownership continues to take place amongst the elite with charges and counter charges of corruption and illegality.

Critically important is the fact that the West has become the arbiter of what democracy is in the region, because it demands a stable democracy as a prerequisite for membership into the EU and/or NATO. In this context, the meaning of democracy is in conformance with Western rules and standards, particularly in the economic and military areas. Today, all the countries of East Central Europe and the newly independent states (NIS) have legislatures whose representatives are, more or less, freely elected in a classical Western competitive electoral process. There may be strong or

weak presidencies, or there may be conflict between legislature and presidency, but most of these countries have some kind of constitutionally independent judiciary, most proclaim the rule of law, and most endorse civil liberties and a free press. Also, most have devolved greater autonomy, either voluntarily or involuntarily, upon regional and local governments.

The new constitutions and legal reforms, however, have yet to persuade the people in this region of the virtues of democracy. Political infighting does not encourage them to believe in the value of a democratic political system, particularly when this infighting is interpreted as a major reason for the poverty of the majority of the peoples in the region. There have been efforts, notably in the environmental area, to build public participation. Report after report stresses the importance of public participation to undergird the legitimacy of the new institutions, to provide the population with a sense that democracy is not a fiction, and to assure the public that their demands are indeed being heard.

Despite these efforts, the public continues to exhibit the apathy and anomie it displayed during most of the Communist period. Voter turnout of 60 percent is considered high.² Interviews with professionals conducted by the author in the summer of 1997 suggested that most did not believe a change of face or another candidate would bring any improvement to the situation, and thus saw no point in voting.

Like the people of the CEE, the EU and NATO do not believe that democracy has taken deep root in the region. Each institution has selectively chosen for admission those countries whose democratic systems seem, at this time, most secure, and delayed admission to the countries where democracy is still in question. The transition period has demonstrated that the adoption of democratic institutions and procedures does not necessarily mean that the country is, or is becoming, democratic. With the possible exception of the Czech Republic, Estonia, Hungary, and Poland, the assertion of democracy is open to reasonable doubt.³

2.3 The Nomenklatura: Knowledge and Managerial Capacity

Knowledge and managerial capacity in the CEE, as it emerged in the transition, retained both positive and negative characteristics of the Communist period. On the positive side, one Communist legacy was a well-trained, world-class scientific community. Each country also had highly trained economists. Some of these were trained in the West, others, in Moscow. By 1989, all the countries of the CEE had a trained core of environmental professionals and experts, most of whom retained their former positions or were promoted to higher positions in the new governments. Among the scientific and technical elite, the environmental experts were signally important in promoting radical change in the communist system prior to 1989 (see Jancar-Webster, 1987). A number of scientists and experts either received training or participated in

exchange research programs in the United States and Western Europe (for a review of these exchanges see Jancar-Webster, 1990). With the collapse of the Communist regimes, those countries whose scientists and professionals had contacts with the West were strategically placed to develop and intensify professional contacts, and to gain ready access to Western technological and scientific information. However, access to world science and technology remains a persistent problem.

The negative side of the Communist legacy was the monopoly of the Communist Party and its dictates regarding the training of managerial and administrative personnel. A deeply entrenched patronage system and the top down principal of accountability influenced aspiring managers or administrators to perceive the top of their ministerial hierarchy as their source of orders and personnel instructions, as well as their pay and bonuses. Because the enterprise plan was subsumed under the ministerial plan, the manager at the plant level often was not trained in those aspects of business management that are commonplace in the West—planning and budgeting, personnel management, and technological development. Individual actions and initiatives were not considered important qualities.

Privatization brought the former Communist trained managers into management positions in the privatized industries. A considerable number of these did not, and still do not, understand how a privately owned corporation is run; nor do they believe that privatization is necessarily a good thing. In all countries, the managers of the largest and most strategic industries continue to oppose privatization. If privatization is inevitable, they urge slowing the pace of change.

Economist and former Russian prime minister, Yegor Gaidar, likens the Communist managerial legacy to industrial fiefdoms (Gaidar, 1995).⁴ The fiefdoms' managers derived their enormous power from the five-year agreements between the enterprises and ministries on the quantity and quality of products sold and purchased. The huge bonuses they earned were not invested locally but used for conspicuous consumption, placed in Swiss banks, or invested on Western stock markets. The current managers in the region have not changed these past practices. There is no country in Eastern Europe that has been spared the ramifications of corruption, the golden parachute, the bribing of government officials, and the resultant undermining of government institutions. The 1996 World Bank Report decried the fact that Russian managers and enterprise owners continued to take their money out of the country, starving the economy of capital for investment. That same report stated that Russia's "robber capitalism" would not change unless the government asserted sufficient authority to enforce laws and regulations (Goble, 1997). Russia is not alone in this problem. In the national parliaments, government administrations, and regional and local leaderships, the old nomenklatura retains its dominant position. The major change is in the composition of the business elite, where individuals who are willing to take risks are often successful.⁵

The holdover of communist attitudes and practices by today's managers is the second factor contributing to environmental insecurity. Under the Communist regime, the priority was industrial production. Every country in the region had introduced some environmental legislation by the late 1960s. As the pollution worsened, the legislation became stricter, covering all areas of environmental pollution. Eventually, it was possible to boast that the standards for air pollution in Czechoslovakia or the Soviet Union were stricter than those in the West. Stricter regulation, however, produced few results, as the regulated and the regulators were in the same ministry. Environmental indicators were forgotten as plant managers rushed to meet the economic and production targets.

Today's managers remain focused on production and economic development. Despite the popular movement generated by adverse environmental conditions in the late 1980s, environmental considerations remain a low priority in the minds of the new owners and managers of industry. As is the case in the political arena, managers are made to realize the importance of pollution controls through their obligation to meet the pollution norms set by either the EU or the international community. The risk is that managers, in their interest to produce export goods, may become unscrupulous in joining joint ventures or in signing export agreements that place no constraints on production methods or product requirements.

2.4 Economic and Technological Conditions

In economic terms, the Stalinist legacy may be described as the freezing of the region's economic capacity into a time warp located somewhere between the second (petrochemical) and third (information technology) industrial revolutions. This condition can be attributed to the insistence on state-owned industries, and the resultant lack of technological development.

The Soviet course of development was based on a one-party system, centralized planning, and state ownership of natural resources and the means of production. The five-year and one-year plans were legal documents that set explicit targets and production goals for most enterprises. Depending on its strategic significance, every enterprise was subordinated to a national ministry or provincial authority. Every branch of the economy had a lead ministry or competent authority that oversaw the operations of that branch. Huge industrial complexes were concentrated in metropolitan areas, and there was virtually a total absence of competition. These complexes were monopolies, controlling resources and serving as the sole producer of a specific line of products throughout the country in which they were located, and throughout the Council of Mutual Economic Assistance (CMEA), the Communist variant of the West European Common Market. In effect, the CMEA economic plans institutionalized a system of barter where, for example, each year Hungary was assured the purchase of

a predictable number of busses by the Soviet Union, in exchange for highly subsidized oil and gas. Where a high-tech firm in the United States might have 80 percent of its sales annually in new product lines in order to maintain market share, the CMEA enterprises were assured of sales, no matter what quality of goods they produced, as long as the product was included in the plan. Not only was innovation not needed, it could be very risky. Since prices, labour, and material costs were set by the national governments, there was no incentive to reduce costs, or to seek more efficient production.

The industrial leviathans were all-powerful at the local level, insensitive to local needs, responsible only to their bosses at the top of the economic pyramid and, ultimately, environmental time bombs. The larger cities—Warsaw, Krakow, Prague, Bratislava, Budapest, and Bucharest—contained many such industrial complexes. Today, Moscow, the largest city in the CEE, is the most polluted city in Russia. The extraction of resources followed a similar path, concentrating production into giant extractive units. Resource removal in the Kola Peninsula and in Siberia resulted in very high human, material, and environmental costs.

Economic development during the communist period meant extensive first generation industrialization. The smokestack industries built during this phase, such as iron and steel, consumed huge quantities of highly polluting energy. The state subsidized energy use in all branches of the economy, including personal consumption. Planning and control of the economy were performed by centralized ministerial entities far removed from the production and sales end of the factories beneath them. New factories were sited on the basis of patronage, not on the merit of the site or its environmental suitability. Local governments might have objected to the location, but in general the central authority prevailed. As the public became aware of pollution, the government-controlled media told them that economic progress was the goal of communism, and pollution was the price people paid for progress.

2.5 Sociocultural and Ethnopolitical Conditions

Several features characterize the post-Communist states of the CEE. First of all, virtually all of them are small in size. Second, with the exceptions of Poland and Ukraine, all have small populations. Third, most of the populations are composed of two or more ethnic groups. Each of these groups has its own language and culture. Long suppressed by totalitarian regimes, the more severe ethnic tensions emerged at the beginning of the transition, while others remain simmering just beneath the surface. Fourth, the reversion to ethnicity signals that democracy has failed to provide a national identity to replace the old communist ideology.

The first and second factors indicate that, even in the best of circumstances, these states would have a difficult time paying for the economic transformation required of them. The billions of marks that West Germany poured into East Germany give some

indication of the amount needed. Failing the discovery of a natural resource vital to the global economy, the CEE states will be dependent upon the international community for some time to come.

The third and fourth factors indicate that conflicts in the region will likely occur in the future. The question of the future of the Russian Diaspora is of particular importance to regional security. Conflict between Russians and their host countries threatens the Baltic States, Ukraine, and Moldova. Russia's willingness to exploit ethnic conflict to promote foreign policy goals within the region, as in Armenia, Azerbaijan, Georgia, Ukraine, and Moldova, further undermines regional security.

Bosnia is a constant reminder of the threat posed by unresolved, and so far irresolvable, ethnic conflicts. Millions of refugees bear bleak witness to the horrors of ethnic cleansing and to the enormity of the environmental destruction produced by violent conflict. Not only did the war destroy the infrastructure that existed prior to the onset of fighting, but over 6 million land mines were planted, enough to kill the entire Bosnian population. The land mines prevent the rehabilitation of agriculture, new development in rural areas, and the return of refugees to their homes. Land mines also dot the borders of all the former Communist countries and are planted along the Baltic coast.

As was the case in the other three dimensions of environmental security, the West's input is decisive to the outcome of ethnic conflict. Seemingly, no country is able to resolve the problem on its own, nor has cooperation within the region yet provided a solution.

3. WESTERN IMPORTS TO THE TRANSITION

The transition states have been involved in westernizing their political and economic system since 1989. Driving the transition is the desire on the part of all the CEE countries to join the EU and NATO. Membership in the former holds the promise of economic and political security, while membership in the latter offers military security, especially from Russia. Membership in the EU further validates these countries' claim to be bona fide members of the European community and contributors to European culture, with a right to the benefits and lifestyle accorded to most Europeans.

Through international agreements such as the 1993 Copenhagen Agreement, the West has made clear its preconditions for acceptance of the CEE states into these organizations. As a consequence, the leaders of the transition countries find that they have relatively few development options. Their main task is to bring their country's political, legal, and economic infrastructures into line with EU and NATO demands, while recognizing that entrance is not guaranteed into either of these organizations. On the one hand, the Baltic countries, considered the CEE's "Northern Tier," with the

Czech Republic, Hungary, and Slovenia, have responded relatively easily to this external stimulus. On the other hand, Slovakia, Bulgaria, Romania, Albania, Croatia, Yugoslavia, Macedonia, and the NIS have had considerably more problems.

Environmentally, the transition has meant writing new laws and creating Western-style enforcement or oversight agencies capable of seeing that the laws are implemented. The new laws must reflect the standards and procedures of the European Community, and the new environmental agencies must be set in public/private infrastructures along the lines of their Western counterparts. Meeting Western criteria has required using Western advisers on subjects that range from reforming the military to retrofitting antiquated industrial equipment to training sessions for popular participation. The cost of the transition has far exceeded the limited financial means of the CEE countries, and they have had to rely on large capital inputs from the West in the form of loans, grants-in-aid, and business investments.

3.1 Democracy and Institutional Capacity Building

The problems and challenges inherent in democratic institution building can be illustrated with a brief example of what is being done in the environmental area. CEE countries that wish to join the EU are required to approximate EU environmental legislation by complying with 33 pieces of EU legislation. In 1996, the Regional Environmental Centre (REC) released its report on the approximation status of the 10 CEE countries that had successfully negotiated Association Agreements. Compliance was found to be both uneven and uncertain.⁶ Some categories ranked high on compliance, such as general environmental policy regulation; some ranked very low (chemicals, industrial risks, and biotechnology). The EU has yet to provide a clear strategy on what it is that has to be approximated. In addition, the guidelines apply only to the establishment of an internal Community market. The CEE governments' incorporation of EU mandated procedure into their environmental legal instruments primarily prepares their countries for integration into this internal market, and only secondarily addresses their own environmental management needs. To facilitate compliance, special units for European integration have been organized in all the countries, some of them overseen by the head of government, some of them attached to the ministries. In addition, many of the CEE parliaments have also set up joint legislative committees with the EU Parliament to review implementation progress.

The first problem in the adoption of Western practices and institutions is the prioritization of the Western needs agenda. This implies adoption of the legal framework and environmental criteria necessary for CEE export of products to Western Europe. It also extends production standards already approved and adopted by West European companies to the manufacturing process in the CEE. Approximation thus transfers the locus of decision making permanently out of the country and the region.

The reward for this transfer will come once the current members of the EU have accepted the application for membership.

A second problem is the high cost of approximation to EU standards. The REC study (1996) said it found no clear strategies in any country for how to meet EU standards. If approximation in the environmental area proves to be financially unobtainable, failure to comply in this or in another area would have a negative impact on the stability of the region's national political systems, and in turn, may undermine confidence in the established governments.

3.2 Structural Adjustment: The Import of Economic Reform

Throughout the region, the remaking of a Stalinist economic system into a free market economy proceeded without a clear blueprint. Little thought was given to the development of a new model prior to the collapse of the system. In the absence of such a model, the international community borrowed heavily from the World Bank's existing program of structural adjustment.

Structural adjustment (SA) is a concept conceived by the World Bank in the 1970s. The SA policy was a reaction to the contraction of world trade resulting from the OPEC oil price increases and the resulting economic and political instability in the developing world that was pushing many countries into crisis. To prevent this, the World Bank developed a lending program to increase the foreign trade of the developing world through the reformation of its political and economic system. This major change in international finance policy was driven by structural changes in the global economy, not by the needs of the loan recipient countries, as perceived by their governments (World Bank, 1990).

With the fall of the Soviet Union, the Western capitalist market became truly global. Not surprisingly, the aim of the post-Soviet governments in the CEE and NIS was to become integrated into this market as quickly as possible. The crash program proposed by Jeffrey Sachs contained most of the features of the World Bank's SA programs: fiscal reform, reform of trade policy, privatization of state-owned enterprises, industrial reform, and agricultural reform.⁷ When the Communist system collapsed, the high-level bureaucracy exploited its political position to acquire economic dominance in the new system. Structural adjustment began to acquire a new meaning and purpose in their eyes.

The driving ambition of the new entrepreneurs is to enter the global market. Their main concern is exports and their influence presses upon the new governments to develop an export market. In this matter, they are joined by the large corps of technocrats, who were previously at odds with the high-level bureaucracy that is determined to hold on to political power. Under the new conditions, interest in the environment on the part of the government, the technocrats, and the people has declined. The strong

technocratic and scientific leadership that opposed the high-level bureaucracy is no longer utilizing the environmental issue as the basis of opposition. Rather, it is working with the bureaucracy to build an economy that can enter and compete on the global market. External pressure in the form of SA is making reform instruments the first priority. These external pressures are reinforced by the perception that the government must deliver on the failed promises of the former regime. It must provide work, health, education, and a comprehensive social net. Economic development has become the political rallying cry.

Fortunately, the EU and the United States were sufficiently informed about the extent of environmental degradation in the region to mandate an environmental contingency in their lending programs. Indeed, the loans to the CEE were the first to make obtaining a loan contingent on an environmental impact assessment and the inclusion in the project of strategies to minimize or prevent any environmental impacts.

Panayotou (1993) argues that a country's adoption of SA reforms has long-term implications, affecting resource allocation and use, but that there is, as yet, no conclusive evidence whether SA exerts a positive or negative influence on the environment or human security. The end of price controls automatically changes energy and food consumption patterns. In the CEE countries, opening domestic markets to imports has had the positive result of reducing pollution through the closure of polluting factories. Trade liberalization has enabled Western environmental technology companies to tackle problems such as waste disposal. On the negative side, some countries, notably Poland, Hungary, and Russia, are offering their vacant land as waste disposal sites for EU countries. In Russia, the absence of adequate oversight and enforcement of environmental legislation has led to wildcat logging deals between local governments that are stripped of funds, and Korean and Japanese loggers in eastern Siberia and the Primore. The end of price controls has not only fueled inflation, but made the price of domestically produced goods noncompetitive, thus driving up unemployment and increasing negative secondary social impacts. Trade liberalization may guarantee the outward turning of the CEE economies at the price of the elimination of local products and the permanent need to secure sufficient export earnings to pay for ever increasing amounts of imports.

The adoption of trade liberalization instruments may contribute to or hinder regional security. Liberalization may be neutral towards the environment, but carries short-term social problems that could be potentially explosive if not dealt with in an appropriate manner. Liberalization may further reinforce the belief already held by many CEE officials and industrial managers that the first purpose of any economic enterprise is to make money and grow, and that the first business of government is to support those endeavors. In the transition world of weak government oversight and global markets, the new corporate owners are relatively free to do what they like. The perpetuation and entrenchment of this attitude augurs poorly for the environment.

The second major aspect of the Western economic model is private economic enterprises. The process of privatization appears to have more political and social liabilities than trade liberalization. In the CEE, multinationals have invested where they saw good possibilities of new markets, a qualified work force, and low production costs. Proponents argue that investment by global corporations is a necessary and salutary measure. The MNCs bring capital and job creation. They bring newer technology that is less polluting than that which existed before, and they bring management skills and training that benefit the entire country. Detractors argue that multinational purchase provides access for the new corporate elite to the global market at the expense of local employment. The purchase of agricultural lands can produce even more social imbalance, and result in a switch in countries like Hungary, which were self-sufficient in food, to food import dependency, layoffs of agricultural workers, and decreased incomes. The import of global beverages such as Coca-Cola or Pepsi undermines the production of domestic beverages, again with adverse social impacts. While enough food may be grown to sustain the global population on average, the current production and distribution ensures that it goes only to those who can pay.

In sum, CEE adoption of structural adjustment mechanisms may be environmentally neutral, but they contribute substantially to the deterioration of secondary social conditions that, in turn, undermine the political stability of the new democracies.

3.3 The Environmental Contingency

There is no precedent in the CEE for the successful integration of environmental protection and economic development. Here more than in any other area, the push has come from the outside. The evidence suggests that the push has been dictated more by Western security and commercial interests than by an altruistic interest in restoring the region's ecosystem.

Topping the list of Western security interests is the status of the region's nuclear power plants. Closing any of these plants means finding an alternative energy source. The situation would seem ideal for alternative energy projects. Yet, among the ERBD and World Bank energy projects for the CEE, only one, the Klaipeda Geothermal Demonstration Project supported by the World Bank and the Global Environmental Facility (GEF), involves the development of a nonfossil fuel or a nonnuclear form of power generation.

The CEE countries know they do not have the financial means to handle the risks and dangers associated with operating a nuclear generating plant. Many of them do not have the technical expertise. In Lithuania, Armenia, and Ukraine, Russians have traditionally provided expertise. Some countries may even seek to strengthen their sovereignty by using the nuclear power issue as a form of blackmail. If Chernobyl, for example, poses such a risk to the world, then the price of closing the plant should

in some way approximate the cost of the risk that has been avoided. By delaying agreement on the future of the plant, thereby raising the perceived level of risk of an accident, Ukraine puts itself in an excellent position not only to increase the financial ante, but also to ensure that the West helps it reduce its vulnerability to Russian power. A similar "alliance" formed between Lithuania and Sweden over the Swedish offer of technical assistance to keep the Ignalina nuclear plant operating. When the Russians reduced the volume of energy exports to the Baltic states in 1993, the Lithuanians were in a nice position to increase their sales of electricity to the other Baltic countries. Sweden is scheduled to close down the generation of nuclear power by the year 2000, although it is now reconsidering this decision. By providing the technical assistance and expertise necessary to upgrade Ignalina, the Swedes can be sure of an energy source for as long as Ignalina operates, as well as the economic benefit derived from power grid modification in the Baltic region. The proposed construction of the Mohavce plant in Slovakia presents a similar alliance formation with the Czech Republic and Russia. Alliances of this kind have doubtlessly encouraged Western builders of nuclear power plants to be more aggressive in the region. The result is that, although there is much Western public and media concern over the threat posed by nuclear power in the CEE, the West has adopted the solution that supports the commercial interests of Western corporations.

The nuclear threat to environmental security is the most salient instance of Western intervention in the interests of Western commercial interests. Between 1990 and 1996, about 20 percent of all foreign investment went into building or extending the CEE's infrastructure. The larger share of this went into telecommunications, a lesser share, into the gas and oil sectors (European Investment Bank, 1996). In transportation, upgrading roadways takes precedence over modernizing railroads. While Japanese investment has been focused on promoting technical cooperation in the region, Japanese and Korean corporations are beginning to invest as well. The largest share of USAID monies to the CEE has been for economic restructuring. The disbursement of these funds is typical of the West's pattern of environmental investment. One of the projects sponsored 50% by USAID is the Energy Project Development Fund. Recipients of grants to conduct feasibility studies include Price Waterhouse, Winrock International Environmental Alliance, and Bechtel Corporation. A biodiversity project grant was awarded to the World Wildlife Fund, Washington DC. While the grants are intended to benefit Eastern Europe, the primary beneficiaries are major US corporations and non-profit institutions. Not unexpectedly, there is some bitterness about the dollar amount of loans and grants that are allocated to the region, but more particularly about the relatively small amounts that actually reach the local level. More relevant to the discussion of environmental security is that grants that primarily address a need or request of a multinational company or an NGO are consistent with the commercial or programmatic agenda of these institutions. The grants address the CEE or NIS economic/

environmental or social agendas only insofar as they constitute a part of the larger global strategy. The same argument can be made for corporate investment either through the purchase of shares or joint ventures.

It appears that external standard setting, the promotion of capacity building, and the use of funding as the carrot and the stick to promote the twin goals of democracy and a free market, have both positive and negative implications for environmental security in the region. Among the negative implications are:

- *the continued short-term deterioration of secondary social conditions*, requiring Western vigilance to see that they do not spin out of control; and
- *a national sense of loss of sovereignty*. There is a fine line between participation in the global economy and domination by the global financial institutions and corporations. The governments in all the countries are struggling with the necessity of foreign assistance and the desire to retain more than a semblance of national independence. The perception by the public that its government has joined hands with the global financial, technological, and industrial elite at its expense risks the political stability of the countries and therefore undermines regional security. If the international community persists in promoting the agendas of the multinational information and energy corporations, over providing affordable housing, health care, and a decent living standard, it once again undermines political stability in the region.

4. OPTIONS FOR MODIFICATION OF THE EAST/WEST IMPORT STRATEGY

The first option would be to let each country follow its own path to a market economy and possible membership in the EU and NATO. In many respects this option is a nonoption. None of the former Communist countries would be able to sufficiently transform itself before its population broke out in discontent; there are not the managerial, technical, or financial resources. Even with assistance from the EU, the rewriting of legislation is far from complete, while implementation trails way behind.

A second option would be to rely on regional institutions, such as the Visegrad group, the Carpathian Euroregion, and crossborder organizations that have helped break down a country's isolation from its neighbours. Certainly, the CEE states should be encouraged to develop more intraregional contacts, both organizational and individual. But this option cannot be undertaken without recourse to Western backing and assistance.

The third option reflects what is taking place today: international dictate of what the change process should be and what steps must be taken in order to induce acceptable economic change, while preserving the environment. This option has fallen

between the rock and hard place of the domestic politics of each state and the region's desire to do what is necessary to join the EU and maybe NATO.

The fourth option is the development of institutional capacity that would bring together national, regional, and international interests. REC and its NIS counterpart were organized to achieve this objective. However, being totally funded from outside the CEE and NIS, they are the implementers of an external agenda, and thus the third option. One way to provide equal input from the states in the region would be to require each to underwrite or donate to the annual budget of regional organizations, in the same way that countries fund the UN. A second way is to demand from the WTO greater regulation of the multinationals. Regulation would have to be at the global level because the CEE states are not yet politically able to enforce domestic regulation and multinationals do not regulate themselves. In this context, membership in the EU would seem to bring a mixed bag of opportunity. While membership assuredly will promote the interests of the global corporations and the richer EU states, it will provide no guarantee of sustainable development or pollution control.

A third way is through the expansion of contacts with international NGOs. There is a growing literature on the transformation of the international system from a state-centered system to a multi-actor system. The international environmental NGOs are among the most recent and active actors in the change process (see Rosenau, 1990). As these NGOs become bureaucratized and their agendas mingle with the agendas of the corporations and nation-states that fund them, it becomes increasingly difficult for them to exercise the kind of motivated and dedicated activism that first made them visible on the international stage. The NGOs of Central and Eastern Europe are no exception to this pattern. In 1989, they had no international support but organized to oppose what they termed the environmental "megalomania" of their respective national regimes. In 1997, the goal of NGOs is self-preservation and survival, by obtaining funding from either a regional organization like REC or from an international organization. In transiting from a pretransition to a national or regional NGO, Oleg Yanitsky argues that the structure of an NGO in transition is oriented towards the search for Western financial aid (Yanitsky, 1996). Every activity is planned with the international donor in mind.

The fifth and final option goes beyond the development of institutional capacity to seek realistic and verifiable forms of regional and international cooperation. If the West desires the assurance of human security in the CEE, it must be ready to commit to the region for the foreseeable future a large portion of financial, technical, and managerial aid. The region on its part must pursue and develop its model of democracy according to its experience during these initial transition years. In this scenario, the West ceases to be the arbiter of democracy, reviews its current loan policy, and demonstrably enables a greater share of its monies to go directly to communities within the region rather than to global corporations and organizations. Scientific exchanges should

continue to be encouraged at CEE universities and more programs could be developed that focus on training in citizenship, communication, and democratic participation. On their part, the CEE governments would attempt to develop more horizontal ties at all levels of societal organization, but especially at the grassroots level. Without spontaneous renewal at the grassroots level, there can be no real public participation in the politics of the transition countries. And without real public participation, there can be no public voice to speak for the environment. The form this participation takes, to my mind, cannot be predicated upon Western models. It must come from national experience. Renewed organizations, with a felt responsibility at the local level, can then reach out to the international environmental organizations and donors. Cooperation is not possible when the relationship is hierarchical, as it now is. To assure human security, the CEE needs to be taken as the West's partner, not its distant relative.

5. ENDNOTES

¹ See Jancar-Webster, 1995; 1996.

² In Russia, the results of regional and local elections are frequently questioned because only 25-35% of the eligible voters vote. In 1996, Rumanian, Bulgarian, and Estonian voters, by varying margins, voted for free market candidates promising efficient government. However, voter turnout in the Baltic States was around 52%, while the Czech turnout for the Senate elections of that same year was only 1/3 of all eligible voters. About 30 percent of Slovenian voters participated in the December 1996 referendum reforming the voting system.

³ Fareed Zakaria (1997) argues that what has been achieved is democracy, but an illiberal democracy characterized by the rule of the mob, rather than a liberal democracy restrained and constrained by constitutional liberalism.

⁴ See specifically pp. 45-101 and chapter IV.

⁵ Among researchers, technicians, and mid-level managers, a 1994 Russian study showed 56 percent came from the former Soviet ministries and 26 percent from former factory managers. While the new elite may be supportive of the free market, surveys suggest that many of them would prefer to run the country with little public participation (Savvatayeva, 1994).

⁶ The European Commission DGXI (Environment) and REC carried out the evaluation within the framework of an on-going effort. The goal of the report was to assess progress "in the transplant of EU legal instruments and mechanisms into CEE legal acts."

⁷ Milanovic (1989) shows in his calculus of reform in the pretransition Communist countries that the political will to implement SA along World Bank lines did not exist at that time. The antireform forces—the middle- and high-level bureaucracy, transfer-income recipients, and state sector workers, outweighed, in relative strength, the reform forces of technocrats, peasants, and small entrepreneurs.

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Chapter 11

Providing Istanbul With Drinking Water: The Politics of Water Security in a Rapidly Growing Metropolis

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Istanbul has persistently experienced rapid population growth in recent years. Procurement of sufficient quantities of high quality water to the city has become a major concern for the national and local authorities. Initially, the central government was the major actor in dealing with water problems, but more recently the role of the local government has been claiming increasing significance. Interagency rivalries flourish, but the urgency of the need has served to depoliticize the problem and bring its engineering and managerial aspects to the fore. Istanbul's experience suggests that strong local institutional capabilities are important in meeting urban needs. Meeting water demand can be ameliorated by adopting policies that are cognizant of existing socioeconomic trends.

1. INTRODUCTION

The province of Istanbul is home to about one sixth of the total population of Turkey. A high percentage of the provincial population, exceeding 10 million according to most estimates, live within the borders of the Greater Municipality of Istanbul. This metropolitan government, formed in 1980 by the national government, represents a union of a number of subprovincial municipalities that was the result of immigration to the growing metropolitan area.

Turkey has experienced continued high population growth rates, accompanied by mass migrations of rural and provincial populations into urban areas, since after the Second World War. One of the major targets of this population movement is Istanbul. Although the population growth rate is easing, the growth of urban areas is expected to persist well into the next century (see Tables 11.1, 11.2, and 11.3). Such rapid growth generates a significant and increasing demand for water while simultaneously generating other outcomes that present difficulties in meeting the demand.

Istanbul does not have large quantities of fresh water. The annual rainfall in the region, concentrated in the autumn months, is at best moderate at 500 to 1000 millimetres. There are no major rivers nearby and underground water resources are not abundant. The influx of large numbers of new residents has strained these sources in a

Table 11.1 Population Growth Rates

<i>Year</i>	<i>Turkey</i>	<i>Istanbul</i>	<i>Population of Istanbul as % of that of Turkey</i>
1950	-	-	5.6
1960	2.85	4.87	6.8
1970	2.52	4.89	8.5
1980	2.31	4.71	10.7
1990	2.36	4.56	13.2

Table 11.2 Predictions of Population Growth in Istanbul Metropolitan Area

<i>Year</i>	<i>Size (x 1000)</i>	<i>% Annual Growth</i>
1990	7.475	4.56
2000	10.110	3.07
2010	12.584	2.21
2020	14.683	1.56
2030	16.120	0.94
2040	16.963	0.51

Table 11.3 Water Demand for Istanbul

<i>Year</i>	<i>Population to be served (millions)</i>	<i>Daily demand (litres) per person</i>	<i>Gross water demand (billions of cubic metres)</i>
1990	5.98	182	.662
2000	9.099	212	1.067
2010	12.584	244	1.601
2020	14.683	255	1.847
2030	16.120	270	2.037
2040	19.963	284	2.198

Source for all tables is ve Iskan Bakanligi, 1991.

variety of ways. First, the incoming population has settled in previously uninhabited areas, thereby effectively reducing the size of the water catchment area for reservoirs, in many instances. Second, a growing resident population has produced pollution such as sewage, which threatens the quality of the water supply unless proper measures are taken. Finally, urbanization has been accompanied by the intensification of commercial and industrial activity both of which not only generate new demand for water but also constitute new sources of water pollution.

2. INSTITUTIONAL DEVELOPMENTS

To meet the challenges of the increased demand for water and the potential for a decline in the quality of the water stock, an effective public organization is necessary. Yet, as witnessed in many rapidly urbanizing environments, the massive influx of new populations into existing cities weakens the ability of governments to deal with problems, including those relating to water. To begin with, it is often the case that municipal governments cannot expand their capacities as rapidly as the rate of population growth demands, leading to a reduction in the amount and the effectiveness of public services. Next, urbanization generates a number of social, economic, and political forces that challenge the existing political arrangements, and demand greater participation in decision making. This means that it becomes more difficult to achieve a consensus on public decisions; therefore, decisions take longer to make and sometimes they are not made at all. Also, the changing socioeconomic needs generally necessitate the creation of new administrative structures, the reorganization of existing ones, and a redistribution of authority and responsibilities between agencies and levels of government. But such adjustments, even if successful, tend to trail behind developments rather than anticipate them. It is the weight of problems that force political and administrative changes; those who might lose in the face of change tend to stand in its way.

Historically, municipal governments in Turkey were given the responsibility for the provision of drinking water to the cities. In the early years of the republic, most of the population lived in rural areas. The few historical urban centres developed public utilities, including city water systems, toward the end of the last century or at the beginning of this century. The population growth that commenced after World War II and the ensuing urbanization graduated former small towns into the status of cities while swelling the population of those that already existed. Many of these cities did not have city water; those cities that did, lacked the capacity to meet the surging demand. The municipalities possessed neither the financial means nor the technical capabilities to build or offer for bidding major dam construction. Placed under the trusteeship of the central government, they were not allowed to collect taxes or, unless authorized by the former, borrow domestically or from the international market.

As the water needs of Turkish cities intensified, the central government felt pressured to produce a response. In 1953, it established a new agency, the General Directorate of State Hydraulic Works (DSI), to build large dams mainly with the purpose of generating electricity. In 1968, the government passed a law authorizing this agency to undertake contracting for the construction of dams and major conveyance and purification systems for cities with a population exceeding 100,000. Interestingly, the name of the law specified Istanbul and Ankara, the two major targets of urban migration, before referring in general terms to cities with a population of more than 100,000 (Law 1053, 1968).¹ The law stipulated that municipalities would retain their responsibility for the distribution and the sale of water to homes and enterprises; however, Istanbul and Ankara gained the privilege of receiving annual grants, up to a specific sum, from the national budget to pay for those services that the law defines as municipal responsibilities. All municipalities, including Istanbul, would become indebted to the DSI for the construction, which was undertaken and paid for by the latter. A maximum 30-year repayment period was envisioned, the loan would bear no interest, and specific terms of payment would be negotiated between the DSI and municipal governments.

The 1968 changes brought temporary relief for the municipalities. Urbanization continued with increasing speed and Istanbul, especially, was growing by leaps and bounds. Small units of settlement, once distant from the city, developed into large squatter communities and then were incorporated as new municipalities. These units were integrated economically and, to an extent, sociologically into the city, but administratively, they were independent. Although their size and their means varied between poor and modest, and most services they provided were dissatisfactory and insufficient, their elected leaders protected their independence jealously. While rationales of efficiency and effectiveness might have dictated cooperation and collaboration, the devising of common and comprehensive solutions to problems shared with other municipalities in the same metropolitan area was not seriously entertained, let alone attempted.

The military National Security Council that assumed power in 1980 soon became aware of the difficulties of running administratively fragmented municipal governments with no overarching metropolitan unit to integrate them. In several cities, with Istanbul heading the list, it proceeded to create a new level of government called the Greater City Municipal Government. The small municipalities that were put under the metropolitan government continued to retain some of their autonomy, but lost powers to the new unit, which was given responsibilities on matters that necessitated coordination, planning, and implementation for the entire metropolitan area. Not surprisingly, meeting the water needs of the metropolis presented particular difficulties. Over time, problems of water procurement became worse. Water catchment areas were invaded by squatter settlers, while municipalities short of funds discharged untreated sewage into rivers that fed the reservoirs. An additional law, enacted in late 1981 (Law 2560),

created the General Directorate of Water and Sewage Administration of Istanbul (ISKI). The ISKI was initially placed under the hegemony of the DSI where members appointed by the central government dominated its board of directors. Changes in 1984 made it an agency run by the metropolitan government. Since that time, the ISKI has become the major force in tending to the provision of water for Istanbul.

The expansion of the powers and responsibilities of the DSI and the creation of the ISKI were the result of a slow process of change. Significant steps—first the creation of metropolitan governments, and then of the ISKI—were realized under military rule when the pressures for building a parliamentary majority were lacking. In other words, the multiplication and the proliferation of the centres of political power had stood in the way of producing solutions. However, solutions were effected during the suspension of competitive politics and these institutional innovations have enhanced the capability of the municipal government to provide water security for Istanbul.

3. THE POLITICS OF WATER IN ISTANBUL

Making decisions about water procurement, the pricing of water, and the preservation of water quality are parts of a political process that involves many actors. Although it is often tempting to treat questions of water security as technical problems, it is important to recognize that we are dealing with a political problem, where individuals, groups, and institutions with sometimes conflicting, sometimes converging interests, compete and collaborate to produce outcomes that are first and foremost to their advantage. We now turn to an analysis of the political process, identifying some of the major actors and studying their interactions.

3.1 Major Actors and Interactions in Water Policy Making and Implementation

There are many actors involved in making water policy. At an interview, an ISKI official provided me with a list of 45 laws, each with clauses associating some government agency with some specific situation regarding city water. Of course, the actors involved in the politics of water are not solely from government agencies. There are other political players: members of political parties, members of parliament, and mayors of urban boroughs and small towns. There are also many private participants, from contractors who build dams and conveyance systems, to businesses that may consume water or discharge pollutants to rivers, to land developers, and to environmental groups. They are all involved in the policy process either regularly or occasionally, as their interests dictate.

3.2 Metropolitan Government: The ISKI and the DSI

The two leading government agencies concerned with the water security of Istanbul are the ISKI, representing the metropolitan municipality and the DSI, an agency of the central government. Both agencies play indispensable roles in water policy making and implementation although their relative role has been subject to changes over time. Of the two, the DSI is the older institution. It is one of the most powerful institutions in the nation's capital claiming, on average, 3 percent of the national budget. Its importance is even more evident when its share in the investment budget is examined. During the 1994-1996 period, for example, the DSI claimed respectively 25.3, 32.1, and 26.0 percent of the entire investment budget of the national government (*DSI in Brief*, 1996, p. 9). The staff of the DSI is highly professional, dominated by civil engineers. The technical nature of its work and the skills required of its personnel have hindered the government from making poorly considered appointments to head the agency. Its leadership nearly always has come from within the organization. Most parliamentary deputies, on the other hand, have an interest in being on friendly terms with the agency since the support of the DSI is often critical in getting water and power services to their districts. The agency has also had the good fortune of having had a prime minister come from among its ranks. Süleyman Demirel, a long time prime minister and current president, laid his initial claim to fame as the general director of the DSI, earning for himself the nickname, "The King of Dams." Turgut Özal, also a prime minister and later president, served in the Electrical Resources Survey and Development Administration (EIEI), a sister organization of the DSI. Many cabinet ministers in cabinets have also come from among the ranks of the DSI. In other words, the DSI has always had easy access to the centres of national power.

Currently, the metropolitan government is the major actor in Istanbul's water issues. Successive mayors have realized the procurement of water and, increasingly, the treatment and disposal of sewage as among their major and most critical responsibilities. The failure to pump water into urban homes tends to be highly damaging politically. The specialized agency charged with water and sewage is the ISKI. The mayor of Greater Istanbul is the Chair of the Board of the ISKI. He appoints the other members of the board and is in a position to give direction to the activities of the agency. While, in earlier years, the ISKI was not financially strong and relied on the generosity of the national government for the implementation of its activities, it has recently improved its ability to collect water bills. According to the current mayor, the ISKI is now the biggest generator of income for the municipality. It is able to finance almost all of the new investments in dams and conveyance systems.² Initially unable to construct dams on its own, the ISKI has increased its powers such that nowadays it is able to initiate some of its own projects and give out contracts.

The two agencies have functions, resources, experiences, and skills that are complementary, creating favourable conditions for their cooperation; yet the relations between

the two agencies tend to be a mixture of cooperation, rivalry, and friction. The law limits the domain of the ISKI to the boundaries of the municipality of Greater Istanbul. The area is mainly residential, commercial, and industrial. Much of it is settled. It does contain some historically important, but small, catchment basins and reservoirs. It certainly does not contain new sources of water. While the residents see the municipality as the agency responsible for the procurement of water, the ISKI's powers to address water-related questions directly are severely limited, much to the frustration of some of its managers.

The agency that has both the job of developing new sources for Istanbul and the power to do so, is the DSI or, more specifically, its 14th Regional Directorate. The domain of the Regional Directorate covers all of Thrace, and extends to the province of Bolu, more than 200 kilometres to the east of Istanbul on the Asian side. In this wide geographical area, the DSI has identified a number of sources that can be developed to meet the water needs of Istanbul into the 2040s. Over the years, in line with its duties, the DSI has conducted studies on the flows and the nature of the soil; it has attempted to map out earthquake zones and the possible location of dams, to predict the amount of water that could be collected for urban use, and to plan the type of conveyance systems to be employed and their routes. It has also estimated the cost of dam and pipeline construction and produced detailed maps of the region.³

Even if, today, the ISKI were given the same authority as the DSI Regional Directorate, it would have to invest no less than 10 years to develop the same kind of database. Some ISKI officials, however, feel that only the information that the DSI deems appropriate is available to them. DSI officials, on the other hand, feel proud that such a database has been developed, and some feel that the quality of the personnel at the ISKI and the resources of that agency would not allow it to develop a similar set. The occasional reluctance displayed by the DSI to share all of its information with the ISKI may be attributed in large part to an institutional rivalry that assumed unpleasant dimensions during the reign of an earlier mayor who, by using his political weight with the government, had the regional office closed, arguing that they were doing nothing but standing in the way of municipal agencies.⁴ However, the rivalry owes much to the fact that the two agencies have different goals and orientations and are serving different constituencies.

The DSI is a national organization specializing in dam and hydroelectric power plant construction. The provision of drinking water, though among its responsibilities, is not viewed as its primary responsibility. For example, currently, the project of highest priority on the DSI agenda is GAP (Southeast Anatolian Project), which aims to build a string of dams on the Euphrates and the Tigris for the purposes of irrigation and hydroelectric generation. Furthermore, as a national agency, the DSI is compelled to give equal attention to a variety of projects located in different parts of the country as deputies from different districts bombard it with requests for service. Despite the

fact that the DSI gets a substantial portion of the national investment budget, the services expected from it are such that the annual allocations are not sufficient to fund the maintenance of ongoing projects or initiate new ones.

There are three reasons the DSI adopted a strategy to implement more projects than it has the means to finance. First, promising funding is a way of responding positively to requests from various constituencies, and thus retaining their support. Second, this is a way of insuring that the DSI, rather than other agencies including the ISKI,⁵ will implement a given project. In this way, the DSI's institutional interests in retaining its power position are served. Finally, the simultaneous implementation of many projects, although at a slower pace, not only legitimizes new budgetary requests, but also serves as a basis upon which parliamentary support for those requests is mobilized.

The ISKI feels itself under constant pressure to make more water available to the municipality. ISKI officials point out that, several years ago, the city faced the real danger of running out of water. While the possibility of such an emergency has been averted for the time being, they point out that, if the city is to continue to be assured of sufficient water, supply must exceed demand. Not surprisingly, the pace at which the DSI proceeds with dam and reservoir construction is slow and not sensitive enough to the local demands. This has led to a search by both agencies to find some solutions that may serve their mutual interests. One of the former mayors, backed by a national government of the same party, took over the construction of the Darlik Dam from the DSI, and was able to complete its construction in eight months. He also wanted, but failed, to acquire the power to offer for bids and award the contracts for the construction of all dams that were being built primarily to furnish water for the ISKI.⁶

It appears, however, that the clash between the former mayor and the DSI demonstrated to the latter that it had to be more responsive to the needs of municipal government; otherwise, increasingly assertive political forces would undermine its prevalent position in dam construction. Some halfway solutions have been found. For example, the ISKI has offered to pay for the Sazlidere dam, already under construction for several years under the DSI. A suitable expression has been coined to define the relationship: the DSI is building the dam "on behalf of the ISKI." A temporary⁷ division of labour between the two agencies also appears to have been achieved. Though they are technically outside the domain of the ISKI, the DSI is now willing to turn over the construction of minor dams (around 60 million cubic metres) to the ISKI, while continuing its role in the implementation of major projects. At present, it is working on two internationally financed major projects; their construction will continue into the second decade of the next century. It is safe to assume that conditions will continue to require both agencies to adjust their behaviours to not only preserve their institutional interests but also to achieve a working relationship that serves the residents of the Istanbul metropolitan area.

The personalities, the attitudes, and the communication styles of the leaders of the DSI (both the national and regional director) and the ISKI also affect how the two agencies relate to each other. In this context, the director of the 14th region⁸ complained that, because of the sheer size of Istanbul and the time it takes to travel from one part of the metropolis to the other, the opportunity did not exist for officials of the various service agencies of the government to come together, either for business or socially. He pointed out that, in other regional offices, there were abundant opportunities to meet colleagues, thus facilitating business communications and cooperation. While such contacts are important in developing working relationships, they may not totally remove a conflicted relationship based on personality and attitudes. The first elected mayor of the Greater Municipality (1984-1989) showed disdain for the DSI, which made interagency cooperation difficult. Successive mayors have been more careful to cultivate balanced relations with the DSI so that they may utilize its resources and potential.

4. THE POLLUTERS AND THE ISKI

Rapid urbanization tends to produce intense demand for land use. Lands that were previously agricultural, areas classified as forests, and land on which settlement has been banned in order to protect water resources gain immensely in value in a relatively short time. The motives of individuals and organizations trying to convert the status of land often conflict with the original reasons that the land was placed under protection. The rush to the cities usually produces the so-called squatter settlement problem, where people unsystematically build poorly constructed units of residence that often lack water and sewage disposal facilities. All of these developments present a formidable challenge to any municipal government trying to secure water for its residents. The ISKI is no exception.

In attempting to insure that the Greater Municipality has access to sufficient quantities of good quality water, the ISKI is engaged in a constant struggle against individuals, groups, and organizations whose ends are not compatible with this goal of water security. In some instances, the actors may not be fully aware of the damage they are inflicting on the city's water security; in other instances, they simply accord a much higher priority to goals other than water security.

It should be pointed out that the municipality of Istanbul and others unified into the Greater Municipality of Istanbul were not concerned about the consequences of land use on water security until recently. A typical indication of the lack of concern was the awarding of the titles of government owned land to those who had settled on it in an unauthorized manner, thus legitimizing the unsystematic use of land. Many parties in national and municipal elections campaigned promising an amnesty for squatter settle-

ments. Attitudes did not change until the critical shortages of water that occurred in the late 1980s demonstrated to the municipal authorities that water had to be given high priority if the city were to avert major crises in the future. In the 1990s, water security is receiving more attention than it has in the past.

The squatter settlers constitute one part of a much larger lobby whose interests are inimical to the pursuit of water security measures. Squatter settlements usually start near industry. The influx of cheap labour entices other industries to come to the area. As the use of land intensifies and its value increases, gangs organize to lay claim to surrounding open areas that have escaped settlement and begin to sell them to settlers. They often promise potential buyers protection against the ISKI and other government agencies that may contest their ownership of the land and try to tear down their buildings. As settlements grow, political parties take an interest in them and try to protect their residents against "encroachments" that may come from government agencies.

The efforts conducted in the name of insuring water security are some of the municipal government's most confusing, conflicted, and politically explosive activities. The confusion arises from the fact that there is a multiplicity of government agencies, each with its own motives and goals; it is only exacerbated by the multiplicity of laws that define the duties, responsibilities, and powers of these agencies. Even a summary analysis of these agencies and laws would exceed the limits of this paper, but it is possible to offer examples.

Many of the water sources that provide water for Istanbul are outside its boundaries. Law 2560, authorizing the establishment of the ISKI while limiting the domain of its operations to within the municipal boundaries of Greater Istanbul, gives the ISKI the power to protect those sources of water despite their location outside the boundaries of the Greater Municipality. Because the law does not specify how to achieve this protection, the ISKI can only alert other agencies and advise them to take the necessary measures. Whether they do is another matter. For example, in these areas, there are municipalities that want to use land for other purposes. Small municipalities tend to be poor, and issuing building permits (often forcing those who want to build to make "voluntary contributions" to the municipal funds) is a major way for them to generate income. It is not important to them that the ISKI does not want houses on the land and they assume that the ISKI will not be able to do much about new settlements.

The government owns much of the land in the catchment basin, where construction is prohibited. The treasury is expected to protect this land, but has no monitoring system and can initiate action only when there is a complaint. Even then, it is a cumbersome process to tear down buildings that already have a roof. Political parties and elected officials, such as deputies, tend to be sympathetic to squatter settlers since they are viewed as potential votes. The concessions made to them appear to hurt no one. A potential by-product of these squatter arrangements is water pollution, but its origins are difficult to trace and its costs are not borne by those occupying the land.

In the past, the ISKI was not able to immediately patrol the no-construction zones in the catchment area. In cases where it became aware of violations, it could not apprehend the violators but had to wait for the police or the gendarmes to deal with the problem. The delay gave those who would be negatively affected by the ISKI's actions the time to mobilize. Gangs, interested in keeping the land open for further settlement, would sometimes threaten ISKI personnel, trying to force them to withdraw their objections, and politicians were often mobilized to protect the new settlers.

Usually, government agencies do not cooperate closely on matters that are of importance to some but not to others. An ISKI official, responsible for the security of the catchment basins, recounted the story of an attempt by the provincial governor to develop an emergency force to respond to violations of water security. The provincial governor is an appointed official of the central government, and all national government agencies operating in a province are, technically speaking, under his authority. In this case, he invited representatives of more than 40 governmental agencies to attend a session in which measures to protect the water catchment basins would be discussed and where there would be an agreement on a common course of action. The ISKI was to coordinate these efforts. Under the watchful eye of the governor, the participants quickly reached this agreement, but when implementation was attempted, joint efforts failed to occur. When the ISKI called upon other agencies, they often found reasons not to become involved in matters that they felt were only of direct relevance to the ISKI.

The difficulty of protecting areas from the intrusion of settlers, industries, and other possible polluters of water sources is well known to national and local water authorities. The remarks of a high official of the DSI Regional Directorate are telling, indeed. Referring to the many pressures to which administrators of public agencies are exposed in the implementation of their duties and the lack of resources available to them to counter these pressures, this official proposed that all publicly owned lands in water catchment basins be turned over to the military. He viewed the army as the only force with the capacity to resist encroachments on land effectively. While the suggestion does not appear to be practical in a democratic society, it reflects the bureaucrats' frustrations with politicians focussed on short-term gains, and a public that, in its search for land upon which to build, refuses to be constrained by public regulation.

Rather than turning the protection of catchment zones over to the military, the ISKI has tried to find less radical ways to cope with the problem. As it has gained financial strength, it has been able to employ economic incentives to reinforce, and on occasion to replace, measures that previously relied on the state's coercive powers. First, the ISKI hired its own security guards to patrol the areas that required protection from intrusive construction practices. This dissolved the ISKI's dependence on other security forces such as the police and the gendarmerie to whom such protection is incidental. Focussing on the areas needing protection, the ISKI security patrols are

able to stop illegal construction efforts at their inception. In this fashion, the force performs essentially a preventive rather than a corrective function. The government enactment of a law allowing public and private corporations (the government had in mind banks, factories, and other similar institutions) to establish their own security forces made the ISKI's actions possible. That is, taking advantage of its own law—the one that defined it as a public corporation whose duties include the protection of sources that provide water for the Greater Municipality of Istanbul—the ISKI developed its own private security service. If the service performs well, its presence may be enough of a deterrent so that more severe forms of intervention may no longer be needed. For the time being, the system is new or, one might say, in the experimental stage.

Second, with improving finances, the ISKI is able to pay fair prices to private owners for property expropriated for the development of reservoirs. For example, in the case of the construction of a new reservoir on the Asian side, no less than five villages that historically were in the area had to be removed. The villagers, deducing from past experience that the state would pay much lower than market prices for their property and would not make its payments on time, viewed the prospect of being removed from their homes dimly. Cooperation among the owners increased, however, when the ISKI paid them the market price for their property in one lump sum.

Third, the ISKI's improved financial situation allows it to deal with pollution in ways other than preventing settlement on land and tearing down existing structures. Utilizing its own income and some internationally financed loans, the ISKI launched a major sewage collection and treatment project. The project, which includes water catchment areas and reservoirs but is not limited to them, is currently near completion. When finished, sewage will not be discharged into rivers or soil where it can make its way into drinking water resources. Instead, after collection, it will be treated at several centres and then discharged into the Sea of Marmara at 80 metres depth. The currents are expected to take the discharge away.

The manner in which the ISKI is dealing with insuring water security reflects a shift in the attitude of the Turkish bureaucracy, which historically has favoured prohibitions and bans as a way of coping with problems. Those decisions, in part, have derived from the lack of economic means but they also owe much to the history of Turkish modernization, which relied heavily on centrally administered change by a military-bureaucratic elite. Now, albeit with varying intensities, there has been a shift away from using the authority of the state and toward placing a greater reliance on economic incentives. These changes are likely to facilitate the efforts of public agencies in coping with water security issues. The perspective of a high-ranking official of the DSI Regional Directorate serves as an example of this shift in thinking. His view is that his agency should reduce its workforce from the current 40,000 employees to about 5,000 and remove itself from dam construction, work that private corporations could undertake. Then, the DSI could concentrate on planning and project development.

5. THE TRENDS IN WATER SECURITY

Water security is ascending in importance in Istanbul. The critical shortages during the late 1980s made it clear to both the administrators and the consumers that, unless more attention and resources were devoted to the provision of water in sufficient quantities and of an acceptable quality to the citizens of Istanbul, the city would suffer serious setbacks in its development. Furthermore, it would cease to be a world city or a regional centre for both the Balkans and the Middle East.

Public reactions to the crisis were more muted than expected, partly because the upper middle class sections of the city did not feel the shortage as intensely as did the poorer districts. There were two reasons for this. First, most middle to upper income housing in Istanbul has storage tanks that remain full while the city water is running. During a shortage, or at other times when additional water is needed, special pumps are used to feed the water into the house. Thus, the more affluent residents are able to claim a greater share of the water for their own use and are less affected by water shortages. Second, shortages of water have led to a thriving business of tanker trucks carrying well water to users. Regulations allow the delivery of this water for industrial purposes. However during a water shortage, tankers supply water to those homes that can afford it, again reducing the pains of water deprivation. Nevertheless, the lessons of critical shortages have not gone unnoticed by public authorities, especially municipal governments that owe their election to majorities in the squatter settlements and the poorer districts of Istanbul.

From the preceding discussion and analysis of the outcomes, five general observations can be made. First, there is an increased importance attached to water security. It is now recognized that the procurement of sufficient water and the protection of the quality of the existing water supplies are major concerns that affect the future of the metropolitan area and therefore cannot be ignored. Second, the local government is playing an increasingly important role in providing the city's water. While this may seem a natural progression, it is worth noting in the case of Turkey because of its powerful tradition of centralism. The ISKI's birth and ascendance are testimony to the validity of this observation. Third, the DSI is no longer the sole authority on water procurement and is discovering that it has to accommodate changing power realities. Fourth, while political processes are important in making water policy in Istanbul, the seriousness of the water security problem is creating pressures on the public authority to emphasize the technical over the political, and the neutral over the partisan. Finally, the administration is shifting away from an authoritative and coercive approach and toward one based on economic incentives. Although water security for Istanbul continues to be a grave concern, that there are now institutions with the capabilities of tackling the problem offers grounds for optimism.

6. CONCLUSION

Does Istanbul's experience offer lessons to other cities with modest water resources and that are experiencing massive in-migration? We can think of two major lessons that can be drawn from the experience of Istanbul. First, recognizing that, in many instances, differences between cities and their situations may be more comprehensive than their commonalities, it is still possible to note that significant local institutional input is important in addressing the water question. Water security can be provided by the presence of strong local agencies, preferably established in the early stages of rapid urbanization. These agencies must have the exclusive task of providing water for a metropolitan area and protecting the sources that produce it. National agencies do not have the ability to focus on one area at the expense of others. Furthermore, insuring water security is a multidimensional process that involves interventions in other areas such as land use. It is easier to cope with these interventions at the local level.

Second, policies that take into consideration powerful socioeconomic trends, rather than those that ignore them or run counter to them, are more likely to be successful. Policy makers should be aware that public authority tends to be more effective when it relies on the consent of those who are affected by its actions rather than on the coercive powers of the state. All too often, bureaucracies deal with problems and achieve ends by relying on prohibitions and bans, only to generate unhappiness and fail to achieve the desired outcomes.

7. ENDNOTES

- ¹ The full name of Law 1053 is "The Law on the Procurement of Drinking, and Industrial Water to Ankara, Istanbul, and Cities with Populations over 100,000."
- ² Remarks made at the European Business Forum, Istanbul, September 4, 1997.
- ³ Interview with a high-ranking official of the 14th Regional Directorate.
- ⁴ In an early interview, the former mayor related this judgement to one of the authors. An official of the Regional Directorate, on the other hand, argued that, because the land on which the offices and the housing for the personnel of the office were located was prime property, the mayor closed the office with the hope of putting it to uses that were of greater interest to him.
- ⁵ A high-ranking official of the Regional Directorate divulged that the ISKI wanted to take over the implementation of the Yesilcay project which is one of the three major projects for generating more water for Istanbul. The official said in an interview that "they (the ISKI) even got the Minister of Energy and Natural Resources, who was from the same party as the mayor, to promise that the implementation of the project would be turned over to them. But, even the minister could not do it. In any case, international sources that make loans for

major infrastructure investments always prefer to make loans to the national government for they are more sure that the money will be paid back when it is due.”

- ⁶ In interviews, this point was made by the former mayor himself and corroborated by a high-ranking official of the Regional Directorate.
- ⁷ I have deliberately called the *modus vivendi* temporary because the mayor, in a recent address to a group of foreign businessmen, expressed rather powerfully his idea that, in the end, the municipality would also undertake the construction of the major dams. In light of the experience of the Sazlidere Dam, his words may mean no more than the ISKI financing the construction of the dam, but the remark offers an insight into the contentious relationship between the two agencies.
- ⁸ Personal interview, September 9, 1997.

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Editorial Note:

Some of the references cited were based on personal interviews conducted by the authors. I have chosen to keep this reference style; for further information about specific interviews, please contact the authors directly.

Chapter 12

Recent Greenhouse Gas Emission and Climatic Trends: A Comparison of Russia with Other Countries

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Data on greenhouse gas emissions, carbon sequestration, and climate warming for Russia have not been adequately assessed. This chapter discusses the impacts of Russia's economic recession on carbon dioxide emissions and the role of forests and bogs in carbon sequestration.

1. GREENHOUSE GAS EMISSIONS

It is widely known that human activities, especially those related to land clearing and fossil fuel consumption, release greenhouse gases (GHGs) such as carbon dioxide (CO_2) and methane (CH_4) into the atmosphere. About 61% of the human-induced enhanced greenhouse effect can be directly attributed to increases in carbon dioxide, while CH_4 and nitrous oxides (NO_2) account for another 23% and 4% respectively (Zavarzin, 1994). Table 12.1 presents recent trends in GHG emissions for selected world regions and large countries.

Total global GHG emissions rose to 6.1×10^9 tons/year by 1994. However, this figure masks the considerable emission increases from China, USA, and Japan, as well as the sharp decline by Russia after 1991. The downward trend in Russian GHG emissions reflects the economic hardship Russia has endured since the collapse of the USSR in 1991 and the resultant decline in fuel consumption generally and fossil fuels specifically. Similar trends have occurred in other former USSR countries. For example, in Ukraine, the economic downturn has reduced fossil fuel consumption, where 1994 CO_2 emissions were about 57% of 1991 levels.

An alternative perspective for studying regional contributions to potential climatic changes is to convert GHG emission levels into an equivalent radiative forcing factor. This is readily estimated by converting the energy trapping potential of each GHG into a CO_2 equivalent. For example, CH_4 is 68% more effective than CO_2 as a GHG. Table 12.2 estimates for 1987 the CO_2 equivalent of GHG emissions for selected countries.

Table 12.1 Recent greenhouse gas emission trends

Year	Greenhouse Gas Emissions (1,000 tons)	Europe (without USSR)						Russia
		World	USA	China	Japan	USSR		
1987	CO ₂	5,700,000	1,220,000	600,000	240,000	120,000	1,030,000	
	CH ₄	256,000	42,000	30,000	4,000	18,000	19,000	
	C1-F-carbonates	1,100	190	32	50	300	110	
1991	CO ₂	6,188,000	1,346,000	694,000	298,000	1,228,000	977,400	
	CH ₄	250,000	29,000	40,000	3,600	29,000	28,000	
	C1-F-carbonates	400	90	8	64	120	44	
1994	CO ₂	5,990,000	1,371,000	835,000	299,000			455,000
	% increase in carbon emissions (previous 5 years)		4.4	13.0	0.1			-24.1

Table 12.2 Contributions from selected GHGs to enhanced greenhouse effect, 1987

Region	Pure contribution to Greenhouse Effect (1,000 tons)				Percentage of World Contribution
	Carbon Dioxide	Methane	C1-F carbonates	Sum	
World	2,500,000	800,000	1,400,000	4,700,000	100.0
USA	540,000	130,000	350,000	1,000,000	17.6
China	260,000	98,000	32,000	380,000	6.6
Japan	110,000	12,000	100,000	220,000	3.9
Europe	520,000	85,000	480,000	1,085,000	18.8
USSR	450,000	60,000	180,000	690,000	12.0

The USA and Europe are, from this perspective, the major sources of GHGs, while China and Japan are of lesser importance. Russia was a major GHG emitter prior to 1991. Its overall contribution, when converted to CO₂ equivalents, was about one third below that of Europe or the USA.

While CO₂ emission reductions in Russia, other former USSR countries, and other east-central European countries were caused by economic recession, CO₂ emission reductions in industrialized countries were driven by modern technologies that enhance fuel efficiency and growth through the use of renewable energy sources. For example, Germany has reduced CO₂ emissions by 9.9%, while Great Britain has stabilized emissions. However, not all industrialized countries, most notably the USA and Canada, have been able to reduce GHG emissions. Furthermore, the rapidly developing economies of India and China have resulted in 23% and 15% increases respectively in GHG

emissions. Russia has been able to reduce GHG emissions recently, but it is important to note it is still a major consumer of fossil fuels. In addition, an economic recession has largely triggered recent GHG emission reductions rather than commitments to improve fuel efficiency and/or encourage conversion to renewable energy forms.

2. CARBON BALANCE

It is now recognized that carbon sinks—the sequestering of carbon by biota, soils, and water—could play a major role in tempering the potential impacts of human activities on the global climate system. While the science of carbon sequestering is not fully understood, there is sufficient evidence to suggest that there is considerable variability in the capacity of nations and major world regions to sequester carbon.

In 1994, fuel consumption and cement production in Europe (not including Russia) emitted about 1400 mt/yr of CO₂. About 10% to 12% of this total was from the former USSR Republics. Landclearing and wetland destruction added another 220 mt/yr to total emissions for the region. The region is relatively small, and therefore carbon-sequestering opportunities are limited. Overall, total carbon emissions approximate the region's total carbon contributions.

Russia, with a relatively large land base and extensive forest systems, stands in sharp contrast to continental Europe. Industrial CO₂ emissions in 1994 were estimated at 455 mt/yr and ecosystem conversion added another 220 mt/yr. Natural ecosystems, mainly the taiga forests, absorbed about one third of the total emissions.

Carbon sequestering by Russian peatlands is not included in this estimate. Peat accumulates in many of Russia's peatlands and it is anticipated this process will continue for another 40,000 years. Overall, Russian taiga forests and peatlands represent a substantial carbon storehouse, which may offset or absorb up to an equivalent of two thirds of Russia's CO₂ emissions.

In China, there is considerably less forest cover in comparison to Russia and therefore carbon-sequestering potential is also more limited. Carbon-sequestering opportunities are even more limited in Japan. Canada, with extensive portions of its land base covered by forests, is one of the few Northern Hemisphere countries that also has the potential to store carbon.

3. CLIMATIC CHANGE

Assessments derived from the observed weather record suggest global mean temperatures have risen over the past century, with the most notable increases occurring in the last 10 to 15 year period. The trend appears to be most pronounced in the Northern

Hemisphere, but it is important to note the considerable variability in temperature trends at the local level. The extent to which increases in atmospheric GHG concentrations have contributed to this macroscale-warming trend remains unclear. Incomplete weather records, an incomplete understanding of weather and climate systems, and the absence of fully developed climate models are some of the factors that make it difficult to develop conclusive links between increases in atmospheric GHG concentrations and the observed temperature record.

It is estimated that the global mean temperature rose by 0.25°C between 1980 and 1990. For the Northern Hemisphere, temperature increases were estimated at 0.55°C (Natsionalny, 1992). Over the past one hundred years, a rise of 0.65°C has been estimated for Russia. As has been the case elsewhere, there has been considerable variability in temperature trends at the local scale, with the largest temperature increase of 1.57°C recorded in the Baikal region. Temporal variations in the overall weather record are also evident. The 1986-90 period was 0.6°C warmer than long-term averages for all of Russia, but this time period includes 1987, which was one of the coldest years on record. For the first time, the average temperature for Russia for a single year exceeded long-term temperature norms by more than 30°C . Overall, the strongest warming trend, as estimated from the observed weather record, occurred in western Russia and middle Siberia, and weather warming trends were evident in northeast Russia and European Russia (Gosudarstvenny, 1994, 1996).

Trend changes in precipitation for Russia were not as conclusive as the temperature trends. The 1901-1991 record for Eurasia suggests annual average precipitation decreased by 12 mm/100 years. Natsionalny (1992) did not find a recognizable trend in precipitation levels for Russia. There is some evidence that precipitation in Russia over the 1980-95 period declined relative to observed levels for 1911-80. Regional precipitation trends across Russia are also inclusive and vary considerably. Data from Western Siberia suggests precipitation has increased for the region, whereas Northeast Russia and Eastern Russia were characterized by recent precipitation decreases.

4. CONCLUSIONS

Russia is currently a major emitter of greenhouse gases and, despite the decline in emissions due to the economic recession after the fall of the former USSR, and the substantial carbon sequestering of Russian forests and bogs, there has not been a significant reduction in carbon dioxide emissions recently. It is important that Russia acquire a mature economy and thereby be able to pursue more environmentally friendly activities; develop further alternative, nonfossil fuel energy sources; and pursue goals relating to a more fuel-efficient society.

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Chapter 13

Environmental Changes Within Kyrgyzstan

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One of the major threats to human security in Kyrgyzstan is from environmental degradation, particularly in the form of industrial pollution, contaminated food products, and radioactive contamination from uranium mine tailings. This chapter presents an overview of these problems, and comments on their potential to affect human security.

1. INTRODUCTION

According to the data presented in the report of the State Statistic Committee of Kyrgyzstan Republic, industrial production in Kyrgyzstan has declined over the past 5 years (NEAP, 1995). As a result of this decline, the environmental quality in the country has changed, in both positive and negative ways. These changes include declines in the following:

- atmospheric contamination caused by industrial production;
- drinking water pollution;
- contamination of food products;
- contamination caused by thermal energy production; and
- radioactive contamination in the environment.

2. THE MAIN IMPACTS

A sharp decrease in contamination of the atmosphere occurred in the period from 1992 to 1997. In industrial zones (Bishkek-city, Chui Valley), emissions were 2 to 3 times lower than 1992 levels. In health resort regions, they were 1.5 times lower. This was true for levels of solid particulate matter, sulphur gases, anhydrides, nitric oxides, and hydrocarbons. However, due to the use of low quality fuels and diesel oil, there was a sharp increase in toxins during this period. For example, the concentration of benzo-piren increased by 3 to 5 times.

Kyrgyzstan's state departments (for example, the Ministry of Health, the State Inspection of Metrology and Standardization, and others) did not respond to the nega-

tive impacts on the environment until 1996 and 1997, after the publication of these data by the State Statistical Committee. One of the key responses was a policy to control petroleum quality and automobile emissions. The national government prohibited the importation of low quality petroleum into Kyrgyzstan.

Contaminated drinking water in Kyrgyzstan is one of the country's main environmental and human health problems. The sanitary treatment of drinking water is almost nonexistent and, as a result, the country is experiencing a marked increase of intestinal disease. In Bishkek-city, for example, these diseases have increased by an average of 60 to 70% since 1992. There are 155 solid waste storage facilities in Kyrgyzstan. Only one of these meets sanitary norms; the remaining 154 sites are contaminating soil, as well as ground and surface water.

Sanitary control of food products also has deteriorated in Kyrgyzstan during the past few years. As a consequence, some diseases have increased among the general population. According to data from Kyrgyzstan's Ministry of Health, the poor health of the country's population is linked to its unfavourable ecological situation, and, accordingly, urgent and effective measures must be undertaken to correct these problems (NEHAP, 1997). The State and nongovernmental organizations responded to this situation by enacting environmental laws.

The laws "On the Quality of Drinking Water," "On the Quality and Safety of Food Products," and "On a Defence of Consumer Rights" were formulated by the State Inspection on Metrology and Standardization and the Ministry of Health, with the participation of the Environmental Protection Foundation of Kyrgyzstan. These laws, the main aim of which is to ensure the population has access to a clean environment, were then passed to the Government of Kyrgyzstan for ratification.

Returning to the use of low quality coal instead of natural gas in thermal energy production is the primary cause of a sharp increase in atmospheric pollution. The overall emissions of these gases, which include sulphur dioxide, sulphides, and nitrates, increased twofold. As an urgent measure, scrubbers were recommended for all thermal plants within the country.

Radioactive safety is a concern in the Kyrgyzstan Republic because of the many uranium tailings located within its boundaries. More than 13 tailings ponds were left without controls following the closure of uranium mines and factories. The waste products of uranium production present a real threat for both the environment and human health. Radioactive contamination of land situated near uranium factories is one of the main problems. The total mass of radioactive wastes is more than 34 million tons and total radioactivity levels are higher than 88,000 curies (1 Ci= 37,000,000,000 Bq). Radium-226 activity ranges from 28,220 to 172,000 becquerels per kilogram (Bq/kg), and Thorium-232 activity ranges from 372 to 660 Bq/kg.

Radon-222 also contributes to environmental contamination in regions situated near uranium tailings. In these areas, radon emanation makes up 100 emans (Kaji Sai, Issyk

Kul oblast; $1\text{ E}=0.0037\text{ Bq/m}^3$) and 40 E (Mailu Suu town, Jalal Abad oblast); the concentration of Radon-222 in the air is over twice the maximum permissible amount. It is imperative this be taken into account during further development of the regions.

According to the standards of the former Soviet Union, the average period of interdiction for uranium tailings conservation is 60 to 80 years with a guaranteed safety until the years 2010 to 2020. Natural processes and cataclysmic events (earthquakes and huge landslides) increase the probability of the breakdown of radioactive pollution, however it is difficult to estimate what their precise consequences may be. The Mailu-Suu uranium tailings are a potential source of radioactive pollution, threatening the densely populated Fergansky Valley (territory of Kyrgyzstan and Uzbekistan).

The other source of radioactive pollution in Kyrgyzstan is the nuclear test site in China, Lop Nor polygon, that is located approximately 900 km from the eastern and south-eastern regions of Kyrgyzstan. Scientists from both Kyrgyzstan and Uzbekistan have identified Sr-95 and Cs-137 in the soil of the Naryn oblast and Tien Shan glaciers. These findings confirm the transport of radioactive material from the nuclear test site in China to the territory of contiguous states. Clearly, the eastern regions of Kyrgyzstan are zones of high ecological risk. Scientific researchers must study, in more detail, the environment in the eastern regions of Kyrgyzstan as part of an effort to improve the health levels of the area's inhabitants.

In response to the problems regarding radioactivity, the law, "On Radiation Safety," was worked out by scientists with the participation of the Environmental Protection Foundation of Kyrgyzstan and subsequently passed to the Kyrgyzstan Parliament. This law includes measures to reduce the consequences of radioactive contamination to people in the affected regions.

3. LONG-TERM ENVIRONMENTAL CHANGE

Regional climate changes are long-term environmental changes. The greenhouse effect is caused by changes in the concentration of carbon dioxide in the atmosphere, as well as by other greenhouse gases. Observations in Kyrgyzstan from 1980 to 1993 show the concentration of carbon dioxide increased from 340 to 364 PPM in conventional units. This represents a 7% rise since 1980. During the period from 1990 to 1993, the concentration of carbon dioxide levels in Kyrgyzstan was constant.

On the basis of these data and using the Budyko formula, one can estimate the increase in temperature due to the greenhouse effect. In Kyrgyzstan, the temperature increased 0.28 degrees over a 10 year period. Thus, the average temperature increase for one year was 0.028 degrees. These data are in accordance with temperature changes obtained on the base of net measurements of temperature in Kyrgyzstan during the period from 1920 to 1990. The results indicate a warming of the regional climate.

4. CONCLUSION

The changes in environmental pollution noted above are having significant impacts on the health of the Kyrgyzstan population. If this continues, it may pose a major threat to the security of the people.

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Chapter 14

Sustainable Land Use: Methodology and Application

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This paper addresses the issue of sustainable land use from two perspectives. First, a substantive and methodological discussion of sustainable development and related environmental security in the context of land use planning is offered. Second, an empirical case study on various land use options of the Po Delta area in Italy is dealt with, in which conflict resolution is analyzed by means of the use of multi-criteria analysis (in particular, the regime method).

1. SUSTAINABLE LAND USE

The widespread destruction of ecosystems and the consequent losses in biological species diversity testify to the unsustainability of current human actions. Such actions form the dangerous obverse of the otherwise benevolent coin of economic and technological progress, and they call for coordinated management among the various states and regions of the world. Environmental security is directly related to economic security in cases where countries, for economic reasons, consider themselves forced to resort to the over-exploitation of natural resources whether within state territories, shared among states, or in the global commons. Without a sustainable natural resource base to which the various nations and peoples of the earth can have equitable access, economic and even military safety will remain problematic. (PRIO/UNEP, 1989, p. 29)

In the past decade the issue of sustainable development has gained much importance (see for an overview of the current debate Munasinghe & Shearer, 1995). While it began as a policy-oriented and action-based concept aiming to alleviate and solve issues about global environmental change, it focussed increasingly on meso issues—mainly sectoral, such as sustainable industry, sustainable tourism, and sustainable transport (van den Bergh, 1996). Furthermore, the discussion on sustainable development shifted toward sub-global spatial units, such as sustainable regions or sustainable cities (Giaoutzi & Nijkamp, 1994; Nijkamp & Perrels, 1994). It also recognized that the distinction between strong and weak sustainability (see also Pearce & Turner, 1990;

van Pelt et al., 1995) meant essentially a spatial substitution between different categories of land use. The important question is whether the purposeful degradation of one area (e.g., industrialization), can be compensated for by the enhancement of the environmental quality of another area (e.g., a tourist area).

Agriculture is an illustrative example. Within this sector there are various options (such as milk production, wheat production, etc.) from which to choose an activity. They cannot, however, be practised simultaneously at the same place (Barnett & Payne, 1995). There is also the possibility of different types of human intervention, such as intensified land use, the use of pesticides, herbicides, etc. (Douven, 1996; Simmons, 1997). The different possibilities and options illustrate how space, in a geographical sense, is multi-faceted. Consequently, the question of whether a certain agricultural land use is sustainable or not, is a complicated one and cannot be answered easily without a thorough knowledge of all trade-offs involved. The following observations further substantiate the previous considerations:

- Space—thus also land use—is the **medium** for environmental externalities in a broad sense; this applies to global environmental change, but also to local issues such as noise annoyance or soil pollution;
- Space—including land—is **heterogeneous**; this means that the distributions of impacts of environmental externalities are geographically specific (e.g., water pollution in a river basin delta area); and
- Space—and consequently also land—is both **productive** and **consumptive**, so that any space consumption has broader welfare implications (including externalities); examples can be found in recreational land use and infrastructure facilities.

The above factors are not only meaningful at the local or regional scale but are also significant globally, having an impact on food supply, resource availability and climatological stability (Cline, 1992; Fankhouser, 1995). In a recent survey article by van Ierland and Klaassen (1996) the authors identify a series of research priorities on socio-economic aspects of land use and climate change, viz., a deeper analysis of:

- agricultural impacts in developing regions;
- the influence of climate scenarios on water availability in sensitive areas;
- socioeconomic impacts of changes in human health;
- socioeconomic impacts of environment induced migration;
- impacts of extreme weather events based on risk assessment; and
- socioeconomic impacts of changes in ecosystems and biodiversity.

Some of these are long range concerns; for example, soil erosion, chemical poisoning, or nuclear waste, also relate to national or international security issues (see Daly & Cobb, 1990). Others, such as water pollution, shortage of food, or resources, are more

directly concerned with the daily quality of life (Homer-Dixon, 1992). Gaining importance in recent years are the often unpredictable natural and environmental catastrophes including floods, land slides, long periods of drought, etc. (United Nations, 1997). These cases provoke the question of how various land uses (including agriculture) can become a vehicle for adaptation or resilience with respect to global change processes.

2. ISSUES OF LAND USE: A SURVEY

At the regional level, the notion of ecogeographical regions is a useful one in demarcating areas within which environmental inter-dependencies may be confined and within which natural resources can be taken to be relatively homogeneous. If security is threatened within such a region as a consequence of the unsustainable use of the natural resources, or because of transboundary pollution, then concerted preventive actions might be appropriate and adequate. However, as ad hoc solutions may come too late, a plea must be made for preparing an inventory of potential environmental hot spots and for the structuring of continuing exchanges of information and perhaps even of joint management. The International Commission for the Protection of the Rhine, the two international commissions for the environmental protection and sustainable utilization of the Baltic Sea, and the comparable mechanism for cooperation among most of the Mediterranean littoral states are examples of this. Similar structures could be envisaged for states in the Horn of Africa and other ecogeographical regions. (PRIO/UNEP, 1989, p. 26)

Externalities manifest themselves often in various land use impacts, but the interest in land use from an environmental perspective has been rather modest. A major part of the literature in the early days of environmental economics was devoted to valuation studies of, for example, tourist areas, natural parks or urban monuments. Most of these studies were based on travel cost methods or willingness-to-pay methods in order to assign a monetary value to the environmental asset concerned, an approach which set the stage for the popularity of contingent valuation studies and hedonic price studies. Cost-benefit studies were used also in this context, but a new class of multi-criteria evaluation studies gradually replaced them (van Pelt, 1993).

Other studies tried to link spatial-economic to spatial-ecological (or spatial-environmental) phenomena by using either materials balance models or multi-regional input-output studies. The latter category meant essentially an extension of conventional input-output analysis by incorporating energy and materials (inputs) and environmental pollution (output) into the standard framework of a multi-regional input-output model. This approach was useful, especially for the purpose of predicting outcomes of policy interventions.

There were also numerous attempts to reinforce the analysis of spatial-economic and spatial-environmental linkages through use of more integrative systems models. This effort was hampered by the lack of proper information and by the near-impossibility of bringing environmental variables under a common monetary denominator.

Finally, by internalizing spatial-environmental externalities, for example, through Pigouvian taxation schemes, policy analysis in the environmental field has improved in various ways. This is particularly meaningful in land use or real estate cases where a compensation scheme for spatial externalities (both positive and negative) is foreseen. Other examples are found in the management of common resources and agriculture.

It is important to note that in spatial-economic studies the environment should not be merely regarded as a burden; indeed, it is also a source of opportunities and of well being. Seen from this perspective, elements characterizing both the space-economy and the ecology may constitute arguments of a social welfare function for a given area. In a multi-region setting this may lead to complicated trade-offs with rather severe conflicts between areas (e.g., the NIMBY phenomenon). Substitutability issues also are at the heart of the debate on weak and strong sustainability; weak sustainability takes for granted the possibility of a spatial substitution of economic and environmental capital (van Pelt, 1993).

Thus, there are many intricate and complex linkages between the economy and the environment, in which land use and space usually act as the vehicles for the transmission of externalities. And, even though our understanding is improved, there are still significant gaps in our knowledge, especially in a dynamic spatial context. *The World Development Report, Development and the Environment* states:

Degradation and destruction of environmental systems and natural resources are now assuming massive proportions in some developing countries, threatening continued, sustainable development. It is now generally recognized that economic development itself can be an important contributing factor to growing environmental problems in the absence of appropriate safeguards. A greatly improved understanding of the natural resource base and environment systems that support national economies is needed if patterns of development that are sustainable can be determined and recommended to governments. (World Bank, 1992, p. 6)

This lack of understanding is not surprising. In the history of economic thinking there have been only a few analytical attempts at positioning natural resources at the heart of economics. Perhaps the best example of these is found in the period of the physiocrats, who claimed the productive capacity of the natural environment as the major source of welfare. However, in other periods, economic thought paid less attention to nature as an important production factor. For instance, in classical economics, capital

and labour, in addition to land, were regarded as the main welfare generators. Classical economists assigned government a minor institutional role in the establishment of the framework for making market decisions.¹

In the postwar period, neoclassical thinking believed that nature, *per se*, was not the only source of welfare. Labour, capital, technology and land generated welfare constituents. Clearly, land and nature have not become irrelevant, as indicated in the following quotation of Randall and Castle (1985, p. 573) "...there seemed no reason to accord land any special treatment that would suggest its role is quite distinct from that of the other factors. Land could safely be subsumed under broader aggregate of capital...". In general, the role of environmental issues in traditional neoclassical economics is rather modest.

In contrast to the neglect of environmental issues in both Keynesian and, to some extent, neoclassical economics, we now have a situation where the externalities and limits to growth (with regard to both renewable and non-renewable resources) are a new focal point of economic research. The major challenge to policy is, in view of the long-term threats exerted by the (seemingly) inevitable and persistent changes in both local and global environmental conditions, to avoid a "tragedy of the commons" (Hardin, 1968). Land use and spatial-environmental aspects of the economy, clearly, deserve more profound attention from social scientists.

In conclusion, despite a great diversity of pressing regional environmental issues we still need a significant improvement in spatial-economic theorizing. On a modest scale some progress has been made, but an operational methodology for regional and environmental analysis with regard to long-term spatial sustainability analysis remains missing (for example, Pezzey, 1989). In particular, more fundamental research at the local and regional level is needed. This would lead to visible and effective action at the local or regional level of the space-economy.

The histories and geographies of environmental economics reveal the multi-attribute nature of land. This multi-functionality gives land an economic value, such as for housing, industry, infrastructure, or agriculture. Also, within these major sectors, several distinct subdivisions are possible, for example, land for forestry, cattle breeding, harvesting, etc. Thus, whether some use of land for agricultural purposes is sustainable not only depends on external sustainability criteria (that is, environmental impacts of agricultural versus alternative land use), but also on internal sustainability criteria (that is, different uses of agricultural land). The question is, which package of land use in the agricultural sector guarantees the best possible environmental outcome? In operational research terms, the question is fundamentally about economic trade-offs between conflicting functions. Which environmental stress factors lead to minimal overall environmental decay in light of different agricultural functions (use and size), aerial attributes and policy (and price) factors? These questions are analyzed in more detail in the following section.

3. A MULTIFUNCTIONAL EVALUATION OF LAND USE

Since sustainable development is a normative concept, any sustainable development strategy involves value judgements. van Pelt (1991) points out at least three questions.

First, is the environment indeed considered a direct welfare attribute, as advocated above, and how are trade-offs with income treated? Second, how does the present generation, particularly government, view their own responsibility to future generations (i.e., inter-generational equity)? Should they, for instance, be able to achieve at least the same welfare levels? Is the present generation willing to take certain risks in this respect, expressing confidence in man's[sic] capability to respond to ecological problems? Or should a risk-adverse strategy be pursued? Third, what are views on the environment as productive input, and particularly on the question of whether man-made capital (machines, cars, etc.) and environmental capital are complementary factors of production, or substitutes? (van Pelt, 1991, p. 17)

van Pelt also draws attention to various attributes of sustainability criteria, which have a clear spatial connotation:

- **environmental parameters:** in general, a single aggregate indicator does not exist, as targets and policy measures are usually group or region specific;
- **critical threshold values:** examples are safe minimum standards or carrying capacity, all of which have a clear site-specific meaning;
- **acceptable risks:** risk perception studies reveal that there is normally a geographical pattern (e.g., distance-decay) in risk perceptions of people; and
- **demarcation of relevant regions:** in many environmental evaluation and impact studies the final result is dependent on the size of the area for which the impacts are investigated.

From this perspective, it is clear that the policy objective of global environmental sustainability is difficult to operationalize (Giaoutzi & Nijkamp, 1994). A more promising approach seems to be the precise identification of concrete policy objectives and strategies at a meso level. A meso level may relate to particular regions or cities within a country. Focusing on regions enables the attainment of a much more coherent and practical policy and management strategy. Clearly, using regions as a focal point for sustainability policies provokes intriguing research problems. For instance, significant variations in economic or environmental conditions among different regions necessitate reliable quantitative indicators for a proper analysis of differences between regions.

The methodology for the integration of socio-economic variables, depicting the pattern and evolution of a local regional economy, and of ecological variables mirroring

the development of ecosystems within the study area is often fraught with difficulties. Following Brouwer (1988) it may be appropriate to design a cohesive economic-ecological structure model on the basis of the so-called satellite principle. This principle means that the core of interaction between the economy and the environment in a regional system is described in a compact but comprehensive way. Other (non-central) phenomena are neither represented in depth, or with all their complex dynamic interactions, but they are depicted in terms of their main linkages to the core. This core-satellite design ensures a consistent, concise, and structured presentation of a complex multi-dimensional system for a regional economy.

The choice of variables and indicators is of critical importance here, but the specification of variables, linkages and equations is co-determined by the methodology to be used in the analysis. Several variables (like landscape and ecological data) can be spatially differentiated, whereas others (like socio-economic data) are only used in an aggregate manner. This means that the spatial component has to be dealt with carefully in the empirical analysis, which is also the reason why GIS (Geographical Information Systems) is an indispensable tool in information and planning studies such as these. In general, system theory offers a fruitful background and frame of reference for assessing various effects in a complex spatial-economic and environmental system.

In order to develop an appropriate methodology for sustainability planning at the local or regional level, we suggest the following set of scientific methods: dynamic systems analysis; impact analysis; scenario analysis; GIS analysis; and multi-criteria decision support analysis. These are briefly outlined here.

Dynamic systems analysis seeks to analyze (i.e., describe and predict) the driving forces and their interdependence in a relevant system. It is evident that this approach should investigate the guiding principles of all subsystems that make up the whole and examine the material basis on which these rules are based. It is then necessary to look at the causal linkages in a comprehensive economic-environmental-human system. Such a systems representation forms the basis for an impact model, in which environmental and economic forces are put together in the framework of an open spatial system.

Impact analysis assesses and quantifies the relationships between the subsystems' functions. In addition, this analysis reveals the relationships between the principles governing each subsystem. Impact analysis is a scientific tool that is widely used to assess the results of policies or projects at national, regional or local levels. Its flexibility allows the use of several types of analytical methods like econometric models, input-output models, simulation and scenario methods, goals achievement methods and qualitative decision support models. It is important to note that policy strategies regarding economic development are often dynamic in nature: such strategies affect a system in successive inter-linked time intervals. Therefore, an impact analysis must be able to assess the impacts over time, and under successive development policies. A dynamic approach to impact analysis is necessary, especially in studies concerning

environmental impacts which manifest themselves in the long run. In many cases dynamic models are used to assess the various effects in an impact chain of a complex system. Hence, it is necessary to use plausible parameter values (either statistically—econometrically estimated or otherwise calibrated) in order to trace the multi-period consequences of changes in external conditions or policy controls for the system at hand. In this context, the openness of spatial systems is worth emphasizing.

Scenario analysis, by generating a rational frame of reference, attempts to establish and evaluate a set of hypothetical development alternatives for a compound and complex system. Scenario analysis may play an important role as a learning mechanism for decision-makers; by assessing, through solid empirical work, all foreseeable and expected impacts of various development strategies (scenarios), we could identify a policy strategy which might fulfill the aim of an ecologically sustainable economic system. This idea is of the utmost importance in the development of regional or local economies. However, if scenario analysis is to lead to feasible and desirable choice alternatives, all the relevant information must be sought and included in the research process.

Effective and accessible information systems are vital to economic performance and strategic decision-making. The rapid development of digital and electronic technologies, for instance, in the form of digital recording and transmission of sound and pictures, optical fibres for the high speed of transmission of information, super-fast computers, satellite broadcasting and video transmission, offers a new potential for sophisticated voice, data and image transmission. From a geographical viewpoint the trend toward advanced information systems has led to the design and use of **geographic information systems** (GIS). A GIS offers a coherent representation of a set of geographical units or objects, which—besides their location—can be characterized by one or more attributes (feature, label or thematic compound). Such information requires a consistent treatment of basic data, from the collection and storage stages to the manipulation and presentation of such data. All such information systems may be highly important for the planning of our scarce space, not only on a global scale (e.g., monitoring rainforest development), but also on a local scale (e.g., physical planning). Within this framework, spatial information systems are increasingly combined with pattern recognition, systems theory, topology, statistics, and finite element analysis. The past 20 years have witnessed the development of various computer-based applications of information systems, which have changed the activity patterns and decision modes of people.

Finally, it is necessary to evaluate the outcomes of alternatives and choose the best (perhaps) alternatives based on a set of criteria and solid evaluation methods. **Multi-criteria evaluation analysis** appraises the effects of each (hypothetical) scenario on all relevant subsystems. To perform these appraisals this analysis uses the relationships revealed by the impact analysis. This evaluation is also performed in order to

choose which of these scenarios may result in an ecologically sustainable evolution of an economic system. Or to put it differently, the evaluation addresses the question, which of these scenarios ensures that an evolving economic system recognizes itself as a subsystem of a biosphere system, so that the former does not disturb the latter? A basic premise is that the effects and the information concerning policy decisions are multi-dimensional in nature. It is important that the methodological framework allows for both the inclusion of and comparison of these effects, whether they are presented in the form of monetary units, physical units, survey measurements, etc. To a large extent, multi-criteria evaluation meets all the above requirements.

This methodology also takes into account, in an applicable decision framework, different and conflicting objectives, and is able to evaluate soft qualitative data. Hence, it forms in principle a suitable tool for environmental policy analysis at both global and local levels. These methods turn out to be very appropriate, especially for land use evaluations. In the next section, we address the use of multi-criteria analysis for sustainable land use in a more detailed manner.

4. EVALUATION FOR LAND USE SUSTAINABILITY

Sustainable land use seems an ambiguous concept primarily because of its multi-dimensional nature. For example, it comprises many areas of economic activity in relation to land use and environmental quality. This presents problems for analysis. It only can be operationalized in a straightforward manner if measurable sustainability indicators that might be defined by a priori critical threshold levels are identified (based on, for example, carrying capacity levels or environmental utilization; Nijkamp & Ouwersloot, 1998). As mentioned in Section 3, multi-criteria analysis is helpful in this framework, as it enables us to encapsulate the relevant, but diverse elements of sustainable development. Multi-criteria analysis has various major advantages in a sustainability analysis:

- it is able to take into account a diverse set of **different criteria** which altogether play a role in the assessment of the sustainable state of an environmental-economic system;
- it is also able to take into consideration—besides quantitative, numerical aspects—various **qualitative** aspects, even of a fuzzy nature (Munda, 1995);
- it allows for a **structured communication** with decision-makers and policymaking bodies (e.g., through the use of a range of policy weights for relevant choice criteria); and
- it has the potential to address future uncertainties by including **scenario experiments** in the analysis.

We do not discuss the technical principles of multi-criteria analysis any further here, but refer to Nijkamp et al. (1995). Table 14.1 illustrates all of the steps.

Table 14.1 Steps in Sustainability Analysis for Land Use

A. PROBLEM IDENTIFICATION

- 1 Demarcation of relevant region and identification of land use
- 2 Identification of relevant agricultural sectors
- 3 Identification of environmental sustainability problem of land use

B. IMPACT ASSESSMENT

- 1 Design of impact system or model for regional land use
- 2 Assessment of (state, target, instrument) variables
- 3 Selection of sustainability indicators or threshold values

C. SCENARIO ANALYSIS

- 1 Identification of alternative futures for the relevant area
- 2 Identification of policy strategies
- 3 Assessment of behavioural responses via impact model

D. POLICY EVALUATION

- 1 Identification of weights for policy criteria
 - 2 Sensitivity analysis on weights or thresholds
 - 3 Multi-criteria evaluation of policy options
-

We offer the following observations:

Evaluation methods—in particular, multi-criteria methods—aim to identify the best possible alternative (or the most plausible ranking of alternatives) from a set of distinctive choice possibilities (Janssen, 1992). In practice, a wide range of multi-criteria methods exists, depending on: the level of measurement of the information used; the formal relationship between policy objectives and choice attributes; the use of weights in the trade off analysis for different criteria; the treatment of outcomes of alternatives in an impact matrix (for example, pair-wise comparison); the specification of decision rules; and the standardization of criteria outcomes. The applications of different methods may sometimes lead to differences in results, particularly if the aim is a complete ranking of alternatives.

In the case of quantitative criteria outcomes (that is, measured on a cardinal scale) several multi-criteria methods can be used, such as weighted summation, multi-attribute utility approach, ideal point method, and concordance (or Electre) method. Details are found in Janssen (1992) and Nijkamp et al. (1995).

If a multi-criteria evaluation problem is characterized by qualitative information (e.g., ordinal or binary), different methods can be applied. Examples are permutation method, evamix method, analytical hierarchy process method, (expected, extreme and random) value method, and regime method.

For our case study (see Sections 5 and 6) we use a mix of quantitative and qualitative information. Under these conditions the regime method is particularly appropriate, as it is able to treat simultaneously quantitative and qualitative data, without losing the essential contents of these two types of data. The regime method is extensively discussed in Nijkamp et al. (1995); here we offer a few of its concise elements.

A regime method presupposes a distinct set of a priori defined alternatives and a distinct set of a priori defined evaluation criteria, which are put together to form an impact matrix (for an illustration see Table 14.2 of our case study). Furthermore, it assumes a set of policy weights ('shadow prices') for each of the evaluating criteria; this becomes a weight vector. When there are multiple criteria weights (i.e., different weight vectors depending on political priorities), a weight matrix develops (for an illustration see Table 14.3). The impact matrix and the weights constitute the basic ingredients of the regime method (and any other multi-criteria method).

Table 14.2 Impact Matrix of Different Policy Strategies for Land Use Development in the Falce Valley (ordinal numbers are to be interpreted as 'the higher the better')

<i>CRITERIA</i>	<i>ALTERNATIVES</i>				
	Business as usual (a)	Optimized agriculture (b)	Flooding for fishery (c)	Mix of (a) and (c) (d)	Mix of (b) and (c) (e)
Net profits (106 litre)	64	159	143	95	147
Employment (number of jobs)	8	20	9	8	14
Tourist attractiveness (ordinal number)	1	1	3	2	2
Recreational attractiveness (ordinal number)	2	2	3	2	2
Ecological equilibrium of forest (ordinal number)	1	1	3	3	3
Security on ecological damage (ordinal number)	2	1	3	1	1

Table 14.3 Indicative Ordinal Weights for Different Interests (policy scenarios)
Regarding the Policy Criteria for Land Use Development in the Falce Valley (ordinal numbers are to be interpreted as ‘the higher the better’)

CRITERIA	WEIGHTS			
	Uniformity (i)	(Socio)-economic Interest (ii)	Environmental Interest (iii)	Security Interest (iv)
Net profits	1	2	1	1
Employment	1	2	1	1
Tourist attractiveness	1	1	2	1
Recreational attractiveness	1	1	2	1
Ecological equilibrium of forest	1	1	2	1
Security on ecological damage	1	1	1	2

The regime method is based on a pair-wise comparison of alternatives. For each pair wise comparison a dominance indicator (quantitatively or qualitatively) is calculated. Once all the criteria are calculated, a regime matrix is constructed. Next, by adding a weight vector, the relative dominance of each alternative can be assessed in the form of a performance (or success) indicator. The regime method leads to an unambiguous quantitative ordering of all choice alternatives. This method is used in our case study on the land use alternatives of the Falce Valley in the Po Delta area of Italy.

5. MULTI-CRITERIA EVALUATION OF SUSTAINABLE AGRICULTURAL LAND USE IN THE PO DELTA PARK: DESCRIPTION OF THE CASE STUDY

The emphasis in Italy on sustainable land use has risen in recent years as a result of the pressing demand from communities for environmental quality. In fact, the protection of natural resources and the promotion of sustainable development have become central concepts in the debate about the future economic progress at both the regional-national and international level. Natural parks and protected areas in general have to fulfill various objectives, such as:

- protection of natural resources, landscape, fauna and flora;
- defense or protection of the environment;
- scientific research; and
- recreational development of the land.

It is difficult to evaluate the economic benefits of such functions. However, it is possible that there may be advantages when the public objectives for a natural resource and traditional private activities are not counteractive, but instead are synergistically beneficial (Prestamburgo & Tempesta, 1994). For example, agriculture often plays a key role, because it is the principal land use activity, and at the same time fulfills important social and ecological functions (Segale & Pareglio, 1990; Whitby, 1994). However, in many cases, agriculture is also a source of strong conflicts between different societal objectives; in particular, between economic and ecological environmental objectives. On the other hand, agriculture is an integral part of the environment and landscape, and it is a challenge to find a sustainable development strategy for a territory under threat. To illustrate an ecological sustainability problem, we present our case study in the small region of the Po Delta Park and offer a method for its resolution.

In 1988, regional law #27 established Parco del Delta (Po Delta Park). Although founded as an interregional park between the two regions of Veneto and Emilia Romagna, the protected area is presently confined to the latter region, and in particular to the provinces of Ferrara and Ravenna. It occupies a significant portion of land area (1456 km²) starting at the northern part of the Po of Goro and includes the entire historical delta. Along the coastal zone and in the immediate hinterland, there are humid salty sites. This is the Sacco of Goro: the Valley of Comacchio incorporates humid zones of fresh water, forests and petrified pine forests, such as the Grand Forest of Mesola.

The major part of the Parco del Delta was recently reclaimed and constitutes an area of high agricultural adaptability with considerable emphasis on the valley-culture or fish rearing in salt-water lagoons. These lagoons are concentrated in the Valley of Comacchio. The park is subdivided into six discrete territorial parts, each one of which has specific historical, landscape, and natural features. One of the six parts is Volano-Mesola-Goro, within which our study area, the Gran Bosco della Mesola and the Falce Valley, is situated (see Table 14.1).

The area's future development is strategically important also in terms of saving the nearby forest of Mesola. Some proposed possibilities for guaranteeing ecological and economic compatibility and sustainable land uses are examined here. In this case, multi-criteria analysis is an indispensable instrument in the process of identifying a hierarchy of the possible policy scenarios and for ensuring a practical and appropriate methodology for reaching solutions to the problems mentioned above.

The conflict between productive systems and forest resource management shows the complexity of the problem and highlights the need for flexible and widely applicable methods to study the following issues (Bernetti, 1993):

- evaluation of the possible supply of public and private goods from agriculture and forestry;
- description of different scenarios representing social forces; and
- appraisal of the efficiency of a possible public intervention.

A sound methodological approach to the evaluation of productive land use must be capable of taking more than one objective into account. These objectives must make reference to three different systems: the economic, the human and the environmental. In order to achieve sustainable development, we propose using a multi-dimensional evaluation system. In case of multi-dimensionality, it is necessary to measure the assumed effects at various levels of precision. The multi-criteria evaluation, and in particular the regime method, allows us to satisfy these research needs.

The description and location of the Falce Valley in the heart of the (Po) delta suggests five possible policy intervention strategies:

- (a) **Business as usual**
This is a continuity of the currently prevailing agricultural practices.
- (b) **Optimized agriculture**
This means there would be an improvement of irrigation through the establishment of new canals and drainage processes, the introduction of a multi-annual agricultural rotation, the introduction of leguminous plants as soil fertilizers and of forage for the improvement of the soil texture and structure.
- (c) **Flooding**
This is a strategy that exploits the water availability in the area, creating fishing valleys for the exclusive artificial rearing of fish in fresh water.
- (d) **Partial flooding and current agriculture**
In this case, we assume fish rearing activity as a possible integration with the traditional agricultural activity.
- (e) **Partial flooding and optimized agriculture**
Analogous to (d), both agricultural activity and fish rearing are foreseen in addition to the land use improvement by implementing eco-compatible agricultural techniques.

The policy criteria taken into consideration for the evaluation are the following:

- (1) Net profit;
- (2) Employment (number of jobs);
- (3) Tourism attractiveness;
- (4) Recreational attractiveness;
- (5) Ecological equilibrium of the forest; and
- (6) Security from ecological damage (in terms of avoiding risks of causing ecological damage).

Once the criteria and possible policy intervention strategies are fixed, the first evaluation stage is the assessment of the impact matrix. This is done by showing how every alternative is positioned with respect to each single criterion of evaluation.

The second stage involves the construction of the weight matrix, which is supposed to attribute a different importance to each single evaluation criterion, and thus allows us to add new information to the existing hierarchical scale of the alternatives.

Naturally, the order or the classification of the policy intervention strategies depends on the importance of the criteria, and therefore will be different depending on whether the priorities concentrate on economic performance, environmental quality or ecological security. It is clear that the political or policy objectives and the decision-makers (political, technical, and social) influence the attribution of weights.

6. RESULTS OF THE REGIME ANALYSIS

The principles of the regime method outlined in Section 4 are applied to the case study described in Section 5. The number of possible policy intervention strategies for the Falce Valley is equal to five, while the number of relevant evaluation criteria is equal to six. The resulting impact matrix is represented in Table 14.2. The policy weights for the criteria concerned could not be assessed unambiguously, therefore a sensitivity analysis based on four policy scenarios was used (see Table 14.3). Thus, Tables 14.2 and 14.3 form the foundation for the application of the regime method. The four types of results based on the four policy scenarios are presented in Table 14.4, where the entries of the matrix refer to the performance index (or success index) of each of the five policy intervention strategies.

Table 14.4 Results of Regime Analysis (in terms of performance or success scores) for Intervention Alternatives for Land Use Development in the Falce Valley, Based on Four Policy Interest Scenarios

<i>POLICY INTEREST SCENARIO</i>	<i>ALTERNATIVES</i>				
	(a)	(b)	(c)	(d)	(e)
(i)	.102	.337	.996	.359	.666
(ii)	.067	.480	.979	.313	.660
(iii)	.117	.253	.999	.482	.650
(iv)	.128	.450	.992	.291	.639

The results are interpreted in a straightforward way. The performance (or success) scores show clearly that of the four policy scenarios envisaged, one is dominant, and therefore can be regarded as the preferred intervention strategy, viz. decision (c). This

means that flooding the area in order to favour fishery farms is superior to any other strategy.

Interestingly, there is a very robust second choice policy alternative, viz. (e), which is a mix of alternatives (b) and (c). Two other policy strategies, i.e., (b) and (d) have varying rank orders, depending on the policy priorities concerned. And just as there is a clear first choice, there is a decidedly apparent last choice, viz., alternative (a), which is the business as usual scenario.

Our results are in conformity with the findings of the original study (Munda, 1995), which concluded, on the basis of the Naiade model for fuzzy data, that alternatives (a), (b) and (d) are inferior and that (c) and (e) would be the best candidates, their relative preference depending on the underlying attribute values and their weights.

7. CONCLUSION

Land use changes have a vast range of implications for economic productivity, environmental quality, human security and the welfare of everyone involved. Policies must encourage humans to achieve development that is more sustainable. They are multi-dimensional, and hence need to be judged from a balanced perspective. This paper argues that changes to land cover means an alteration in a complex and interactive system linking human action to biophysical systems. Given the complexity, there is a need for a structured analysis of 'what-if' questions. We have attempted to systematically develop an analytical framework in which alternative choice options are combined with various policy perspectives. The regime method utilized here appears to be a meaningful vehicle for creating a structured investigation of relevant choice options, even in cases where the level of information is rather poor. Needless to say, there is scope for continued rigorous research on the issue of sustainable land use.

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8. ENDNOTE

¹ It is interesting to note that the classical economists were aware of the possibility that a stagnating economy might be due to a lack of natural resources.

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Chapter 15

A New Class of Global Models of Associative Memory Type as a Tool for Considering Global Environmental Change

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This chapter considers the global problem of environmental change and security. The authors adopt the concept of “sustainable development,” defined as the stable state of complex human society-environment interactions, to consider this problem. Mathematical modelling is one approach to understand contemporary global environmental change and to project future scenarios. This chapter also introduces the notion of space-time ecological patterns of regions for the purpose of ecological modelling and decision-making.

1. INTRODUCTION

Recently ecological concerns have played a more important role in all aspects of human affairs. Most countries, regions, leaders, and managers must incorporate ecological concerns into their decisions. It is now clear that decision-makers must move from local problems to global considerations. There is also a new concept for considering ecological problems—sustainable development. The reason for this lies in the growing complexity of our world, in the depletion of existing resources, and in the increasing size of human population. In this chapter, however, we consider primarily the global security aspects of ecological problems.

2. GLOBAL SECURITY ASPECTS OF PROBLEMS

Sustainable development is a very complex concept that deals with all aspects of life. Many scientists share the belief that only interdisciplinary approaches with different points of view and different methods can solve the problems of sustainable development (Hegseimann et al., 1996; Tombe & Rosendaal, 1997). But while new solutions presumably will be available in future, we now must be content with different approaches. One such approach is the methodology of the author (Makarenko, 1994), based on cybernetics, synergetic and mathematical modelling.

Much literature exists on sustainable development (Dilworth, 1997; Sachs, 1995). Roughly speaking, a discrepancy exists between the natural resource base and the rate of extraction of these resources, leading to unsustainability. This has been termed the "Vicious Circle Principle" by R.G. Wilkinson, which implies an unsustainable path of development when the increase in population demands technological expansion for supporting a high quality of life. How can we describe and understand these two paths of development (economic and ecological)? What are these development paths? Why is our understanding of the dangers of economic development not adequate to change the path of development now? One answer assumes that these two paths are quite distinct. We suppose that these two paths are stable formations, implying that particular adjustment measures cannot essentially change the situation. Development paths are considered unique, complex objects which incorporate economic, ecological, cultural, political, and other factors.

3. CONCEPTUAL FRAMEWORK

The initial component of this framework consists of understanding the situation and projecting future scenarios. There are many obstacles that hinder conceptual understanding. One such obstacle is finding an adequate representation of problems. A possible approach is to construct mathematical models. The second component of our conceptual framework consists of incorporating ecological issues into the framework itself. We also must consider the problems of perception and willingness to follow the "right" ecological way of thinking.

The third component of any conceptual framework relates to education in the broad sense. What is the nature of ecological thinking? What is the role of different types of education? How can ecological principles assist in changing development? Such problems also may be solved with the assistance of mathematical models.

4. EVOLUTION OR REVOLUTION

Assuming that development is comprised of a set of stable structures, we can pose the problem in the following way. The illustrative example we will use is the disintegration of the USSR and its transition to a market economy. The old societal infrastructure of the former USSR has been partially destroyed, but not replaced. This has allowed for two types of transition—evolutionary or revolutionary (gradual or fast change). Revolutionary transition from one stable state to another consists of abrupt, broken connections and the fast creation of new connections. On the other hand, evolution consists of a gradual reconstruction of the steady state. With regards to sustainable development, evolutionary transitions consist mainly of a gradual changing in the goals

of development from consumption-based to ecologically-oriented ones. It is clear that evolutionary transition may be a lengthy process. There also may exist situations when old goals and connections are rejected, but new ones have not been established. This can create difficulties and uncertainty. Revolutionary transition may occur under conditions of resource exhaustion. In such cases, society may be forced to adapt to another structure with substantially reduced employment and production. Such phenomena have caused the decline of past civilizations (Toinby, 1991).

To implement a smooth transition process, it is necessary to have appropriate methodologies for transition implementation. We have already noted the importance of models as tools for consideration. The key is the establishment of relevant indexes or goals. This creates controversial problems in identifying measures of progress, assessing the costs of different development patterns, and determining the impacts on the ecology (Makarenko, 1994; see, for example, Levkov & Makarenko, 1995). These measures can be included in most global models of the type described below.

Many organizations exist to assist in transition implementation—UN institutions, the European Union, national governments, and so on. But presumably there will need to be entirely new institutions as well (ecological police, ecological courts and others), because the old organizations will be insufficient.

Last, we must comment on the methodological aspects of transition implementation. This question is connected with conceptual thinking and is also very difficult. It is important to include a case study approach, gaming and simulation, when incorporating changing perceptions and behaviour (Dilworth, 1997; ISAGA, 1997). There are also important roles for education and the mass media.

Within the developed West, industry has created new approaches to globalization based on new possibilities in information processing. These approaches are termed “Intelligent Manufacturing Systems” and will be manifest in factories of the 21st century where the key ideas will be flexible global planning and information processing.

As described above, global security perspectives are very important and may be considered on the basis of the global models as outlined in Makarenko (1994). From the experience of local problem solutions (Makarenko, 1994; WACRA, 1997) it is clear that the global approaches help in solving local problems. Moreover, in many cases local solutions are impossible without global thinking. The example given below relates to transition problems in the Ukraine.

5. MODELS WITH ASSOCIATIVE MEMORY PROPERTIES

There are many models in economics (Samuelson, Leontieff, Gale, Pareto, and so on) which correctly model some aspects of economics. But the application of these models to the recent situation in the Ukraine is under question because of the evident

transition period. There are also many models in ecology relating to particular processes for estimating the regional spread of pollution. But so far there are no good quantitative and qualitative models for addressing the global problems of adaptation of a society as a whole in the field of human security. Our investigations on large system models demonstrate that existing models cannot explain all aspects of the current situation, especially in connection with geographical, political, international, and perception components.

Our analysis in economics, ecology, geopolitics, information science, and physics allows us to formulate the list of key topics for a future theory of global ecology in transition periods. First of all, we must be able to distinguish the global structure in society. For example, capitalism or socialism, global ecological patterns, and so on. Second, the perception and behaviour of people and authorities must be considered. The evolutionary nature of society and uncertainty of transition also must be taken into account.

Principles of global model construction are relatively new and were introduced in Makarenko (1994). The society is described as a set of objects of different natures. These objects are characterized by given parameters, within a set of connections between objects. The dynamic laws for parameters and bounds are then introduced. These laws cause the system to have global structures, which can be considered as global ecological patterns. In common circumstances these structures are very stable. There are some subprocesses—political, social, cultural, and so on—in such a system that are considered as a subsystem of the whole society.

The whole model is very complex and expansive because it must contain many processes. But even global principles shed some light on the complex dynamics of transition processes. In this chapter, we consider only some conclusions from the global model. In Levkov and Mararenko (1995), we demonstrate the applicability of the model to principles of geopolitical problems. Such proposed models are useful as a methodological basis for posing and solving problems of development, and also for developing the indicators and criteria of adaptation mechanisms in society.

6. SOME POSSIBLE APPLICATIONS

A complete description of the model used is beyond the terms of this chapter. However, we have applied it to both sustainable development problems. These applications may form the basis for considering different ecological problems. A key issue is the introduction of space-time ecological patterns of regions. We can then consider different types of elements such as forests, rivers, plants, towns, fields, individuals, land-use, and so on. Then, we can consider the bounds between them. The main assumptions are that spatial relations are rather stable historically. These relations

have the properties of associative memory and incorporate naturally the human factor in the specified region.

The next step is to consider the evolution of spatial relations, environmental turbulence, and so on. There remains considerable development for the full implementation of such models. We only provide some cursory remarks. First of all, such concepts are very useful for geographical information system (GIS) applications because the main elements in GIS are the vector elements as in models above. We are now trying to develop an approach in the Ukraine for purposes of ecological monitoring and decision making. These proposed models also can help to consider the problems of ecological collapses of regions under high levels of pollution. There is also the possibility to create new definitions of geographical space using this type of modelling. In conclusion, the concept of spatial modelling is useful for quantitative measures of national security (Vlasuk & Pirogov, 1995) and for the control of state development.

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Section IV

Transboundary Issues

Chapter 16

Solving Transboundary Air Pollution Conflict: A New Framework for Countries in Transition¹

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In this chapter we discuss the transboundary air pollution conflict between the Nordic countries and Russia; the main source of this pollution is emissions from Norilsk Nickel's nonferrous facilities on the Kola Peninsula. We attempt to assess the major elements of Russia's newly created economic and political framework and their implications for the implementation of possible solutions to this environmental problem. Further, we offer an explanation of the failures of efforts, both domestically and internationally, to solve the problem.

1. INTRODUCTION

Conflict between Russia/USSR and Scandinavian countries over transboundary air pollution has been notable over the last two decades. The primary cause of the tension is emissions from Norilsk Nickel's nonferrous facilities on the Kola Peninsula. They pose a particularly significant threat to extremely vulnerable ecosystems of the Arctic, since they result in acidification of the environment in both Russia and the Nordic countries, undermining the environmental security of the entire region. At present, annual emissions of sulphur dioxide from the Kola facilities exceed the combined levels in Finland, Norway, and Sweden. In recent years, several attempts to solve the transboundary air pollution problem have been undertaken domestically, and through the international collaboration of the Nordic countries. Although a wide range of different domestic and international policies and measures has been used, and various instruments employed, the results have been minimal. Norilsk Nickel continues to pollute the Arctic without penalty. The unsuccessful efforts to solve this conflict raise a number of questions: Why have environmental policies and measures adopted from the West failed to solve this conflict? Why have Russia's domestic efforts to reduce air pollution from these facilities, done in order to comply with international environmental agreements, been ineffective? What particular mistakes have been made in the design of policies and measures to solve the problems of transboundary air pollution? Finally, what lessons can be drawn from these failures?

This chapter attempts to answer some of these questions. It includes a description of the sources of transboundary pollution and a review of domestic and international

efforts to resolve these issues. As well, it devotes special attention to the analysis of significant changes in Russia's domestic framework for environmental policy implementation, a result of Russian society's transition to a new economic and political system. This framework creates important preconditions, both positive and negative, for environmental problem solving and for the resolution of transboundary conflicts, and it significantly affects the outcomes of cooperative international solutions of such conflicts. The West, in its policies and measures aimed at resolving transboundary environmental conflicts that involve countries in transition, needs to take into account the major parameters of this modified framework (at macro- and microlevels). Not doing so may doom to failure the actions of the West, and a great deal of the efforts, good will, and resources invested in the course of the (international) resolution of transboundary environmental conflict may be spent in vain.

2. NORILSK NICKEL: A MAJOR SOURCE OF TRANSBOUNDARY AIR POLLUTION

Solutions to the transboundary air pollution conflicts between Russia and the Scandinavian countries hinge on finding mechanisms to reduce the deposition in Scandinavian countries of sulphur dioxide that originates in the northwest of Russia.² More specifically, they involve regulating SO₂ transborder flows from Murmansk Oblast and, in particular, from the Norilsk Nickel facilities, that is, the Pechenga and Severo smelters, which are located on the Kola Peninsula. Murmansk Oblast is responsible for about 70 percent of SO₂ transboundary flows transported from Russia to the Scandinavian countries. During the first half of the 1990s, the sources in Murmansk Oblast annually contributed to about 13 percent of total sulphur deposition in Finland (19,000 tons), 11 percent in Norway (10,000 tons), and 3 percent in Sweden (4,000 tons). Importantly, these account for only a minor portion of the total emissions from Murmansk Oblast, since the bulk of these were deposited within Russian borders.

The Severo and Pechenga smelters are the primary sources of transboundary sulphur deposition in the Scandinavian countries. According to official national environmental data, in 1996 Pechenga and Severo emitted 368,500 tons of air pollutants (Ministry of Environment, 1997, pp. 169-170), and the major portion (95 percent) was SO₂. There are a number of reasons for the high levels of sulphur dioxide emissions and for the transborder flows: the type of technology, such as the procedure currently used for processing nonferrous metals from ores with high sulphur content; the age of the technology; low levels of sulphur absorption from flue gases; and, purification equipment that functions only on flue gases with high sulphur content. The construction in the 1980s of higher smokestacks (150-200 metres) to replace the shorter ones

contributed to the dispersion of air pollutants and their transborder deposition. As a result, according to the scientific assessments of some experts, the territory affected by pollution increased from an area of 50 square kilometres in the beginning of the 1970s to an area of 400 square kilometres, reaching as far as Finland and beyond, in the early 1990s.

2.1 The Dynamics of Transboundary Air Pollution

During the 1990s, emissions of air pollutants in the Murmansk Oblast decreased by 25 percent (from 714,100 tons in 1988 to 538,800 tons in 1993), with a reported 30.5 percent reduction of SO₂ emissions from 1980 to 1993. The latter complied with the requirements of the 1985 Sulphur Protocol to the international convention on Long-Range Transboundary Air Pollution (LRTAP). It is remarkable that only part of this reduction, however, reflected policies implemented as a result of the LRTAP international regime. Meeting the international obligations under the Sulphur Dioxide Protocol during the 1990s, when transborder fluxes had declined from the European part of Russia, was likely a result of the sharp economic recession, and had little to do with antipollution measures. This is a classic example of compliance with international environmental agreements without their domestic implementation. This situation continues in Russia today (Kotov & Nikitina, 1998).³

By 1993, when the 1985 Sulphur Protocol of LRTAP was to expire, the Norilsk Nickel facilities (Kola) were in nominal compliance with the initial goal of reducing sulphur dioxide emissions and their transborder flows by 30 percent from their 1980 levels. Pechenga and Severo had reduced their SO₂ emissions by 38 percent from 1980 levels but operational changes, such as the installation of scrubbers, accounted for only a fraction of the improvement. Most of it was due to a downturn in production.

However, it is especially disturbing that these emissions decreased less than did the output of nickel. Ageing equipment largely accounts for this discrepancy. This is typical of Russia, in general, and Murmansk Oblast and Norilsk Nickel, in particular. The implication is that problems of transboundary air pollution have merely been masked by poor economic performance. With a resurgence of economic growth and increased emissions leading to transboundary air pollution, one might anticipate that Russia's efforts to comply with their international environmental obligations may well be inadequate (Kotov & Nikitina, 1996a).⁴

2.2 The Damage From Air Pollution

Norilsk's Kola facilities are among the primary sources of environmental deterioration in northern Europe. Less than a decade ago, domestic environmental statistics, results

of emissions inventories compilations, and, more importantly, results of assessments of environmental damage and damage to human health were the exclusive property of Russian agencies and ministries. As such, they were, for the most part, concealed from the public. Today, the situation is changed; environmental information is widely circulated. Official national environmental statistics indicate that the Norilsk Nickel facilities have had a serious negative impact on human health and on the natural environment throughout the region. According to recently published data, an estimated 8,100 hectares (ha) of land on the Kola Peninsula are irreparably damaged. An additional 126,000 ha of forested lands including one third of a Lapland nature reserve, as well as areas inhabited by indigenous peoples, have suffered (Ministry of the Environment [RF], 1993, p. 9). Other domestic official sources note that about 1,000 ha of forests have been destroyed. Health problems have appeared also. For example, official health statistics indicate that the city of Monchegorsk, where the Norilsk Nickel facilities are located, is among the 11 Russian cities with the highest rates of death due to air pollution among children under 14 years of age (PAIMS, 1995). Thankfully, new Russian environmental policy is gradually moving away from the previous Soviet approach of reporting to the international community any achievements in solving transboundary air pollution problems, but, at the same time, masking the severity of the domestic environmental situation.

National environmental reports also confirm that sulphur dioxide emissions from the Kola area contribute to the Scandinavian transborder fluxes and deposition. A number of international assessments of transboundary air pollution suggest significant damage from acidification in Scandinavian countries. For instance, a survey conducted by the World Bank (1993) in the Murmansk Oblast concludes that it is not only local environmental damage that can be detected as a result of air emissions; the negative impacts can also be noted at the regional scale. The effects of air emissions from the Murmansk region can be traced from their point of origin to their deposition in northern Finland and Norway. The most notable effects are the short-term peaks of SO_2 , which have had a negative impact on vegetation in areas of Norway near the Russian border. On the Norwegian side, the highest concentrations measured exceeded 2,000 milligrams per cubic metre, which is about 10 times higher than the recommended level. In Finland, the highest peaks have been close to 300 milligrams per cubic metre. The deposition of heavy metals from Nickel-Zapoliarny and Monchegorsk does not significantly affect other countries except for a relatively narrow zone (30 kilometres) near the border in Norway.

Similar assessments, confirming the negative impacts from transboundary air pollution at the regional level, were made by the experts of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe, Meteorological Synthesizing Centre-West (EMP/MSC-W), located in Norway

(EMP/MSC-W, 1994). They indicate that the Kola emissions may have international consequences that extend far beyond the border areas. The zones of influence reach a considerable distance into Finland, and across northern Sweden and Norway. Current deposition exceeds critical loads by the highest amounts for grids in southern Norway. The level of critical loads in some parts of Finnmark also exceeds the norms, and this is attributed to acid deposition from the Kola area. EMEP/MSC-W confirms that large point sources of emissions at Norilsk Nickel plants contribute significantly to regional depositions of sulphur.

3. POLICY AND MEASURES TO SOLVE THE CONFLICT

Since the late 1970s, various efforts aimed at resolving transboundary air pollution and acid rain originating from the Kola facilities of Norilsk Nickel have been undertaken both internationally—on multilateral and bilateral levels—and domestically (Kotov & Nikitina, 1996b). However, neither national and international regulations nor domestic and bilateral measures have had positive outcomes for the resolution of the transboundary environmental conflict.

3.1 Regulations at the Multilateral Level

In 1979, the Soviet Union signed the LRTAP convention agreement. This agreement, and its sulphur protocol adopted in 1985, required that the Soviet Union reduce by 30 percent (relative to the 1980 levels) emissions of sulphur dioxide or their transborder flows from the European part of the country by 1993. Although the revised sulphur protocol adopted in 1994 requires even greater reductions and establishes ceilings of emissions for European Russia (emissions of sulphur dioxide must be reduced 38 percent from the 1980 levels by 2005 and by 40 percent by 2010), Russia has already met these targets.

Although not specified directly in the first sulphur protocol, Norilsk Nickel's non-ferrous smelters in the Murmansk Oblast, together with other critical sources of transboundary air pollution situated mainly within the several hundred kilometre belt along the western border of the country, were major targets of these domestic commitments. During the 1980s, the Kola facilities were considered the critical factor that compromised national efforts to comply with international standards. Although, currently, this region is nominally in compliance with multilateral standards, if urgent and profound antipollution measures are not undertaken, the expected increase in nonferrous metals production by Norilsk Nickel will soon violate these targets.

3.2 Bilateral Regulations

Along with multilateral regulations established to solve the problem of transboundary air pollution, there have also been efforts at the bilateral level between Scandinavian countries and Russia to resolve regional conflicts.

Joint actions on environmental protection between the Soviet Union and Finland developed in the 1980s as a part of active bilateral economic and technical cooperation. In 1985, the Soviet Union entered into an environmental agreement with Finland and, by 1989, the two countries had adopted an action program for reducing air pollution along their common border as well as a protocol for cooperation on the Kola Peninsula in Murmansk Oblast. These agreements went further than the LRTAP, requiring each country to reduce its emissions of sulphur dioxide in the border regions by 50 percent (from 1980 levels) by 1995. In 1992, the new Russia and Finland adopted a framework for an environmental agreement and an agreement for cooperation in several different areas, including air protection, that affects several regions of the northwest of Russia, but was not limited to the Murmansk Oblast (Ministry of the Environment [Finland], 1993).

Since the 1980s, there has also been greater environmental cooperation with Norway on the issues of transboundary air pollution. In 1988, the Soviet Union and Norway signed an agreement for the protection of environment, which Russia affirmed in 1992. Although the agreement focused on the problems of transboundary air pollution from the Kola Peninsula, it did not include targets for air pollution reduction in the area. The major emphasis of this agreement was a broad range of environmental problems, and the development of monitoring and scientific research with regards to the impact of acid rain.

Within these bilateral arrangements, there have been recent efforts to reduce transboundary air pollution from the Kola Peninsula. For example, at the beginning of the 1990s, the Russian government approved the reconstruction of the Pechenga plant, which involves the participation of the government of Norway and Nordic-based companies. High expectations for an amelioration of the environmental situation and for solving the transboundary air pollution conflict are associated with the implementation of this project; as a result, SO₂ emissions are to be reduced by 97 percent.

The 1980s were marked with active public pressure by the Scandinavian countries on issues of transboundary air pollution and acid rain. The Norilsk Nickel facilities in Murmansk Oblast were the major targets of public and political campaigns, which identified them as principal sources of transborder flows and the deposition of acidifying substances in Scandinavia. At the domestic level, local protests in the Murmansk Oblast were initiated at the beginning of the current decade only after the introduction of new environmental policy and the development of the green movement.

3.3 Responses at the Domestic Level

Several responses were undertaken during the late 1980s and early 1990s in order to implement these international commitments to reduce transboundary air pollution. The Soviet government imposed restrictions on sulphur dioxide emissions within the country, and Norilsk Nickel's two smelters in Murmansk Oblast were prime targets of this effort. For example, in the mid-1980s, the government ordered the Kola plants to reduce their emissions by more than half by 1993 (from 590,000 tons in 1980), when the first LRTAP sulphur protocol was to expire. Following the adoption of bilateral commitments with Finland in 1990, the USSR government introduced a national program for environmental protection and the rational use of natural resources. The program envisaged reducing SO₂ discharges by 50 percent in the northwest regions of Russia bordering Finland by 1995. These emission targets were passed on to the Severo and Pechenga plants. Partly because of the ineffective Soviet system of environmental management, and partly because the Soviet Union lacked the technology and resources to achieve such reductions in emissions, the government's ambitious goals have gone largely unmet, and a serious gap exists between goals and their implementation.

It is assumed that following the ratification of the second sulphur protocol of the LRTAP by Russia, domestic measures to reduce SO₂ emissions and their transborder flows from Norilsk Nickel facilities in Murmansk Oblast will be adopted. The assumption is based on the protocol's recommendation for levels of sulphur deposition within each EMEP grid on the Kola Peninsula. However, the new sulphur protocol will be implemented in thoroughly different conditions in Russia; there is both a new system of environmental management, and a different economic and political framework that, to a great extent, will define how effectively environmental management policies are put into practice.

4. MODIFICATION IN THE DOMESTIC FRAMEWORK FOR CONFLICT RESOLUTION

4.1 Major Changes

The shift to a market economy and to a democratic system established a new framework for environmental policy implementation in Russia.⁵ However, along with significant positive developments, such as the application of techniques and mechanisms that are new for this country, the transformation period in Russia has also brought certain negative consequences into this process. It appears that, under the present conditions in Russia, the standard techniques for environmental problem solving, which have been successful in the West, could have not only less successful outcomes but unexpected ones as well. This situation may inhibit the process of resolving those

transboundary environmental conflicts that, only a couple of years ago, seemed close to resolution. One reason for the recent delays and failures in solving the problem of transboundary air pollution from Norilsk's Kola facilities through the reconstruction of Pechenga is that proposed policy measures do not sufficiently take into account the rapidly changing economic, political, legal, institutional, and social framework of Russia today. Policy makers, from both the West and Russia, in designing policy options and measures aimed at reducing transborder pollution in the region must consider seriously the important new domestic factors.

Today, the implementation of new Russian environmental policy is taking place under extremely unfavourable political and economic conditions. These conditions include the weakening of state authority, a lack of public control in the face of the strong power of the local "elite," growing corruption and economic crime, economic crisis, a deficit of the state budget, a halt in investments in all spheres, a crisis of payments, and so on. As a result, the system of environmental management in Russia appears to be seriously deformed and distorted. Moreover, while the environment ranked high as a public concern—second or third in the beginning of the 1990s—it has since slipped to below 10th place on the public agenda, ranking, in the mid-1990s, below other concerns such as wages, prices, and crime. Naturally, all these factors affect the patterns and schemes of possible joint international solutions of transboundary issues.

Radical modifications in the institutional framework of environmental management at both the federal and local levels must be taken thoroughly into account in the environmental policy of the West. First, as a result of decentralization, the local level plays an increasing role in environmental management today. Second, not only have vertical and horizontal interactions between different governmental institutions at all levels been substantially modified, interactions between governmental institutions and nongovernmental actors have changed as well. New, active participants have emerged recently. Since their privatization, the bargaining power of large industrial firms has increased considerably, and they now participate more actively in the decision-making process.

The West's environmental policy for Russia is facing a serious problem. During the past few decades, the West's main strategy in dealing with the Soviet Union with regards to environmental problem solving has been to establish contacts with authorities in Moscow, that is, the institutions and ministries of the central government. Today, the diffusion of power and control away from the centre of Russia makes this strategy less and less effective. Previously, attempts by the Nordic countries to assist in reducing SO₂ emissions from the Kola plants of Norilsk Nickel were negotiated through the central government. The Soviet government exercised complete control over industrial operations; in this particular case, the Ministry of Nonferrous Metals made all the important decisions, including those dealing with environmental quality. Today, under the changed institutional framework, the West must pay more attention

to establishing ties at the local level. The overall distribution of decision-making power has shifted significantly. Currently, there are three key actors: the central government, regional authorities, and enterprise. New interaction patterns, within this triangle, have to be taken into account by the West. Moreover, the West must involve all participants within this triangle, since the decision-making process increasingly is becoming a negotiated process between multiple parties.

In order to have effective bilateral or multilateral policies that regulate environmental pollution where Russia is one of the counterparts, it is necessary to shift away from traditional approaches, and toward identifying the key elements that could help to define solutions appropriate to the new conditions in Russia. A strategy for resolving transboundary air pollution conflicts involving the Kola Peninsula must take the following into account: 1) the major factors that make up the new domestic framework for environmental problem solving; and, 2) the new patterns of interactions between domestic actors involved in this environmental problem solving at macro- and microlevels. These issues are discussed below.

4.2 Weakening of the Power of the State and Changes in Its Interactions with Nongovernmental Actors

Transformation in Russia has greatly lessened the power of the state vis-à-vis major industrial companies, thereby constraining its ability to enforce environmental regulations. At the same time, the state relies on large companies like Norilsk Nickel for a significant portion of its budget revenues. The complexity and conflicting pressures inherent in this situation make it difficult for government agencies to wield much influence in the area of environmental management. In today's economy, Norilsk Nickel—now being privatized—appears to be powerful enough to bargain for increasing assistance and concessions from the government to support its environmental initiatives. Moreover, Norilsk Nickel is strong enough to, for example, reject the suggested governmental assistance for the reconstruction of its polluting plant if it felt that the government was not meeting its full obligation of financial assistance to this project. The recent dynamics in the bargaining between the company and the government regarding the execution of the reconstruction of Pechenga, with assistance from the Norwegian and Russian governments, perfectly illustrate the case.

In July 1995, the Russian government decided to provide assistance for the reconstruction of the Pechenga plant, and issued the governmental resolution (No. 667), "Measures of Governmental Support for the Renovation of the Pechenganickel Metallurgical Process." This resolution confirms that the Russian government accepted the concept of Pechenga's reconstruction during the period of 1996 to 2000 based on the results of an international tender, which was organized according to presidential decree. Russia's government allocated \$42 million as a means of governmental support

for reconstruction, which was equal to a grant from the Norwegian government. Perhaps more significant than the direct financial assistance from the state was Norilsk Nickel's financial support for the remainder of the project. This support was to be drawn from additional hard currency obtained as a result of privileges, such as the lifting of export taxes, given to the company by the government (Russian Federation, 1995). A year later, this resolution was followed by another governmental decree (No. 1040), pledging governmental support. Additional financial resources of \$200 million (from privileged allocation of foreign investment loans for 1996-1997) were allocated to Norilsk Nickel and its subsidiaries for the import of equipment for technical reconstruction. The resolution also extended the period for the return of governmental credits (Russian Federation, 1996). Still unsatisfied with the scale of direct governmental financial support, Norilsk bargained intensely for even broader concessions.

In the end, these governmental provisions did not materialize. The Russian government cancelled its resolution to support and assist Norilsk. The Norwegian government also removed its grant for the reconstruction of Pechenga, thus drawing into question the effectiveness of external transnational subsidization for environmental projects. Currently, the reconstruction of the Pechenga plant is in a state of uncertainty and, by postponing all environmental investments, Norilsk has engaged in greater environmental risk taking. Again, it faces the familiar dilemma of finding new approaches and solutions to environmental problems. Today, however, the company is stronger and more "finicky" in its selection of possible problem solving options. The conflict between the company and the government is obvious; describing its interactions with the government, the former accused the latter of not meeting its obligations or providing adequate support. The differences between macro- and microlevel approaches to environmental problem-solving are clear. At the macrolevel, the Russian government, through its concessions to and support for this rich industrial producer, has shown its desire to solve the problem of transboundary air pollution. In contrast, Norilsk has shown it is in no hurry to address its environmental problems. In the current framework for environmental policy-implementation in Russia, the government does not have enough power to force the polluter to change its behaviour and, as a result, the dirty factories continue to operate.

Domestic actors who do not comply with governmental regulations produce many excuses and arguments; some are relevant, while others are groundless. Notwithstanding possible differences in evaluations of these arguments, one thing is perfectly clear: the Russian government, by its recent resolutions, has confirmed that serious regional environmental problems, as a result of the industrial activities of Norilsk Nickel on the Kola Peninsula, do exist. It also has confirmed that the way to solve these problems is through the thorough technological reconstruction of the Pechenga plant; this is the measure necessary for achieving a reduction in transboundary air pollution. This plan of action contrasts with some of the suggested offset measures, such as the installation

of higher smokestacks at the Pechenga plant. Norilsk Nickel is considering this option, among others. Higher stacks would reduce local environmental pollution; ultimately though, they would aggravate the conflict over transboundary pollution with Russia's Scandinavian neighbours.

4.3 New Economic Mechanisms of Environmental Management

The new framework for the implementation of Russia's environmental policy has specific implications for the use of newly adopted market instruments aimed at making producers reduce air emissions and, consequently, for the reduction of transborder flows. Sometimes, it limits the usefulness of these economic mechanisms.

One component of the new system of environmental management, introduced at the beginning of the 1990s, was the adoption of pollution charges. It envisaged that firms could emit a variety of pollutants (up to specific limits), but for this privilege they would be required to pay fees. Whenever a firm exceeded the allowable limits the fees would increase fivefold. For example, Severo Nickel paid 19 billion rubles in pollution charges in 1995, compared with 12.5 billion rubles in 1994. These fees were for emissions of air and water pollutants, and for solid waste disposal. Pechenga Nickel paid 20.5 billion rubles in 1995, compared with 9.7 billion rubles in 1994. More than 80 percent of these fees were for allowable emissions of air pollutants, virtually all of which were in the form of sulphur dioxide (Segodnya, 1996b).

These pollution charges were intended to provide incentives for firms to reduce their discharges. In practice, however, they have not been as effective as anticipated. Many firms prefer to pay the penalty fees instead of increasing their investment in abatement facilities. One reason for this is that the level of fees was fixed at a much lower rate than the cost of investing in environmentally responsible technology. As experts from the World Bank recently concluded, it would be one thousand times more expensive for Severo and Pechenga to invest in new equipment than to pay the environmental fees (World Bank, 1993).

The general weakening of state authority offers producers another way to avoid paying pollution charges and acquiescing to economic regulations. With the current economic situation in Russia, failure to meet financial obligations has become widespread. Firms evade taxes, default on bank loans, and fail to pay their suppliers and employees. Still, defaulting producers continue to conduct business, and rarely is a bankruptcy declared. Inevitably the question arises: Can environmental agencies expect a firm to pay pollution charges when it does not pay taxes to the state? Norilsk Nickel is on the list of large Russian enterprises with substantial debts to the state. According to a press release, Norilsk Nickel has accumulated debts for environmental fees of about \$56 million (Segodnya, 1996a). Meanwhile, representatives from Norilsk Nickel assert that the firm is not in arrears for environmental fees.

4.4 Changes in the Interactions Between Central and Regional Authorities

In Russia today, there is an atomizing of the power of the state; power is moving from the centre to the local level. During the Soviet period, all decisions related to industrial production were made in Moscow, with the participation of regional authorities being largely pro forma. Now, regions are playing increasingly larger roles in the formulation and implementation of domestic environmental policy.

In the Norilsk Nickel case, authorities in both the Murmansk Oblast administration and the Murmansk regional environmental committee (a territorial branch of the State Committee of the Environment) are involved in making decisions about the company's operations. Using uniform national standards, regional environmental officials determine the amount of pollutants Norilsk's Kola facilities may emit, as well as the fees the company must pay. They also monitor the company's compliance with environmental regulations. Murmansk regional authorities play an active role in distributing the funds collected through pollution charges, 90 percent of which are paid into a regional environmental fund. Although these funds are supposed to be spent on projects to enhance the environment, Murmansk authorities sometimes divert them to non-environmental activities, such as building a church or buying fuel.

The regional authorities have offered several concessions regarding pollution charges to Kola plants. At the present time, many Russian firms are exceeding their allowable emissions and incurring the fivefold increases in fees. According to the law, the additional charges are to come out of profits and cannot be deducted as a business expense. However, when a firm significantly exceeds its allowable emissions, another standard is applied, termed "provisionally coordinated levels of emissions." In this case, the firm still pays the higher fees but may deduct them as costs. Under current circumstances, the government makes such concessions in order to avoid the possible bankruptcy of firms in which it has an interest. Both Severo and Pechenga are examples of facilities to which such concessions are made. Pechenga, for example, is effectively being allowed to emit five times as much sulphur dioxide as it would be otherwise.

In such an economically depressed region, where many other firms have become insolvent, Norilsk Nickel is clearly important to the region's economic development. The company's two facilities account for nearly three quarters of the tax revenue collected in the Murmansk region. In a sense, the entire area depends on the health of this company. There are no other major employers, and its earnings provide much of the region's social infrastructure, including schools, hospitals, libraries, shops, transport facilities, and food and water supply. Officials from Norilsk Nickel often complain that a large part of their capital spending goes toward such infrastructure, limiting their capacity to make other investments. According to their data, in 1995 the company spent one trillion rubles on housing, utilities, and other amenities.

5. AFTERWARD: CLOSING DIRTY PLANTS TO RESOLVE TRANSBOUNDARY ENVIRONMENTAL CONFLICTS?

In this particular case, both the polluter and governmental authorities prefer to modernize existing facilities instead of closing dirty plants. Social considerations are the primary reasons that authorities at all levels do not view closing Norilsk's Kola facilities as a solution to environmental problems and transborder conflicts. Predicting social upheaval, authorities fear that the impact of closing the dirty plants would be too serious. Options that have been discussed include moving the region's population to southern areas and developing new industries. These solutions were deemed excessively expensive and thus unworkable. In the case of the latter, high costs were linked to the severe climatic conditions of these northern regions.

It is important to note that the continued operation of Norilsk Nickel enhances the opportunities for economic recovery in the region. Also, governments, at all levels, are interested in the tax revenues from the significant export operations of Norilsk Nickel, a world leading producer of nonferrous and precious metals. In addition, a reduction in production, or the closure of the Norilsk facilities would foreclose the possibility of future benefits to the donors from the Scandinavian countries. Benefits to Scandinavia, such as providing work for its own firms and the creation of additional jobs, would result from the subsidies offered for the implementation of joint reconstruction projects (Darst, 1996). Thus, it too is reluctant to have the government close the dirty plants.

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Chapter 17

Social Adaptation in Romania to the Chernobyl Accident

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On 26 April, 1986, the Chernobyl nuclear power station, located in Ukraine, suffered a major accident, which was followed by the prolonged release of large quantities of radioactive substances to the atmosphere. This chapter summarizes the results of radioactivity measurements related to this nuclear accident (various foodstuffs, soils, water) and comments on the potential role of small spectroscopy groups in future, similar cases. Intense radiometric activity started in our laboratory in May 1986. We have used common dosimetric and spectrometric devices. The principal effect of a nuclear power station accident on population is radioactive exposure via food consumption. Fortunately, the consumption of contaminated products in May and June of 1986 was strongly limited by monitoring and warnings, so the contribution to the internal dose was quite low. It could be appreciated that the population's supplementary Chernobyl irradiation in 1986 was compatible with normal medical irradiation, for example, less than 0.40 mSv. A simple model to minimize the contamination via foodstuffs is presented: greens require strong washing for the first two weeks after an accident, no milk and cheese consumption in the first six weeks, limited egg and meat consumption in the first three months, and destruction of fodder in the first two weeks. The use of ground water is recommended. Some aspects of psychological effects, especially "radiophobia," induced by the Chernobyl accident in Romania, are also discussed.

1. INTRODUCTION

On 26 April, 1986, the Chernobyl nuclear power station, located in Ukraine, suffered a major accident that was followed by the prolonged release of large quantities of radioactive substances into the atmosphere. Meteorological conditions and wind regimes resulted in widespread distribution of radioactivity throughout the Northern Hemisphere. Though mainly found across Europe, radioactivity from the multiple plumes from Chernobyl was also measured in Canada, Japan, and the United States. Only the Southern Hemisphere remained free of contamination. The accident caused acute radiation injuries, deaths among plant workers and firefighters, and the exposure to radiation of the thousands of people who were involved in rescue and clean-up operations. There was severe radioactive contamination in the area (1019 Bq total released radioactivity—approximately 300 times that of the Hiroshima bomb), resulting in the evacuation of people from a 30 km zone around the power plant. In the

months following the accident, it became apparent that radioactive contamination of varying severity had also occurred in extensive areas of Eastern Europe, including Romania.

From a biological point of view, the most significant radioactive substances in the emissions were iodine, caesium, strontium, and plutonium, each one presenting its own set of problems. Radioactive iodine is short lived and, as a consequence, practically disappeared a few weeks after the accident. It is significant because, if inhaled or ingested, it accumulates in the thyroid gland, where it may deliver large radiation doses as it decays. The doses may result in impaired thyroid function and, many years after the exposure, in thyroid cancer. Caesium is the element that clearly dominates concern about the long-term radiological effects of the Chernobyl accident. Because of its penetrating radiation, caesium deposited on the ground may give an external dose. It might also enter the food chain and give an internal dose. Caesium is relatively simple to measure and it is eliminated metabolically in a matter of months. Plutonium and strontium, on the other hand, are difficult to measure. Strontium only affects organisms when ingested or inhaled and, luckily, there was relatively little strontium in the Chernobyl fallout. Very little plutonium travelled far from the reactor site, and because of its chemical stability, it does not easily find its way into food chains.

In the first weeks following the accident, lethal doses of radioactive substances were reached in local biota, notably coniferous trees and voles (small mice), in the area within a few kilometres of the reactor. By the autumn of 1986, dose rates had fallen by a factor of 100, and by 1989, these local ecosystems had begun to recover. Sustained, severe impacts on animal populations or ecosystems have not been observed. Possible long-term genetic impacts and their significance remain to be studied (Gonzales, 1996).

A by-product of the environmental contamination was the contamination of foodstuffs produced in the affected areas. For some time following the accident, key foodstuffs showed activity levels exceeding the maximum levels permitted by the Codex Alimentarius (which is established by the Food and Agriculture Organization [FAO] and the World Health Organization [WHO] and sets the maximum permitted level of radioactivity for foodstuffs being traded internationally, for example, 370 Bq/kg of radiocaesium for milk products and 600 Bq/kg for any other foodstuffs). In addition, wild food products, such as mushrooms, berries, and game, from forests in the more affected areas, as well as fish from some European lakes also exceeded Codex levels.

This chapter summarizes the results, obtained by a small nuclear physics laboratory, of radioactivity measurements related to the Chernobyl nuclear accident and discusses the potential role of small spectroscopy groups in future, similar cases.

2. TEST RESULTS

The results of measurements taken since May 1986 show that all of Romania was affected by the radioactive cloud. The lowest concentrations ($0.3\text{--}0.8\text{ kBq/m}^2$) were measured in the Western Plain (the Timisoara-Oradea-Satu Mare area). High values ($15\text{--}25\text{ kBq/m}^2$, as compared to 555 kBq/m^2 for the nearby Chernobyl area) were reported at the mountain stations (Parang, Fundata, Babele, Ceahlau-Toaca), in the Transylvania Plateau (Targu-Mures, Cluj), in the eastern part of the country (Iasi-Tulcea-Buzau-Sf. Gheorghe Delta-Constanta), and in the southern area (Bucharest-Pitesti-Tg. Jiu-Drobeta Tr. Severin). For the southeastern region of Romania, the radioactive particle deposition after the Chernobyl nuclear accident occurred mainly on 1-2 May, with rainfall favouring the process.

The principal effect on Romania's population was radioactive exposure via food consumption (Constantinescu et al., 1988). The contamination mechanisms were the direct deposition of particles on existing plants and fruits during 1-2 May, and the indirect contamination of milk products, eggs, and meat in May-June 1986. Our research concentrated on three issues: environmental global gamma measurements, food-stuff contamination evaluation, and ^{131}I determination in the thyroid. Using Romanian type GAMMARAD portable dosimeters (based on Geiger-Mueller counters), our data showed on 3 May a total gamma radioactivity level of $8.50\text{--}11\text{ Sv/h}$ for Bucharest macadam (asphalt) but of $20\text{--}25\text{ Sv/h}$ for water sewers (after raining) and of $15\text{--}18\text{ Sv/h}$ for vegetation. For Campina (the hill region 100 km north of Bucharest) on 4 May, the data were $3.50\text{--}4\text{ Sv/h}$ (macadam that had been washed by rain), and 11 Sv/h (vegetation). For Sinaia (150 km north of Bucharest, in the Carpati mountains), on 5 May, the measurements were 3 Sv/h (macadam) and $3.50\text{--}4\text{ Sv/h}$ (vegetation). The main contributor in all cases was likely ^{131}I . These data confirm the heavy contamination of the Bucharest area and the importance of raining and washing processes, especially for macadam (Constantinescu et al., 1993).

The importance of washing greens to minimize the impact of contamination was evident, especially during the first half of May (one month after the accident), as was the need to avoid the consumption of milk products during the same period. Radioactivity levels in soils (e.g., ^{131}I : $30\text{--}240\text{ Bq/kg}$ in the middle of May 1986; ^{137}Cs : $45\text{--}200\text{ Bq/kg}$ for soil and $12\text{--}54\text{ Bq/kg}$ for sea sand) and in various grains (e.g., ^{131}I : $180\text{--}360\text{ Bq/kg}$ for barley in the second part of May 1986; ^{137}Cs : $135\text{--}630\text{ Bq/kg}$ fodder; and $15\text{--}3300\text{ Bq/kg}$ for granulated lucerne, depending on geographic zone) were also reported. The scatter in radioactivity concentration values, especially for greens and cheese, can be explained by an important spreading of radioactive particles in the southeastern region of Romania. For example, in the areas without rainfall between 1 and 10 May, 1986, the measured mean deposition values were 7500 Bq/m^2 for ^{131}I and 1100 Bq/m^2 for ^{137}Cs . In the areas with intense rainfall, the values were up to 75000 Bq/m^2 for ^{131}I and 18500 Bq/m^2 for ^{137}Cs .

If contaminated, water bodies such as rivers, lakes, and reservoirs can be a significant source of human radiation exposure because of their use for recreation, drinking, and fishing. In the case of the Chernobyl accident, this segment of the environment did not contribute significantly to the total radiation exposure of the population. It was estimated that the component of the individual and collective doses that can be attributed to the water bodies and their products did not exceed 1 or 2 percent of the total exposure resulting from the accident. Contamination of the water system has not posed a public health problem during the last decade.

Due to transport processes, the aquatic ecosystems in Romania were contaminated two to three days later than the atmosphere. For ^{137}Cs average concentration in surface water, values of 50 Bq/m^3 and only 7 Bq/m^3 were found in 1986 and 1988, respectively. In the Black Sea, the measurements taken at the same time were 230 and 60 Bq/m^3 .

Beginning 1 May at 6:30 a.m., the Maximum Permissible Concentration (MPC) for drinking water of 0.7 Bq/l was exceeded (1.7 Bq/l). The contamination level continuously increased, reaching 20 Bq/l on 2 May, and 30.5 Bq/l on 3 May, with the maximum value being registered on 4 May, 9:39 a.m. (49.3 Bq/l). After that, values decreased until 7 May, and reached a plateau between 7 and 13 May in the range of $3.7\text{--}5.6 \text{ Bq/l}$. From 14 May until 28 June, a second period of measurements registered decreasing and fluctuating values. After that date, tap water radioactivity remained below the MPC. Measurements for 1986 of the radioactivity of the groundwater in Bucharest showed a lack of any contamination. Unfortunately, due to technical impediments, groundwater was only used in Bucharest. Under these circumstances, the sanitary authorities took into account the major risk of epidemics as compared to the radiological risk due to the radioactive water consumption, and decided to carry on the delivery of tap water from the river water supply (Onicescu, 1990).

3. SOCIAL RESPONSES

Simple recommendations to minimize the contamination via foodstuffs include washing greens for the first two weeks after the accident, no milk and cheese for the first six weeks, limited egg and meat consumption in the first three months, and destruction of fodder in the first two weeks. The use of ground water is recommended. The consumption of contaminated products in May to June of 1986 was strongly limited by monitoring and warnings, so their contribution to the internal dose was quite low. In fact, the population's supplementary Chernobyl internal irradiation in 1986 was comparable to normal (e.g., less than 2 mSv).

In the case of Chernobyl, as with many other radiological incidents, psychological effects play a predominant role. Information about the severity and significance of

contamination was often sparse and uneven, public opinion was uncertain, and many doctors were not sure how to interpret information that did become available. As a result, there was a loss of confidence in the information and in the countermeasures recommended.

In general, the most widespread countermeasures were those that were not expected to impose a significant burden on lifestyles or the economy. These included advice to wash fresh vegetables and fruit before consumption and not to use rainwater for drinking or cooking, as well as programmes to monitor citizens returning from potentially contaminated areas. In some cases, experience has shown that these types of measures had a negative impact, which was significant (The International Chernobyl Project, 1991). Protective actions that had a significant impact on dietary habits and imposed a relatively significant economic and regulatory burden included the restriction or prohibition of marketing and consumption of milk, dairy products, fresh leafy vegetables, and some types of meat, as well as the control of the outdoor grazing of dairy cattle. There were some minor disruptions to normal life and economic activity in the affected areas. In particular, agricultural and forestry production was partially disturbed and some production losses were incurred.

After the Chernobyl accident, scientists who were not well versed in radiation effects attributed various biological and health problems to radiation exposure. Many of these problems cannot be directly attributed to radiation exposure, especially when the normal incidence is unknown; psychological factors and stress are more likely the cause. Attributing all health problems to radiation not only increases the psychological pressure on the population and provokes additional stress-related health problems, it also undermines confidence in the competence of the radiation specialists. These observations apply not only to the Former Soviet Union (FSU) regions, but also to Romania.

The effects of radiation on health are complicated and it is wrong to dismiss their impact as irrational or to label it "radiophobia." Many factors contribute to the development of problems, including widespread association with nuclear bombs, a lack of openness in the past on the part of governments, and the absence of intelligible explanations by scientists. Such effects are real and understandable, particularly for a mainly rural population whose work and recreation are closely interwoven with the land and on whom the authorities may have imposed restrictions. Even physicians and other leaders are often confused. The result is that rumours spread, fears increase, and any health problem is quickly attributed to a nuclear cause. Uncorroborated narratives become commonly held wisdom, and unverifiable statistical data is accepted with insufficient scrutiny.

In the case of Romania, a small rise (10-15%) in miscarriages in some regions and a slight decline in pregnancy rates were noted following the disaster. These could be attributed to a psycho-social response to the Chernobyl accident. Similar effects were

reported for Sweden, Norway, and some Russian regions. There are no data about induced abortions, strictly prohibited in Romania in 1986. In our opinion, the 1986 activity of our laboratory contributed not only to a better understanding of the phenomenon and better protection of individuals, but also to a reduction in “radiophobia” induced psychological effects.

4. CONCLUSION

To enable radioactive contamination measurement activity in small nuclear laboratories, the following are important:

- free access to portable and robust radiometers;
- standardized measurement procedures for environmental and foodstuffs samples (specimens preparation, geometry);
- available standard radioactive solutions, point and volume sources; and,
- portable big volume NaI(Tl) counter, coupled to Single Channel Analyzers for ^{131}I -determination in the thyroid.

We must add that the ability to access prompt, accurate information from government authorities is essential to establishing a solid relationship with the population and, consequently, minimizing psychological effects. With regard to long-term effects (cancer and genetic anomalies), a serious international scientific effort to study, treat, and prevent nuclear power station accidents is strongly recommended.

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Chapter 18

“Water Wars” and Water Reality: Conflict and Cooperation Along International Waterways

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There are 261 international rivers, covering almost one half of the total land surface of the globe, and untold numbers of shared aquifers. Water has been a cause of political tensions between Arabs and Israelis, Indians and Bangladeshis, Americans and Mexicans, and all 10 riparian states of the Nile River. Water is the only scarce resource for which there is no substitute, over which there is poorly developed international law, and the need for which is overwhelming, constant, and immediate. As a consequence, water and war are two topics being assessed together with increasing frequency. This chapter investigates the reality of historic water conflict and draws lessons for the plausibility of future water wars. The data sets of conflict are explored for those related to water—only seven minor skirmishes are found in this century; no war has ever been fought over water. In contrast, 149 water-related treaties have been signed in the same period. These treaties, collected and catalogued in a computerized database along with relevant notes from negotiators, are assessed for patterns of conflict resolution. War over water seems neither strategically rational, hydrographically effective, nor economically viable. Shared interests along a waterway seem to overwhelm water's conflict-inducing characteristics. Furthermore, once cooperative water regimes are established through treaty, they turn out to be tremendously resilient over time, even between otherwise hostile riparian states, and even as conflict is waged over other issues. These patterns suggest that the more valuable lesson of international water is as a resource whose characteristics tend to induce cooperation, and incite violence only in the exception.

1. INTRODUCTION: “WATER WARS”

Water and war are two topics being assessed together with increasing frequency. The 261 international watersheds (Wolf et al., in press), covering a little less than one half of the land surface of the globe, affect about 40% of the world's population. Water is a resource that has no substitute and is vital to human survival; it ignores political boundaries, fluctuates in both space and time, and has multiple and conflicting demands on its use. The problems of water management are compounded in the international realm by the fact that the international law that governs it is poorly developed, contradictory, and unenforceable. As a consequence, recent articles in the academic literature (e.g., Cooley, 1984; Remans, 1995; Starr, 1991) and popular press (e.g., Bullock & Darwish, 1993) point to water not only as a cause of historic armed conflict, but also as *the* resource that will bring combatants to the battlefield in the 21st century. Invariably, these writings on water wars point to the arid and hostile Middle East—

where armies have, in fact, been mobilized and shots fired over this scarce and precious resource—as an example of a worst-case scenario. Citing water as the prime motivator for military strategy and territorial conquest, elaborate, if misnamed, hydraulic imperative theories have been developed for the region, particularly to deal with potential conflict between Arabs and Israelis.

The argument that water will show itself to be the single greatest threat to peace goes, basically, as follows: Water is a resource that is vital to all aspects of a nation's survival, from its inhabitants' biology to their economy. The scarcity of water in an arid and semi-arid environment leads to intense political pressures, often referred to as water stress, a term coined by Falkenmark (1989). Furthermore, water not only ignores our political boundaries; it also evades institutional classification and eludes legal generalizations. Water's natural management unit, the watershed—where quantity, quality, surface water, and ground water all interconnect—strains both institutional and legal capabilities often past capacity. Analyses of international water institutions find a rampant lack of consideration of quality considerations in quantity decisions, a lack of specificity in rights allocations, disproportionate political power by special interest, and a general neglect for environmental concerns in water resources decision making.

The establishment of legal principles to address water ownership and allocation has been equally elusive (described in more detail in Wolf, 1997). The 1997 Convention on the Non-Navigational Uses of International Watercourses Commission, which took 27 years to develop, reflects the difficulty of marrying legal and hydrologic intricacies: while the Convention provides many important principles for cooperation, including responsibility for cooperation and joint management, it also institutionalizes the inherent upstream/downstream conflict by calling for both "equitable use" and an "obligation not to cause appreciable harm." These two principles are in implicit conflict in the setting of an international waterway: upstream riparian states have advocated that the emphasis between the two principles be on "equitable use," since that principle gives the needs of the present the same weight as those of the past. In contrast, downstream riparian states have pushed for emphasis on "no significant harm," which effectively protects the pre-existing uses generally found in the lower reaches of most major streams. The Convention also provides few practical guidelines for allocations—the heart of most water conflict. The Convention proposes that allocations be based on seven relevant factors, which are to be dealt with as a whole.¹

Furthermore, international law only concerns itself with the rights and responsibilities of *states*. Some political entities that might claim water rights, such as the Palestinians along the Jordan River or the Kurds along the Euphrates River, therefore would not be represented. In addition, cases are heard by the International Court of Justice (ICJ) only with the consent of the parties involved, and, except in the most extreme cases, no practical enforcement mechanism exists to back up the Court's findings. A state with pressing national interests can therefore disclaim entirely the

court's jurisdiction or findings (Rosenne, 1995). Given all the intricacies and limitations involved, it is hardly surprising that the ICJ has decided on only a single case regarding international water law.²

Put all of these characteristics together—international water as a critical, non-substitutable resource, which flows and fluctuates across time and space, for which legal principles are vague and contradictory, and which is becoming relatively more scarce with every quantum of growth in population or standard of living—and one finds a compelling argument that, in the words of World Bank vice-president Ismail Serageldin, “the wars of the next century will be about water” (quoted in *The New York Times*, 10 August 1995).

This chapter puts forward four arguments against the plausibility of future water wars: 1) an historic argument; 2) a strategic interests argument; 3) a shared interests argument; and 4) an institutional resiliency argument. Data sets of conflict are explored, while recent attempts at the resolution of international water disputes, as exemplified in 149 transboundary water treaties and 14 process case studies, are described.

2. THE HISTORIC ARGUMENT AGAINST THE PLAUSIBILITY OF “WATER WARS”

2.1 Water and Conflict

As mentioned earlier, there is a growing literature that describes water as both an historic and, by extrapolation, a future cause of interstate warfare. Westing (1986) suggests, “competition for limited...freshwater...leads to severe political tensions and even to war”; Gleick (1993) describes water resources as military and political goals, using the Jordan and Nile Rivers as examples; Remans (1995) uses case studies from the Middle East, South Asia, and South America as examples of water as a cause of armed conflict; Samson and Charrier (1997) write, “a number of conflicts linked to freshwater are already apparent,” and suggest, “growing conflict looms ahead;” Butts (1997) suggests, “history is replete with examples of violent conflict over water,” and names four Middle Eastern water sources particularly at risk; and Homer-Dixon (1994), citing the Jordan River and other water disputes, comes to the conclusion that “the renewable resource most likely to stimulate interstate resource war is river water.”

A close examination of the case studies cited as historic interstate water conflict suggest some looseness in classification. For example, of the 18 cases of water disputes listed by Samson and Charrier (1997), only one is described as an “armed conflict,” and that particular case (on the Cenepa River) turns out not to be about water at all, but rather about the location of a shared boundary which happens to coincide with the watershed. Armed conflict did not take place in any of Remans' (1995) “well-

known" cases (save the one between Israel and Syria, described below), nor in any of the other presented lists of water-related tensions.

The examples that are most widely cited are wars between Israel and its neighbours. Westing (1986) lists the Jordan River as a cause of the 1967 war and, in the same volume, Falkenmark (1986), mostly citing Cooley (1984), describes water as a causal factor in both the 1967 war and the 1982 Israeli invasion of Lebanon. Myers (1993) writes, "Israel started the 1967 war in part because the Arabs were planning to divert the waters of the Jordan River system." In fact, in the years since Israel's invasion of Lebanon in 1982, a "hydraulic imperative" theory, which describes the quest for water resources as *the* motivator for Israeli military conquests, both in Lebanon in 1979 and 1982 and earlier, on the Golan Heights and West Bank in 1967, was developed in the academic literature and the popular press (see, for example, Beaumont, 1991; Cooley, 1984; Davis et al., 1980; Dillman, 1989; Schmida, 1983; Stauffer, 1982; Stork, 1983).

The only problem with these theories is a complete lack of evidence. While shots were fired over water between Israel and Syria from 1951 to 1953 and from 1964 to 1966, the final exchange on July 14, 1966, which included both tanks and aircraft, stopped Syrian construction of the diversion project in dispute, effectively ending water-related tensions between the two states; the 1967 war broke out almost a year later. The 1982 invasion provides even less evidence of any relation between hydrologic and military decision making. In extensive papers investigating precisely such a linkage between hydrostrategic and geostrategic considerations, both Libiszewski (1995) and Wolf (1995b) conclude that water was neither a cause nor a goal of any Arab-Israeli warfare.

To be fair, I should note that I am only describing the relationship between *inter-state* armed conflict and water as a *scarce resource*. I exclude both internal disputes, as well as those where water was a means, method, or victim of warfare. I also exclude disputes where water is incidental to the dispute, such as those about fishing rights, access to ports, transportation, or river boundaries. Many of the authors I cite, notably Gleick (1993), Libiszewski (1995), and Remans (1995), are very careful about these distinctions. The bulk of the articles cited above, then, turn out to be about political tensions or instability rather than about warfare, or about water as a tool, target, or victim of armed conflict; these are all important issues, but are not the same as "water wars."

In order to cut through the prevailing anecdotal approach to the history of water conflicts, we investigated those cases of international conflict where armed exchange was threatened or took place over water resources *per se*. We utilized the most systematic collection of international conflict research: the International Crisis Behavior (ICB) data set, collected by Michael Brecher and Jonathan Wilkenfeld (1997). This data set contains only those disputes that were considered to be international crises by the principal investigators. Their definition of an international crisis is any dispute

where: 1) basic national values are threatened (e.g., territory, influence, or existence); 2) time for making decisions is limited; and 3) the probability for military hostilities is high. Using these guidelines, they identified 412 crises for the period 1918-1994. Joey Hewitt, of the University of Maryland at College Park, searched the text files of the ICB data set for water-related keywords, and found four disputes where water was at least partially a cause. These have been researched and supplemented by three others at the University of Alabama. The complete list includes seven disputes:

- *1948.* Partition between India and Pakistan leaves the Indus Basin divided in a particularly convoluted fashion. Disputes over irrigation water exacerbate tensions in the still-sensitive Kashmir region, bringing the two riparian states “to the brink of war.” Twelve years of World Bank led negotiations lead to the 1960 Indus Waters Agreement.
- *February 1951-September 1953.* Syria and Israel exchange sporadic fire over Israeli water development works in the Huleh basin, which lies in the demilitarized zone between the two countries. Israel moves its water intake to the Sea of Galilee.
- *January-April 1958.* Amidst pending negotiations over the Nile waters, Sudanese general elections, and an Egyptian vote on Sudan-Egypt unification, Egypt sends an unsuccessful military expedition into territory in dispute between the two countries. Tensions were eased (and a Nile Waters Treaty signed) when a pro-Egyptian government was elected in Sudan.
- *June 1963-March 1964.* Boundaries set in 1948, which left Somali nomads under Ethiopian rule, cause border skirmishes between Somalia and Ethiopia. The disputed territory in the Ogaden desert includes some critical water resources (both sides are also aware of oil resources in the region). Several hundred are killed before a ceasefire is negotiated.
- *March 1965-July 1966.* Israel and Syria exchange fire over the “all-Arab” plan to divert the Jordan River headwaters, presumably to sabotage the Israeli national water carrier, an out-of-basin diversion plan from the Sea of Galilee. Construction of the Syrian diversion is halted in July 1966.
- *April-August 1975.* In a particularly low-flow year along the Euphrates due to upstream dams being filled, Iraqis claim that the flow reaching its territory has been intolerable, and ask that the Arab League intervene. The Syrians claim that less than half of the river’s normal flow is reaching its borders that year and, after a barrage of mutually hostile statements, pull out of an Arab League technical committee formed to mediate the conflict. In May 1975, Syria closes its airspace to Iraqi flights and both Syria and Iraq reportedly transfer troops to their mutual border. Only mediation by Saudi Arabia breaks the increasing tension.
- *April 1989-July 1991.* Two Senegalese peasants are killed over grazing rights along the Senegal River, which forms the boundary between Mauritania and Senegal,

sparkling smoldering ethnic and land reform tensions in the region. Several hundred are killed as civilians from border towns on either side of the river attack each other before each country uses its army to restore order. Sporadic violence breaks out until diplomatic relations are restored in 1991.

As we see, the actual history of armed water conflict is somewhat less dramatic than the water wars literature would lead one to believe: a total of seven incidents, in three of which no shots were fired. As near as we can find, *there has never been a single war fought over water*.³

This is not to say there is no history of water-related violence—quite the opposite is true—only that these incidents are at the subnational level, generally between tribe, water-use sector, or province. Examples of internal water conflicts are quite prevalent, from violence and death along the Cauvery River in India, to California farmers blowing up a pipeline meant for Los Angeles, to much of the violent history in the Americas between indigenous peoples and European settlers. In 1934, the desert state of Arizona even commissioned a navy (made up of one ferry boat) and sent its state militia to stop a dam and diversion on the Colorado River (Fredkin, 1981).

Also, one need look no further than relations between India and Bangladesh to note that internal instability can both be caused by, and exacerbate, international water disputes. At issue is a barrage that India has built at Farakka, which diverts a portion of the Ganges flow away from its course into Bangladesh, and towards Calcutta 100 miles to the south, in order to flush silt away from that city's seaport. Adverse effects in Bangladesh resulting from reduced upstream flow have included degradation of both surface and groundwater, change in morphology, impeded navigation, increased salinity, degraded fisheries, and danger to water supplies and public health. Refugees from the affected areas have further compounded the problem. Ironically, many displaced Bangladeshis have found refuge in India (Biswas & Hashimoto, 1996).

So, while no water wars have occurred, there is ample evidence that the lack of clean freshwater has led to occasional, intense political instability and that, on a small scale, acute violence can result. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are *inversely* related.

2.2 Water and Cooperation⁴

2.2.1 The Transboundary Freshwater Dispute Database

While evidence for a history of water wars is not that impressive, there is an impressive documentation supporting a history of cooperative water-dispute resolution. The UN Food and Agriculture Organization (FAO) has identified more than 3,600 treaties, dated from 805 to 1984, relating to international water resources; the majority of which deal with some aspect of navigation (UN FAO, 1978; 1984). Since 1814, approximately

300 treaties, which deal with non-navigational issues of water management, flood control or hydropower projects, or allocations for consumptive or nonconsumptive uses in international basins, have been negotiated. Through an ongoing project of the Department of Geosciences at Oregon State University in conjunction with projects funded by the World Bank and the U.S. Institute of Peace, we have collected the full texts of 149 treaties in a Transboundary Freshwater Dispute Database. In collecting these treaties, we have restricted ourselves to those signed in this century which deal with water per se—in other words, we have excluded those which deal with boundaries or fishing rights.

Negotiating notes and published descriptions of many treaty negotiations are also being collected. Fourteen case studies have been described in some detail and in similar format in order that they can be used for comparative purposes in forthcoming work. These cases include nine watersheds (the Danube, Euphrates, Jordan, Ganges, Indus, Mekong, Nile, La Plata, and Salween); two aquifer systems (U.S.-Mexico shared systems and the West Bank Aquifers); two lake systems (the Aral Sea and the Great Lakes); and one engineering works (the Lesotho Highlands Project). These treaties are catalogued by basin, countries involved, date signed, treaty topic, allocations measure, conflict resolution mechanisms, and nonwater linkages.⁵ A series of forthcoming articles describe the lessons learned from comparative analyses of these treaties.⁶

2.2.2 International Water Resources Association's (IWRA) Committee on International Waters

Representatives from many of the basins listed as cases of conflict in the water wars literature have been involved in water-related negotiation, both official and unofficial (or track II). One of the most extensive and best documented sets of unofficial talks has been organized under the auspices of the Committee on International Waters of the IWRA, which has taken the lead in organizing high-level meetings between riparian states of especially contentious basins from around the world. Asit K. Biswas, as chair of the Committee, has to date arranged forums on the international waters of the Middle East, Southeast Asia, and Latin America. Each forum brought together about 30 policy makers, academics, and representatives from funding agencies, each in his or her private capacity, for an open and frank exchange of information and ideas.

The Middle East Water Forum, with an emphasis on the Nile, Jordan, and Tigris-Euphrates Rivers, was convened in February 1993 in Cairo, and had two subsequent meetings, in 1995 and 1997.⁷ High levels of water stress, exacerbated by extreme political tensions, characterize the three Middle Eastern rivers that were the focus of the forum. The waters of the Middle East are regularly cited as worst-case scenarios for international waters. Yet, along with the crises associated with these contentious basins, comes intense political and financial support of the international community. The Israel-Jordan Treaty of Peace has an extensive water component, as does the Oslo

II Interim Agreement between Israel and Palestine. The Multilateral Working Group on Water Resources, working in conjunction with the Middle East bilateral peace negotiations, has been especially active (Wolf, 1995c).

The Asia Water Forum was held in Bangkok in January 1995, with an emphasis on the Mekong, the Ganges-Brahmaputra, and the Salween River systems. A summary of the meeting was published in 1995 (Wolf, 1995a), and the papers commissioned for the meeting were published in 1997 (Biswas and Hashimoto, 1997).

In contrast to the international waters of the Middle East, those of Southeast Asia exhibit little potential for crisis. Even along the Ganges-Brahmaputra where, at the time of the meeting, a 1988 agreement on the flow from India to Bangladesh had lapsed with no renewal in sight, there was never a threat of violence; this is particularly significant when one considers that this lapse resulted in great ecological and human damage in Bangladesh and that there was no renewal in sight (although a new treaty was signed in late 1996). A new treaty had just been signed for the cooperative management of the lower Mekong; while the earlier treaty had not resulted in any projects along the main stem of the river, it had allowed for joint dialogue and data sharing among the riparian states over the years, even amidst political tensions and outright warfare. Dialogue among the riparian states of the Salween is an exercise in preventative diplomacy; the river is only now being examined for joint development and preliminary agreements are being negotiated.

The Latin American Water Forum was held in Sao Paulo in January 1997; discussion centred on the Amazon, La Plata, and San Francisco systems. These rivers are characterized by extremely large flows and the riparian states have relatively cordial political relations. This combination of high flow and low tension is actually a mixed blessing for the region. On the positive side, the riparian states still have the luxury of being able to save relatively healthy ecosystems—one never hears talk of the ecosystem of the lower Jordan or Nile. This forum was the first of the three where much greater emphasis was on water quality, rather than quantity, issues. On the negative side, these basins do not benefit from the intense international attention and resulting availability of resources that tend to flow to regions in imminent crisis. While treaties and river commissions already exist along the Amazon and La Plata (the San Francisco lies entirely within Brazil), water management and water law (even national water law) are at a much earlier stage than in either the Middle East or Southeast Asia; the Amazon and La Plata commissions had not even been in close contact prior to the forum.

Of the nine basins discussed at the three forums, three—the Jordan (Israel-Jordan and Israel-Palestine), the Mekong (lower riparian states), and the Ganges (India-Bangladesh)—have new treaties for international cooperation. While the forums cannot be credited for this achievement, the open exchange of dialogue outside of official negotiations helped formulate some ideas that then became embedded in the treaties: some treaty text can be traced directly back to presentations and discussions from the forums.

The historic reality has been quite different from what the water wars literature would have one believe. In modern history, only seven minor skirmishes have been waged over international waters; invariably other interrelated issues also factor in. Conversely, over 3,600 treaties have been signed over different aspects of international waters, almost 150 of which have been in this century and dealt with water *qua* water, and many of which show tremendous elegance and creativity in dealing with this critical resource. Furthermore, a close look at the very cases most commonly cited as conflicts reveal ongoing dialogue, creative exchanges, and negotiations leading, fairly regularly, to new treaties. The question which emerges, which is arguably more interesting than where water wars will break out, is, given all of the seemingly conflict-inducing characteristics of transboundary waterways, why has so *little* international violence taken place?

3. OTHER ARGUMENTS AGAINST THE PROBABILITY OF WATER WARS

Basing an argument about the future on historical evidence alone would be specious. Part of the argument for the probability of future water wars is, after all, that we are reaching unprecedented demand on relatively decreasing clean water supplies. The following arguments present further evidence against the probability of future water wars.

3.1. Strategic Argument

If one were to launch a war over water, what would be its goal? Presumably, the aggressor would have to be both downstream and the regional hegemon—an upstream riparian state would have no cause to launch an attack and a weaker state would be foolhardy to do so.⁸ An upstream riparian state, then, would have to launch a project that decreases either quantity or quality, knowing that it will antagonize a stronger downstream neighbour.

The downstream power would then have to decide whether to launch an attack—if the project was a dam, destroying it would result in a wall of water rushing back on downstream territory; if it was a quality-related project, either industrial or waste treatment, destroying it would probably result in even worse quality than before. Furthermore, the hegemon would have to weigh not only an invasion, but also an occupation and depopulation of the entire watershed in order to forestall any retribution—otherwise, it would be extremely simple to pollute the water source of the invading power. Both countries could not be democracies, since the political scientists tell us that democracies do not go to war against each other, and the international community

would have to refuse to become involved (this, of course, is the least far-fetched aspect of the scenario). All of this effort would be expended for a resource which costs about one U.S. dollar per cubic meter to create from seawater.

While there are 268 international watersheds, there is only a handful for which the above scenario is even feasible (the Nile, Plata, and Mekong come to mind), and many of those either have existing treaties or ongoing negotiations towards a treaty. It turns out that finding a site for a water war is as difficult as accepting the rationale for launching one.

3.2. Shared Interest Argument

By reading the treaties that have been negotiated over international waterways, one is offered insight into the question of what it is about water that tends to induce cooperation, even among riparian states that are hostile over other issues. Each treaty shows sometimes exquisite sensitivity to the unique setting and needs of each basin, and many detail the benefits the cooperative development of a common waterway will bring. Along larger waterways, for instance, the better dam sites are usually upstream at the headwaters where valley walls are steeper and, incidentally, the environmental impacts of dams are not as great. The prime agricultural land is generally downstream, where gradient drops off and alluvial deposits enrich the soil. A dam in the headwaters, then, cannot only provide hydropower and other benefits for the upstream riparian state, it can also be managed to even out the flow for downstream agriculture, or even to enhance water transportation for the benefit of both riparian states.

Other examples of shared interests abound: no development of a river which acts as a boundary can take place without cooperation; farmers, environmentalists, and beachgoers all share an interest in seeing a healthy stream system; and all riparian states share an interest in high water quality.

These shared interests are regularly exemplified in treaties. In conjunction with the 1957 Mekong Agreement, Thailand helped fund a hydroelectric project in Laos in exchange for a proportion of the power to be generated. In the particularly elaborate 1986 Lesotho Highlands Treaty, South Africa agreed to help finance a hydroelectric/water diversion facility in Lesotho; while South Africa would acquire drinking water for Johannesburg, Lesotho would receive all of the power generated. Similar arrangements have been suggested in China on the Mekong, Nepal on the Ganges, and between Syria and Jordan on the Yarmuk.

The unique circumstances surrounding each basin, whether hydrological, political, or cultural, are reflected in the creativity of many of the treaties. A 1969 accord on the Cunene River allows humanitarian diversions solely for human and animal requirements in Southwest Africa as part of a larger hydropower development project. Water loans are made from Sudan to Egypt (1959) and from the USA to Mexico (1966).

Jordan stores water in an Israeli lake while Israel leases Jordanian land and wells (1994), and India plants trees in Nepal to protect its own water supplies (1966). In a 1964 agreement, Iraq agreed to give water to Kuwait, "in brotherhood," without compensation. In a different vein, a 1957 agreement between Iran and the USSR has a clause which allows for cooperation in identifying corpses found in their shared rivers.

The changes of local needs over time are reflected in the boundary waters agreements between Canada and the USA. In order to bolster the war movement, the boundary waters agreements of 1910 were modified in 1941 to allow for greater hydropower generation along the Niagara River for both Canada and the United States. However, the two countries nevertheless reaffirmed that protecting the "scenic beauty of this great heritage of the two countries" was their primary obligation. A 1950 revision continued to allow hydropower generation, but allowed a greater minimum flow over the famous falls during summer daylight hours, when tourism is at its peak.

3.3 Institutional Resiliency Argument

Another factor adding to the stability of international watershed agreements is that, once cooperative water regimes are established through treaty, they turn out to be tremendously resilient over time, even between otherwise hostile riparian states and even as conflict is waged over other issues. The Mekong Committee has functioned since 1957, exchanging data throughout the Vietnam War. Secret talks between Israel and Jordan have been held since the unsuccessful Johnston negotiations of 1953-55, even as these riparian states, until only recently, were in a legal state of war. The Indus River Commission survived two wars between India and Pakistan.

3.4 An Economic Argument?

It is tempting to add an economic argument against the probability of water wars. Water is neither a particularly costly commodity nor, given the financial resources to treat, store and deliver it, is it particularly scarce. Full-scale warfare, on the other hand, is tremendously expensive. A water war simply would not cost out. This point was probably best made by the Israeli Defense Forces analyst responsible for long-term planning during the 1982 invasion of Lebanon. When asked whether water was a factor in decision making, he noted, "Why go to war over water? For the price of one week's fighting, you could build five desalination plants. No loss of life, no international pressure, and a reliable supply you don't have to defend in hostile territory" (quoted in Wolf, 1995b).

However, to make such a case convincingly, one would have to demonstrate times when war was cost-effective and, if such an analysis is possible, it is beyond the scope of this chapter.

4. CONCLUSIONS AND CAVEAT

There is a large and growing literature warning of future water wars—it points to water not only as a cause of historic armed conflict, but also as *the* resource which will bring combatants to the battlefield in the 21st century.

The historic reality has been quite different. In modern times, only seven minor skirmishes have been waged over international waters; invariably other interrelated issues also factor in. Conversely, over 3,600 treaties—149 in this century on water *qua* water—have historically been signed over different aspects of international waters and many show tremendous elegance and creativity in dealing with this critical resource. This is not to say that armed conflict has not taken place over water, only that such disputes generally are between tribe, water-use sector, or subnational jurisdiction. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are *inversely* related.

War over water is not strategically rational, hydrographically effective, or economically viable. Shared interests along a waterway seem to deter conflict and, once water management institutions are in place, they tend to be tremendously resilient. The patterns described in this chapter suggest that an accurate description of international water would be as a resource whose characteristics tend to induce cooperation, and incite violence only on the exceptional occasion.

One caveat should be noted. While water wars may be a myth, the connection between water and political stability certainly is not. The lack of a clean freshwater supply clearly does lead to instability, which, in turn, can create an environment more conducive to political or even military conflict; Bangladeshi instability and refugees brought about by environmental degradation, which was, in turn, caused by Indian diversions of Ganges waters, is perhaps the best recent example. Simply because water wars will not likely be fought is no reason to reduce efforts to provide an adequate clean water supply for the world's population.

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6. ENDNOTES

- ¹ These factors include geographic, hydrographic, hydrological, climatic, ecological, and other natural factors; social and economic needs of each riparian state; population dependent on the watercourse; effects of use in one state on the uses of other states; existing and potential uses; conservation, protection, development and economy of use, and the costs of measures taken to that effect; and the availability of alternatives, of corresponding value, to a particular planned or existing use.
- ² The ICJ came into being in 1946, with the dissolution of its predecessor, the Permanent Court of International Justice. That body did rule on four international water disputes during its existence from 1922-1946. The one case decided by the ICJ was that of the Gabčíkovo Dam on the Danube River.
- ³ This is not quite true. The earliest documented interstate conflict known is a dispute between the Sumerian city-states of Lagash and Umma over the right to exploit boundary channels along the Tigris in 2,500 BCE (Cooper 1983). In other words, the last and only water war was 4,500 years ago.
- ⁴ Some of this section is drawn from Wolf (1997).
- ⁵ Jesse Hamner, a graduate student in the Department of Geography, University of Alabama, developed a systematic computer compilation of these treaties.
- ⁶ Details of the 14 case studies listed can be found in Bingham et al., 1994. We expect that both the full text of each treaty and the compilation summaries will be uploaded to the World Wide Web by the time this article is published. See the Home Page of the Oregon State University Department of Geosciences <<http://osy.orst.edu/dept/geosciences/>> for more information.
- ⁷ Papers commissioned for the initial meeting were published in 1994 (Biswas), and the work of the Middle East Water Commission, established to continue work on ongoing issues from the region, was summarized in 1995 (Middle East Water Commission) and published in its entirety in 1997 (Biswas et al.).
- ⁸ Foolhardiness apparently does not preclude such asymmetric conflicts. Paul, 1994, describes eight such case studies from 1904-1982, but points out that in none did the weaker power achieve its goals.

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Section V

**Institutional Capacity
and Adaptation**

Chapter 19

Strengthening Institutional Capacity for Implementation in Central and Eastern Europe

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The timely and effective implementation of policy responses to environmental change in the countries of Central and Eastern Europe (CEECs) is a significant challenge given their lack of appropriate institutional structures, expertise and financial resources. Poor or nonimplementation by CEECs, in turn, undermines efforts to address common environmental security threats on a pan-European basis.

Under conditions of transition, adaptive implementation strategies capable of accommodating pervasive uncertainty and incomplete information appear to offer distinct advantages over the more limited conceptions of programmed implementation. Opting for flexibility over rigidity as a guiding principle for environmental policy measures would require CEECs to strengthen institutional capacities for implementation by introducing feedback mechanisms for institutional learning, promoting new professional standards for public officials and actively involving all stakeholders in the pursuit of environmental policy goals.

1. INTRODUCTION

The elaboration of effective responses to complex policy problems is a challenge for governments the world over and problems of a novel, pervasive, and non-proximate nature such as threats to environmental security present particular difficulties for policy making. These obstacles are not restricted to the initial stages of policy formulation (problem definition, agenda setting, specification of alternatives) and adoption (choice between policy options) but extend well into the policy implementation phase (Kingdon, 1984). In the face of new and emerging environmental security threats, policy formulation may even prove to be one of the least problematic stages when compared to the considerable adaptive capacity, institutional resources and commitment which must be mobilized and maintained in the course of implementing a chosen course of action.

However, while environmental threats may be “securitized” in a bid to raise the level of priority accorded to the issue, the same does not hold true for the generally low-profile implementation processes which serve to deliver policy outcomes (Buzan et al., 1995). As a result, concern over a given environmental security issue reaches its peak at the point of decision making only to wane rapidly thereafter. Yet despite its low visibility, policy implementation remains a crucial issue, since the best laid plans of

strategists and policy makers are often undone by poor, partial, or non-implementation (Pressman and Wildavsky, 1973).

Environmental security provides a vivid illustration of this point. The rapid formulation and timely adoption of policy measures to address environmental change will have little impact in the absence of their swift and substantial application. Efficacy and rapidity of implementation thus constitute crucial factors in overall policy success—a targeted policy response is to no avail if the target of the action has, in the meantime, vanished or been substantially transformed.

Implementation, in turn, depends on institutions. The collection and processing of information, along with its timely evaluation and the subsequent readjustment of actions, are just a few of the key functions performed by institutions in the course of policy implementation. The adaptive capacity of institutions is revealed by their ability to respond to changes in background conditions, policy objectives, and problems (March and Olsen, 1984). Nowhere is this more important than in the case of those policy challenges (such as the ones arising from environmental turbulence) for which current understanding of the origins, magnitude, and consequences of the phenomena is far from complete.

The implementation of appropriate policy responses to such unprecedented security risks represents a major challenge even for those countries that enjoy a high level of stability with respect to the overall institutional framework of the state. This is even more so in situations in which basic institutions and the rules of their mutual interaction are still being consolidated.

Such are the conditions under which Central and Eastern European Countries (CEECs) are currently obliged to implement policy responses to environmental change and its security implications. They are characterized by (Offe, 1996):

- *an unprecedented degree of macroinstitutional novelty* under which the basic “rules of the game” for policy making and implementation have undergone (and are still undergoing) substantial change;
- *a continued reliance upon inherited microinstitutional implementation structures and resources* with the use of administrative divisions, personnel and equipment from the previous regime whose presence strongly conditions the implementation of new policies; and,
- *an all-pervasive and significant degree of uncertainty* with regard to both processes and outcomes in policy implementation and subsequent difficulties in policy monitoring, evaluation and adjustment.

Such problems are not the sole concern of CEECs themselves. This is true in virtue of the fact that although the development of adequate responses to large-scale environmental risks requires policy coordination within the international arena, the implementation of policy obligations assumed therein generally falls exclusively within the sphere

of national competence. As a result, collective agreements risk being undermined by nonimplementation on the part of states with reduced institutional capacity such as in the case of the CEECs (Haas et al., 1993). In this light, the current focus on the transfer of policy exemplars (as witnessed in the "Environment for Europe" process) and legislative harmonization (in the case of the European Union) appears in need of a distinct broadening in scope to squarely address the issue of improved policy implementation, and redirection of programmes of technical assistance towards fostering institutional capacity for action (REC, 1996).

2. IMPLEMENTATION: THE PROBLEM, ITS CONTEXT AND GENERAL APPROACHES

The factors influencing policy implementation are numerous and tend to vary over time, but generally fall into one of two main categories: the background conditions against which implementation takes place, and the institutional instruments with which it is to be pursued (Mazmanian and Sabatier, 1981). Foremost among these background conditions, to be reviewed in the first part of this section, are:

- the tractability of the policy problem itself; and,
- the overall approach to implementation which is adopted.

The second part will focus upon the institutional factors which play a prime role in ensuring successful implementation, including:

- the capacity of formal institutions to pursue implementation;
- the impact of informal institution on policy implementation by formal institutions; and,
- the dynamics of institutional change and strategies for institution building.

2.1 Characteristics of the Policy Problem: Estimating Tractability

The ability to devise appropriate solutions to a given policy problem depends, to a large degree, on the nature of the problem itself. In turn, the tractability of a given policy problem significantly conditions the successful implementation of a chosen policy option, in terms of:

- the availability of a valid technical theory and adequate technology, in the absence of which not only will policy solutions be incorrectly developed but also incompletely applied;

- the degree of diversity of target group behaviour, greater diversity increases the difficulty in designing and applying policy solutions to encompass all potential activities;
- the degree of resistance or support for a proposed policy measure on the part of the main target groups that, when taken together with their cohesion and political weight, substantially affects the degree of successful implementation; and,
- the extent and cost of the behavioural change required of the target group, which will play a key role in determining their receptivity to a given policy solution.

That tractability is a key condition in the field of the environment is borne out by the European Environment Agency’s 1996 publication *Europe’s Environment: The Dobrís Assessment*, which reminds us that “it is the very nature of the environment, its complexity, its multiple interconnections and in-built delay mechanisms, which render environmental problems difficult to understand and thus easy to ignore” (EEA, 1995). The general features characterizing the tractability of policy problems associated with the environment are set out briefly in Table 19.1.

Table 19.1 Tractability of environmental policy problems
(based on Mazmanian & Sabatier, 1981)

<i>General Features</i>	<i>Environmental Policy Problems</i>
availability of a valid technical theory and adequate technology	incomplete knowledge of ecosystems and pervasive uncertainty with regard to natural cycles, long-term consequences of human activities, and efficacy of mitigation measures
degree of diversity of target group behaviour	high degree of variation among human activities having environmental impacts
degree of resistance to policy by target group	generally high resistance to changes in behaviour (industries, consumers)
extent and cost of behavioural change	potentially significant behavioural changes required on part of the majority of producers and consumers

2.2 Approaches to Implementation: Characterizing Policy Contexts

The second background condition for policy implementation centres on the overall approach adopted, of which there are two main types: “programmed implementation” and “adaptive implementation” (Berman, 1980). The former aims to eliminate subsequent problems by specifying a priori the entire range of conditions to be encountered, actions to be taken and contingency plans to be adopted, the emphasis being on the specification of exhaustive operational *procedures*. One of the distinguishing features

of this approach is a general suspicion of the role of implementors, particularly those at the lower levels of the "implementation hierarchy." In an attempt to curtail the realm of possible action on the part of implementors, programmed implementation advocates clear lines of authority and places strict limits on the number of participants to be involved in the process.

In contrast, adaptive implementation regards most of the problems associated with implementation as arising from overspecification, rigidity with respect to goals and scant attention to the involvement of all relevant actors. In order to address such obstacles to successful implementation, this approach advocates the development of a suitable *process* for the adaptation of the original policy to its surroundings in the course of putting it into practice (Majone and Wildavsky, 1978). The choice of an appropriate implementation strategy depends in large part upon the evaluation of the overall context in which a given policy is to be pursued, which may be described in terms of a set of "situational parameters" (Table 19.2).

Table 19.2 Choice of implementation approach (based on Berman, 1980)

<i>Situational Parameters</i>	<i>Situation Type</i>	
	Structured	Unstructured
Scope of change	Incremental	Major
Certainty of technology or theory	Certain	Uncertain
Conflict over policy goals	Low conflict	High conflict
Structure of institutional setting	Tightly coupled	Loosely coupled
Stability of context	Stable	Unstable
Implementation Approach	Programmed	Adaptive

The application of these parameters to the specific policy implementation context of CEECs in transition/consolidation gives rise to the characterization of an essentially unstructured policy situation, in which:

- The *scope of change* required in terms of behavioural adaptations by both public administration (PA) officials charged with implementation and target groups alike is large indeed. Under the previous system, apparently strict environmental legislation was accompanied by "weak compliance accompanied by lax enforcement" (Wajda, 1993). With the privatization of state-owned industries, the growth of a new private sector and the proliferation of entities to be regulated, the enforcement of environmental regulations requires an entirely new set of professional norms and capacities on the part of PA officials as well as the acceptance of the legal force of environmental protection obligations on the part of target groups.

- The *theoretical basis* for the application of environmental policy and the reliability of policy tools under conditions of transition/democratic consolidation is yet to be established. Under such conditions of uncertainty, it proves difficult to predict the outcomes of policies whose effectiveness elsewhere may not necessarily guarantee their applicability in CEECs.
- The *conflict over policy goals* which has characterized national political debates in the region are, on the one hand, an encouraging sign of reinstated democratic plurality but are also expressions of the emergence of “normal” interest-based politics. Given the realities of political fragmentation and the precedence of economic issues over those of the environment, securing consensus for the thorough implementation of even minimal provisions for environmental protection often proves arduous (Waller & Millard, 1992).
- The *institutional settings* of all countries in the region are in a state of flux—the creation, suppression, and redefinition of the areas of competence of national ministries, the devolution of greater responsibility to local and regional governments, and the emergence of new forms of public-private sector cooperation are all contributing factors (SIGMA, 1995). Under such conditions, the coordination of government action between different sectors and levels of administration may readily be described as “loosely coupled,” at times even verging on “uncoupled.”
- The *stability of the larger context* of CEECs is beset with potential threats to security, in the traditional military sense of the term, such as those deriving from tensions over ethnic minorities, international environmental disputes (such as that between the Slovak Republic and Hungary over the Nagymaros-Gabcikovo dam) and differential treatment of applications for membership of such Western economic and security institutions as the EU and NATO (Galambos, 1993). To this must be added the specific environmental security risks represented by continuing environmental degradation, depletion of natural resources and a limited capacity to cope with potential environmental emergencies.

On the basis of such considerations, CEECs would appear to fall squarely within the category of unstructured policy contexts and thus be clear candidates for an adaptive implementation approach (Table 1.2). But has such an approach been taken up? In fact, the current approach to environmental policy implementation in CEECs resembles more one of programmed implementation than the adaptive variant advocated by this particular reading of the overall policy context. This characterization rests upon the observation of:

- a continued reliance upon traditional top-down structures for implementation (generally under the direct control of national Ministries of the Environment);
- an emphasis upon the specification of operational procedures to be followed by lower-level officials charged with implementation; and,
- a generally restrictive definition and interpretation of the number and role of recognized participants in the implementation process, as well as the parsimonious

application of public participation procedures, preventing the regular involvement of nongovernmental actors (where they exist).

In this respect, however, CEECs are in good company. The majority of Western European countries also approach policy implementation in a manner that is, on the whole, more akin to the programmed than the adaptive version (van Waarden, 1995). Indeed, it is only to be expected that routine implementation tasks, which constitute the bulk of any given government bureaucracy's activities, are carried out in a largely programmatic fashion. The real test, however, lies in the extent to which such institutions prove capable of responding to novel policy problems and managing the demands of adaptive implementation in those cases, such as those arising from environmental turbulence or change, which may be rare but potentially of far greater impact.

3. STRENGTHENING INSTITUTIONAL CAPACITY: THE SOLUTION?

This diagnosis of the current policy context in CEECs would seem to argue for the introduction of a greater degree of adaptability in policy implementation. However, the success of such an initiative depends upon the possession of a particular set of institutional characteristics far removed from the overall institutional framework for environmental policy implementation inherited by the CEECs.

The solution lies in institutional reform efforts aimed at creating the conditions under which adaptive responses to changing circumstances may be carried out rapidly and effectively. However, such an objective poses a challenge even for those countries whose availability of resources, quality of PA structures, and level of commitment to adaptive implementation are high. It is greater still for CEECs, currently faced with the multiple constraints of limited financial resources, negligible capital investments in information technologies, scant attention on the part of political elites, cutbacks in PA personnel, low public sector wages and low morale.

3.1 Understanding Institutions and Institutional Change

Before tackling the difficult issue of institutional reform in CEECs, the nature of institutional change under conditions of transition/consolidation must first be examined. An important analytical distinction to be introduced at this point is that between "formal institutions" and "informal institutions," both of which play an important role in ensuring successful implementation (Caddy, 1997).

Formal institutions for the environment include explicitly codified organizational elements such as laws, ministries, inspectorates, and fines. They require tangible

resources (such as budgetary, human, and technological assets) to pursue their institutional goals. However, although such resources are necessary, they are not sufficient to ensure adequate levels of performance. Intangible resources (such as legitimacy and credibility) are also required for the operation of formal institutions, which must be supported by a widespread recognition of the legitimacy of both the actions taken to achieve their ends (legitimacy of goals) and the manner in which their decisions are made (legitimacy of process). Furthermore, to be effective, formal institutions must appear capable of delivery on their policy goals (policy credibility) and be supported by a clear and well-calibrated set of applicable sanctions (enforcement credibility).

Informal institutions underpin and permeate formal institutions. Their operations are influenced by such factors as values, norms, codes of conduct, attitudes, and practices. Informal institutions may be divided into two subsets: first, the general value and belief systems which characterize a given social context, and second, the organized social groups which act as vehicles for their propagation. In the case of environmental policy, it may reasonably be expected that the extent to which the value of environmental protection is shared by members of a given society may affect the degree to which environmental provisions are implemented. Environmental protection may be a value held, albeit to differing degrees, by inspection officers, target groups and individual citizens alike and which coexist with the many other values held by each one. Thus, while all actors may approve of environmental protection, in the case of the inspection officer, this value will coexist with that of minimizing disruption to his or her established routines, for the industrialist, with that of limiting direct costs, and for citizens, with that of defending existing jobs. Despite the contemporary presence of many other conflicting values, the fact that environmental protection is shared by all relevant actors in this hypothetical community constitutes a general "attitudinal receptivity" to the introduction of new environmental measures and provides good grounds for successful implementation (Rosenbaum, 1981).

This analytical device of formal-informal institutions comes into its own, however, when the object of investigation is the *modus operandi* of an institutional system rather than just a static description of its components and their characteristics. It also goes some way towards explaining how the ability of formal institutions to achieve their goals (including implementation) in CEECs may be, in large part, attributable to the enabling power provided or constraints imposed by the underlying framework of informal institutions. The interplay between the two in the course of transition away from the old single-party/command economy regime and towards consolidation of the new pluralist/market-based economy in CEECs may be traced briefly as follows.

Prior to regime breakdown, the formal and informal institutions of the party-state had a strong purchase on their respective spheres and the informal institutions associated with the (future) democratic regime were underdeveloped and latent. During transition, the formal institutions of the old communist regime were overthrown and

replaced with a full canopy of newly redesigned formal institutions. Because all of this took place within a relatively short period, consolidation of the capacity for action of these newly grafted (Mény, 1993) formal institutions of democratic governance remains limited by the large and continuing presence of informal institutions whose roots lie in the previous regime and which persist alongside (and in competition with) the slow growth of the set of informal institutions consonant with, and supportive of, the new formal institutional environment (see Figure 19.1).

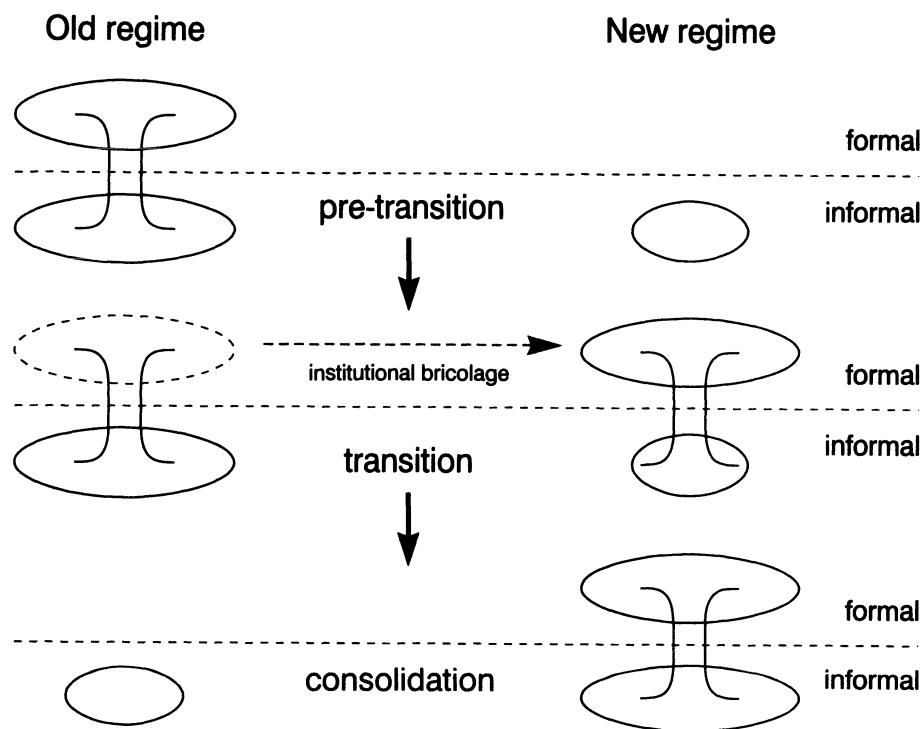


Figure 19.1 Growth and obsolescence of formal and informal institutions during transition

This general dynamic may be observed in each field of public policy in CEECs, including that dealing with the environment. What appears at first sight to be the vigorous growth of newly introduced and, for outside observers, entirely familiar formal institutions for the environment (up-to-date legislation, national environmental programmes, inspectorates, and so on) often conceals numerous unresolved tensions between past and present due to the coexistence of diverse formal and informal institutional components.

3.2 Building Formal and Informal Institutions for the Environment

Few institutions are built on bare ground. For the most part they are cobbled together by modifying and combining existing elements, and this is particularly true in CEECs, where substantial amounts of institutional patrimony (in various states of disrepair) abound and whose rubble provides the building blocks for new institutions (Stark, 1992). A further observation is that institution building is rarely straightforward, and all institutions, whether new or old, are the result of intentional design combined with a large dose of unintended consequences. Finally, the best of efforts may still founder due to the twin hurdles of proving the effectiveness and establishing the legitimacy of newly introduced institutions.

However, measures for facilitating institution building do exist and include setting focal points (around which different reform agendas may coalesce), increasing returns to adoption (in which a chosen institutional format becomes more productive as its use becomes more widespread and consolidated) and “institutional *bricolage*.” The last of these three measures is of the most relevance here given that “*bricolage* may be the only way to build and innovate in situations characterized by high uncertainty, risk aversity, lack of trust, political conflict, resource shortage, and high sunk costs” (Lanzara, 1997). This description appears tailor-made for contemporary CEECs.

It is the ability of *bricolage* to allow for a dynamic balance between the exploration of new solutions and the exploitation of existing arrangements which allows institution building to begin in the first place. But the fundamental strength of institutional *bricolage* is also its greatest source of weakness. Its strengths lie in its capacity to make do with what is available, and to allow for the continuation of meanings and identities, and to confer a high degree of structural flexibility. Its weaknesses are the mirror opposites, namely, the risk of transmitting the negative qualities of old institutions into the new, the possibilities for distortions in use and roles as well as structural indeterminacy, by which new institutions may well end up satisfying no one. The toolbox of institutional *bricolage* includes patchwork, copying, transposition of functions, recombination and reinvention. All of these may help to increase the effectiveness of newly reformed institutions to respond to the numerous (and often contradictory) claims made upon them. Yet effectiveness alone will be insufficient to ensure the longevity of institutions in the absence of legitimacy; an institution may not even be granted a minimum grace period in which to prove its worth (Héritier, 1997).

Problems of legitimacy are inherent in the term “institution building” itself, as it denotes an intentional activity. It is precisely this quality of intentionality that is pinpointed by some authors as constituting one of the two greatest impediments for would-be institution builders in their efforts to establish the legitimacy of their offspring. Designed institutions suffer from a dual handicap, that of having an architect and of being successors (Offe, 1994).

The greater the identification of a newly introduced institution with a specific group of designers, the greater the suspicion that it will have been built to further their particular interests. Herein lies the first handicap. This may be obviated by the explicit imitation of institutions operating in a different national context, thereby providing both evidence that the institutional model actually works (albeit in a different setting) and the basis for the claim that such institution building consists of mere transplantation. In this way, replications diminish the visibility of the designers (who become mere handling agents) and increase the legitimacy of newly introduced institutions. Such an operation is currently underway on an unprecedented scale in all CEECs, where institutional reformers make continuous reference to policy and institutional templates drawn from abroad. They are encouraged in this regard by the general phenomenon of international policy convergence and the specific promotion activities undertaken by bilateral and multilateral programmes of technical assistance (such as EU-PHARE, and the World Bank; Jachtenfuchs, 1992).

The second obstacle is less easily removed and is rooted in the fact that institutions are never constructed on a *tabula rasa*. When formal institutions are transplanted from outside the CEEC context, they are detached from the network of informal institutions which originally contributed to their capacity to produce certain outputs. In their new environment, they come into contact with a new system of informal institutions that greatly condition (often with unpredictable results) their ability to function and also influence perceptions of their legitimacy. An awareness of the potential influence of informal institutions is thus, arguably, a first step in responding to such concerns and one which might easily be built into domestic strategies of institutional reform which intend to draw upon foreign exemplars (Bochniarz et al., 1994).

Attempts at institution building in CEECs are thus shaped by:

- existing institutional elements (such as staff members, expertise, roles, and influence) which are incorporated into new institutions through *bricolage* and may have significant impacts on their new hosts;
- the external conditions of competing expectations and demands made upon newly established institutions which may be multiple and conflicting; and,
- their path dependency which ensures that choices made at an early stage may effectively rule out other, equally plausible and potentially viable options, thus "solutions selected at critical junctures in history are frozen into structures within which changes are piecemeal" (March & Olsen, 1989).

As described above, informal institutions play an important role in the implementation of environmental policy by formal institutions but are generally less amenable to direct intervention and tend to need much longer time periods to change. However, this is not to say that informal institutions such as values, attitudes, and practices cannot be changed over time, as the emergence of environmental protection values since the 1970s

themselves testify. Formal and informal institutions thus stand in close and reciprocal relation to one another, are distinguished by the difference in their response times and may either undermine or support one another depending on the circumstances.

The general category of informal institutions may be further subdivided into two main groups. The first is the set of general value and belief systems which characterize a given social context, while the second consists of the organized social groups which provide vehicles for the propagation of given values and constitute their visible manifestation. Both types of informal institutions have significant impacts on the process of environmental policy implementation, yet it is the latter which participates most directly and visibly in the form of environmental NGOs and citizens' associations.

The role of NGOs and other such expressions of civil society in implementation may be carried out either in conjunction with formal institutions (for example, by providing an additional source of information on the compliance of target groups) or by performing a valuable watchdog function with respect to the policy making and implementation activities of the formal institutions themselves (REC, 1995).

4. INSTITUTIONAL REFORM: KEY OBJECTIVES AND PRACTICAL MEASURES

Having highlighted the conditioning factors in implementation and the potential pitfalls for institutional reforms, I begin this section by tracing three broad objectives for strengthening institutional capacity for implementation in CEECs. These objectives explicitly take into account the particular nature of the transition/consolidation process underway in the region and, to that extent, avoid some of the traps into which many institutional reform initiatives, launched during the first wave of enthusiasm which swept over the region in the early 1990s, have since fallen.

These three general objectives for programmes of institutional reform aiming to improve the implementation record of environmental policy in CEECs rest upon the recognition of the key role played by *incentive structures, interests, and time horizons*. They may be expressed as the need to:

- change the incentive structures of existing actors (public administration officials, target groups) through the redefinition of their interests in order to raise the chances of implementation;
- stimulate the emergence and active involvement of new actors with an interest in successful implementation; and,
- extend the temporal horizon within which environmental policy actions are conceived in order to encompass the entire life-cycle from policy formulation to implementation, monitoring, and evaluation.

The three broad objectives for reform outlined above must be followed up with practical measures if they are to produce concrete improvements in CEECs' institutional capacity for the implementation of environmental policy. Thus, changes in incentive structures may be achieved through general PA reform initiatives which, in turn, impact upon target group behaviour. Support to the emergence of new interests may be provided through guarantees for public participation (PP), while time horizons may be extended by rules for policy-making which require the explicit evaluation of the fate of environmental policy decisions once taken.

Recognition of the influence of informal institutions implies that the success of institutional reform strategies in CEECs rests crucially upon their degree of appropriateness to the specific national context in which they are to be applied. That said, the following set of measures appear to be worthy of consideration by reformers throughout the region.

4.1 Incentive Structures and Public Administration (PA) Reform

The rigidly hierarchical structures of state administration developed under the previous regimes in CEECs represent a legacy which is clearly ill-adapted to respond to the challenges of rapid change from whatever quarter they may arise. The general mismatch between capacities for policy adoption and those for effective implementation is also of consequence for environmental protection, where it has been observed that "[a]dministrations are ill-equipped to implement policy, in terms of experience and expertise...There is a contrast between highly developed environmental legislation being passed by parliaments, and the ability to implement the laws" (Fisher, 1992). Likely PA reform measures include:

- simplification and delayering of vertically integrated organizational structures with the clear specification of competencies (exclusive, joint, overlapping) for environmental policy implementation and of available resources (human, budgetary) between different levels of PA (central vs. local government), sectors (health vs. environment) and functions (strategic planning vs. execution vs. control);
- improved information collection, processing and analysis capacities with respect not only to environmental indicators and the socio-economic impact of environmental change but also with regard to the extent and effectiveness of environmental PA actions;
- adoption of a flexible, interlinked, cellular structure within which functional or goal-oriented behaviour is promoted through the delegation of a greater degree of independent decision making accompanied by full responsibility for ensuring expected outputs and outcomes. This, in turn, requires specification of a clear set of tasks, as well as security of and full control over allocated resources;
- inclusion of control functions to verify the delivery of expected outputs through the

use of measures ranging from traditional budgetary control and external audits to ongoing evaluations of programme management; and,

- introduction of a performance-related system of direct incentives for PA officials charged with implementation by means of a rewards scheme offering in-service training, opportunities for work experience or training abroad, and career advancement.

Such changes in the incentive structures under which the PA responsible for implementation operates may have substantial “knock-on” effects upon those of target groups. This can be deduced by the theorem which holds that the rate of voluntary compliance with a given regulation is determined by the level at which the sanction for noncompliance is set, multiplied by the probability of detection (Diver, 1980). Thus, even without imposing stricter environmental provisions and higher fines, the increased motivation of PA officials to pursue implementation may lead to increased levels of voluntary compliance among target groups by raising the chance of detection. Clearly, such indirect measures may be accompanied by traditional regulatory, fiscal and economic measures which act directly upon the incentive structure of target groups, but whose introduction are also subject to considerable resistance.

4.2 Promoting New Interests Through Public Participation (PP)

Formal institutions for the environment, such as the units of PA charged with environmental protection, clearly have a statutory interest in successful implementation. But they are not alone. The representatives of diffuse interests, in whose name much of current environmental policy is promulgated, also have a strong interest in seeing paper commitments transformed into tangible improvements in the level of environmental protection afforded. Their ability to influence the implementation process depends crucially, however, upon the clarity with which their stake in policy outcomes is articulated, the nature of the opportunity structure for participation and the available tools for action. For public participation (PP) to be meaningful, three basic provisions must be ensured (REC, 1994):

- *Access to information:* in the case of environmental policy this is of two distinct types—information on the state of the environment, and information regarding key policy initiatives and administrative procedures related to the environment. The former rests upon the existence of comprehensive and reliable data collected by public authorities (presupposing the presence of monitoring networks, sufficient resources and expertise) and its availability to citizens (guaranteed by law without the need to demonstrate a direct interest in the information requested). The latter belongs to the realm of national practice in policy making and administrative law and pertains to information on forthcoming policy decisions, legislative initiatives, and permitting procedures.

- *Provisions for consultation*: just as public consultation without information represents a largely empty exercise, so may information without consultation (in the form of public hearings or forums) lead to frustration on the part of citizens and NGOs, their rejection of the official implementation process and ultimately the loss in credibility and legitimacy of the formal institutions charged with policy implementation.
- *Rights of standing*: the recognition of NGOs as representatives of diffuse interests and of their right to pursue instances of nonimplementation or lax enforcement by PA agencies or officials through the courts represents an important impetus for formal institutions responsible for environmental policy. The office of the ombuds-person, which acts on behalf of citizens in bringing complaints against the PA and may also handle environmental cases, is an important tool for action and effectively lowers the costs involved in the actual use of opportunity structures. Equally, such rights may form the basis of legal actions aimed at inducing noncompliant target groups to adopt environmental measures prescribed by public authorities.

The effective use of such rights by NGOs and citizens' associations may prove limited without supplementary measures which provide the necessary support to these expressions of civil society in CEECs. Available actions include targeted financial support (direct transfers or indirect incentives, such as through fiscal rebates) and training for NGOs, as well as general measures such as environmental education.

4.3 Extending Temporal Horizons Through Rules for Policy Making

The root causes of many implementation problems can be sought in policy making itself, a point at which the political effort needed to bring about a given decision appears paramount and thereby overshadows all subsequent steps, which are dismissed as mere technical detail. Arguably, however, a limited investment of attention on the part of policy makers to such issues as budget allocation, designation of competencies and scheduling early on may have substantial pay-offs further down the line at the stage of implementation.

One means of focusing the minds of perennially distracted policy makers lies in the adoption of a set of rules establishing an obligation to provide all new-born policy decisions with a minimum survival kit, including an institutional guardian, adequate informational, financial, and human resources, an indicative timetable for subsequent steps, and a mechanism for periodic review (SIGMA, 1994). Spelling out such conditions in detail would clearly overburden the decision making apparatus and severely limit margins of manoeuvre during implementation. Indeed, overspecification would immediately expose policy decisions to the shortcomings of programmed implementation. Yet, in order to tap its strengths, even the adaptive implementation approach requires a minimum of direction as to how to proceed from the decision point onwards.

4.4 The Independent Agency Model: A Solution for CEECs?

A time-honoured solution to the problem of ensuring that today's policy decisions continue to influence tomorrow's events is that of the establishment of tailor-made institutions. In this manner, specific policy choices and approaches to their implementation become "immortalized" and their effects remain long after their original creators have been replaced in office. Among the wide range of possible institutional formats, the independent agency model appears to merit considerably more attention in the context of environmental policy in CEECs than it has received to date (Majone, 1994). The greatest appeal of the model lies in its ability to simultaneously address not only the problem of temporal horizons but also those of incentive structures and new interests; the source of its strength is its credibility.

Indeed, the single most important reason for which policy makers may wish to delegate key policy making and implementation activities to agencies (once the exclusive reserve of elected governments and their operational branches) is that, in so doing, the *credibility* of the policy thus produced is greatly enhanced. By being one step removed from the political sphere, the agency is perceived by actors both within and outside the institution itself as more likely to be autonomous, impartial, and consistent over the long term with regard to its central tasks. At the same time, however, the removal of the agency's decisions from the direct control of elected representatives raises the problem of ensuring *accountability* (Shapiro, 1988). Given the wide range of activities which are brought under the purview of the independent agency (especially in such cross-sectoral policy fields as environmental protection), this is no small concern. However, there are a number of means by which to ensure accountability while defending agency autonomy, foremost among which is the requirement of clear statutes that, in establishing the agency, define its realm of competence, set out strict procedural requirements, and ensure its amenability to judicial review.

The independent agency is characterized by its possession of technical expertise (scientific, legal, economic), statutory independence, a well-defined sphere of action, and an open-ended mandate. Beyond these minimum attributes, however, independent agencies may vary enormously with respect to their effective powers and functions, which may include some or all of the following: fact-finding, rule-making, adjudication, implementation, and enforcement. Concrete examples of environmental agencies range from those granted strong regulatory and enforcement powers, such as the US Environmental Protection Agency (EPA), to those like the European Environmental Agency (EEA), whose activities are restricted solely to the collection and dissemination of information (the inspection functions included in the original proposals being conspicuously absent; Kreher, 1997).

As a result of its particular configuration, the independent agency model for the environment responds well on all counts with respect to the three reform objectives set out above:

- *Time horizon*: an institution which, by statute, is required to take a long-term, overriding interest in the implementation of a policy for which it was created makes such activities its very lifeblood. The continued independence, authority, and credibility of the environmental agency rests precisely on its success in implementation given that it has few alternative resources upon which to rely (that is, it cannot accumulate consensus through its distribution of funds, as in the case of social security institutions, nor through the provision of basic public services, as in the case of health, education, law and order).
- *New interests*: environmental agencies may have statutory obligations to consult with all interested parties prior to decision making or implementation and generally have fewer constraints on the use of such instruments as public hearings, forums and joint working groups than do traditional ministries. Furthermore, it is often in their own interests to adopt proactive measures for establishing links with environmental NGOs as these represent a valuable source of legitimacy and public opinion support for the agency itself.
- *Incentive structures*: the strong emphasis upon professionalism which characterizes the independent agency, and which constitutes one of the main justifications for its existence, ensures due regard for result-oriented performance standards in staff evaluation and career progression. In a similar fashion, the high value placed on interagency reputation within a given network of agencies (for example, that which holds between national environmental agencies and the EEA) ensures a continuing concern for status and effectiveness, with agency networks thus acting as the “bearers of reputation” (Majone, 1997).

Last but not least, the independent agency is well-equipped to pursue an adaptive implementation approach in its ability to combine centralized coordination with a high degree of flexibility in implementation. At the same time, the risk of agency capture is reduced by means of strict provisions for transparency and accountability, which hold independent agencies in check. These are given real force in the presence of tripartite governance structures whereby NGOs and citizens’ associations, if given access to adequate resources and the courts, act as counterweights to the development of overly close relations between agencies and target groups.

5. CONCLUSIONS

The uncertainty, complexity and novelty of transition/consolidation in Central and Eastern European Countries call for innovative approaches to environmental policy making and implementation. The seriousness of environmental conditions in certain hotspots and the limited institutional response capacity throughout the region make the CEECs particularly vulnerable to environmental security threats.

Under such conditions, strategies capable of accommodating pervasive uncertainty and incomplete information appear to be well-suited and the advantages of adaptive implementation over more limited conceptions of programmed action are clear. Opting for flexibility over rigidity as a guiding principle for environmental policy measures would lead CEECs to strengthen institutional capacities for implementation by introducing feedback mechanisms for institutional learning, promoting new professional standards for PA officials and actively involving all stakeholders in the pursuit of environmental policy goals. In this manner, the prospects for ensuring timely and effective responses to future environmental risks in contemporary CEECs could be greatly enhanced.

Much remains to be done in terms of designing concrete measures to strengthen institutional capacity for implementation which are adapted to the specific conditions of each country, a task which goes beyond the scope of this chapter. Nevertheless, should the conceptual framework presented here prove useful to environmental policy makers in CEECs as they grapple on a daily basis with obstacles to implementation, it will have succeeded in its original objective.

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Chapter 20

Radioactive Contamination, Environmental Changes, and Strategies for Adaptation

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Environmental problems have become a constant focus of public concern. Among many urgent issues such as global warming and depletion of the ozone layer, radioactive contamination is of special concern in Russia and elsewhere. The use of atomic energy for economic and military purposes has resulted in radioactive environmental contamination that is a direct threat both to the natural environment and to the health and safety of people. Of particular concern are contaminated territories near nuclear test sites, in areas around mining enterprises, and around conversion and storage sites, as well as regions of emergency contamination near atomic energy stations.

Recently, areas contaminated with radionuclides have been found in large cities such as Moscow and in other inhabited regions, where secret nuclear waste storehouses were located. In Russia, these areas constitute more than 61,000 hectares, a figure that does not include areas of emergency contamination (Krivolutskii, 1996a). Significant environmental changes occur under the influence of ionizing radiation. The nature of these changes depends on both the type of radiation and specific environmental factors.

1. INTRODUCTION

1.1. Characteristics of Radiation Exposure

Depending on the quantities of specific radionuclides, radiation exposure ranges from low (a few multiples of the natural background for which, according to Moiseev & Ivanov, 1990, $[4.8 \pm 1.1] \times 10^{-8}$ gray per hour [Gy/h] can be taken as the average outdoor absorbed dose rate) to high (absorbed doses greater than about 1 gray, which is equal to 1 joule per kilogram [J/kg]). For the higher total doses, different phases of biological response can be distinguished. Initially, and particularly if short-lived radionuclides make up a significant proportion of the release, there is likely to be an acute phase in which immediate or relatively early biological responses are evident. In the intermediate phase, dose rates become lower due to the decay of the short-lived radionuclides and possibly, but not necessarily, due to the redistribution of the longer-lived radionuclides by natural processes.¹ In this phase, the slower accumulation of radiation doses may still result in total integrated doses sufficient to prevent the recovery of organisms damaged in the initial phase and/or to produce medium-term damage.

In the final, long-term phase, postirradiation recovery and adaptation become apparent, provided that the initial and medium-term damage have not been of sufficient magnitude to radically alter the population or ecocommunity structure.

Aside from the radioactive half-lives, other radionuclide-dependent factors significantly affect the potential radiation exposures received by organisms. Chemical identity of the radionuclide influences its environmental behaviour, as well as its radiation characteristics (i.e., alpha, beta, or gamma emissions) that profoundly affect the spatial dose field from any given source distribution. Additional complicating factors are the variable habits and target geometries presented by organisms in the environment. These organisms range, for example, from soil bacteria to single-celled algae and protozoa, to a wide variety of terrestrial and aquatic invertebrates, to mammals, and deciduous, evergreen and coniferous trees. In the case of the release of a radioactive aerosol, plants provide a very high surface-area-to-mass ratio for deposition and adsorption, because the leaves, flowers and terminal buds of plants are responsible for both energy absorption and growth and reproduction.

1.2. Environmental Characteristics

The responses of organisms to radiation exposure are many and varied, and may become manifest at all levels of organization from the individual biomolecule to the ecosystem. The significance of any given response depends on various factors, and it should not be concluded that a response at one level of organization will necessarily produce a consequential, detectable response at a higher level. Moreover, whereas in humans it is the risk of harm to the individual that must be minimized, for the great majority of other species, it is the population that is valued and for which appropriate radiation exposure controls must be implemented to ensure protection.

Certain indicators can be defined for populations of organisms in order to insure their health. These indicators are aggregations of properties that are measured in individual organisms. It may therefore be concluded that the impact of radiation on a population (or, indeed, on any higher level of organization) will be manifest in clearly detectable effects on some individual organisms (or on lower levels of organization). This implies that the protection of the population (as the ultimate objective) can be achieved by restricting the exposure of individual organisms, to the extent that there are no significant radiation effects on ancillary processes that are necessary for the maintenance of that population.

It is also important to consider environmental changes caused by indirect radiation exposure. For example, the exposure of an ecosystem, which is comprised of organisms with a wide range of radiosensitivity to radiation, may result in direct damage only to the more sensitive species. Other species, however, may be indirectly affected, for example, by loss of habitat or through gains in competitive advantage. Following

any stress to an ecosystem, such as radiation exposure, there may be a complex and long-term period of disruption, adjustment, and rebalancing.

In addition, account should be taken of external influences, such as season (e.g., the rapid growth of plants in spring, or the lower metabolic activity in hibernating animals) and temperature (e.g., metabolism rates in poikilotherms), on a contaminated environment. The response of an organism to increased radiation exposure is also likely to be modified if it is under stress from other sources (e.g., due to the presence of nonradioactive contaminants in the environment or because it is at the limit of the normal biogeographical range for its species). It has been shown, for example, that exposure to DDT increases the retention of Cs-137 in rats; thus, in addition to the potential stress from pesticide exposure and its possible interaction with irradiation, there is also a DDT-dependent increase in the radiation dose rate from internal sources (UNSCEAR, 1996).

2. ASSESSMENT OF ENVIRONMENTAL CHANGES

In order to respond effectively to radioactive contamination, it is necessary to assess its impact to date, predict possible further development of the situation, and develop adaptation mechanisms designed to ensure the greatest safety of people and ecosystems. Further, on the basis of available data, it is possible to develop an “early warning system” that would allow us to predict and thus minimize the negative consequences of radioactive contamination in the future.

To assess the import of radioactive contamination on the environment, we have developed the Environmental Assessment Framework (Figure 20.1). Using this framework allows us, for example, to classify the impact of radioactive contamination on wildlife as follows:

DENSITY

- Positive: potential for increase in resource abundance or quality;
- Negative: potential for decrease in resource or abundance quality;
- Neutral: no measurable effect on resource.

GEOGRAPHIC EXTENT

- Local: residual impact on population measurable within Local Study Area (LSA) only;
- Regional: residual impact on population measurable within Local and Regional Study Areas (RSA);
- Beyond Regional: residual impact on population measurable beyond RSA.

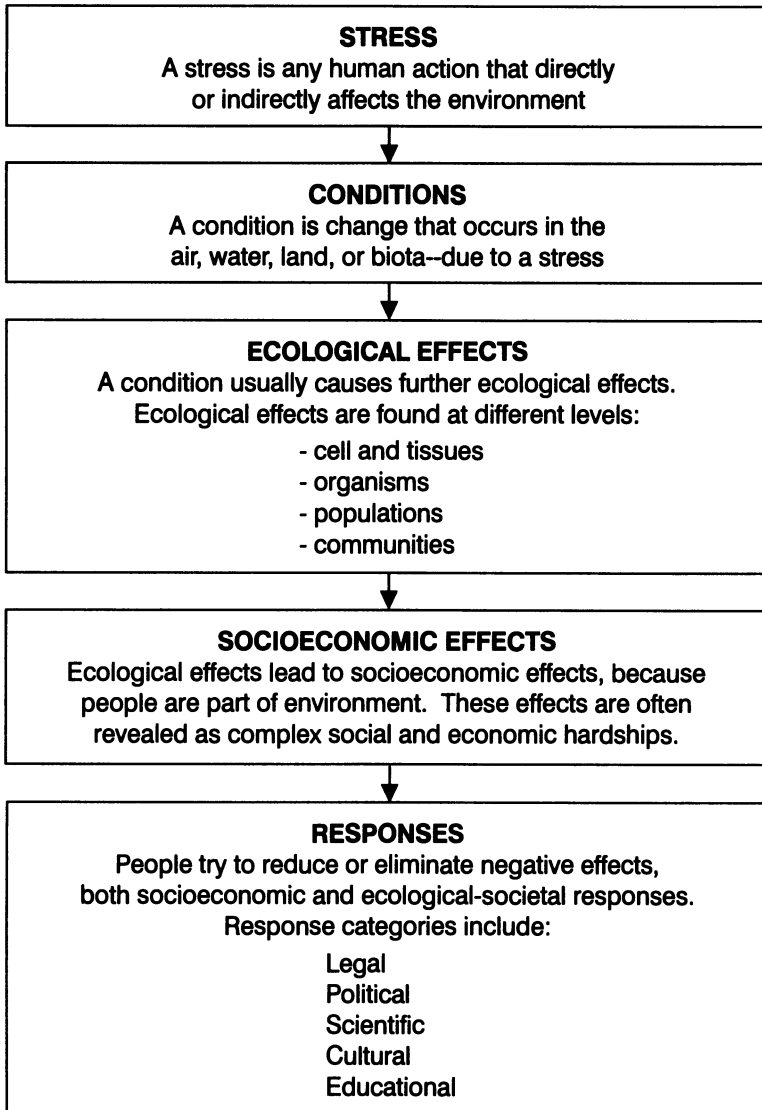


Figure 20.1 The parts of an Environmental Assessment Framework

DURATION

- Short-term: residual impact on population is not measurable beyond three years;
- Mid-term: residual impact on population is measurable for 3 to 30 years;
- Long-term: residual impact on population is measurable for 30+ years.

FREQUENCY

- Low: residual impact will result from less than one event per year throughout the life of the project;
- Medium: residual impact will result from one to ten events per year throughout the life of the project;
- High: residual impact will result from greater than ten events per year throughout the life of the project;
- Continuous: residual impact will result from continuous events throughout the life of the project.

MAGNITUDE

- Low: residual impact will adversely affect <1% of the population residing seasonally or year-round within RSA;
- Moderate: residual impact will adversely affect 1-10% of the population residing seasonally or year-round within RSA;
- High: residual impact will adversely affect >10% of the population residing seasonally or year-round within RSA.

A number of general characteristics of diminished ecosystem functioning due to environmental stress also result from radiation stress. These are: (a) loose cycling of nutrients; (b) changes in primary production; (c) reduction of species diversity; (d) retrogression, as opposed to natural succession; (e) reduction in the average size of organisms; and (f) other distress, such as alterations in disease incidence.

2.1. Main Difficulties of Assessment of Environmental Changes

One of the problems in evaluating the effects of radiation on populations and ecosystems lies in determining which parameters to measure and how radiation actually influences them. For most parameters, measurable changes in populations and communities require rather severe effects at the cellular and individual organism levels. For example, alteration in the structure of a biotic community requires a change in component populations which, in turn, requires widespread mortality and/or reduced reproduction of individuals (UNSCEAR, 1996).

Further complicating matters, radiation effects at the population and community levels are manifest as some combination of direct changes from radiation damage and indirect responses to the direct changes. This seriously complicates the interpretation of radiation effects on organisms exposed in the natural environment.

Individual populations of organisms and the community as a whole may possibly be altered by radiation exposure only as a consequence of dependence on a much more

radiosensitive species for food or shelter. For example, many plant species in a pine forest would be largely unaffected by an acute dose of 10 Gy, but the pine component would be likely to experience severe mortality. This would cause both positive and negative perturbations in populations of other species not directly damaged by the radiation exposure. Because of such indirect responses to radiation exposure, in any situation where all species in a community have been exposed concurrently, great care is necessary in any attempt to positively identify the species most directly affected by the irradiation (UNSCEAR, 1996).

Consequently, for the evaluation of environmental change due to radiation, it is necessary to identify all effects and their consequences for the most sensitive representatives of the ecosystem. For this purpose we have developed a “warning system” based on certain criteria and factors, including the most sensitive bio-indicator species, critical parts of food chains, as well as the most resistant species, and so on. Using this system it is possible to estimate the magnitude of environmental change.

2.2. The Main Environmental Changes Due to Radiation Exposure

The effects of two major accidents in the former Soviet Union (Kyshtym in 1957, and Chernobyl in 1986) have provided opportunities to observe radiation-related changes in plant and animal communities. This study focuses on the Kyshtym accident.

The area in the territory of the South Ural near the towns of Kyshtym and Kasli (the Chelyabinsk region) was radioactively contaminated on September 29, 1957, after the chemical explosion of a storage tank for radioactive wastes. Approximately 78 PBq (2.1 MCi) of the wastes, which precipitated mainly in an area of over 1000 km², were released into the environment. This area was named the East Ural Radioactive Track (EURT). Where long-lived radionuclides are released, as was the case here, biogeochemical processes determine the long-term behaviour and redistribution of the radionuclides in the environment.

2.2.1. Environmental Responses to Radiation Exposure

Coniferous trees of the genus *Pinus* have been found to be the most sensitive plant species among those that have been studied following either acute or chronic irradiation, and plant communities including these species are the most radiosensitive of those for which data are available. In general terms, a forest in which pines are the dominant (or codominant) species is likely to suffer minor effects if exposed to total, short-term doses of 1 to 5 Gy or long-term, chronic dose rates of 400–4,000 mGy/h. Severe effects in the coniferous forest could occur from acute doses (>20 Gy) or from long-term chronic dose rates in excess of 40 mGy/h. Severe effects would include the mortality of almost all higher plants, and the ecosystem would recover, if at all, only

over time periods of decades or centuries. Other types of plant communities can withstand doses or dose rates at least one order of magnitude greater before demonstrating corresponding effects (UNSCEAR, 1996).

Changes in vegetative cover can result in effects on animal communities. When plant species die in highly irradiated areas, the food supply of herbivorous animals and insects and their predators is reduced. These animals may disappear and be replaced by species that subsist on dead and decaying material.

Because of compensation and adjustment that is possible in animal species, it is considered unlikely that radiation exposures causing only minor effects in the most exposed individuals would have significant effects on the population. As long-term study has shown, mammals are the most sensitive animal organisms. On this basis, chronic dose rates of less than 0.1 mGy/h to the most highly exposed individuals would be unlikely to have significant effects on most terrestrial animal communities (UNSCEAR, 1996).

The greatest environmental damage caused by the Kyshtym accident occurred in the forests of the southern Urals. This was due to the coincidence of high interception capacity for the active aerosol, a relatively slow clearance of the deposit and a relatively high radiosensitivity, especially in the case of coniferous trees. Pine trees that had accumulated total absorbed doses estimated to be greater than 30-40 Gy during the autumn and winter of 1957-1958 showed radiation damage—a desiccation of the needles in the crown—in the following spring. Due to the relatively rapid clearance of the active deposit from the upper canopy by wind and rain, the damage initially appeared in the lower and middle parts of the canopy. However, by the autumn of 1959 the pine trees had died completely; the absorbed dose to the bud apical meristem was estimated to be greater than 15-20 Gy (Sokolov & Krivolutzkii, 1993) (see Tables 20.1 and 20.2.)

Because the deposited radionuclides accumulated rather rapidly in this zone, invertebrate populations inhabiting the litter and underlying surface soils in the birch forests of the contaminated area of the southern Urals were subject to some of the highest long-term dose rates. Eleven years after the accident, in an area of Sr-90 contamination in the range of 165-340 MBq/m², the total mesofauna densities were less than half those in control plots. The most severely affected groups were the saprophages (phytodetritivores: earthworms and millipedes). It was concluded that this response arose from the enhanced radiation exposure resulting from their relatively sedentary lifestyles rather than any intrinsically greater radiosensitivity; the more mobile predatory species showed a lower response (UNSCEAR, 1996).

The presence of many types of plants and animals with different radiosensitivities (Figure 20.1), which may be used as bioindicators, allows us to successfully conduct biomonitoring and assess environmental changes.

Table 20.1 Normalized radiation dose rates affecting organisms during the acute period following the Kyshtym accident¹
(Sokolov & Krivolutzkii, 1993)

<i>Species</i>	<i>Organism</i>	<i>Maximum normalized absorbed dose rates (mGyd⁻¹ per MBq m⁻² 90Sr)</i>	<i>Absorbed doses during the acute period</i>	
			<i>Normalized doses (Gy per MBq m⁻² 90Sr)</i>	<i>Maximum doses near release point (Gy)</i>
Pine trees	Bud meristem	30-50	3-5	100-800
	Seeds in the canopy	20-30	2-3	50-400
	Seeds on the soil	10-20	0.5-1	20-200
Birch trees	Bud meristem	20-30	0.5-2	20-200
	Seeds in the canopy	10-20	0.3-0.7	10-100
Herbaceous plants	Dormant buds	0-100	0-10	0-2000
	Seeds on the soil	20-100	2-10	70-2000
Soil invertebrates	In the leaf litter	3-20	0.5-5	200-800
	At 1 cm depth in the soil	2	3	10-40
Mammals	Large herbivores (GI tract)	30	3	100-400
	Small rodents (whole body)	3-5	1-2	10-100
	Carnivores (GI tract)	10	3	30-100
Birds	Small, over-wintering	20-30	2-3	50-400
	Carnivorous, over-wintering (GI tract)	10	1	30-100

Table 20.2 Radiation damage to trees in the contaminated area of the Southern Urals (Sokolov & Krivolutzkii, 1993)

⁹⁰ Sr contamination density (MBq m ⁻²)	Average absorbed dose (Gy)		Radiobiological effect
	Needles	Bud meristem	
1.5-1.8	5-10	2-4	Pine: desiccation of needles in the lower part of the crown, non-viability of pollen and seeds, reduction in growth increment
3.7-4.4	10-20	5-10	Pine: desiccation of 95% of the crown, growth retardation
6.3-7.4	20-40	10-20	Pine: complete death (LD ₁₀₀)
37-59	-	40-60	Birch: desiccation of the upper storey in 1% of trees, up to 30% reduction of young growth, low germination capacity of seeds reduction in growth increment
92-140	-	100-150	Birch: desiccation of the upper storey in 30% of trees, up to 75% reduction of young growth (LD ₅₀)

3. ADAPTATION MECHANISMS

On the basis of our assessment of the impact of the Kyshtym accident on the flora and fauna, it is possible to describe the current state of the environment, model its further development, and recommend adaptation mechanisms.

At present in Russia there are two possible responses to high radioactive contaminated territory:

- Quick deactivation of contaminated lands and renewal of economic activity within a short time period. This is very costly and thus not viable under current economic circumstances. Cleaning lands of Sr-90, Cs-137, and Pu-239, for example, costs more than 400,000 US\$ per hectare (Krivolutzkii, 1996b).
- Temporary exclusion of contaminated territories from economic use and the resettling of the population on "clean" territories. Russia has considerable experience with the creation of "radiation reserves" on such lands. They currently exist on the nuclear testing site in Semipalatinsk, in Novaya Zemlya, and in areas of radioactive contamination in the South Ural region and in Chernobyl (Krivolutzkii, 1996b). The East Ural State Reserve (EUSR) was established in 1966.

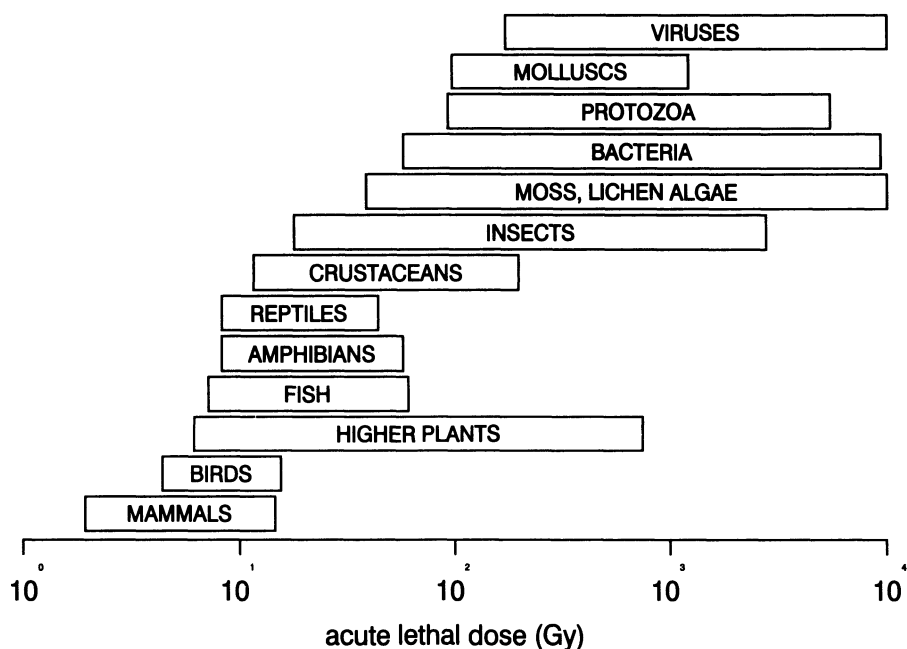


Figure 20.2 Approximate acute lethal dose ranges for various taxonomic groups

3.1. Creation of “Radiation Reserves” as the Most Reliable Way of Ensuring Safe Use for Contaminated Territories

On “radiation reserves” people are not allowed to work or reside permanently or on a temporary basis. Radioecological monitoring, and long-term natural land “cleaning” by radioactive decay takes place. According to long-term observations, the reduction of biodiversity, evident for several years immediately after the accident, is reversed in subsequent decades in the protected territory. Isolating the area encourages migration of birds and animals from outside to these tranquil spots and generates changes in biota on former agricultural lands.

A striking fact is that certain rare species of birds are found only on the territory of the East-Ural State Reserve where local radioactive contamination once exceeded normal levels by 1000-fold.

Surveys of vertebrate populations in the EUSR show unusually high biodiversity when compared to surrounding areas and the rest of the Transuralian region. Practically all species recorded in both southern and central parts of the Transuralian region have been observed in the EUSR area. Forty-five species of mammals, 171 bird species, 5 reptilian species and 6 amphibian species are registered in a territory of about 300 km². These make up 82% of the mammal species, 73% of the bird species, 83% of

the reptilian species and 60% of the amphibian species ever recorded for the Chelyabinsk and Sverdlovsk regions (Pokarzhevskii et al., 1998).

We believe that this unusually high number of terrestrial vertebrate species resulted from several factors:

- the position of the site at the junction of three biogeographical regions (the Ural mountain biome, the coniferous forest biome, and the forest-steppe biome);
- effective protection of the area and adjacent habitats for over 35 years;
- successional changes in protected ecosystems; and
- anthropogenic changes in areas surrounding the EUSR, although immigration from the adjacent biogeographical regions could have contributed to high biodiversity numbers (Pokarzhevskii et al., 1998).

4. CONCLUSION

The EUSR became an island of regional biodiversity due to very strict protection and the presence of a buffer zone around the contaminated area. Similar observations were made in studies at the Chernobyl accident site (Pokarzhevskii et al., 1998). Radiophobia and strong protective measures guard these islands of biodiversity and provide a unique opportunity to investigate the function and structure of terrestrial ecosystems with little or no human impact. These features of radioactively contaminated areas suggest protection rather than recultivation is the most practical way for managing such lands. The “radiation reserves” must play an important role as regional biodiversity pools and can be used for investigating the adaptive mechanisms of ecosystems and landscape restoration following anthropogenic impact.

Moreover, the existence of such reserves on contaminated territories also protects people from the negative impacts of radioactive contamination.

5. ENDNOTE

- ¹ The activity is a number of spontaneous nuclear disintegrations per unit of time (s^{-1}), (1Bq = 1/s; A special unit if 1Ci = 3.7×10^{10} Bq).5.

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Chapter 21

Water Alliances in the Euphrates-Tigris Basin

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This chapter investigates possible alliances between Turkey, Syria, and Iraq in their dispute over water in the Euphrates-Tigris basin. A noncooperative game in extensive form models Turkish-Syrian interactions related to water and terrorism. Iraq is modeled as a dummy player having no choice in the game but benefiting from Turkish-Syrian concessions. A Turkish-Syrian alliance cannot target Iraq, as the latter has no means of reducing the water volume upstream. The equilibria of the game explain the current state of the conflict by providing two different rationales. A unique equilibrium stipulates the conditions for a Turkish-Syrian cooperation. Turkish-Iraqi and Syrian-Iraqi alliances are found to be formed to balance threats in the basin.

1. INTRODUCTION

Turkey, Syria, and Iraq are respectively the upstream, the midstream, and the downstream riparians in the Euphrates-Tigris basin. Both rivers rise in Turkey but only the Euphrates crosses all riparian territories thus receiving more attention than the Tigris. Iraq is the water-richest riparian with its territory comprising the larger part of the basin, while Syria is the water-poorest riparian.

The Euphrates and the Tigris combined do not supply sufficient water for irrigation and hydroelectric power projects in the region to be altogether profitable. However, the realization of these projects is seen as necessary for food and energy security given the rapidly growing riparian populations. Serious food and energy deficits are possible future prospects and constitute major environmental problems, which could be exacerbated by global changes in the climate.

The rivers themselves have quite variable water flows. Water management by dams is therefore greatly needed (Bilen, 1993; Lowi, 1993). Yet, the building of dams is perceived as a means of strict national control over water resources, and is thus viewed as a tool for political blackmail. Unfortunately, environmental issues associated with water issues are inextricably intertwined with territorial and political conflicts.

Given volatile and conflictive riparian relations, experts do not agree on the composition of alliances needed to secure a comfortable level of access to water. Bulloch and Darwish (1994) discuss a possible Syrian-Iraqi alliance against Turkey. Naff and Matson (1984) argue that the Turkish-Syrian alliance against Iraq is the most conducive to

conflict. This chapter discusses these alliance possibilities. It investigates how alliances can result out of adaptation needs to water shortages in the long or short term, and examines their impact on basin-wide cooperation. Such an analysis, as opposed to simple descriptions or policy recommendations based on intuition or political events, is greatly needed. There is no thorough discussion of these alliance possibilities in the Euphrates and Tigris basin available to date.

The literature in the field of international relations also lacks a theory of alliances but offers discussions, albeit fragmentary, of alignments among states. There is no analysis of water alliances using variables and causality connections offered by those works, and the description of what happened does not constitute an analysis of interactive decisions in the Euphrates-Tigris basin. Alliances form as a result of interactive decisions. The tool to analyze interactive decision making is game theory. Therefore the analytical tool this chapter uses is a simple game that models interactions in the basin.

Frey (1993) indicates that there is a need for theory building to analyze water issues. There are few theoretical works focusing on the interactive nature of conflicts over water. Güner (1997) poses the Turkish-Syrian issue linkage as a war of attrition to deduce the riparians' propensities for giving a unilateral concession. These probabilities are found to depend on the costs riparians suffer and their evaluations of the future benefit of using the Euphrates. Güner (in press) also investigates the implication of Syrian misperceptions about the cost Turkey suffers in fighting terrorism. Turkish water policy with respect to Syria is not sensitive to different Syrian beliefs. Kilgour and Dinar (1995) propose various models to manage water supplies. Their concern is the identification of self-enforcing agreements. Young et al. (1982), Dinar and Yaron (1986), Tijs and Driessen (1986), and Rogers (1993) instead assume that cooperative agreements among states are binding. However, the assumption of binding agreements on water quotas is in sharp contrast with the anarchic nature of international politics.

In international relations, countries cooperate out of self-interest and defect from agreements whenever they do not profit from them. So, if cooperation occurs, it must be resistant to riparians' threats to defect from agreements. To take this feature of international politics into account, this chapter offers a non-cooperative game. If a decision to sign an agreement is implied in an equilibrium, this means that this decision is implied by the game rules alone. Thus, the agreement would be self-enforcing.

The issue-linkage game proposed indicates that an overall cooperation in the basin is possible. For such a cooperative endeavor to occur there must be confidence and trust building measures between Turkey and Syria: if Syria will not support terrorism after a Turkish water concession, Turkey may evaluate the status quo as less preferable than an outcome of mutual concessions.

There are no alliances associated with the outcome of mutual concessions. In contrast, the current Turkish-Syrian conflict is explained by two alternative strategy

profiles each indicating different Iraqi alignments. Particular water alliances result depending on the Iraqi position in a continuing Turkish-Syrian conflict. Iraq is the swing country either aligning with Turkey or Syria. In none of these alliances would Iraq find it beneficial to align with the threatener, thus each different combination of forces against the third riparian indicates a balancing alliance. Moreover, the two alliances implied by the status quo equilibria constitute no adaptation mechanisms to deal with water shortages.

The next section of the chapter briefly summarizes the main aspects of riparian conflicts. The issue-linkage game represents the interactions of Turkey and Syria, with Iraq being a dummy player. That is, Iraq is a player with no choices but who has stakes in the possible outcomes. The equilibria of this game are then interpreted and discussed. The final section concludes the discussion with a hint to future developments of the proposed framework.

2. RIPARIAN RELATIONS

Because Turkey immediately joined the United States led coalition in the 1991 Gulf War, the Iraqi leadership suspected it of aiming for the annexation of the oil-rich regions of Mossoul and Kirkouk. Such worries, however, were not grounded. Turkey made no annexation attempt during the war, and other Turkish military expeditions into northern Iraq ended with withdrawal from the region once the objectives were met. While Kurdish separatist movements could lead to an Iraqi-Turkish cooperation against them, water is a perennial source of bilateral conflict.

Iraq linked the amount of oil it let flow through the pipeline in Turkish territory to the Turkish exploitation of the Euphrates in 1977 (when the Karakaya Dam became operational). Iraq still opposes Turkish exploitation of the Euphrates and Tigris upstream and favours establishing a water-sharing agreement like the one it has with Syria. For the time being, Iraq receives 58% of the Euphrates flow at the Iraqi-Syrian border by an agreement it signed with Syria in April 1990. Iraq and Syria signed this agreement 4 months after the impounding of the Atatürk Dam, the centrepiece of the Turkish Southeast Anatolian Project (GAP).

Unlike Syria, that has only the Euphrates as its main source of fresh water, Iraq also benefits from access to the Tigris. The Euphrates alone represents as much as 86% of the water resources available to Syria (Lowi, 1993). It is generally agreed that Iraq can make up for its water loss in the Euphrates by transferring water from the Tigris by linking the Tharthar Canal to the Euphrates (Naff & Matson, 1984). However, the official Iraqi position is to keep the Tigris out of negotiations and concentrate mainly on the Euphrates. This is in opposition to the Turkish position that considers both rivers together.

As to Turkish-Syrian relations, there are two concerns: territory and water. These two issues are linked by the Syrian support of terrorism. Syria has never recognized the province of Hatay (the Sandjak of Alexandretta), a part of the French Mandate of Syria that decided by a plebiscite to join Turkey in 1939, as a Turkish territory. Syria supports the Kurdish separatist group (PKK), engaged in armed attacks in Turkey with the aim of establishing a Kurdish state in Turkish territory. The Syrian objective is principally to destabilize Turkey so as to secure a water concession and the Hatay province in the future (Beschoner, 1992; Cohen, 1992; Frey, 1993; Olson, 1992; Robins, 1991; Starr, 1991). A U.S. government report published in April 1990 overtly linked the Syrian support of the PKK to the water dispute (Elekdag, 1993).

The Syrian support of terrorist and separatist activities in Turkey followed the Turkish harnessing of the Euphrates waters, in particular the 1973 operationalizing of the Keban Dam. Syrian support of terrorism is a direct response to the Turkish water policy. The terrorist attacks politically destabilized the upper part of the basin (the GAP region in Turkey). The GAP project will irrigate a large part of southeast Anatolia and produce energy with numerous dams and power plants on the Euphrates and the Tigris (Kolars & Mitchell, 1991). With irrigation scheduled to begin around the year 2010, more than half of the water volume let by Turkey to Syria will be used upstream (Beschoner, 1992). This decrease in the water volume will be accompanied by deterioration in the water quality due to upstream agricultural uses. The GAP is thus a common source of concern for Syria and Iraq, but the midstream and the downstream riparians also have their own rivalries.

Faced with the prospect of upstream water development, Syria and Iraq both prefer a water agreement that binds Turkey to a fixed midstream and downstream water quota well above 500 m³/s to at least 700 to 1000 m³/s. However, at this rate Turkey cannot efficiently operate the GAP. Turkey guaranteed Syria a minimum water flow of 500 m³/s in 1987 provided that Syria cooperates in border security matters.¹ Yet, Turkey complained of terrorist activities a few months later and threatened to cut the water flow. The issue still dominates Turkish-Syrian relations. The conflictive nature of Syrian-Iraqi relations is well known. Iraq and Syria compete for the leadership of the Arab world and the Bat'h ideology. That Syria won respect in Western eyes by joining the coalition against Iraq during the Gulf War only exacerbated their historical conflict over the Arab leadership.

Water is inescapably a source of conflict in Syrian-Iraqi relations. Hence, water conflicts in the basin are not unidirectional with the midstream and the downstream riparians 'lining-up' against the upstream country. Syria and Iraq had their own water rivalry that culminated in a crisis after the Yom Kippur War with the Syrian reduction of the Euphrates flow to Iraq in 1974 and 1975. Syria punished Iraq for forming a group of Arab states that favoured a closure of all possibilities of negotiation with Israel, a policy of which Syria did not approve (Lowi, 1993; Walt, 1987). Nevertheless,

following the impounding of the Atatürk Dam in January 1990, Syria and Iraq cooperated by finalizing an agreement allowing 58% of the Euphrates waters to flow from Syria to Iraq. This agreement is subject to one important constraint: Syria can always reduce the water flow to Iraq by using the level of water it receives from Turkey as a pretext.

The linking of concessions in water conflicts to those associated with other issues is the rule in the Euphrates-Tigris basin. The linkages between water and terrorism, water and oil, and water and common policy towards Israel exemplify this fact. In fact, LeMarquand (1977) indicates that water conflicts are linked to other issues of riparian contest in all river basins.

3. ISSUE-LINKAGE GAME

Figure 21.1 represents the game of Turkish-Syrian issue linkage with Iraq being a dummy player having no choice. Each decision maker knows the previous choices. For example, Syria moves knowing that Turkey decided to fix the water flow at 500 m³/s or 700 to 1000 m³/s when it moves and Turkey is informed that Syria supported terrorism after it agreed to sign an agreement fixing a water quota desired by Syria and Iraq. Turkey and Syria are also informed of the payoffs.² We assume that in each outcome Iraq obtains its share of 58%; thus, an incremental gain that Syria receives in the water volume also means a water gain for Iraq.

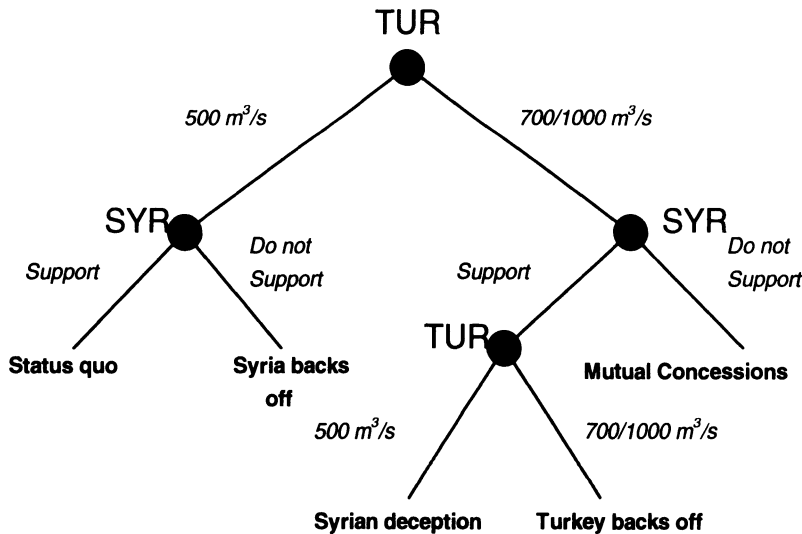


Figure 21.1 The outcome tree of the Turkish-Syrian issue linkage

In Figure 21.1, the outcomes of interaction are given in bold and the choices in *italic*. In the first step, Turkey (TUR) considers whether to release 500 m³/s or 700 to 1000 m³/s of Euphrates water to Syria (SYR) by signing a water quota agreement. If Turkey releases 500 m³/s, Syria chooses in the second step whether to react by supporting the PKK or not. This reflects the empirical observation that Syria reacts to water developments upstream. If Syria supports the PKK, the status quo results. Otherwise, Syria backs off and Turkey suffers no terrorism as supported by Syria. If Turkey releases the water volume desired by Syria, then, in the second step, Syria chooses whether to cease its support to the PKK or continue it by double-crossing the Turkish cooperative move. If it ceases its support, then the outcome of mutual concessions is reached. If Syria supports the PKK, even after it receives its desired water volume from Turkey, the play reaches the third step where Turkey faces the choice of either punishing Syria by reducing the water volume to its original status quo level or continuing to release the desired water volume to Syria. Turkey may back off and still flow 700 to 1000 m³/s of water to Syria after Syria's support of the PKK; otherwise, Syrian deception is the outcome.

Iraq obtains an increase in the water volume only when mutual concessions are given or when Turkey backs off (i.e., 58% of the 700 to 1000 m³/s water volume). Iraqi payoffs in outcomes other than those two are relatively smaller (i.e., 58% of the 500 m³/s water volume). Thus, the Iraqi utilities are higher in those cases of increased water volume, assuming that Syria will flow a greater amount of water into Iraq in the case where the Turkish water concession is obtained.

The choices are abbreviated in Figure 21.2. A flow of 500 m³/s is denoted as 5, 700 to 1000 m³/s as 7/10, supporting of terrorism as *s*, and not supporting terrorism as *-s*. The status quo payoffs are normalized to (0,0). All other payoffs are defined relative to players' values of the status quo. We have now to determine the key variables that define Turkish and Syrian preferences over the possible water-conflict outcomes.

If Syria backs off, the only difference with respect to the status quo is a lack of Syrian support for the PKK. Similar to the status quo, there is no change in the level of water Turkey releases to Syria. Thus, there is no water gain for Syria or water loss for Turkey, yet Turkey obtains the greater satisfaction of not having to incur the costs associated with fighting the PKK and Syria loses that card of support for the PKK in its relations with Turkey. Consequently, Turkey obtains *k* and Syria *-k*.

If Turkey reacts to Syria's choice of *s* by 5 after its decision of 7/10 both suffer small costs. The Turkish cost is $l_t > 0$, while the Syrian cost is $l_s > 0$ due to being attested as a "resolute terrorism supporter country." Thus, Turkey and Syria respectively receive $-l_t$ and $-l_s$. If Turkey chooses 7/10 even after Syria's deception move of *s*, then Turkey loses water but Syria wins an increase in the water volume at no cost. In that case, Turkey and Syria respectively get $-w_t$ and w_s . This outcome differs from the status quo as Turkey loses the water issue, but Turkey still suffers the cost of fighting terrorism as with the status quo, and Syria obtains a greater amount of water

and still reaps the benefit of destabilizing Turkey through its support to the PKK. If Turkey still chooses 7/10 even after the Syrian support, Syria gets its desired water volume and Turkey unilaterally concedes.

If Turkey chooses 7/10 and Syria reacts by -s, then mutual concessions outcome is reached. The outcome differs from the status quo in two respects: Turkey loses water but benefits from the Syrian decision of -s, and Syria gets more water but loses the PKK card with respect to Turkey. Consequently, the Turkish payoff is $-w_t + k$ and the Syrian payoff is $w_s - k$.

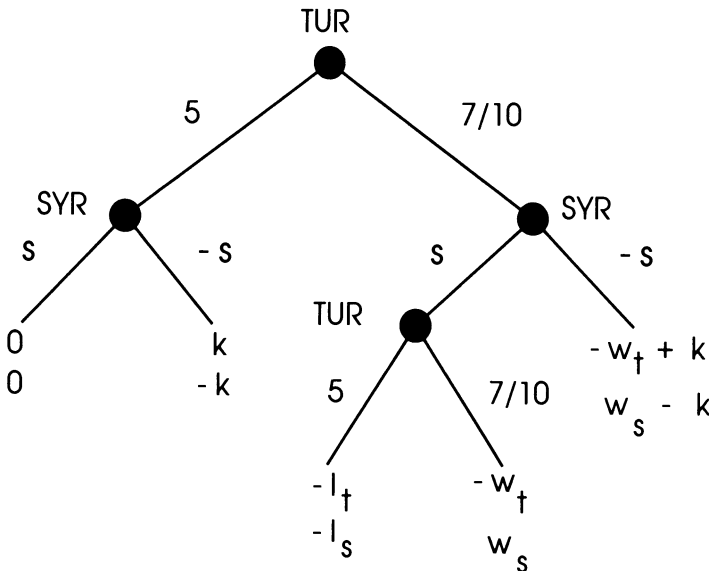


Figure 21.2 The issue-linkage game with payoffs

To sum up, in Figure 21.2 we have identified three key variables that define states' preferences over the possible issue-linkage outcomes: the values of the water issue for Turkey and Syria (w_t , w_s), the cost and the benefit created by the Syrian support of the PKK ($-k$, k) for Turkey and Syria, and the costs of Syrian cheating ($-l_t$, $-l_s$) for Turkey and Syria. The payoffs are defined in terms of these variables with respect to the status quo that is normalized to be 0 for both players.

4. EQUILIBRIUM BY BACKWARDS INDUCTION

To solve this game we have to reason backwards from the end points of the tree, finding the equilibrium by backwards induction. This is because players look forward but reason back (Dixit & Nalebuff, 1993). From the bottom to the top, there are four

decision nodes: the Turkish move after Syria supports the PKK given that Turkey chooses 7/10, the Syrian move after Turkey flows 7/10, the Syrian move after Turkey chooses 5, and the initial node of the game where Turkey moves by choosing between 5 and 7/10.

Concentrate on Turkey's last move. Here, informed of the Syrian choice of support for the PKK, Turkey decides between 5 and 7/10. If Turkey chooses 5, it obtains $-l_t$ because Syria responded to the initial Turkish choice of 7/10 by supporting the PKK. If it chooses 7/10, it gets $-w_t$. Here we can safely assume that $w_t > l_t$ because the cost of being deceived once and immediately punishing the cheater is strictly smaller than losing entirely the stake in the water issue. Hence, as $-w_t < -l_t$, Turkey will make the choice leading to the lesser of the two evils, which is 5. We can then prune the tree by deleting the branch leading to the outcome where Turkey backs off.

Anticipating that Turkey will retaliate to its cheating by reducing the water flow to its status quo level, Syria will compare the consequences of choosing $-s$ and obtaining $w_s - k$, and double crossing to get $-l_s$. There can be two cases here: either $w_s - k > -l_s$, which will result in Syria choosing $-s$, or $w_s - k < -l_s$, which will result in Syria choosing s . Assume $w_s - k > -l_s$, then Syria chooses $-s$. Now we can further prune the tree by deleting the branch leading to the last Turkish move.

After Turkey chooses 5, Syria decides between s and $-s$. Its choice of s leads to 0 and $-s$ to $-k$. By definition $0 > -k$. Therefore Syria will choose s . So, the branch leading to Syria's backing down is also deleted.

At the initial node of the game, Turkey will compare the consequences of choosing 5 and 7/10. The choice of 5 leads to 0 and 7/10 to $-w_t + k$. If $0 > -w_t + k$, then Turkey chooses 5, otherwise it chooses 7/10. Thus, if $0 > -w_t + k$, then the right half of the tree is discarded, and we are left with the following best replies: at the start Turkey chooses 5 and Syria responds by s : (5, s). This is the first equilibrium. If $0 < -w_t + k$, Turkey will choose 7/10 at the start and Syria will choose $-s$: (7/10, $-s$). This is the second equilibrium.

Now assume that $w_s - k < -l_s$. As $w_t > l_t$, Turkey will choose 5 in its last move. Then Syria will choose s after Turkey chooses 7/10, as $w_s - k < -l_s$. Syria again chooses s after the Turkish initial decision of 5 because $0 > -k$. Therefore, at the beginning, Turkey is to choose between 5 and getting 0 and 7/10 obtaining $-l_t$. As $0 > -l_t$, Turkey will choose 5 at the start. Thus, the right half of the tree is again completely left out. The equilibrium is composed of the Turkish choice of 5 and the Syrian choice of s : (5, s). To summarize, we have two distinct equilibria indicated in parantheses (the cases 2 and 3 lead to the same equilibrium):

Case 1:	$w_s - k > -l_s$	Case 2:	$w_s - k > -l_s$	Case 3:	$w_s - k < -l_s$
	$-w_t + k > 0$		$-w_t + k < 0$		(5, s)
	(7/10, $-s$)		(5, s)		

In all three cases, Turkey and Syria look ahead, compare the consequences of their choices, and reason back to find their best replies. Given the Turkish choice of 7/10, Syria looks ahead and finds out that its cheating gives only $-l_s$ and its nonsupport $w_s - k$. As $-l_t > -w_t$, Turkey will always retaliate against cheating by reverting the river flow to its status quo level. By assumption $w_s - k > -l_s$. Syria will not double cross Turkey by responding with $-s$ to 7/10. So, Turkey reasons back and finds out that its choice of 7/10 leads to $-w_t + k$. Turkey also foresees that Syria will retaliate against 5 by s to obtain 0 instead of $-k$. Hence, the choice of 5 will lead to 0 for Turkey. Therefore, at the beginning, Turkey reasons back and finds out that the choice of 5 leads to 0, and 7/10 to $-w_t + k$. As $0 < -w_t + k$, Turkey opts for 7/10 at the beginning and Syria responds by $-s$. The equilibrium outcome is the mutual concession point. Note that the agreement is enforced by the game rules, not by exogenous factors or an assumption of binding agreements.

In the second case $0 > -w_t + k$, so following similar reasoning, Turkey finds that by choosing 5 it obtains a greater payoff than by 7/10. Note that Syria still prefers not cheating in this case. Thus, the Turkish payoff from 7/10 is still $-w_t + k$ but smaller than the payoff from 5: 0. Consequently, Turkey will choose 5 at the start and Syria will retaliate. The equilibrium then is the current status quo.

In the third case, we do not even have to examine the value of the mutual concessions outcome for Turkey, because Turkey looks forward and knows that Syria will respond by cheating to 7/10 as $-l_s > w_s - k$. There is no chance for the outcome of mutual concessions to be reached. As Turkey will also retaliate against the Syrian cheating, Turkey reasons back and finds that its choice of 7/10 leads to $-l_t$ and its choice of 5 to 0. But by definition $0 > -l_t$. Thus Turkey will choose 5 at the beginning and Syria s . The equilibrium is again the status quo but the rationale is different. In the second case Turkey prefers the status quo to the mutual concessions. Here, in the third case, Turkey prefers the status quo because Syria prefers cheating, so there is no room for mutual concessions. Thus, the possibility of mutual concessions is ruled out, as either Turkey prefers the status quo or Syria cheating.

5. INTERPRETATION OF THE EQUILIBRIA AND DISCUSSION

Millenia ago, in his work *Arthashastra*, the Indian philosopher Kautilya described the qualities, in addition to common commitments and goals, that alliance partners should share. Alliances still form an integral part of political relations among states. We could even define the discipline of international relations (IR) as the study of alliance formation and dissolution. However, unlike game theory, sociology, and social psychology, which offer alliance theories, there is no coherent IR theory examining why alliances are formed and dissolved (Holsti et al., 1973; Modelski, 1963; Smith, 1995; Ward,

1982). Even though scholars think that alliances are responses to the perceptions of threat, little attention has been paid to how states weigh different sources of threat in forming and dissolving alliances.

The IR theory directly concerned with alliances is the controversial theory related to balance of power. This can be taken to mean the study of "the distribution of power, equilibrium, hegemony, stability and peace, instability and war, power politics, universal law of history and system and guide to policy making" (Haas, 1953, p. 443). According to Claude (1962), the balance of power can connote a specific distribution of power where an equilibrium or, on the contrary, a disequilibrium, a policy of creation and preservation of equilibrium, or a system as a kind of arrangement for the operation of international relations. Yet, the formation of balancing alliances is not the only possible alignment pattern. Bandwagoning is the opposite of balancing; weaker states bandwagon by aligning with the threat. A definition of alliance will clarify these alignment patterns.

Alliances are groupings of states formed in order to decrease the uncertainty of who will oppose whom in case of conflict. Allies increase each others' security by pooling their joint capabilities. To increase the amount of resources available in prospective wars is indeed a state's main reason for forming alliances. The nature of alliances thereby indicate the array of forces rival parties control and can use should the need arise. In a triad (a three state system), an alliance is a security collaboration between two countries against the third country (Caplow, 1968) and transforms an opposition of interests between two states into one between a group of two states and an unaligned state. This only serves to elevate the level of conflict by increasing the number of states targeting each other.

In a water basin, a security collaboration between two riparians may target a threatener to counterbalance the threat. As indicated in the above analysis, the array of forces indicates that one of the rival parties will be the threatener state. Either a war or a long sequence of conflictive relations without arms are possible outcomes. The balance-of-power theory supports this type of alignment (Liska, 1962; Waltz, 1979). Bandwagoning, whereby a riparian collaborates with the threatener against the third, is the opposite of balancing.

In our specific context, we can define the threat as the upstream riparian having aggressive intentions and the capability to reduce the water volume. This definition parallels the one alliance analysts use (Walt, 1987). As the three countries share common borders with each other, we cannot distinguish a weighty threat source related to distance (the distant country without major transportation capabilities to project power is not a serious source of threat). The interpretation of the equilibrium outcomes is now possible.

The outcome of mutual concessions is possible if and only if (i) Turkey evaluates a water concession and the end of the costly fighting with terrorism as more valuable than the continuing of the status quo, and (ii) Syria evaluates stopping its support for

terrorism and obtaining its desired volume of water as more valuable than double-crossing Turkey. This is the only equilibrium where Iraq obtains an incremental increase in the Euphrates waters as released by Syria. For Iraq, a percentage of 58% of a greater volume exceeds 58% of a lesser volume (or another arrangement increasing the Iraqi share). This aspect of riparian relations demonstrates the free-rider character of Iraq: Syria bears the cost of conflict with respect to Turkey but Iraq benefits from a Turkish-Syrian cooperation. In this case, there is no adversary combination either. All three riparian countries reach a cooperative outcome.

Overall cooperation conditions may be fulfilled with the attrition of Turkish resources to fight terrorism and Syria's end to the claim of territory from Turkey. The fulfillment of only one of these two conditions does not imply basin-wide water cooperation, because even if the Turkish cost of fighting the PKK increases, a Turkish perception of a possible Syrian deception will definitively make the current status quo more desirable.

The status quo sustained by the two equilibrium strategy profiles means that the issue linkage is due to either the Turkish fears that Syria will still support the PKK even after it obtains the water concession from Turkey, or the Turkish evaluation, that mutual concessions are more costly than the current conflict. A Turkish diplomat confirmed the existence of such fears, stating that Turkey does not want Syria to bring up the issue of Hatay after an agreement over water (Sariibrahimoglu, 1995). The third case has a greater explanatory power than the previous two, because it takes into consideration the observed conflict and incorporates the Turkish fear of being double-crossed by Syria.

Alliances become possible in the status quo equilibria. If Iraq perceives that Turkey will concede in the water issue if Syria ends its support to the PKK, then it could put pressure on Syria along with Turkey. Iraqi pressure against Syria, to mitigate Turkish expectations of possible Syrian deception once Syria obtains its desired water level, would mean an opposition against Syrian aggressive intentions. This is the Turkish-Iraqi alignment against Syria: both countries oppose, though by different means, Syria's revisionist aims.

Does Iraq balance or align with the threatener by forming a joint front with Turkey against Syria? Note that the Iraqi problem with respect to the Euphrates is twofold: Iraq perceives both Turkey and Syria as capable of reducing the water volume, and thus both Turkey and Syria are perceived as threats to its water security. Therefore, an Iraqi-Syrian alliance against Turkey is by no means automatic on the ground that Turkey is the upstream riparian. Constant Syrian territorial aims, causing a Turkish perception of Syrian threat, and Turkish intransigence about a water agreement can only make Iraq's access to water less secure. An Iraqi-Turkish combination of forces then balances Syria.

If Syria did not threaten Turkey and Turkey did not propose a water management plan for the whole basin (displaying aggressive intentions with respect to the midstream

and downstream riparian countries), a Syrian-Iraqi alliance would balance Turkey, indicating the array of forces that could be used in a war to secure water. Such a preference ordering is reflected in the second case. Thus, an Iraqi-Syrian alliance in this equilibrium profile depends on more stringent conditions. A Syrian recognition of Hatay as a Turkish territory is impossible. In the second case, Turkey prefers the current conflict to mutual concessions and Syria prefers the mutual concessions over deceiving Turkey. Here, Syria weighs the value of the water issue as greater than its support of terrorism after a Turkish water concession, but Turkey evaluates its stakes in the water issue as more valuable than its costs of fighting the PKK. Iraq could then perceive Turkey as the threat and align with Syria to balance Turkey.

To sum up, one of the two equilibria indicates the need for no alliance in the basin and the status quo is sustained by two distinct profiles of best replies. The status quo can imply an Iraqi alignment with Turkey to balance Syria or an Iraqi alignment with Syria to balance Turkey. Therefore, we find no rationale for bandwagoning, where a riparian aligns with the threatener against the third, in the basin. Iraq could not benefit from an alliance with the threatener, because if Syria prefers cheating and Turkey evades a water agreement, an Iraqi alliance with Syria will either not change the Turkish position or cause the Turkish position to become harder to tackle. Such an array of adversary forces could lead to a quick destabilization of the region. Similarly, Iraq could not find an alliance with Turkey against Syria to be beneficial when Syria prefers a water agreement and not cheating but Turkey prefers the continuation of the issue linkage to a water concession. Its natural interests are then concordant with those of Syria.

The equilibrium of mutual concessions indicates no need for alliances. However, the status quo of hostile relations between Turkey and Syria has more strategic support. A Turkish-Syrian alliance against Iraq would mean that both allies perceive Iraq as having aggressive intentions and potentially reducing their water volume, but this is simply impossible as Iraq is the downstream riparian with respect to both of them. As Turkey and Syria will not align against Iraq, Iraq becomes the swing country that tips the balance either in favour of Syria or Turkey.

We can also examine the conditions that must be satisfied to arrive at a Turkish water concession in the case of Syrian cheating. Let v denote the probability of the Turkish choice of 5 after Syria responded by support against 7/10 (Syrian cheating), r the probability of Syrian cheating, q the probability of support after 5, and p the probability of 5. As $-l_t > -w_t$, $v = 1$. Thus, the expected Syrian utility from cheating is $r(-l_s)$. The expected Syrian utility from not cheating (responding by non support after 7/10) is $(1-r)(w_s - k)$. It then follows that if $r(-l_s) > (1-r)(w_s - k)$, then Syria will cheat, and if $r(-l_s) < (1-r)(w_s - k)$, then Syria will not support the PKK after 7/10. This implies that if

$$r > \frac{w_s - k}{w_s - k - l_s}$$

then Syria will cheat and if

$$r < \frac{w_s - k}{w_s - k - l_s}$$

Syria will not cheat. If Syria cheats, then Turkey will not choose 7/10 and the status quo will result as an equilibrium. However, suppose that

$$r < \frac{w_s - k}{w_s - k - l_s}$$

so Syria will prefer not cheating. In this case, if $0 > k - w_t$, then Turkey again will choose 5 ($p = 1$), and the status quo will be the equilibrium. If $0 < k - w_t$, Turkey will choose 7/10 ($p = 0$). Consequently, the conditions for an overall cooperation (or a “win-win” outcome in the basin) are

$$r < \frac{w_s - k}{w_s - k - l_s}$$

and $0 < k - w_t$, or equivalently $k > w_t$. The ratio

$$\frac{w_s - k}{w_s - k - l_s}$$

measures how Syria values mutual concessions over cheating and being punished. It approaches 1 (the maximum) as l_s gets close to zero and it approaches zero as l_s gets larger. This means that if the cost Syria suffers in cheating Turkey (being responded to by the outcome 5) decreases, then it will be very easy for r to satisfy the condition

$$r < \frac{w_s - k}{w_s - k - l_s}$$

As r is a probability, it cannot exceed 1. And as the ratio gets close to 1, the range of values r can take to satisfy it becomes wider. Thus, decreasing costs of being punished by Turkey make Syria's cheating more probable, and increasing costs will make it easier for r to satisfy the condition. Also, $k > w_t$ means that Turkey finds a unilateral Syrian concession to be more beneficial than its stakes in the water issue. This implies that Turkey evaluates the Kurdish question as more important than water. A possibility of a Turkish-Iraqi alliance could make the cost of cheating quite high for Syria; one step towards an overall cooperation could then be taken. This is only one step, because Turkey must also evaluate a water concession as less important than the end of terrorist activities originating from Syria. One can then hope for the end of the issue linkage.

Turkey could also suspect that Syria will cheat by mistake even if the Syrian utility from mutual concessions ($w_s - k$) is greater than the Syrian utility of being punished ($-l_s$). This implies that Syria will choose s after 7/10 by a probability of error ϵ .

Turkish expected payoff from 5 is 0 but the Turkish expected payoff from 7/10 then becomes $(1 - \epsilon)(w_t - k) + \epsilon(-l_t)$. Turkey will choose 5 if $0 > (1 - \epsilon)(w_t - k) + \epsilon(-l_t)$. This implies the Syrian error that makes the status quo payoff more attractive for Turkey than the outcome of mutual concessions. Solving the inequality we obtain

$$\epsilon < \frac{w_t - k}{w_t - k - l_t}$$

As l_t gets bigger, the right-hand side of the inequality approaches 0. Therefore, even a very small Syrian error satisfying the inequality will lead to a Turkish choice of 5. Equivalently, higher costs of punishing Syria will make Turkey more suspicious and a choice of 5 more attractive, while mutual concession is preferred to the status quo for both riparians. A chance at the resolution of the water conflict will then be missed, and Iraq will have no incremental increase in its Euphrates water level due to such an interaction.

6. CONCLUSIONS

Posing Iraq as a dummy player that has no choice but does have stakes in the possible outcomes of the Turkish-Syrian issue linkage, Iraq is found to balance either Turkey or Syria. Alliances are formed against the threat of the riparians reducing the water level downstream and displaying aggressive intentions. Water alliances have no *raison d'être* when all three riparians cooperate, but such cooperation depends on restrictive conditions.

A Turkish-Syrian alliance against Iraq is not found to be meaningful, because Iraq cannot pose a threat to Turkey and Syria. However, one could also extend the analysis by considering that Iraq could indirectly lower the water level upstream by not transferring water from the Tigris to the Euphrates, thus demanding a high water quota from Turkey and Syria. This could particularly harm Syria because it depends to a great extent on the Euphrates for water, and imply a balancing Turkish-Syrian alliance targeting Iraq. This alliance, however, is not similar to the alliances Iraq can form: Iraq could swing to either Turkey or Syria depending on the origin of threat, whereas Turkey and Syria could simply oppose Iraq with no alternative alignment possibilities.

Finally, the status quo receives greater support than the outcome of mutual concessions, with two alternative strategy profiles, and the possibilities of making irrational strategic choices. With Iraq benefiting from the mutual concessions, the status quo

indicates the possibilities of the Iraqi alignment with Turkey or Syria. A Turkish preference for the status quo makes Syria more attractive as a strategic partner for Iraq against Turkey, and Turkey becomes a possible ally against Syria for Iraq given the possibilities or explicit Syrian preference for cheating.

The game proposed could be extended by introducing Iraqi choices after the outcomes, indicating no incremental increase in the water volume Iraq receives. This extension requires further preference assumptions, making the analysis a little more complicated. Overall, the analysis offered investigates alliance possibilities as depending upon the Turkish-Syrian linkage. Thus, the strategic implications of the Turkish-Syrian linkage per se are also examined.

7. ENDNOTES

- ¹ In fact, the water level Syria currently receives is far above 500 m³/s.
- ² In technical terms, this is a non-zero sum noncooperative game of perfect and complete information.

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Chapter 22

Environmental Preservation Strategy in the New Romania: Institutional and Behavioural Challenges

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The development of a new institutional and legislative framework is considered a prerequisite to building a realistic and effective environmental preservation strategy in Romania. The modification of behaviour—increasing participation and communication, and changing attitudes—must be seen as a crucial element of the strategy, which pervades all others.

1. INTRODUCTION

As the world enters the next century, sustainable development is its greatest challenge. This challenge is twofold, aiming to improve and maintain the well-being of both people and ecosystems. The key elements underlying the achievement of sustainability create a long-term objective. Barbanente et al. (1994, p. 1) define these key elements as “*equity* (the achievement of widespread social justice in the distribution and accessibility to resources in both space and time), *environment* (the acknowledgment of nature’s rights and values), and *development* (economic development able to guarantee both the quality and quantity of natural resources).” At first, only the major challenges for environmental preservation should be addressed, allowing tradeoffs in some components. The emphasis in the first stage, thus, will be on weak sustainable development, which “implies a rise in the overall welfare function, but allows substitution and compensation phenomena” (Nijkamp et al., 1996, p. 504). However, strong sustainable development, which mandates no decline in any component, is the final goal. In other words, sustainable development entails integrating economic, social, and environmental objectives, and making choices among them when integration is not possible. People are a key factor in this process. They “need to improve their relationships with each other and with ecosystems that support them, by changing and/or strengthening their values, knowledge, technologies, and institutions” (Carrew-Reid et al., 1994, p. xiii). People also contribute to major obstacles, such as the lack of agreement on what should be done, resistance by special interest groups, and uncertainty about the costs and benefits of alternative actions.

In order to provide “a framework for analysis and focus for debate on sustainable development and processes of negotiation, mediation, and consensus building” (Carrew-Reid et al., 1994, p. xiii), and to plan and carry out actions in accordance with priority issues, sustainable development strategies are required. As sustainability is a global challenge with spatial implications at all levels, these strategies may be international, national, or local. Without neglecting crucial international environmental problems, such as acid rain, global warming, the destruction of tropical forests, and the exploitation of oceans, each country is confronted with specific cases of air and water pollution and soil degradation, making it necessary to conceive and implement adequate national-level strategies. These strategies go by different names, for example, sustainable development strategy, environmental preservation strategy, environmental action plan, environmental management plan, and environmental policy plan, reflecting their different histories. This chapter focuses on the environmental preservation strategy for Romania.

In its transition to a market economy, Romania, like other Central and East European countries, is undergoing a stressful and often painful process of radical change. Prior to 1990, the central planning system had a set of priorities that focused on production maximization; environmental concerns had lower priority. Although there was no incentive to pollute (since there was no opportunity for private profit), that set of priorities created serious environmental problems: high levels of air and water pollution, harmful solid waste, poor quality food, and deteriorating human health. Hence, it must be accepted that centrally planned production is not necessarily more “environmentally friendly” than market-directed production (Schiller, 1994).

Considering these realities, the transition to a new society faces important environmental challenges, along with great political, economic, social, organizational, cultural, and behavioural ones. Solutions must focus on all the elements of the structural reform, including the institutional and legislative framework for the market economy, the reform of enterprise structures, the physical structure for a competitive economy, and human capital and attitudes (Pinder, 1991). Accordingly, the national strategy developed in 1995 to prepare Romania for joining the European Union contains, as one of its main components, the strategy for environmental preservation. But the development of the environmental preservation strategy is only a means to an end; implementation, monitoring, and evaluation are crucial. While issues of financing, and adequate communication, information, and education are important, the entire society’s participation is the cornerstone for carrying out the proposed objectives. It is also acknowledged that “successful strategies are participatory” (Carrew-Reid et al., 1994, p. 52); participation must be conceived of in terms of both government and nongovernmental actors. In order to carry out their specific functions, these actors must rely on an appropriate legal framework, economic instruments, and mechanisms for mediation and conflict resolution. The commitment of the participants, as well as

a conducive political and social climate, are critical in a people-centred approach to a sustainable development strategy.

Starting from these overall conditions, this chapter highlights the institutional and behavioural challenges to Romania's environmental preservation strategy. Two preliminary steps are considered useful in this respect, namely an analysis of the environmental situation before and after 1990, and a critical synthesis of the environmental preservation objectives contained in the environmental preservation strategy. They can help to answer questions, such as, "To what extent is Romanian society able to adapt to environmental change?" and "What are the mechanisms, and the instruments that can be employed to face this change and to attain the objectives proposed?" Without denying the role of technical change in such processes, this chapter focuses on the need for real, radical changes, not only in terms of the institutional and legislative framework, but also in terms of behaviour and attitudes. The reason is that the long communist period had a negative influence on Romanian society. The perception of democratic values and general attitudes has been perverted to such a great extent that the transition to a democratic society faces enormous challenges. The approach taken here will be a behavioural one: "behaviour simply means what people do, as opposed to what they say they do or what they are supposed to do, in legal and institutional terms" (Stayner, 1980, p. 26).

2. ENVIRONMENTAL PRESERVATION IN ROMANIA

The analysis undertaken in this section evidences the degree of environmental degradation in Romania in terms of natural resource and energy waste, air pollution, water pollution, soil degradation, waste disposal, habitat and species destruction, and forestry damage. Even though Romania has not suffered extensive environmental damage, it has had to face significant environmental problems. Their roots can be found in the socialist industrialization policy as well as in the lack of a formal policy of environmental preservation. After 1990, the state of the natural environment improved to some degree, as a result of important changes in the institutional and legislative framework.

2.1. The Situation Before 1990

The forced industrialization policy was a major cause of environmental degradation during Romania's communist period. It concentrated on the development of heavy industries such as metallurgy, heavy machinery, chemistry, and electricity production—considered the driving forces of economic development—whereas little attention was paid to other sectors such as agriculture and infrastructure. The main goal was production maximization, with environmental concerns having lower priority. Under

these circumstances the rapid economic growth recorded in the 1960s and 1970s (an annual rate of about 11% in some periods) was accompanied by a high degree of energy intensiveness (thus, the energy consumption per unit of gross domestic product [GDP] was approximately three times greater than that in the Organization for Economic Cooperation and Development [OECD] countries), overconsumption of natural resources, and a deterioration of the natural environment and of human health. These phenomena were exacerbated by irrational price structures that kept prices low for both natural resources and electricity. No incentives were created for industries to become more efficient. Coal mining and its growing production costs were subsidized, but there was not enough money to deal with the environmental consequences. Cheap electricity and energy also led to overconsumption and energy waste by both industries and individual consumers. As a general rule, the actions and measures needed for environmental preservation were included in the category of nonproductive activities, so that the investment funds allocated for this purpose were gradually diminished. During this period of extensive industrial development, the central planning system was not able to address the problems of environmental degradation; this situation continued to worsen during the 1980s.

The provisions of environmental regulations were similar to those applied in the developed countries in the early 1960s. Even these standards and regulations were weakly enforced and fees were so low that it was easier and cheaper for industrial polluters to pay penalties than to improve their environmental record. The state also granted many exemptions from its own regulations, making them ineffective. Furthermore, these regulations did not cover the whole range of environmental problems and were not connected with institutions specially designated to implement and supervise the observance of the established rules.

The information monopoly of the communist regime also made it possible to conceal statistics and other information on the quality of environment. Environmental data were secret and the public did not have any access to them. Local communities were not aware of the environmental conditions in their regions, except in those areas where environmental devastation was obvious. The lack of information led to a lack of interest among the public about environmental issues. As was the case with residents of other communist countries (Pavlinek & Pickles, 1994), Romanians who tried to express their dissatisfaction with environmental policy were persecuted.

2.2. The Situation After 1990

Compared with the previous period, a favourable evolution of environmental preservation measures and actions occurred after 1990. This situation was stimulated by the following factors: a considerable improvement of the institutional and legislative framework, the economic situation, direct measures, and actions for environmental

preservation. The improvement of institutional and legislative framework is discussed in a later section.

Economic factors are mainly related to the pronounced decrease in industrial production, by 30%-50% in the first years of transition compared with the 1989 level. This has directly led to a corresponding decrease of emissions of various pollutants. For example, annual sulfur oxide emissions decreased from 65.1 kg per capita in 1989 to 40 kg per capita in 1993. Carbon dioxide emissions also decreased, from 2.23 tones per capita in 1989 to 1.45 tones per capita in 1993 (Ministerul Apelor, 1995). Another significant improvement occurred in the quality of surface and underground water. This is the result of lower use of pesticides, insecticides, and chemical fertilizers in agriculture.

However, these results are only temporary: the slight economic recovery, the increase in private car ownership (still burning leaded gas), and other circumstances are expected to bring about additional environmental damages. It is very clear that the market-oriented economic transition will not necessarily lead to improving environmental quality in Central and East European countries, and that "free market mania" can result in wasting the opportunity to restructure the economies toward a sustainable path of development (Pavlinek & Pickles, 1994). The implementation of market principles alone will not be able to solve the pollution problems and needs to be associated with further governmental actions.

In Romania, several important measures have been taken to address environmental problems. They include improving working parameters of the existing equipment, with direct consequences in terms of pollution reduction; funding research on pollution issues in Romania, so as to identify the most damaged areas and the priorities in allocating resources for environmental preservation; carrying out investment projects to diminish pollution effects in the most damaged areas; intensifying air and water quality monitoring; and, promoting ecological reconstruction works supported by the World Bank in the Delta of Danube, one of the biosphere reservations.

However, in the face of growing economic and social problems, Romania is unable to allocate the funds that have been estimated for environmental clean-up. Nevertheless, the transition to a market economy and democratic system makes it possible to overcome the biggest obstacles that prevented communist environmental policies from being effective. First, the new institutional and legislative framework should allow for the coordination of environmental and economic policies, via enforcement and incentive mechanisms that were missing in the centrally planned economic system. Second, the democratization of society creates a framework for active participation of the public in promoting environmental preservation projects in accordance with its own interests: the public may protest against pollution practices and demand better governmental action.

3. THE ENVIRONMENTAL PRESERVATION STRATEGY: INSTITUTIONAL AND BEHAVIOURAL CHALLENGES IN THE TRANSITION PERIOD

3.1. The Institutional and Legislative Framework

Since 1990, serious efforts have been made to create a new institutional and legislative framework of environmental preservation in accordance with the exigencies of the modern, democratic society and the radical changes required by the transition to a market economy. Appropriate institutions and legislation are considered a prerequisite to building a realistic and effective environmental preservation strategy. This process is a multitrack one, in which these two prerequisites—creating institutions and developing specific acts—occur simultaneously with other elements of strategy preparation (information assembly and analysis, policy formulation, action planning, and document preparation). Although some mismatches between the new and the old can not be avoided (for example, the Ministry of Environment was set up soon after December 1989 whereas the Environmental Preservation Act was not issued by the Parliament until December 1995), this procedure is considered more effective than a single-track approach.

According to the ultimate goal of sustainable development—improving and maintaining the well-being of the people and ecosystems—societies need to improve continuously the ways in which they respond to social and ecological change and moderate their pressure on people and ecosystems. Specifically, societies need to change or strengthen the values guiding them in human and human-ecosystem relationships, knowledge, technologies, legislation, and institutions. These values are based on customs, laws, social and economic incentives, and the organizations that manage human-ecosystem relationships (Carrew-Reid et al., 1994). For a society in transition from totalitarianism to democracy, like Romanian society, a radical change of institutions and legislation is a must.

Even though Romania had quite comprehensive environmental legislation, it was largely ineffective. Most laws were issued in the 1960s and 1970s, and some of them revised in the 1980s. These include the Environmental Preservation Act (1973), Water Act (1974), Forest Act (1962), Hunting Act (1976), Agricultural Protection Act (1974), Nuclear Activity Act (1974), Toxic Substances and Products Act (1979), and so on. Nevertheless, environmental preservation was very fragmented, because there was no central institution dealing with environmental protection and management, and enforcement of existing regulations. Instead, various ministries such as the Ministry of Agriculture and Food Industry, the Ministry of the Forest and Woodworking Industry, the National Water Council, the Ministry of Health, the Ministry of Culture, the Ministry of Building, and the Commission for the Preservation of Natural Monuments were responsible for different areas of environmental protection and management.

The immediate institutional changes after December 1989 included a new organizational framework with environmental preservation as a national priority. In this context, the Ministry of Water, Forest, and Environmental Preservation (usually called the Ministry of Environment) was set up in 1990. It adopted an integrated approach to environmental management, to prevent pollution from spreading among various environmental elements. It is structured into several directorates, which deal with water resources, forestry resources, nuclear protection, strategies and regulations for environmental preservation, ecological reconstruction programmes, and international and public relations (Helm, 1991). The responsibilities of the Ministry of Environment are mainly related to the development and implementation of an environmentally sustainable development strategy.

At the regional level, the Ministry of Environment relies on the activity of territorial agencies. These agencies are set up at the county level in order to carry out the regional tasks and responsibilities of the Ministry of Environment. However, their effectiveness is poor, owing to the insufficiency of adequate equipment, trained personnel, and financial means. Many efforts are being undertaken in order to promote the decentralization of environmental management.

One of the most important achievements of the Ministry of Environment is the development of the Environmental Preservation Act, issued by the Parliament of Romania in December 1995. A range of principles, quite similar to those expressed in international agreements and other domestic legislations, underlie this act. These include the precautionary principle and the principles of preventing ecological risks, maintaining biodiversity, and conserving ecosystems. These principles must be applied in a way that reflects the cultural, political, and economic climate of Romania and its communities. This is one of the greatest challenges to this act. It is also worth mentioning that "these principles work best when applied together, especially when some circumstances would mean that the rigorous application of one principle alone might be impracticable or inequitable" (Carrew-Reid et al., 1994, p. 134). Special chapters of the Environmental Preservation Act are devoted to the regulation of economic and social activities with significant environmental impact, natural resource preservation, and biodiversity conservation.

3.2. Building an Environmental Preservation Strategy

An environmental preservation strategy has been developed by the Ministry of Environment as a component of the national strategy of transition to a market economy and structural reform. From the beginning, the environmental preservation strategy has been seen as a process. This process is adaptive; it develops continuously and responds to change. It is also multitrack, with most of the strategy components occurring simultaneously (Carrew-Reid et al., 1994). The need for a new institutional and legislative framework specific to the new, emerging society forced the Ministry of

Environment to deal with developing a new legislation while, at the same time, designing objectives and actions for environmental preservation. An important lesson to be learned from international experience is that the components of the strategy process—information, analysis, policy formulation, implementation, monitoring, and evaluation—must continue together and reinforce one another. The case of Romania demonstrates that a strategy of environmental preservation can grow in scope, degree of participation, and degree of relation to other components as capacities to undertake it are developed. The updated environmental preservation strategy developed in 1995 is a relevant example of this evolution. Based on new economic, social, and environmental facts that emerged as a result of fulfilling the first steps of reform, it has also become a component of the national strategy to prepare Romania for joining the European Union.

The actual strategy of environmental preservation is conceived of as a national multisectoral strategy and includes components of the sectoral economic development strategies, the national spatial plan, and the strategy of socioeconomic regional development; it represents a synthesis of the strategies developed by each county and by Bucharest. It includes local, regional, and global objectives, entailing responsibilities at national and international levels. From a temporal perspective, the strategy contains short- and long-run objectives (Ministerul Apelor, 1995).

The short-run objectives have either immediate results (and require relatively small costs) or long-term results. They have been carefully selected for two main reasons: a strategy is more likely to be implemented successfully if it concentrates on a few priority issues, and the financial means are very limited in this transition phase. The annual average investment that will be needed in the next few years for environmental preservation has been estimated at 400-750 million USD, while the amount that can be assured is 250-400 million USD. All short-run objectives concentrate on institutional capacity reform. The main concern is better cooperation between the Ministry of Environment and other ministries responsible for activities with environmental impact. In addition, the environmental legislation must be completed as soon as possible and continuously improved. Another primary concern is environmental monitoring. The actual monitoring network is unevenly distributed over space. Moreover, new requirements for monitoring have appeared related to other factors (solid waste, sediments, noise, acid rains, crossborder pollutant transportation, and so on), the improvement of database administration, and the self-monitoring of pollution sources. From a sectoral viewpoint, the main polluting industries are identified as priority regulation targets, namely those associated with nonferrous metallurgy, ferrous metallurgy, chemicals, fertilizers, petrochemistry, synthetic fibres, pulp and paper, and cement. Electric energy production and transportation must also be considered serious pollution sources. Fourteen highly polluted areas have been demarcated as emergency action zones, where immediate and strong intervention is needed. Examples are Baia

Mare (where suspended particulates contain lead from the plants treating lead ores), Copsa Mica (site of a carbon black factory), and Zlatna (where the air has been polluted by copper and hydrogen sulphide from the treatment of copper ores). Specific global objectives refer to forest, flora, and fauna preservation and protection against natural catastrophes (droughts, floods, and earthquakes).

Long-run objectives are related to the ultimate goal of environmentally sustainable development, namely improving and maintaining the well-being of people and ecosystems. Romanian legislation must also be harmonized with the European Union's legislation. European Union legislation requires a large number of acts, which establish priorities and set firm deadlines for implementation. Another primary concern is interregional and crossborder cooperation.

Last, but not least, all these objectives must be supported by adequate training and scientific research programmes, as well as by extensive information and educational programmes that will aid in changing the behaviour of the people and increasing their involvement in promoting ecological projects.

After defining the objectives, the emphasis must be placed on adopting policy instruments, action planning, and program implementation, monitoring, and evaluation. As mentioned before, the strategy of environmental preservation is a national multi-sectoral strategy that also includes a spatial dimension. Considering the close links between the socioeconomic, environmental, and spatial dimensions of the development processes, an approach that integrates all these elements is recommended. At the outset, only the big challenges of environmental preservation will be focused on, so that some tradeoffs in terms of positive and negative changes will be allowed. This means that, in the first stage, an emphasis will be put on weak sustainable development, which implies a rise in the overall welfare function, but allows substitution and compensation phenomena in different areas of the spatial system. Strong sustainable development, without allowing a decline in any component, is only the final goal (Nijkamp et al., 1996).

A specific Romanian response to these issues that takes into consideration each county's sectoral structure is the concept of "mosaic ecodevelopment" (Manea, 1991). This concept proposes the implementation of sustainability principles for small areas; these areas will be gradually enlarged until the entire country has been covered. The ecological space should then look like a chess board where large agricultural areas dovetail with more confined industrial and infrastructural ones. In such a framework, ecology and bioeconomy can bring about original solutions for spatial planning, so that corresponding ecological areas will be allotted to agriculture, forestry, industry, and service in accordance with specific parameters such as the existence and availability of energy sources for these economic sectors; the functional complementarity of agriculture and industry so as to amplify their outcomes; and, the need for local processing of fossil raw materials.

As far as the Romanian economy is concerned, mosaic ecodevelopment could be supported by many arguments: it promises a rational coexistence of agriculture, forestry, and industry, based on complementarity, and a proper service sector to ensure that material and labour resources are better accounted for. Mosaic ecodevelopment can contribute to reinforcement of the Romanian village, whose basic activities are conducive to a clean environment. These and other arguments outline the action framework for an environmentally sustainable development structure at the regional level (Constantin, 1996).

A critical question must be addressed: How can the concept of mosaic ecodevelopment become operational? A possible answer lies in including it in all regional development strategies, sectoral strategies, and national spatial plans, thus giving expression to the complex relationship between environmental patterns and spatial organizations. With the inclusion of the concept of mosaic ecodevelopment, the national environmental preservation strategy, the strategy of socioeconomic regional development, and the national spatial plan would represent a step toward a real complementarity.

Practical solutions should focus on all components of the structural reform, namely the reform of the institutional and legislative framework for the market economy; of enterprise structures; and, of the physical structure needed for a competitive economy (Pinder, 1991).

In a new emerging democratic society, local efforts are considered vital. In the past, despite the declarative formulation of local self-administration, local authorities and communities were treated as voiceless executors of commands from central levels of government. Therefore, empowering the local, democratically elected authorities and giving them legal, financial, and other instruments of action within their regions are necessary components of basic social and economic reform. The national environmental preservation strategy stipulates that the Ministry of Environment is charged with promoting environmental legislation and, specifically, with formulating strategies and organizing the coordination of the entire process. The responsibility of implementing the environmental legislation and the corresponding strategy and policy at a county level belongs to the territorial environmental agencies. Unfortunately, as mentioned earlier, their actual situation is generally weak, due to the insufficiency of adequate equipment, trained staff, and financial means. Many efforts need to be undertaken at the county level in order to promote the decentralization of environmental management. The reinforcement of the local tax revenue base and the automatic budget transfer from the state should be a positive contribution. Also, the spatial externalities linked to land-use patterns and site-specific development create the basis for territorial agencies to intervene using various regulatory options. Thus, territorial environmental agencies are expected to play an active role in contributing to a new perspective on the effectiveness of economic activities and to a new spatial planning outlook.

Economic restructuring and privatization are also of crucial importance to the long-term economic health of each county, creating the basis for increased employment and income. As far as the privatization process is concerned, the responsibilities and obligations of the new owners, with regard to present and future effects of pollution, will be stipulated in the final privatization documents. Also, their obligations for previous cases of pollution will be negotiated. However, these requirements are not meant to become tough constraints that could seriously affect production continuity and competitiveness. As a general rule, the environmental authorities will stipulate the main objectives regarding environmental quality and allow the firms to find the most efficient ways and means to fulfill these objectives.

In general terms, sustainable development involves tradeoffs among economic, social, and environmental objectives. It is important to stress that such concessions cannot be determined by scientific means alone. They are value judgments, and, therefore, people-centred approaches to sustainable development strategies are needed as well (Carrew-Reid et al., 1994). Under these circumstances, the challenge of participation is considerable. Undoubtedly, defining objectives, planning a strategy, and proposing economic policy actions are major components in the strategy process, but the most difficult time for most strategies is when plans must be turned into action. International experience shows that many strategies have not made the transition, and others have been only partially implemented. For some, the strategy process appears to have stopped dead following the preparation of the main document. Aware of this trap, the national action plan, developed to support the implementation of the national environmental preservation strategy, concentrates on priority issues for the short and medium run and on the tools needed to carry out the measures proposed.

Promoting action is a cornerstone in this process and methods of promotion should be carefully considered. The national action plan mainly refers to promoting action through regulation and through the use of economic instruments.

Promoting action through regulation is a traditional command-and-control approach that is very much reflected in the Romanian environmental preservation acts. The existing environmental regulation is aimed at specific sectors of the economy and specifies production, technology, or emission standards aimed at reducing environmental degradation or resource depletion. For these standards to be effective and economically efficient in promoting sustainable development actions, they should be based on objective criteria and scientific knowledge, specify a level of performance rather than a particular design of technology, and be reassessed periodically. However, this approach has its disadvantages, since regulations are seldom the most cost-effective way to reach a given standard of environmental quality. They are often inflexible, requiring polluters to adopt standard solutions even if they are able to find better alternatives. Moreover, regulations do not provide incentives for further improvement beyond the required standard.

The strategy and the national action plan should be revised in the next few years because of the need for continual improvement. This will enable greater concentration on the possibility of using market-based mechanisms as an alternative approach. These mechanisms attempt to utilize the informational advantages of the price mechanism and the institutional framework provided by markets to decentralize pollution control to individuals and firms. Thus, economic instruments aim to sensitize both producers and consumers who, as a result of internalizing environmental and social costs, will move toward the responsible use of environmental resources and the avoidance of pollution. Broadly, there are two types of market-based mechanisms: one deals with the setting of taxes, charges, and subsidies to alter the prices confronting market participants, while the other one focuses on the creation of property rights through tradeable or market permits. In the former case, the aim is to directly alter the costs in order to bring pollution back to the target level. Thus, a tax on fossil fuels might be imposed to encourage a substitution effect: producers would be encouraged to move away from coal and towards nuclear power, and consumers would be encouraged to reduce their demand in the face of higher prices (Helm, 1991). Subsidies should only be utilized in special cases where severe environmental problems and equity issues come into play: "A common effect of subsidies is to place a significant economic burden on a country by supporting technological backwardness and inefficiency. Also, they often result in large scale environmental damage by discouraging full internalization costs" (Carrew-Reid et al., 1994, p. 139). The latter method, creating property rights through tradeable or marketable permits, consists in setting the desired level of pollution in the form of target reduction. Permits will be equal to the amount of pollution; those involved in polluting activities must buy a permit for the amount they intend to emit. The advantage of this system is that "the market works out the price (the tax) rather than the government. All the government has to do is to check that nobody pollutes without a permit" (Helm, 1991, p. xiv).

The tools corresponding to these approaches will need to be applied together, in combinations specific to each situation. Five criteria proposed by the OECD can be used to judge whether economic instruments and/or regulations would be best for a given environmental problem. These five criteria are environmental effectiveness, economic efficiency, equity, administrative feasibility and cost, and acceptability to groups who will be affected by the policy (OECD, 1991).

Strategy implementation requires not only appropriate tools, but also financial support. So far, the main source for financing the implementation of the environmental preservation strategy is the state budget. Considering the deep recession Romania has had to face, only 0.08% of the GDP, compared with 3-5% in the developed countries, can be allocated to environmental purposes. In order to increase financing capacity in this field, the creation of the National Environment Fund is now a main concern. It would aim to attract financial resources not only from the state budget, but also from

private donors and from international financial institutions. Although the National Environment Fund would provide an important way to coordinate external funding, ultimately it must mobilize financial resources related to the environment. Ways of channeling taxes, charges, or fines associated with the use of natural resources or maintenance of environmental quality to the Fund should be explored. Relying on participatory management approaches, the National Environment Fund would be expected to distribute its funding consistently over a long period at levels that local institutions could effectively absorb.

Finally, assessment should be considered an integral part of the environmental preservation strategy and should cover all aspects: objectives, participation, communication, policy formulation, action planning, implementation, and results. It should combine monitoring, evaluating, and reporting on the strategy, not only in terms of environmental sustainability but also in terms of economic, social, and institutional sustainability. Related to the last two aspects, behavioural challenges—participation, communication, attitudes, and mentalities—even more than financial constraints, are crucial for the real success of an environmental strategy in new Romania.

3.3. Behavioural Changes: A Key Element of a New Perspective on Environmental Preservation

Participation and communication are crucial elements of the strategy, pervading all others. People-centred approaches to sustainable development entail the participation of stakeholder groups in decision making during all phases of the strategy cycle. Ideally, this will result in a more realistic strategy, with a broader base of knowledge, understanding, and commitment from the groups involved and with better links to promising local initiatives. A participatory strategy is defined as “a sharing by groups of people in all the tasks ultimately affecting them (information gathering, analysis, decision making, implementation and capacity building, and monitoring and evaluation)” (Carrew-Reid et al., 1994, p. 54). The benefits of participation can be noticed during the whole strategy cycle, but it entails some risks as well (e.g., difficulty focusing on priorities, due to multiple perspectives; lack of control over certain critical aspects if responsibilities are spread too thinly among participants; and the stimulation and aggravation of conflicts between groups). These risks can be minimized through good planning and management as well as through maintaining independence from party politics. In order to accomplish one of the main aims of participatory strategies—“developing a strategy with a broad base of support” (Carrew-Reid et al., 1994, p. 58)—the processes of negotiation and consensus building should continue during the whole strategy cycle.

In these processes all actors involved in the environmental preservation strategy can be identified: national government, local governments, the corporate sector,

nongovernmental organizations (NGOs), and, last but not least, communities and individuals. Participation in this strategy is both horizontal (across sectoral interest groups, ministries, and communities in different regions of the country) and vertical (from the national to the local level, or from leaders down to marginalized groups and individuals). Thinking that participation is entirely a nongovernmental affair would be a big mistake: government is the one group that can help provide the right conditions for participation; it should build structures and implement empowering policy in order to actively support participation. Moreover, the strategy should be able to survive changes in government and not be overly dependent on political patronage (Carrew-Reid et al., 1994). The sociopolitical situation in Romania after the November 1996 elections confirms that the environmental preservation strategy has successfully survived changes in government and other political processes.

Within the clear tendency to decentralization in the new Romania, local public administration is expected to play an increasingly important role in implementing the environmental preservation strategy. There are close links between this strategy and regional development strategies, based on the rational combination of top-down and bottom-up approaches. Generally, the sooner the national strategy is complemented by local strategies and other local activities, the better.

In Romania, the move to reform public administration in order to ensure the success of all components of the transition strategy will not be considered completed without a real commitment to continuous renewal of the corresponding organizational structures. Accordingly, there is a need to change the status and behaviour of civil servants and the mentality and behaviour of local communities, so as to make possible the involvement of both groups in promoting local development projects. Indeed, the modern approach to analyzing local government is a behavioural approach; in legal and institutional terms, behaviour simply means what people do, as opposed to what they say they do or what they are supposed to do (Stayner, 1980). Thus, democracy depends on democratic values as well as on the efficiency of officials at all levels. Democracy is a principle not just of political organization but also of human relations, meaning that democratic reform is partly about the organization of the civil service, but also about attitudes (Ridley, 1995). A civil service law is expected to be issued soon in Romania, but it will not of itself change the way in which civil servants behave. This is the real challenge of democratization. Of course, the reform of the legal and institutional framework is a starting point, but it is only a means to an end and "it is taking a great risk to think that is sufficient" (Ridley, 1995, p. 11).

The participation of nongovernmental sectors in the environmental strategy process is the other side of the coin. Potential nongovernmental participants are environmental organizations, community groups, academic and research institutions, industry and business, and the media. When involving nongovernmental interest groups, care has to be taken to ensure representation, accountability, and fairness (Carrew-Reid et al.,

1994). Before discussing the involvement of NGOs and community groups in participation, some other key participants should be mentioned. These are professional associations and the corporate sector. Many professional associations have been established in Romania since 1990, and are considered very effective in various sectors. If the government encourages their participation, these associations can also be an important source of support for companies that want to improve their environmental performance. Industry and business should also be encouraged to participate in the movement towards sustainable development, through both the growth of new environmental enterprises and the increase of the environmental sensitivity of established companies (Conklin et al., 1991).

A successful transition to sustainable development requires substantial strengthening of NGOs. In the Romanian case, the most representative NGOs are concern-based NGOs (e.g., environmental and animal welfare campaigning and advocacy groups) and solution-based NGOs (e.g., education, information groups). The increasing concern with environmental preservation has resulted in the formation of more than 500 NGOs. Some NGOs have been effectively involved in organizing a wide range of activities, some of which receive much media coverage. In the environmental preservation field, conferences, workshops, roundtables, information campaigns, and educational programmes all contribute to increasing public awareness about environmental problems. NGOs also have organized protests and taken action against major polluters.

The activity of NGOs would be substantially improved if a deep engagement with community groups and individuals was realized. The local level is the most practical one for public participation. Although the involvement of every community is neither practical nor possible, the participation of the communities most affected by priority issues, and of those from various geographical regions, ecological zones, and livelihood types should be ensured. Unfortunately, this goal is far from being achieved.

In Romania, the long communist period had a very negative influence on the behaviour of local communities and society as a whole. The perception of democratic values and attitudes has been greatly perverted, and, in the transition to a democratic society, old mentalities and attitudes are not easily transformed. After nearly 50 years of a government monopoly on environmental information and a lack of education, it is hard to believe that a completely new way of perceiving environmental issues can be realized in a few years. Even though it cannot be denied that the efforts to create a real environmental culture are under way, the economic and social problems such as production decline and growing unemployment have made public concerns shift away from environmental issues to more immediately stressful ones: real wages are falling and job insecurity is growing.

To conclude, Romanian society still suffers the consequences of communism; it did not disappear at the same time as the totalitarian state. And, as a famous Romanian

journalist has just written, "We will be able to talk about the failure of totalitarianism only when our souls, our minds will be completely decollectivized. This 'privatization' is infinitely more difficult than that occurring in the economy and, in fact, it has started only at the level of instinct and good will. Under these circumstances how could one discuss post-transition?" (Paler, 1997, p. 1).

4. CONCLUSIONS

Environmental sustainability has a complex significance. It is both a theoretical concept and a practical challenge that implies a specific approach, with concrete time and space considerations. Romania, as it experiences a stressful and often painful process of transition to a market economy, has to face important environmental challenges at the same time as great political, economic, social, organizational, cultural, and behavioural ones. The environmental preservation strategy is closely related to other components of the national strategy and reforms that take into consideration environmental constraints. The concept of mosaic ecodevelopment is proposed as a strategy for creating complementarity between all these components. The development of a new institutional and legislative framework is considered a prerequisite to building a realistic and effective environmental preservation strategy, whereas behavioural challenges—increasing participation and communication, and changing attitudes—are seen as crucial elements of the strategy, pervading all others.

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Chapter 23

Environmental Change, Social Conflict, and Limits to Adaptation in Developing Countries

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This paper contrasts conventional views of the relationship between endogenous growth, natural resource scarcity, and innovation with a wider view that takes into account the effects of environmental change on social conflict and adaptation.

1. INTRODUCTION

The recent debate in economics over the role of innovation in economic growth has fostered empirical investigations across countries and regions to investigate the factors underlying long-term economic growth (Barro & Sala-I-Martin, 1995; Mankiw et al., 1992; Pack, 1994; Romer, 1994). Unexpectedly, these cross-country comparisons of growth rates have pointed to an important but unresolved issue for analysts: why is it that the long-term economic growth rates of poor countries as a group are not catching up with those of rich countries? Conventional explanations suggest that the inability of poor countries to “take off” economically can be attributed to failed policies and weak institutions (Pack, 1994). The lack of stable economic policies and institutions in poor countries, in turn, inhibits the generation or use of new technological ideas to reap greater economic opportunities, thus constraining economic growth and development.

Although such arguments are persuasive, they may be only half correct. Institutional and policy failures in poor economies are significant determinants of their inability to innovate sufficiently and achieve higher long-term growth rates. However, an equally important factor overlooked in conventional analyses and explanations is the structural economic dependence of poor economies on their natural resource endowments.

Barbier (1994) showed that many low-income and lower middle-income economies, especially those displaying low or stagnant growth rates, are highly *resource dependent*. Not only do these economies rely principally on direct exploitation of their resource bases through primary industries (e.g., agriculture, forestry, fishing, etc.), but also over 50 percent or more of their export earnings come from a few primary commodities (see Table 23.1). These economies tend to be heavily indebted and are

Table 23.1 Poor economies with high export concentration in primary commodities^a

	<i>Contribution of Primary Commodities to Total Exports^b</i>		<i>Export Share</i>		<i>Main Export Commodities^b</i>	
			<i>in 1980/81</i>	<i>in 1965</i>	<i>1</i>	<i>2</i>
<i>Over 90%</i>						
Uganda (\$280)	100	100	100	100	Coffee	Tea
Eq. Guinea (\$410)	100	91	91	NA	Cocoa	Coffee
Sao Tome & Pr. (\$490)	99	100	100	NA	Cocoa	Copra
Ethiopia (\$120)	99	99	99	99	Coffee	Hides
Rwanda (\$320)	99	99	99	100	Coffee	Tea
Yemen PDR (\$430)	99	NA	NA	94	NA	NA
Zambia (\$290)	98	99	99	100	Copper	Cobalt
Burkina Faso (\$210)	98	85	85	95	Cotton	Livestock
Nigeria (\$290)	98	99	99	97	Petroleum	Cocoa
Liberia (\$450) ^c	98	98	98	97	Iron Ore	Rubber
Ghana (\$400)	97	98	98	98	Cocoa	Gold
Mauritania (\$480)	97	99	99	99	Fish	Iron Ore
Bolivia (\$570)	97	100	100	95	Gas	Tin
Niger (\$300)	96	98	98	95	NA	NA
Somalia (\$170)	95	99	99	86	Meat	Banana
Papua N.G. (\$810)	95	100	100	90	Gold	Copper
Zaire (\$170)	93	94	94	92	Copper	Coffee
Sudan (\$480)	93	99	99	99	Cotton	Livestock
Ecuador (\$1120)	93	93	93	98	Petroleum	Fish/Shrimp
Togo (\$370)	92	85	85	97	Phosphate	Cotton
Comoros (\$440)	92 ^c	86 ^c	86 ^c	NA	Cloves	Vanilla
Lao PDR (\$180)	90	100 ^c	100 ^c	NA	Timber	Electricity

Table 23.1 (continued)

	Contribution of Primary Commodities to Total Exports ^b		Export Share in 1980/81	Export Share in 1965	Main Export Commodities ^b		
					1	2	
Over 80%							
Chad (\$160)	89	96 ^c	97	Cotton	69.4%	Hides/Skins	3.8% ^c
Myanmar (\$210) c/	89	81 ^d	NA	Rice	32.7%	Teak	32.2% ^e
Yemen A.R. (\$640)	89	49	100	Oil	93.7%		
Honduras (\$860)	89	89	96	Bananas	39.0%	Coffee	21.0%
Congo (\$910)	89	94	37	Oil	71.6%	Timber	15.6%
Cote d'Ivoire (\$770)	88	90	95	Cocoa	25.7%	Coffee	13.1%
Cameroon (\$1010)	88	97	94	Petroleum	48.9%	Coffee	12.2%
Paraguay (\$1180)	88NA		92	Cotton	10.3%	Timber	2.5%
Guinea-Bissau (\$190)	87 ^c	71 ^d	NA	Cashewnut	73.3%	Groundnut	6.7% ^c
Guyana (\$420)	87 ^c	NA	NA	NA		NA	
Madagascar (\$190)	84	92	94	Coffee	26.6%	Cloves	5.7%
Malawi (\$170)	83	93	99	Tobacco	62.8%	Tea	10.3%
Burundi (\$240)	83	96	95	Coffee	82.6%	Tea	5.0%
Kenya (\$370)	83	88	94	Coffee	26.2%	Tea	21.9% ^c
Tanzania (\$160)	81	86	87	Coffee	31.4%	Cotton	12.7%
Over 70%							
Peru (\$1300)	78	83	99	Copper	12.9%	Zinc	8.8%
Maldives (\$410)	77 ^c	70 ^e	NA	Fish	57.1% ^c		
Senegal (\$650)	75	81	97	Fish	26.9%	Groundnut	14.8%
Colombia (\$1180)	75	72	93	Coffee	30.2%	Oil	17.0%
Benin (\$390)	74	96	95	Cotton	13.4%	Fuel	9.4%

Table 23.1 (continued)

	Contribution of Primary Commodities to Total Exports ^b		Export Share in 1980/81		Export Share in 1965		Main Export Commodities ^b	
							1	2
Egypt (\$660)	74		92		80		Oil	Cotton
Dominican Rep. (\$720)	74		81		98		Nickel	Sugar
Indonesia (\$440)	71		96		96		Petroleum	Rubber
El Salvador (\$940)	71		63		83		Coffee	Fish
Mali (\$230)	70		83		97		Cotton	Livestock
Over 60%								
Guatemala (\$900)	62		71		86		Coffee	Bananas
C.A.R. (\$380)	60		74		46		Diamonds	Coffee
Zimbabwe (\$650)	60		63		85		Tobacco	Gold
Over 50%								
Sri Lanka (\$420)	57		79		99		Tea	Rubber
Jordan (\$1500)	53		57		81		Minerals	Food
Morocco (\$830)	50		72		95		Ph. Acid	Phosphate

Notes: ^aPoor economies are those with per capita incomes of \$1500 or less in 1988. US dollar figure after each country listed indicates GNP per capita in 1988. ^bContributions to the value of total merchandise exports in 1988, unless indicated. ^c1987 value. ^d1981-83 average value. ^e1984 value

Source: Barbier (1994), based on various editions of the following World Bank documents: World Development Report; Trends in Developing Countries; Commodity Trade and Price Trends; African Economic and Financial Data.

experiencing dramatic land-use changes, especially conversion of forest area to agriculture, as well as problems of low agricultural productivity, land degradation, and population carrying capacity constraints. A recent cross-country analysis by Sachs and Warner (1995) confirmed that resource-abundant countries (i.e., countries with a high ratio of natural resource exports to GDP) have tended to grow less rapidly than countries that are relatively resource poor.¹

Thus, the continuing dependence of most of the world's poorest economies on their resource base suggests that environmental management should be given a higher priority as a development concern. This is particularly the case given that past economic policies and investments have led to rapid changes, frequently with adverse economic consequences, in resource stocks and patterns of use. Demographic trends have often worsened the relationship between population and resource carrying capacity in many regions. Continuing agricultural extensification into marginal lands has increased the susceptibility of economic systems and livelihoods to environmental degradation.²

In short, the available physical indicators suggest that the natural asset base of the poorest, resource-dependent economies is being rapidly run down. Yet these economies remain in a fundamental state of underdevelopment and cannot generate sufficient long-term economic growth to "take off." That is, development remains essentially "unsustainable" in poor economies because the net depreciation of their natural asset base (and any increase in population) is not being compensated for by investment in renewable human and physical capital. Clearly, a major factor affecting the long-term development prospects of poor economies is their failure to place a higher priority on policies for efficient and sustainable management of the natural resource base that would maintain the capital required for the transition to and achievement of long term sustainable economic development goals.

There is also evidence that, in many poor economies, depletion and degradation of natural resources, such as croplands, forests, fresh water, and fisheries, may be a contributing factor in social processes that destabilize the institutional and economic conditions necessary for innovation and growth (Barbier & Homer-Dixon, 1996; Homer-Dixon, 1995). Despite the relative abundance of natural resource endowments in many low-income countries, incidences of resource scarcity and conflicts over resource use and allocation can be sufficiently severe to cause widespread social unrest, friction, and even violent conflict. The result is continual disruption of the stable institutional and policy environment necessary for these countries to generate sufficient human capital, to develop research and development capacity, to utilise existing technological knowledge available domestically and internationally, and to produce and disseminate new technologies throughout the economy. In short, while resource scarcity often induces market and endogenous technological responses that, in turn, mitigate scarcity, it can also disrupt the stable policy and social environment necessary for these responses to occur automatically.

2. ENVIRONMENTAL CHANGE, INNOVATION, AND SOCIAL INGENUITY

On the whole, endogenous growth theorists have not been concerned with the contribution of natural resources to growth or with the role of innovation in overcoming resource scarcities.³ However, for some years, resource economists have explored the effects of resource scarcity on growth (Dasgupta & Heal, 1979; Stiglitz, 1974). They have usually employed neoclassical growth models that assume exogenous rather than endogenous technological change. The results have been generally optimistic: even under conditions with exponential population growth and with exhaustible and limited supplies of natural resources that are essential for production, sustained growth and a long run steady state level of positive per capita consumption are attainable (Stiglitz, 1974).

Barbier (in press) extends this analysis to an endogenous growth economy. He combines the exhaustible resource model developed by Stiglitz (1974) and the endogenous growth model developed by Romer (1990) to determine whether natural resource scarcity is necessarily a binding constraint on growth. The results of the analysis are fairly conclusive: although technological change is endogenous, it is still effectively resource augmenting. Sufficient allocation of human capital to innovation will ensure that in the long-run resource exhaustion can be postponed indefinitely, and the possibility exists of a long-run endogenous steady-state growth rate that allows per capita consumption to be sustained, and perhaps even increased, indefinitely.⁴

However, working largely outside of economics, Homer-Dixon (1995) points to another potential relationship between innovation and resource availability. He argues that an economy's supply of "ingenuity" may itself be constrained by resource scarcities, especially in low-income countries. Homer-Dixon defines ingenuity as the stock of ideas applied to solve practical social and technical problems.

In Homer-Dixon's analysis, an increase in the level of technical ingenuity is similar to the technical innovation discussed by endogenous growth theorists. These theorists, he notes, are mainly interested in technical ideas such as manufacturing techniques, industrial designs, and chemical formulas, especially those developed and applied within the firm. But the supply of this technical ingenuity depends on an adequate supply of "social" ingenuity at many levels of society.

Social ingenuity, according to Homer-Dixon, consists of ideas applied to the creation, reform and maintenance of institutions such as markets, funding agencies, educational and research organizations, and effective government. If operating well, this system of institutions provides psychological and material incentives to technological entrepreneurs and innovators; it aids regular contact and communication among experts; and it channels resources preferentially to those endeavours from and necessary

for technical innovation. Therefore, in agreement with the institutional arguments of Romer (1993) and Pack (1994) above, Homer-Dixon identifies social ingenuity as a precursor to technical ingenuity.

Homer-Dixon further describes two mechanisms by which resource scarcity can limit both the total supply and the rate of supply of ingenuity. First, increased scarcity often provokes competitive action by powerful elite groups and narrow social coalitions to defend their interests or to profit from the scarcity through “rent-seeking” behaviour.⁵ These actions, which Homer-Dixon calls “social friction,” can hinder efforts to create and reform institutions and can generally make it harder to focus and coordinate human activities, talents, and resources in response to scarcity. Moreover, severe scarcity sometimes causes social turmoil and violence, which can directly impede the functioning of ingenuity-generating institutions, such as markets (Homer-Dixon, 1994, 1995; Homer-Dixon et al., 1993). Second, endogenous growth theory notes that capital, especially human capital, is essential to the generation of innovation (Romer, 1990). Yet, Homer-Dixon argues, resource scarcity often reduces the availability of human and financial capital for the production of ingenuity by shifting investment from long-term adaptation to immediate tasks of scarcity management and mitigation.

Figures 23.1 and 23.2 illustrate the contrast between the conventional and alternative views of the innovation process proposed by endogenous growth theory and Homer-Dixon respectively (Barbier & Homer-Dixon, 1996). According to the conventional view (Figure 23.1), market responses to natural resource scarcity automatically induce endogenous technological change that leads to resource conservation, and in turn, to the reduction of scarcity. However, as noted above, this view assumes that stable economic policies and social institutions exist to facilitate endogenous innovation. This assumption may not be valid for many poor economies.

According to an alternative view based on Homer-Dixon’s analysis (Figure 23.2), in some poor countries resource scarcity itself contributes to an unstable social and policy environment at local, regional, and even national levels. Scarcity exacerbates social friction and conflict, which results in an undersupply of social ingenuity. Social frictions and conflict interfere directly with the smooth functioning of markets, while the reduced supply of social ingenuity perpetuates market, policy, and institutional failures. These failures, in turn, undermine the innovation process; in particular by disrupting the ability of poor economies to generate sufficient human capital, to develop research and development capacity, to utilize existing technological knowledge available domestically and internationally, and to produce and disseminate new technologies throughout the economy. In short, while resource scarcity often induces mitigating market and endogenous technological responses, it can also disrupt the stable policy and social environment necessary for these responses to occur automatically.

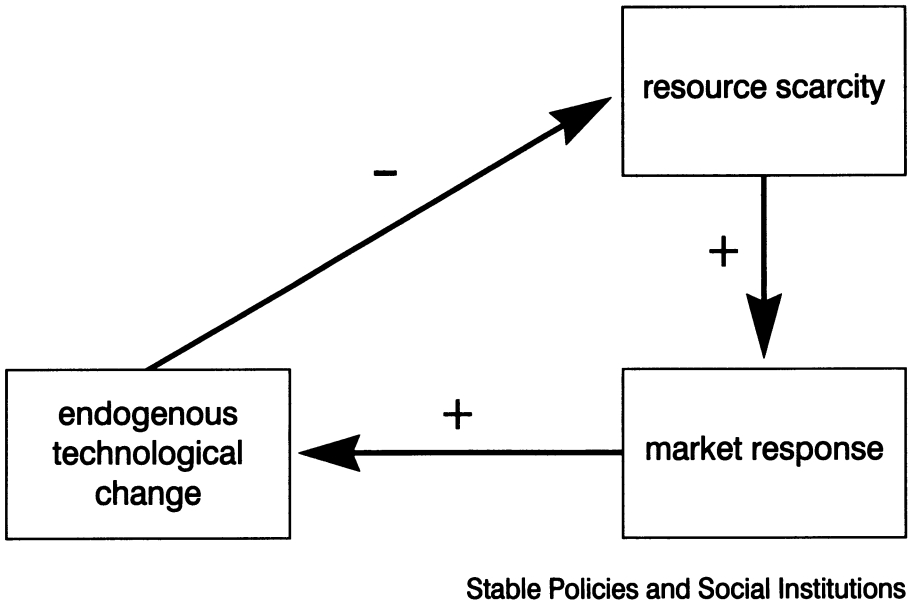


Figure 23.1. Endogenous technological change and resource scarcity:
Conventional view

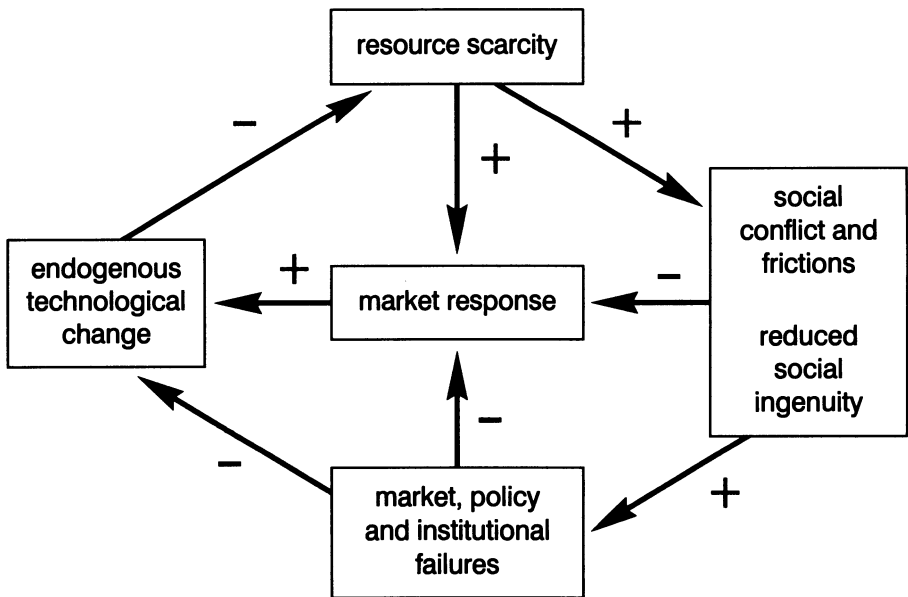


Figure 23.2. Endogenous technological change and resource scarcity:
Alternative view

3. EVIDENCE FROM POOR ECONOMIES

The latter view, that environmental change and social conflict may disrupt adaptation, is well-illustrated by the examples of Bangladesh and Haiti. The United Nations Population Fund (1994) predicts that Bangladesh's current population of 122 million will grow to 223 million by the year 2025. Cropland is already extremely scarce at about 0.08 hectares per capita, and since virtually all of the good agricultural land has already been exploited, population growth will almost cut this figure in half by 2025. Yet average yields of rice per hectare remain comparatively low—about one third of those obtained in China or Taiwan, with an even smaller fraction of yields attained at research stations in Bangladesh itself. There is therefore great potential for increased productivity despite land scarcity.

Research shows that land scarcity induced by Bangladesh's rapid population growth has, in fact, spurred agricultural innovation. In addition, according to Goletti (1994), removal of impediments to trade and distribution of irrigation equipment and the liberalization of the import of irrigation equipment in 1988 has resulted in a wider spectrum of small-scale irrigation equipment available to farmers. Although there has been a substantial reduction in Bangladesh's overall grain deficit, Goletti also notes that, in comparison with other low-income Asian countries, Bangladesh has one of the lowest records in terms of agricultural growth rate. In his analysis of agricultural production in Bangladesh in the 1970s and 1980s, Boyce (1987) suggests that, during this period, the binding technological constraint on further increases in productivity was lack of innovation in controlling flood and irrigation waters. But water control is, to a large extent, a public good that requires institutions to permit and guide collective action. In rural Bangladesh, this institutional innovation was largely blocked by struggles among social groups over the distribution of power and wealth. Although Boyce does not make the point directly, it is clear from his analysis that these struggles were sharply aggravated by worsening scarcities of land and water.

Boyce shows that powerful landlords were reluctant to hire seasonally idle labour for the construction of water-control projects as they feared the potential for unrest when large groups of the rural poor worked together. Government efforts to mobilize local resources for water control, through the construction of tanks, wells, and irrigation canals were distorted to benefit large landowners. For example, landowners sought to control wells to permit monopoly pricing and to gain rights to adjacent cropland. At the same time, poorer groups, threatened by the increased economic and political power of landowners with access to the well water, often sabotaged new tubewells.

In Haiti, scarcities, especially of forests and soil, have also inflamed distribution struggles that obstruct social and technological innovation. Wallich (1994) notes that more than 90 percent of the country has been denuded, leaving it without the natural resources crucial to economic survival. This scarcity exacerbates the poverty of

Haitian rural communities and produces significant profit opportunities for powerful members of the elite, which further deepens divisions and distrust between rich and poor. In one case, the Haitian army blocked a reforestation project by destroying its tree seedlings, because the army and the notorious Tonton Macoutes feared the project would threaten their highly profitable control of forest resource extraction by bringing disgruntled rural people together. In general, Wallich argues that wealthy landowners in Haiti had little incentive to raise their opponent's standard of living, and peasants saw no reason to improve their husbandry as long as those above them stood ready to extract whatever surplus they might produce.

There are few cross-country studies examining the effects of unstable social and policy environments on economic and technological responses to natural resource scarcity. One exception is an analysis by Deacon (1994) that attempts to test empirically across 120 countries for three possible causes of deforestation: growth in income, population pressure, and insecurity of property rights as reflected in associations between deforestation and measures of political turmoil and oppression. Deacon finds the latter two causes to be the most significant, and he suggests that the overall results of his analysis are broadly consistent with the hypotheses that deforestation results both from population growth—and the increased competition for land and natural resources that accompany it—and from political environments that are not conducive to investment.

To explore further the hypothesis that political turmoil and repressive governments are harmful to investment, Deacon looks for corroborating evidence by examining data for ordinary investment to see if investment rates are associated with the same variables that are related to deforestation. This was done through simple correlation coefficients between investment as a share of gross domestic product of a country and the variables representing political turmoil and repressive governments that were included in the deforestation analysis. For low and middle income countries, Deacon finds that the political variables associated with deforestation tend also to be negatively associated with ordinary investment. In particular, the strongest (negative) associations were between investment and guerrilla warfare, revolutions, constitutional changes, military executives (i.e., dictatorships or juntas), and the condition in which the "executive is not a premier" (i.e., the executive of a government is not chosen by elected representatives). Thus, although very preliminary in its results, Deacon's analysis supports, at least indirectly, the hypothesis that, across poor countries, social and political instability is highly correlated both with low levels of productive investments generally and resource scarcity (in this case increasing deforestation). Although he suggests that rapid population growth and the consequent dilution of land and other natural resources in a country may be important factors promoting political unrest and the instability or repression it may cause, Deacon is unfortunately not able to analyze this key relationship explicitly.

4. CONCLUSION

We have argued that some poor economies may, in their economic development, face resource-scarcity constraints that have not been adequately explored in the theoretical or empirical literature on growth, natural resource scarcity, or innovation. To date, analysts have generally addressed separately the relationships between, on the one hand, resource scarcity and growth and, on the other, innovation and growth. This separation has prevented analysts from seeing important linkages between these relationships.

Resource depletion and degradation in poor economies may have their most inimical effect not by directly constraining growth but by indirectly affecting the potential of these economies to innovate. This process may explain why poor economies, particularly those that are heavily resource dependent, are failing to achieve high rates of growth and sustained economic development. We have presented preliminary theoretical and empirical evidence to support this hypothesis, which merits further research.

5. ENDNOTES

- ¹ Recent explanations of why resource dependence may be a factor in influencing economic growth point to a number of possible fundamental links between environment, innovation, and long-term growth relevant to poor economies. For example, Barbier (1997) demonstrates the possible influences of depletion on innovation and growth in a resource-dependent economy, which vary depending on the feedback effects between resource scarcity and innovation. The limitations of resource-based development have also been studied by Matsuyama (1992) and Sachs & Warner (1995). Matsuyama shows that trade liberalization in a land-intensive economy could actually slow economic growth by inducing the economy to shift resources away from manufacturing (which produces learning-induced growth) towards agriculture (which does not). Sachs and Warner extend the Matsuyama model to allow for full "Dutch disease" influences of a mineral or oil-based economy (i.e., when an economy experiences a resource boom, the manufacturing sector tends to shrink and the nontraded goods sector tends to expand). The authors' theoretical and empirical analyses support the view that a key factor influencing endogenous growth effects is the relative structural importance of tradable manufacturing as opposed to natural resource sectors in the economy.
- ² Statistical evidence of these trends for resource-dependent poor economies can be found in Barbier (1994). For a theoretical exploration of how poor initial resource endowments can lead to unsustainable growth paths, see Barbier & Markandya (1990).
- ³ Recent efforts to extend endogenous growth models to incorporate environmental considerations have mainly focused on the short- and long-run implications of including the accumulation of pollution and its disutility in an endogenous growth context (see Bovenburg & Smulders, 1995; Musu & Lines, 1995).

- ⁴ However, Barbier (in press) also develops a further version of the model that shows negative feedback effects between the rate of resource utilization and innovation, along the lines suggested by Homer-Dixon (1995). Although, according to this model, it is possible to sustain per capita consumption over the long run, the conditions under which this occurs are much more stringent and again assume that the economy is able to build up sufficient human capital and innovate.
- ⁵ If increasing resource scarcity is reflected in market prices, then the value of the depleted resource will rise relative to the costs of depletion. The result is that increasing scarcity generates higher economic profits, or rents. If property rights are well-defined and maintained, and in particular if the resource is under sole ownership, then economic theory suggests that the resource will be depleted to maximize long-term economic rents, and thus be generally "conserved" for as long as possible. However, these conditions rarely hold in developing countries, and often there is competitive rent seeking by many powerful interest groups to extract maximum rent in the short run through resource depletion (Barbier, 1994).

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Section VI

Environment, Health and Security

Chapter 24

Water Pollution and its Influence on Population Health

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This chapter focuses on disease rates among children in Uzbekistan, a country under severe ecological stress. The combination of industrial pollution, domestic pollution and an inadequate social structure has significant negative impacts on the health of children. The chapter documents these impacts and recommends measures to protect the environment and improve the health of the population.

1. INTRODUCTION

Studying the general fitness and adaptation by humans to their surrounding environment provides a basis for evaluating population health status, and also provides insights into rehabilitation and preventive care. Individual healthy persons and age groups can be characterized by a set of physiologic indices, and derivations from the norms reflect adaptation to the environment. Each age group can be characterized by a set of physiologic and morphologic indices, and fluctuations from these standards represent unfavourable changes in human health (Agadzahanyan, 1989; Kaznacheev, 1988).

According to the WHO's charter, health is not only the absence of diseases or physical defects but also the presence of mental, physical, and social welfare. Overall, healthy organisms can adapt actively to surrounding environmental conditions, which in turn make it possible to satisfy individual, social, material and spiritual demands. Health status is constantly responding to changes of the environment, and therefore the estimation of health must consider environmental influences on all aspects of the body. The level of health is the result of its interaction with the environment (Agadzahanyan, 1989; Erinkyan, 1989; Lupandin, 1989).

The following classification and indicators of the body's functional state are based on its adaptation levels and homeostasis:

- Satisfactory adaptation to environmental conditions: Functional abilities of the organism are evident and homeostasis is supported by minimum tensions within regulatory systems.
- Adaptation tensions: Functional abilities of the organism are not reduced. Homeostasis is supported due to a certain tension of the regulation systems.

- Insufficient adaptation to the environmental conditions: The body's functional abilities are reduced. Homeostasis is preserved due to significant tension of the regulation systems or participation of compensating mechanisms.
- Failed adaptation mechanisms: Sharp reduction of the functional abilities of the organism (Baevsky, 1989). Failure of adaptation results in pathologic conditions and can include prenosologic (i.e., previous to the disease development) to premorbid traits.

The present study emphasizes the data on disease-rate in the population living in ecologically unfavourable regions. Adaptation mechanisms and levels are indicated according to the above classifications. Health status of populations is estimated in relation to the condition of water resources. Water (quantity and quality) is one of the major factors influencing human health, and is an urgent environmental concern in Uzbekistan. The result of pollution in the Aral Sea is an example of negative effects water contamination can have on human health. This environmental concern interacts in complex ways with other natural concerns and the socioeconomic surroundings. It is in this context that multi-factor analysis is useful for examining underlying causes of morbidity, and thereby suggests preventive measures.

2. DEMOGRAPHIC CHARACTERISTICS OF THE POPULATION

Population has been increasing rapidly in Uzbekistan. Total population in 1996 was just over 23 million, with the majority of the population (61.8%) living in rural areas. The average population density is 51.2 people per square kilometer. Population increases are driven by relatively high birth rate (29.8 per 1000 population in 1995) rather than low mortality rates (6.4 per 1000 population in 1995). Population increases vary considerably across the Republic, ranging from 8.5 per 1000 population in Tashkent to 31.8 per 1000 population in Surkhandarya region. High birth rates for many years have been typical for Uzbekistan, and as a result, the population structure is skewed towards younger age groups and 41% of the population are children under 14 years (Ministry of Health, 1996).

3. WATER RESOURCES

3.1 State of water resources in the region

Population growth and concomitant growth of water consumption has resulted in water sharing disputes and ecological degradation. Expansion of the agricultural land base has resulted in about 7.6 million hectares of irrigated land in production, with around

150 to 170 thousand hectares added per annum. Irrigation projects in upstream areas and the opening of adyrs and pebble lands, which are characterized by a thin fertile layer, were carried out without consideration of the adverse impact on downstream lands. Waterlogging of soils, water erosion, pollution of underground water and water mineralization have become more prominent as water consumption rates increased 1.5 to 2 times (Razakov & Konukhov, 1996). In the intensively irrigated crop zones, mineral fertilizer applications have increased nine-fold and are applied at 300 to 600 kg per hectare. Significant amounts of pesticides, herbicides, and defoliants are also used. Inefficient irrigation schemes result in water return rates of about 32-34 km³, representing some 30 to 50% of the total irrigation water supply. As little as 35 to 40% of the applied nitrogen and 15 to 20% of the applied phosphorus are absorbed by plants. The remainder of these agricultural chemicals are incorporated into the water and eventually enter the collector-drainage network of rivers and reservoirs, and degrade groundwater supplies. Mineralization rates reach to 2 to 16 g/l in these water courses. Concentrations of biogenic elements, pesticides, fluorine, phenols, oil products, trace elements, hardness of water, BOD, COD, and inadequately treated municipal and industrial waste water were added into the collectors (Razakov & Konukhov, 1996).

The volume of the highly mineralized waste water that is being transferred to Amudarya and Syrdarya reaches 21 to 23 km³. As a result, irrigation and drinking water quality has worsened in mid- and downstream river areas, and mineralization in river mouths has increased 2 to 5 times. Average hydrocarbonate-calcium levels of rivers draining to the Aral Sea are in the 0.3-0.4 g/l range, but water draining from irrigated areas have mineralization levels of 4.0-4.5 g/l (Chembarisov, 1996). Extensive use of chemicals in the agriculture in Central Asia has resulted in substantial declines in land fertility, the degradation of useful micro-flora, and increases in phytotoxic pathogenic microorganisms.

Morbidity rates of the population have increased due to the use of surface water for drinking purposes, and substandard water purification facilities in built-up and rural areas have amplified the problem (Chembarisov, 1996; Iskandarov, 1993; Razakov & Konukhov, 1996). As little as 30 to 40 years ago, surface and ground water supplies were not contaminated with toxic substances and there was ample potable water for human consumption. However there has been a rapid degradation of water supplies. Contamination by agro-chemicals of 10- to 50-metre deep wells in rural areas is common. In industrial zones, additional organic compounds and metals exacerbate water quality problems, and parasites have been found in urban water distribution systems.

3.2 Hygienic characteristics of drinking water

Worldwide clean water and practical hygiene are considered the main weapons in the struggle against major infectious diseases and intestinal infections. Water supply in Uzbekistan, especially in the rural areas, remains one of the foremost environmental

concerns. Until recently, over five million people used water from open contaminated reservoirs for their everyday and household needs. This problem is most pressing in the rural areas where over 60 percent of the population do not have centralized water supply system and only two percent have a centralized sewage system. The worst areas are the Republic of Karakalpakstan, and the provinces of Khorezm, Kashkadarya and Bukhara (Ministry of Health, 1996).

The contamination of open water resources is exacerbated by poor sanitary conditions and water distribution systems built in the 1950s-60s which do not meet modern requirements for stability. These problems are most serious in summer months in the aforementioned regions when bacterial and chemical contamination regularly exceed safe standards 18 to 50 percent of the time (Iskandarov, 1993).

Contamination of the open water reservoirs and underground water is also the result of substandard sewage systems in towns. There are few sewage systems in rural areas and open reservoirs are the major water source for most rural populations. Laboratory analysis in 1990 to 1993 of water from the surface reservoirs revealed that about 22 percent of the samples exceeded safe bacterial levels and about 36 percent of the samples were chemically contaminated. The situation is deteriorating greatly in Dzhizak, Khorezm and Navoi regions in Karakalpakstan. Bacterial and chemical contamination continues to be a problem in open water reservoirs used for drinking water, especially in Bukhara and Navoi regions. Overall, bacterial and chemical contamination is a serious environmental problem which adversely impacts the health status of the population, mortality, and total and infection morbidity (disease rate).

4. HEALTH STATUS OF POPULATION

4.1 Overall health status of Uzbekistan population

We assessed the population health according to information on morbidity and visitation to medical institutions (Ministry of Health, 1996). As Table 24.1 shows, the highest levels of morbidity of adults in Uzbekistan are observed in the respiratory system diseases, the digestive system diseases, and the diseases of blood and blood-forming organs. This trend was also evident among teenagers, but the incidence of each disease was about double in the adult population compared to the teenage group. The trends in morbidity for children were somewhat different. Respiratory diseases were most common but the second most common set of diseases related to blood and blood-forming organs, with diseases of the digestive system being the third most common group. Other significant morbidity rates include endocrine system diseases and disturbances of nutrition, metabolism and immunity; diseases of the nervous system and sense organs; infectious and parasitic diseases.

Table 24.1 Morbidity recorded in 1995 (per 10000 population)

<i>Disease groups according to ICD-9</i>	<i>Adults</i>	<i>Teenagers</i>	<i>Children</i>
Total	8684.2	3570.8	6115.4
1. Infections and parasitic diseases	287.8	127.3	445.9
2. Tumours	122.2	9.1	5.9
3. Diseases of endocrine system and disturbances of nutrition, metabolism and immunity	227.8	179.9	521.3
4. Diseases of blood and blood-forming organs	1236.0	524.5	856.2
— among them: anemia	1139.7	436.3	754.0
5. Mental Disorders	279.1	110.7	61.9
6. Diseases of the nervous system and sense organs	779.8	406.6	512.1
7. Diseases of the circulatory system	762.9	136.3	70.2
8. Diseases of the respiratory system	1715.4	855.0	2578.6
9. Diseases of the digestive system	1403.8	566.6	738.5
10. Diseases of the uro-genital system	613.3	175.6	128.0
11. Complications of pregnancy, delivery and post-delivery period	314.8	1.7	—
12. Diseases of skin and subcutaneous tissue	431.6	176.8	364.8
13. Congenital anomalies (defect of development)	13.1	22.9	66.8
14. Injuries and poisoning	448.9	199.4	270.5

4.1.1 Infections caused by unsanitary drinking water in the Republic

Because intestinal diseases are often directly related to environmental (water and soil) pollution, taking into consideration morbidity rates for this group of infectious diseases provides insight into the potential impacts of environmental degradation on human health. The infectious diseases in epidemiology, including typho-paratyphoid diseases, viral hepatitis A, and acute intestinal diseases, are influenced to a large extent by water quality and the degree of microbial contamination of the surroundings. Table 24.2 demonstrates the indices of some infectious diseases in Uzbekistan for 1994-1995.

Table 24.2 Rate of some infectious diseases in Uzbekistan

<i>Diseases</i>	<i>1994</i>		<i>1995</i>	
	absolute	per 100000	absolute	per 100000
1. Typhoid Fever	577	2.6	486	2.1
2. Paratyphoid A, B, C	221	1.0	167	0.7
3. Others, salmonella infections	4903	21.8	4165	18.1
4. Bacterial Dysentery	18447	81.9	140911	61.1
5. All acute intestinal infections	110387	489.8	90774	393.9
6. Viral Hepatitis A	87944	390.2	140000	607.2

A comparison of 1994 and 1995 data indicates the incidence of typhoid fever was reduced by 31.5%, paratyphoid by 20.6%, and viral hepatitis A by 58.6%. These reductions were achieved by several preventative and anti-epidemiological measures by medical institutions. Three outbreaks of typhoid fever were recorded, two of them in Kashkadarya region and one in Samarkand. All three outbreaks were caused by using water from open reservoirs, or by damage to the water supply system (Iskandarov, 1993). One of the urgent problems in Uzbekistan health care remains viral hepatitis. The increase of viral hepatitis in 1995 was attributed to the regular cyclic rise of the disease rate. The proportion of children under 14 years suffering from viral hepatitis was 82-86%. The pathologic condition most actively affects children of 3 to 6 years of age. The index of their morbidity is 24.0 - 26.0 per 1000 children of the same age and 20.9 - 23.4 for children under 2 years, while the morbidity rate was 20.5 - 23.4.

4.1.2 Children's health and environmental degradation

With a disproportionately large share of Uzbekistan's population being children and teenagers, and considering the existence of relatively severe environmental problems, it should not be surprising that there is an urgent need to investigate the complex set of relationships between environmental quality and human health. Children are especially susceptible to unfavourable environmental conditions, and negative impacts during growth and development phases of childhood can contribute to lifelong health problems. Children and their surrounding environments represent a complex system, and the adaptation of anatomic and physiologic systems to environmental degradation can involve both direct and indirect responses. Human responses to altered environments may include illness, and hypo-reactive and reactive symptoms. Changes in human health may not only appear in the site of direct contact (e.g., diseases of the alimentary tract connected with contaminated drinking water), but also indirectly by

altering human adaptation mechanisms, most notably the major regulating systems such as the endocrine and nervous systems. Differences in each child's genetic make-up will influence each individual's vulnerability to surrounding conditions. However, from a human ecology perspective, the complex set of relations between environment and health needs to be investigated at the individual through population levels. The health of an individual can be represented as the processes of preserving and developing psycho-physiologic functions and thereby increasing opportunities for work and social activity. At the broader population scale, health is perceived in a somewhat different manner and focuses on the biological and psycho-social viability of populations, as well as the longer term evolution and adaptation of a population to its surroundings (Kaznacheev, 1988; Lupandin, 1989).

The present unfavourable socioeconomic situation in Uzbekistan can largely be accounted for by past industrial and technological developments where priority was given to boosting economic capacities and environmental protection was of much less significance. As a result, economic development contributed to considerable industrial and territorial imbalance in national economy, unfavourable ecological conditions in the Tashkent, Fergana, Navoi, and other regions, and deterioration of human health on a national scale. The next section of this paper examines the health of school children living in ecologically degraded districts of the Tashkent region and focuses on relationships amongst their functional abilities, their level of psycho-physiologic development, and environmental quality.

4.2 Children and environmental degradation in the Tashkent region

The study found that only about 18% of school children in the Tashkent region had no significant health problems (Health Group I). Health Group II, children with some morpho-functional problems, accounted for 51% of the region's children. The third Health Group, characterized by children receiving medical care, included 26% of school children, while Health Group IV, children with chronic diseases but not receiving medical care, accounted for 4% of the child-age population. Among chronic diseases, those of digestive, respiratory and nervous systems, as well as the diseases of sense organs and endocrine pathology prevailed. In 30% of all examined children, limited functional abilities impaired learning and social adaptation. In this group of children 43% had chronic diseases, and the remaining 67% had various morpho-functional disorders. Overall correlation analyses were used to develop linkages between a child's health status and exogenous factors, including prevailing climatic, geographic, and ecologic and socioecologic condition's of the child's life. It was revealed that the most powerful links between contamination of the environment and children's health related to endocrine system diseases, nutrition levels, disorders of metabolism and immunity, blood and blood-forming organ diseases, and mental disorders.

The analysis of children with adaptation disorders showed that 43% had some disturbance of intra-uterine development, 17% had some pathology during the labour period, and there is speculation that an unknown percentage had some combination of both. It was found that 45% of children with adaptation disorders were born fifth or later, 50% and 8% of them were living in unsatisfactory and poor living conditions respectively, 16% were being raised in an unfavourable psychological climate, and 7% were from single parent families. Overall, the study showed that school children with health symptoms relating to environmental degradation had impaired nervous system function and processes, as well as more difficulty with memory functions and attention.

An additional concern is that the medical professionals, including specialists, often fail to detect morpho-functional deviations (i.e., Health Group II). Inaccurate and incomplete diagnoses often result in no or inappropriate medical treatments, and over time the health of these children can deteriorate to the status of Health Group III. Hence, it is necessary to improve the mechanisms for diagnosing various morpho-functional and immunologic deviations in children living in environmentally degraded areas.

4.3 Health status of adults and children living near the Aral Sea

The drying of the Aral Sea and its negative influence on conditions of habitat represents a region-wide ecological crisis, with impacts on human health. The ecological problems, which have gained the attention of the world community, cut across national borders and involve Governments of Uzbekistan and Republics of Central Asia. While there has been considerable effort to decrease the negative influences of ecological degradation on the health of people, there are long-term negative consequences, especially for those who live nearest the most advanced forms of environmental degradation in the Kungrad District of the Republic of Karakalpakstan (Table 24.3).

Table 24.3 Selected indices of health status and health care for the Republic of Karakalpakstan

<i>Indices per 1000 pop.</i>	<i>Republic of Karakalpakstan</i>			<i>Kungrad District</i>		
	1990-1994 average	1995	1996	1990-1994 average	1995	1996
Total disease rates in adults	1296.7	1295.0	1481.0	1329.1	1385.7	1488.3
Total disease rate for children aged 0-14 years	970.0	948.5	1029.2	757.4	797.8	833.8
Total mortality of population	6.5	6.8	6.2	7.0	6.8	6.7
Infant mortality (live births)	42.2	44.5	35.8	55.3	40.7	35.9

Data presented in Table 24.4 are based upon thorough medical examinations which also document prevailing social and hygienic conditions for individuals, and therefore provide a more objective view of health status and morbidity than data drawn from visitations. Recent trends show increases in gastro-intestinal pathology, diseases of the liver, biliary tracts, and kidney, all of which may be connected to highly mineralized drinking water. The incidence of the intestinal infections in this region is about three times CIS levels (Iskandarov, 1993). Incidence of hepatitis A is also very high and ranged from 624 to 948 cases per 100,000 population, or about 2 to 3 times the CIS average. Over 70% of infectious diseases are recorded in children under 2 years of age.

Table 24.4 Adult and child morbidity rates for Raushan, Kungrad District, Republic of Karakalpakstan

<i>Disease groups according to ICD-9</i>	<i>Adults</i>		<i>Children</i>	
	1990	1996	1990	1996
Total number of disease cases per 1000 population	982.2	1052.7	724.3	1113.9
1. Infections and parasitic diseases	12.5	22.4	24.4	46.7
2. Diseases of endocrine system and disturbances of nutrition, metabolism and immunity	6.8	5.6	8.1	76.0
3. Diseases of blood and blood-forming organs	381.3	287.7	187.2	399.2
4. Diseases of the nervous system and sense organs	40.2	93.4	19.0	101.0
5. Diseases of the circulatory system	70.5	85.9	26.6	12.3
6. Diseases of the respiratory system	294.7	235.4	377.6	348.3
7. Diseases of the digestive system	70.5	134.5	14.7	39.2
8. Diseases of the uro-genital system	63.4	100.9	15.2	26.9
9. Diseases of skin and subcutaneous tissue	12.5	35.1	27.7	29.2
10. Injuries and poisoning	25.6	50.8	11.4	22.8

These data provide preliminary evidence of the negative consequences stemming from ecological degradation, especially with regards to health implications for children. About 96% of children in the Republic of Uzbekistan suffer from anemia, while

endocrinological diseases affect about 87% of the children. The number of children with congenital anomalies and suffering from developmental problems is also increasing. In total, these data suggest environmental degradation is having considerable negative impacts on human health in general, and represents a substantial threat to children now and into the future.

5. MEASURES TO PROTECT THE ENVIRONMENT AND PRESERVE THE HEALTH OF THE CHILD POPULATION

The complex program on environmental improvement throughout the Aral Sea basin underpins long-term human health and is receiving support from the World Bank, the UN Development Programme (UNDP), and the UN Environmental Programme (UNEP). The major goals include:

- restoration of environmental quality in the Aral Sea basin;
- decontamination of coastal districts;
- improving the quality of water resources in the Aral Sea basin; and
- increasing institutional capacity to implement the Program.

Districts in and around the Aral Sea basin are presently characterized by poor quality of drinking water and poor hygienic conditions, which in turn increase the risk of infectious diseases. Solutions being pursued by local authorities include deepening of wells, increasing reliance on ground water rather than surface water for drinking, and demineralization of saline water. There has been some success, but only about half of the population has access to these potential solutions. There is urgent need to further develop water supply infrastructure (especially in rural areas), to improve hygienic conditions, to enhance the technical capacity of institutions responsible for managing the water supply system, and to expand hygienic education. One of the necessary goals is to explain to all people the importance of improving water quality and hygienic conditions in general.

The complicated ecological situation coupled with the absence of a regulated system of public health pose urgent and extreme problems for children in the Aral region. The health of children is threatened by weakened immune systems and socioeconomic conditions which do not ensure health protection. For the Aral region, rehabilitation of children is of special importance and goes beyond traditional medical treatments to improve health. A complex and thorough rehabilitation must be accessible to all children in Uzbekistan and take into account the initial health status, age, mental and physical development, mode of life, and family characteristics.

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Chapter 25

Adapting to Climate Change in Bulgaria: An Economic Approach

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The deterioration of human health in Eastern Europe during the past two decades has been an issue of increasing concern. While this deterioration has been primarily the result of local pollution, issues such as climate warming could pose additional problems to the health of the population. This chapter outlines a study conducted in Sofia, Bulgaria on attitudes towards health risks and health prevention. In addition, social attitudes towards climate change are assessed.

1. INTRODUCTION

During the periods of centrally planned development, human health in Eastern Europe continually deteriorated. In recent years, new factors, many of which will have long-term negative effects, are influencing human health in transition economies. Because climate change, in particular, threatens to create new problems that the populations of transition economies are not prepared to meet, in-depth research on this subject is vital to ensuring the success of the transition process.

1.1. Human health and Climate Change

The analysis of the cost of human health adjustment to climate change in transition economies starts with assessing the value of health in the context of transition conditions. Although health is of great value to human beings, it is not the only thing they value. Indeed, social attitudes towards health are determined by many factors, and vary considerably from one context to another. This is also true of the value society gives to the quality of its environment.

While social priorities may suggest otherwise, health and environment are very closely connected. Good health (both physical and mental) requires, among other things, a clean environment. Climate change is expected to modify the environment in various ways, some of which may have a negative effect on human health. Due to

changes in ecosystems, some species will be seriously endangered and even eliminated, with possible implications for human health.

From an economic point of view, human health is regarded as a good that can be traded against other goods. This means that we can define a human utility function for health as a good, consumed like other goods. For simplicity, we restrict human utility functions to two variables regarded as substitute goods: health capital and intellectual capital. We define health capital as the complex of physical, mental, and related welfare criteria determining normal productivity and intellectual capital as the complex of accumulated knowledge, values, and so on that determine the behaviour of human beings. Both health and intellectual capital are regarded as components of human capital.

This division is imperfect insofar as health capital and intellectual capital are not perfect substitutes, and in many respects, are even complementary. However, for simplicity, we maintain this division and thus our utility function is defined as

$$U = U(H, I), \text{ where } H \text{ is health capital and } I \text{ is intellectual capital.}$$

Health is undoubtedly the most important component of individual welfare. Its loss or impairment directly affects the utility function, lowering the indifference curve at which the individual's preferences are located (see Figure 25.1). But individuals do not spend all their money on health; to the contrary, they spend a lot of money on the consumption of goods that have detrimental effects on health.

Climate change introduces new elements to this puzzle about human consumption. The problem seems to crystallize in a rather straightforward manner when framed in terms of the individual's willingness to pay (WTP) to reduce health risks due to climate change. It may sound cynical to ask someone about his or her WTP to enjoy good health. However, since it is quite common for a government or local municipality to undertake programs to reduce health risks, people obviously are willing to pay for such reductions. The policy makers must take WTP into account when they assess different measures to reduce greenhouse gases (GHG), CFCs, and other climate change related substances.

If we assume that society makes choices between health capital and intellectual capital, thus reallocating its resources (assumed to be fixed for a given period of time), we can construct a health possibility boundary, representing the distribution of the resources for producing health and intellectual capital. There is some optimal combination of both goods where the indifference curve touches the health possibility boundary (point E, Figure 25.1) and it is postulated to represent the upper limit of the cost of adjustment to climate change. Provided that both the health possibility boundary and human utility functions are monotonic and convex, we can analyse the preferences in question as normal and apply the whole complex of analytical tools provided by utility theory.

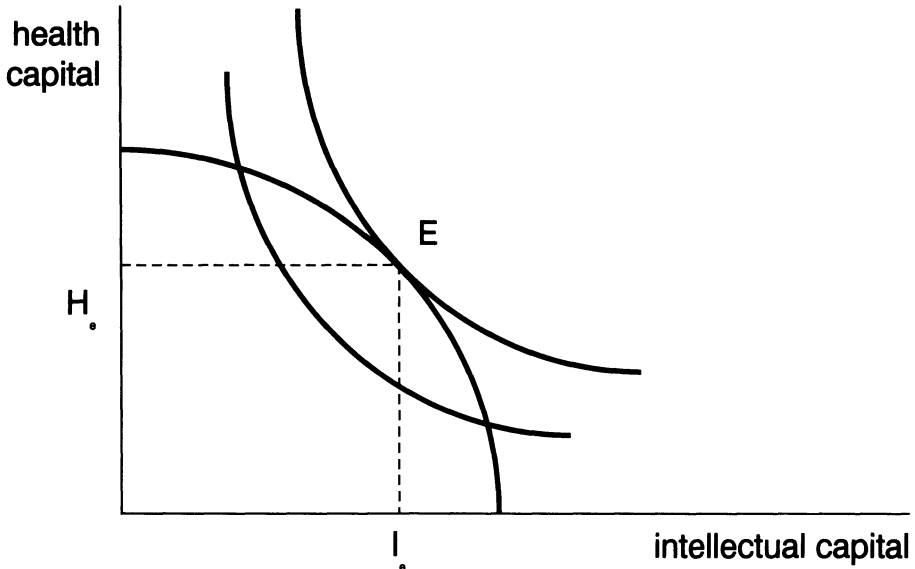


Figure 25.1 Health possibility boundary and social preferences

1.2. Climate Change and Social Preferences

The proposed assumptions cannot be accepted, however, without reservations. Health might be regarded as a lexicographic preference which would mean that utility theory could not be applied.

This argument is especially appropriate when health is represented as a public good. S. Mourato (1997) writes,

In the context of public goods, individuals may hold strong lexicographic preferences implying a total refusal of money trade-offs for changes in the good, whether positive or negative (an extreme case of utilitarian theory), or they may have weak lexicographic preferences in the sense that only income gains for decreases in the good beyond a certain threshold may be unacceptable (in which case, they can be seen as an extreme case of the reference-dependent model). (p. 58)

According to this perspective, once a certain threshold has been crossed, health will not be traded for some other good; the utilitarian approach would, therefore, be inapplicable.

WTP estimations based on contingent valuation theory can also be used to assess the value of a statistical life, which is also relevant to climate change and social preferences. Since the objective is to reduce the environmental risk caused by climate change, such estimation involves calculating the value of a statistical life and the contribution

of climate change to it. In a case without lexicographic preferences, a statistical life may be valued in the context of all factors influencing environmental risk including climate change. Following this logic, the WTP, depending on the duration of a health risk, may involve different values of a statistical life saved.

2. THE SOCIOECONOMIC SETTING OF THE RESEARCH

The research for this study was undertaken 7 years after the transformation of Bulgaria from a centrally planned system to a market economy had begun. The data indicate a strong decrease in human capital during this period and thus a significant deviation from sustainability in overall economic development. If this process continues, it would further weaken the country's capacity to adapt to new conditions, including climate change, and could thus destabilize the region. There are, however, self-regulating processes in the society that naturally countervail and balance negative tendencies in development. The detailed study undertaken since the implementation of the centrally planned system indicates that people seek self-mitigating behaviour to address the increasing health risk. This behaviour includes travelling outside polluted zones, visiting national parks or fishing sites, and escaping to a second home during the holidays. This behaviour appears as an opportunity cost needed to offset the negative influence of environment on health.

During this transition, individuals are trying to maximize utility functions under conditions of declining income. Environmental and health considerations are often sacrificed in order to meet more immediate needs: food and clothing. Although no one interviewed in our study would deny that health and environment are of primary importance, there has, nonetheless, been a reduction in their WTP for good health and a clean environment.

In terms of income, the transition process has seen the populations of second echelon countries, such as Bulgaria, move from low income (and low quality of consumption) to lower income (and worse quality of consumption). This leads to a further deformation of value preferences.

All of this complicates any attempt to assess the cost of adjustment to climate change outside the contingent valuation approach. Technical estimations of these costs potentially neglect many natural restrictions. The basic merit of the contingent valuation approach lies in simplifying the whole complex of puzzles about value preferences by identifying a single preference, measured by WTP/WTa (where WTa is willingness to accept compensation for increase in health risk).

Climate change, however, has another dimension to which self-mitigating behaviour is irrelevant. An active policy is needed to facilitate the adjustment process, which may be very costly and beyond the capacity of poor societies.

3. PRACTICAL RESULTS

Our research was conducted in Sofia, the capital of Bulgaria, where the negative aspects of a centralized society are most acute. The rapid growth of the city during the 1960s and 1970s led to the creation of huge panel zones around it, where the greatest number of people coming from the rest of the country (mainly rural areas) were concentrated. These zones—with large apartment blocks—have had strongly negative social, psychological, and health effects. As a whole, they exhibit very low environmental quality, combined with a strong degradation of social values. This process of degradation was exacerbated during the crisis of the mid-1990s, when the standard of living dropped dramatically. We began our research when signs that the economy had reached its zenith were evident.

3.1. Organization of the Study

The interviews followed the following basic scheme:

- Interviewers who had undergone special training explained, in common language, the issue of climate change and presented a detailed explanation of its expected effects—increased health risks and the endangering of some species. We did not present the consequences of climate change as apocalyptic; rather, we described a process in which a two-way adjustment would be needed: the activities contributing to climate change must be reduced and humans must adjust to the anticipated negative consequences of climate change. The aim was to prepare the interviewees to reveal their WTP for such adjustments.
- A test of lexicographic preferences was administered. Questions were dispersed throughout the whole questionnaire so that some of the answers could be repeated in order to check for possible biases.
- The interviewees were selected to represent a cross-section of the population using three criteria: gender, age, and employment. Analysis of the data and reporting of the results focused on the following:
 - Different aspects of valuing the cost adjustment were tested. WTP was compared with WTA in order to measure the effect of inaction (in the sense of compensation payments). WTP revealed different values assigned to the cost of adjustment. We tested cases of option value, bequest value, and so on.
 - We assessed the health risks. We measured the cost of a statistical life saved depending on the duration of the risk. All valuations were correlated with various socioeconomic indicators.
 - Policy measures intended to reconcile human health and climate change were discussed.

3.2. Attitudes Toward Climate Change in Sofia

In order to assess social attitudes, the importance placed on two climate change issues (the reduction of GHGs and wildlife/forest degradation) was measured against that placed on six other issues of concern. The results are presented in Table 25.1. The ranking is from 1 (not important) to 6 (very important).

Table 25.1 Attitudes to climate and health related activities
(as a percent of total respondents)

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>Weighted Value</i>
1. Reduction of GHG	2	17	46	28	7	2	8
2. Crime	0	0	0	19	81	0	1
3. Unemployment	0	0	1	44	56	0	3
4. Quality of education	1	9	45	40	6	0	7
5. Cultural heritage destruction	0	1	25	53	22	1	5
6. Wildlife/forest destruction	1	3	29	54	14	1	6
7. Public health services	0	0	1	37	63	0	2
8. Political instability	0	1	5	64	31	0	4

The weighted value of the ranking indicate that, at present, Bulgarian society's main concern is combating crime (first), followed by improving public health services. This may be explained by the fact that a crime wave, probably connected to the significant decline in the standard of living, occurred during the interview period. The high rank assigned to public health services may be explained by the fact that, at this time, there was much discussion of reform in this sector and the adoption of new laws introducing a health and insurance system based on European standards. That unemployment, traditionally ranked first, was ranked third in this survey is likely due to the slight rise in employment that occurred in 1997. It is difficult to explain why education is in seventh place since there had recently been a steep increase in education payments that had created a strong public reaction. It is interesting that both climate-change related indicators—the reduction of GHG and the wildlife/forest destruction—have very close rankings (sixth and eighth place). Our conclusion is that, due to the deepening crisis, social preference was given to the solution of short-term rather than long-term problems, such as climate change.

It was also very important to know how the society assessed variables that had a negative effect on health. The weighted results indicate that the perceptions of the reasons for health deterioration are distributed in the following manner: first, social uncertainty (crime and unemployment); second, bad nutrition; third, bad health services (this relates to the poor organization of health services, rather than to the quality of medical treatment); fourth, climate change; and, fifth, genetic factors.

The fact that climate change has such a low ranking among the reasons given for the deterioration of human health does not mean that the respondents neglected its importance. The clear preference for addressing social issues of immediate concern is, in our view, due to a context where the problems of survival are of paramount importance. Climate change appears too remote to pose any real threat to hungry people.

We formulated several factors that influence social attitudes to climate change:

- general impression of climate change;
- possible health consequences of climate change; and
- other activities related to climate change.

The general impression is that climate change is an on-going process. About 45% of the interviewees think that there has been some change in the climate, 38% think that there has been significant change, 13% that there has been a slight change, and 4% that there has been a serious change. Although no one thinks that there has been no change in the climate, the situation is not perceived as very dramatic. Rising energy prices and the cost of heating in the winter has led some respondents to indicate that an increase in temperature due to climate change is desirable. In the city of Sofia, where most buildings are centrally heated and the cost of heating is more than most low-income people can afford, 39% of respondents expressed this sentiment. But, possibly responding to the hot summers of recent years, there are some respondents (10%) who would prefer some cooling. Most respondents (43%), however, prefer to preserve the present state of the climate. Only 5% are indifferent to a changing climate and 3% are seriously worried about climate change.

The overview of attitudes toward climate change was completed by obtaining a ranking of activities needed to slow down climate change. We warned respondents that it is difficult to say which activity should have priority. Our question, however, was oriented to reveal respondents' feelings about devoting money to activities linked to climate change. The answers seem to be quite logical: 75% would be willing to pay for new energy sources; 21% for reforestation; and 4% for the replacement of CFCs. We should take into account the fact that 65% of respondents think they have a very poor knowledge of climate change, 17% rather poor, 16% poor, and only 2% classify their knowledge as good. No respondents classified their knowledge as very good.

3.3. Is Health Traded or Lexicographically Preferred?

The above results indicate the presence of lexicographic preferences as to health. The test of lexicographic preferences included several related questions dispersed throughout the interview in order to detect false answers.

When the question was phrased, "Health is the most valuable thing for me and I would devote all my money to keeping it good," 90% definitely agreed (rank 5), 5% put rank 4, and 5% rank 3. No one definitely disagreed. This could be read as an indicator of lexicographic preference. When we formulated the question to read, "I appreciate good health, but I have to spend a part of my money to have a normal way of living," the ranking was rather high. Although 85% definitely agree (an obvious influence of the previous formulation), 13% ranked the statement at 4, and 2% at 3. The statement "If I have enough money I can have good health too" was ranked as follows: 39% definitely agreed and 26% definitely disagreed (rank 1). This shows a rather polar distribution of opinions. The statement was ranked 2 by 1% of the respondents, 3 by 10%, and 4 by 14% of the respondents.

Asking respondents about the famous Bulgarian saying, "Earlier I spent my health to make money, now I spend my money to have health," we expected interesting results as to the time distribution of the trade-off between health and money. The low support for this statement can be explained by the fact that there was a small number of respondents in the group employed in activities with high health risks, such as mining. Only 2% ranked this statement 5, while 27% ranked it 4, followed by 44% at 3, 12% at 2, and 15% definitely disagreed (rank 1).

Our conclusion is that the share of respondents expressing lexicographic preferences for health is relatively small, and this is therefore not a problem that would negatively influence our study in any serious way.

3.4. WTP for Reducing Health Risks Caused by Climate Change

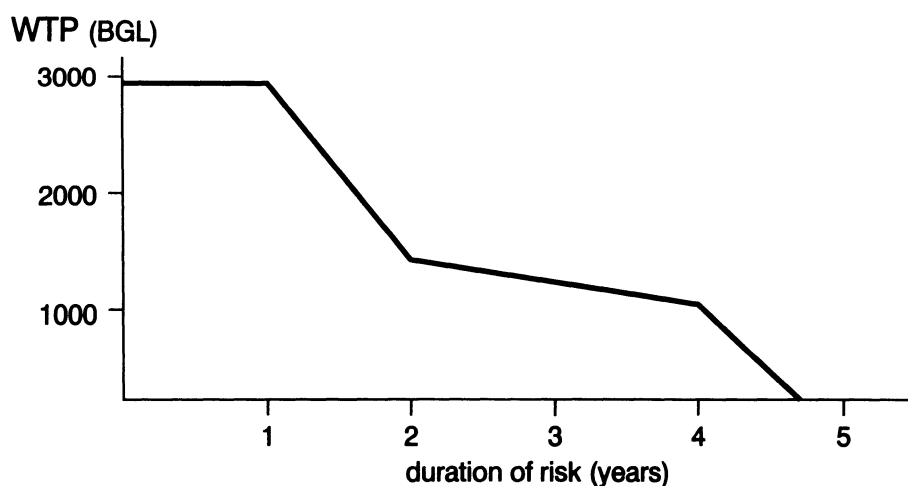
In our survey, we described climate change as caused by a combination of natural changes on the planet and human activity resulting in increasing GHG emissions. Following our logic, the response to climate change should include two strategies: the adjustment of society to what is unavoidable and the reduction of activities that may affect climatic warming. Strategies were assessed in terms of the cost of reducing the health risk from 0.0002 to 0.0001 (by one of ten thousand). The statistical characteristics of the WTP are presented in Table 25.2.

Taking into account the fact that the average wages in Bulgaria for this period were 120,000BGL, the proposed WTP₁ accounts for about 3.4% of the average wage, which is normal for this kind of estimation. It is an indication of the social readiness to support initiatives to reduce the activities influencing climate change and thus to reduce the health risk due to this change.

Table 25.2 Statistical characteristic of the WTP to reduce health risk due to climate change depending on the duration of the risk (in BGL)

	WTP_1	WTP_2	WTP_3	WTA	<i>Duration of Risk (Years) with $WTP=0$</i>
Mean	4,060.1	2,502.0	1,921.7	15,995	5.9442
Standard deviation	5,624.2	4,349.7	3,806.5	26,353	4.9510
Skewness	2.248	3.049	3.935	5.457	0.721
Kurtosis	8.061	13.814	21.953	43.656	2.911
Minimum	0	0	0	0	0
Maximum	25,000	25,000	25,000	25,000	20
# of cases	198	198	198	198	198

The link between the WTP and the duration of health risk due to climate change is presented in Figure 2. According to our estimation, the average duration of risk is about 5.9 years. It is the upper boundary that reduces the WTP to zero. Although it is difficult to say how acceptable this figure is, it seems to be a relatively low boundary; the duration of risk might be much longer, considering the lengthy duration of the whole process of climate change.

**Figure 25.2** WTP and duration of health risk due to climate change

3.5. WTP Versus WTA to Avoid the Health Risk

In testing WTP versus WTA, it is natural to expect that a high preference would exist for WTA, as the traditional inaction by the state on the reduction of health risks still prevails. Although, according to the classic postulates of utility theory, these two measures should be equal, most studies indicate great deviations between them (Hannemann, 1991).

Our study was no exception. The results reported in Table 25.2 indicate that, while the average WTP is 4,108.6BGL, the corresponding WTA is 15,995BGL. The WTA is thus 3.9 times higher than the WTP. Such a difference is evidence that the compensation structure will be more important in these cases than the purchase structure. Decision makers should pay more attention to this fact. It appears that the dramatic drop in the standard of living in Bulgaria compels people to sacrifice their most valuable form of capital—their health—for the sake of survival.

3.6. The Value of a Statistical Life

The rise of uncertainty in the transition economy connected to the high level of unemployment and crime increases the interest in estimating a statistical life saved in the context of the complex of factors influencing health risk in transition conditions. Traditionally, this starts with the estimation of so-called physical risk (the extent of an individual's exposure to the probability or chance of death or injury during a specified period of time). We estimated the value of a statistical life saved due to climate change depending on the duration of risk. The value of a statistical life saved was measured as the ratio WTP/time reduced risk or WTP/0.0001. The data on WTA permits us to estimate a compensated statistical life equal to WTA/reduced risk or WTA/0.0001. The results are presented in Table 25.3.

That these results are much lower than those reported by other authors may be explained by the very low income of people in transition economies in comparison to those in developed market economies.

Table 25.3 The value of statistical life saved due to reduction of the health risk connected with climate change depending on the duration of risk (1 USD= 1975 BGL)

	<i>Duration</i>	<i>Duration</i>	<i>Duration</i>	<i>Compensated statistical life saved</i>
in BGL	40,601,000	25,020,000	10,217,000	154,950,000
in USD	20,557	12,668	5,173	78,456

4. POLICY MEASURES

Traditionally, economic theory devoted to climate change policy has emphasized taxation as the prime way of funding the reduction of emissions of GHG and other substances that cause climate change. We attempted to move beyond this precedent by emphasizing a broad-based National Climate Change Program, for which taxation would be but one of the enabling instruments.

Before being asked about their WTP, interviewees were presented with several strategies to potentially reduce the negative influence of human activity on the climate. It was explained that, despite the small size of the country, Bulgaria contributes to the world-wide greenhouse effect and a national strategy is therefore needed to reduce the emission of damaging gases. It was further explained that a National Climate Change Program (NCCP), proposed by different institutions (including the Ministry of Energy, Ministry of Industry, the Ministry of Environment and Waters, and the Bulgarian Academy of Sciences) was under discussion. Interviewees were provided with an outline of the program's basic goals: the implementation of new projects and sets of measures in order to restructure those segments of the economy that produce GHGs; the reshaping of agriculture and industry over the next ten years; the financing of new energy sources; reforestation; replacement of CFCs; irrigation improvement; new health facilities; and increase research and development in the area of climate change. It was emphasized that the plans for the NCCP were being formulated with the assistance of international organizations that specialized in climate change issues.

A detailed explanation of the financial aspects of the problem was also presented. The interviewees learned that, in order to finance the program, it would be necessary to invest resources, and that the existing funds would not be sufficient to support the necessary efforts. Different strategies could be used to raise money to fund the program; the basic one would be the taxation of firms and individuals. We proposed that all the money collected for this program be placed in a special fund from where it would be redistributed to those sectors that emit the highest amount of GHG. This fund would be managed and monitored by specialists from international institutions and the money collected would be exclusively used for the purposes indicated above.

In this context, we explained that the government is considering whether or not it is worth investing additional tax money to reduce GHG emissions. It is therefore important to find out how much addressing climate change is worth to the Bulgarian people in terms of its ultimate result—reducing the risk to human health.

The results provide evidence of positive public support for initiatives aimed at reducing the health risks caused by climate change. The data are rather optimistic, with 71% believing that the NCCP would receive public support and 14% that it would definitely receive public support. In contrast, 10% predict weak support, 3% very weak support, and 2% no support.

There is controversy over the way the money should be collected for the implementation of the program. Only 26% approve of taxation but 57% think that it would probably be a successful method.

Because the activities that cause climate change are the result of an entire structure of industry and consumption, many institutions must be involved in combating climate change and reducing its associated health risks. The implementation of a NCCP should be organized nation wide and include the representation of various social groups. The preliminary results of the survey indicated that, despite the high social price and low incomes, Bulgarian society is, as a whole, ready to consider paying the price of avoiding health risks to themselves and future generations.

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Section VII

Measuring Environmental Change and Human Security

Chapter 26

Environmental Security and Sustainability in Natural Resource Management: A Decision Support Framework

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This chapter seeks to offer an overview of recent issues in sustainable development and environmental security policy, as far as resource management is concerned. The focus is on agricultural policy analysis, with particular attention paid to the development of an operational decision support system. Three topics receive particular attention: the use of relevant indicators, the development of a set of critical threshold conditions, and the design of an assessment and evaluation methodology.

1. RECENT ISSUES IN THE SUSTAINABILITY AND SECURITY DEBATE

The interest in environmental issues, which dates back to the time when Greek philosophy divided the natural world into four elementary substances—earth, air, fire, and water—has persisted over the centuries. However, it is only in the past decades that there has been a growing awareness that problems of environmental sustainability and security are interwoven phenomena with dimensions ranging from local to global (see Benedick, 1992). In this context, various thematic issues relating to global environmental change such as land use and land cover change, industrial transformation and energy use, demographic and social dimensions of resource use, social and individual choice mechanisms, institutions, and environmental security have been distinguished. A main question that arises when addressing all such issues is whether our society has the capability and resilience to adjust to stress factors of a sociopolitical or environmental nature. Furthermore, it is also important to appreciate that adequate scientific knowledge on the nature, backgrounds, and directions of environmental change processes should become available to a worldwide audience in order to induce the necessary behavioural and political adjustments (see also Lonergan, 1996; Opschoor, 1996).

This chapter looks at various methodological aspects of environmental sustainability and security, and particularly focuses on land use and agricultural activities.

Particular attention will be given to new evaluation methodologies, based on recently developed decision support methods that use critical threshold values via the flag model.

2. AGRICULTURE: A NATURAL RESOURCE SECTOR IN A MULTI-POLAR FORCE FIELD

Agriculture is a natural resource sector of immense importance. It plays a pivotal economic role in many developing countries and is crucial for any development policy. In this context, the World Conference on Agrarian Reform and Rural Development (WCARRD, 1988) claimed that the primary objective of rural development is the eradication of poverty, hunger, and malnutrition. This can be further specified by means of the following development objectives:

- reduce rural poverty;
- eliminate severe undernutrition;
- provide minimum levels of public services;
- expand employment opportunities;
- improve productivity and incomes;
- increase agriculture and food production;
- increase self-reliance;
- achieve food security; and
- increase public resources management.

This long list comprises a variety of relevant policy angles that may be at least partly naturally conflicting. A more compact set of objectives was adopted at the UN Food and Agriculture Organisation's (FAO) preparatory meeting in Hertogenbosch, The Netherlands (1991a) for the United Nations Conference on Environment and Development (UNCED), where three goals for agricultural policy and rural development were formulated:

- to attain food security;
- to generate employment and income in rural areas and to eradicate poverty; and
- to conserve natural resources and protect the environment.

Clearly, such goals will take on different policy weights in different circumstances and will depend on the development stage of an area. This is illustrated in Figure 26.1.

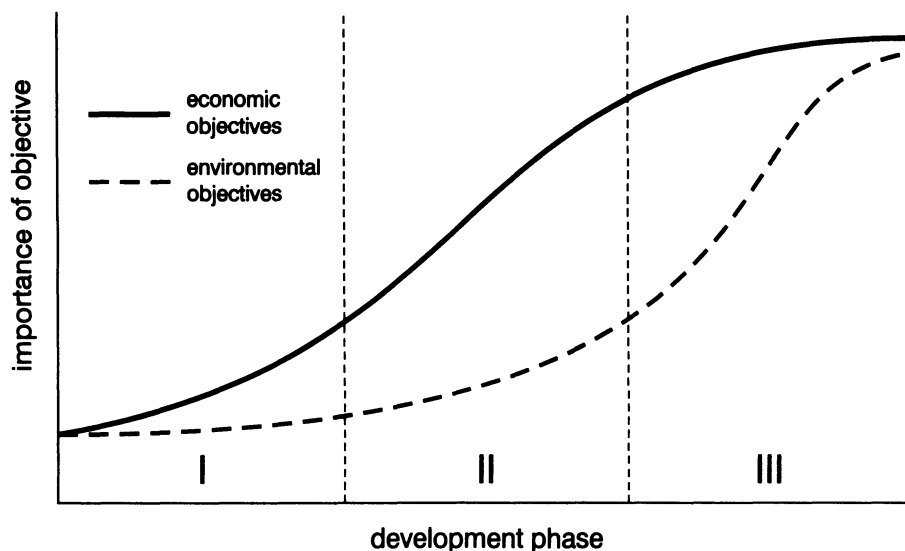


Figure 26.1. Objectives and development

In Figure 26.1, the economic objectives start with the achievement of food security (I), move to the reduction of poverty in rural areas (II), and end with the provision of a minimum level of public services (III). The environmental objective, in the first phase, is the maintenance of the quantity and quality of natural resources (I); it next moves to an improvement of natural resources management (II) and finally to the maintenance of environmental quality (III). Clearly, in both economic and environmental objectives, we may face issues of equity and access to resources, factors which may also have to be included in such a scheme.

Economic development and management of natural resources find a point of concentration in the agricultural sector (including fishery and forestry) that plays a key role in both developing and developed economies. Agriculture is thus a strategic economic sector in almost all countries, while it is, at the same time, a threat to the natural environment. Agriculture has to find a balanced position in the complex field of *economic objectives*, *social needs*, and *environmental protection*. Complicated trade-offs will be faced.

The strategic position of agriculture rests on the fact that the sector serves to satisfy basic human needs. Also, especially in developing countries, a large share of employment is generated by this sector. Agriculture is concerned with the use of natural resources whose functioning is critical for ecological systems quality. Overexploitation of such resources erodes not only the ecological base, but also the economic prerequisites for our life-support systems. This means that agriculture plays an absolutely critical role in the evolutionary development strategy of each country.

Clearly, new technologies may help improve efficiency in agricultural production but, by leading to overexploitation of resources and modes of production that are not environmentally benign, they may also cause harm. A fine tuning of the balance between economic progress, technical skills, and environmental management is thus necessary for a balanced development of agriculture in all countries. At the same time, it must be recognized that specific countries or regions may need tailor-made agricultural development strategies. In general, involving the local population as much as possible in the development process is an important objective because it may obviate large welfare gaps in the same agricultural area and lead to a maximum degree of self-sufficiency. Compliance with efficiency and equity targets would suggest that a food security level be achieved, whenever possible, by indigenous growth efforts rather than by foreign aid policies. In agreement with the words of Ogotu (1993), we might thus say that “development is for the people, from the people and with the people.”

3. SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL SECURITY IN AGRICULTURE

The rising popularity of the notion of sustainable development has increasingly provoked the need for an operational (i.e., practical, measurable, and policy-relevant) description or definition of this concept. The standard, widely-cited World Commission on Environment and Development (WCED) definition of sustainable development, “development that meets the needs of the present generation without endangering the needs of future generations,” is a meaningful starting point, but fails to offer manageable practical guidelines for sustainability strategies of local, regional, national, or international decision-making bodies or other actors. The complementary description of sustainable development by the International Union for the Conservation of Nature (IUCN), the UN Environmental Programme (UNEP), and the World Wildlife Foundation (WWF) emphasizes the need for “improving the quality of human life while living within the carrying capacity of supporting ecosystems.” This definition is more normative in nature and may more clearly offer a test framework for resource policy, particularly once a consensus on the meaning of carrying capacity has been achieved. Although, thus far, no uniformly accepted definition has emerged, the basic intentions of sustainability are becoming clear; it aims at directing decisions of policy bodies and private actors towards a joint state of the economy and the ecology, such that the needs of current and future generations are met without eroding the ecological basis for a proper welfare and activity level of these generations (see also Opschoor, 1994).

A *normative* orientation of sustainability requires, in general, an assessment and evaluation framework that should be capable of testing actual and future states (or developments) of the economy and the ecology against a set of reference values. This

approach, also adopted in the present chapter, requires three important components in any sustainability analysis:

- a set of *measurable sustainability indicators* (see Section 4);
- a set of *normative reference values* (e.g., carrying capacity; see Section 5); and
- a *structured impact and evaluation methodology* for assessing future developments (as a result of behavioural processes, exogenous developments or policy responses; see Section 6).

Although these three items seem evident, it must be recognized that a major problem in operationalizing the notion of sustainable development is its lack of specificity in concrete circumstances (e.g., particular regions or economic sectors). Sustainable development in a given region or sector is not necessarily sustainable elsewhere. Thus, apart from the intrinsic complexities in the interpretation of sustainability (as a process with ongoing trade-offs between social, economic, and environmental goals), sustainability is context specific and hence determined by the needs of and opportunities in a particular region or sector. This awareness has led to a more flexible delineation of sustainable development as is evidenced by the use of terms such as regional or sectoral sustainable development; references to terms like the sustainable city, sustainable transport, sustainable tourism, and sustainable agriculture have also become widespread.

Within the context of the ongoing discussion on defining sustainable development, the FAO has developed its own definition. Sustainable development is to be conceived of as that which is “environmentally non-degrading, technically appropriate, economically viable and socially acceptable.” This broad notion was put in a more precise context by specifying the features of sustainable development: “Resource use and environmental management are combined with increased and sustained production, secure livelihoods, food security, equity, social stability, and people’s participation in the development process.” This notion points to the importance of a balance between environmental, social, and economic objectives in order to obtain maximum welfare (as it is most broadly defined), while taking into account external factors (such as technology). This definition regards sustainability as a balanced state existing within a field of three distinct factors, each with its own indigenous value. It must be added that agriculture comprises various heterogeneous subsectors (such as cattle breeding, food production, forestry, and fisheries), each of which may require its own specific operational definition within the above reference definition.

From a more normative policy perspective, it seems plausible to extend the above FAO definition by describing sustainable development more precisely as a balanced development policy for agricultural resources in the region concerned, to such an extent that a maximum level of welfare (including quality of life), now and in the future, is achieved through a coevolutionary strategy in which environmental constraints emerging from the regional carrying capacity or critical loads are taken into consideration.

As mentioned above, in addition to sustainable development, the concept of environmental security has become an important signpost for a cohesive and balanced socioeconomic-environmental policy, not only at a global level, but increasingly also at a meso (regional or sectoral) level.

Adopting a normative interpretation of environmental security is also necessary. The concept of environmental security refers to the ability of members of a society to access natural resources in order to fulfil their basic human needs. Environmental security may be seen as the *absence* of malnutrition, starvation, illness due to lack of medical care, adequate housing, or of safe living conditions (e.g., in flood areas). However, in a positive, normative context, we might use the term environmental security to refer to the socio-economic state of an area that is employing its natural environment base and its natural resources to such an extent that all members of society have the opportunity to meet their basic needs.

The introduction of normative conditions (limits, standards, norms) on resource use and access is in agreement with popular notions like carrying capacity, maximum yield, critical loads, environmental utilization space, maximum environmental capacity use, and so forth. The use of reference values, critical conditions, or threshold values is an appropriate way of generating new and practical insights regarding the identification of conflicts, inconsistencies or incompatibilities between different agricultural development scenarios (in terms of both types and levels of agricultural activities, as well as of their underlying life support systems).

Clearly, this requires an identification of various classes of relevant indicators which may, in general, relate to

- impacts on ecosystems;
- impacts on water quality and quantity;
- effects on climate change and atmosphere;
- use of (renewable and nonrenewable) resources;
- generation and disposal of waste;
- changes in land use and landscape;
- visual intrusion; or
- impacts on human health.

Such a set of classes of indicators is not exhaustive; the ultimate choice of relevant indicators depends on the general agricultural field area under investigation (e.g., livestock, forestry, fishery) and on the specific policy issues and strategies to be envisaged (e.g., new cultivation methods, the use of herbicides or pesticides, changes in land ownership, changes in animal husbandry, changes in the natural resource base, new quota systems for a fishery).

By assessing all relevant effects, a database can be created that may help to determine whether a certain agricultural development is sustainable or not, the degree to which policies have been successful, and whether new initiatives support sustainable development or environmental security. This implies the use of an impact assessment, which means that the status quo (the initial conditions), the extent and type of intervention (e.g., policy), and the resulting new state have to be assessed and evaluated.

4. INDICATORS FOR SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL SECURITY

In general, an indicator is a partial, representative, and quantitative mapping of a compound phenomenon into a one-dimensional measure that is relevant to decision making. Single indicators or sets of indicators serve to assist analysts in preparing balanced policy decisions based on the principle of communicability of data via a systematic representation of measurable facts or aspects. Such indicators have to fulfil the following conditions:

- scientific basis (i.e. verifiability);
- measurability (quantitative or qualitative);
- predictability (under “what-if” conditions);
- user- and policy-relevance;
- flexible space-time aggregation scale;
- monitoring capability (in a flexible information system); and
- compatibility with available information bases.

Only under such conditions may we expect indicators to be reliable, relevant, and sufficiently manageable.

A first step towards operationalization of the concepts of sustainable development and environmental security is to specify a set of manifest or observable/measurable indicators, each of which depicts an important aspect of sustainability or security. Such indicators should measure all relevant dimensions of sustainable development and environmental security by including environmental, social, and economic characteristics.

In order to assess the level of economic welfare, we usually look at GNP per capita. This is a macroeconomic tool which measures production and economic growth in an aggregate and quantitative way. In principle, this measure can be further subdivided into regional or sectoral measures (including the social distribution of GNP), but average GNP per se does not seem to be particularly helpful in measuring sustainable

development or security. In this respect, the Human Development Index (HDI) advocated by the UN Development Program (UNDP, 1992), which incorporates both social and economic indicators, appears to be a more appropriate indicator for development. The HDI assumes that human development is the process of expanding people's choices, where the most basic rights are associated with a healthy life, education, and a decent standard of living. For many environmental variables, it is still difficult to include indicators in a measurable way. Composite indicators that reflect social and environmental values are even more difficult to define.

In a natural resource and agricultural context, indicators may relate to different stages of the production chain and their related environmental effects. We may distinguish between

- *input* indicators (e.g., pesticides, fertilizers, labour, land);
- *output* indicators (e.g., production, income, pollution emission); and
- *impact* indicators (e.g., efficiency, health, ambient concentration, nutrition levels).

Such indicators may concern economic, social, and environmental aspects of agriculture. These indicators can also be subdivided into *efficiency*-oriented and *equity*-oriented indicators. Sometimes the economic and social variables are brought together in a single socioeconomic profile. In all cases, policy-relevant sustainability indicators are concerned with both the socioeconomic and environmental aspects of agricultural development. Examples of elements of a socioeconomic profile in the agricultural sector are

- income per capita;
- skewness of income distribution;
- unemployment level;
- access to natural resources;
- average duration of unemployment;
- investments;
- growth in production;
- access to and use of technological knowledge and equipment;
- training and educational level;
- demographic structure and growth; and
- cultural inertia.

Examples of environmental indicators (interpreted in a broad sense) are:

- water quality;
- health condition;

- quality of and access to health care systems;
- longevity;
- infant mortality;
- food supply;
- nutrition level;
- air pollution;
- soil pollution;
- noise;
- landscape deterioration;
- general natural resource condition;
- topsoil quality;
- pollution abatement technologies; and
- distribution of pollution over various social classes or regions.

The above lists of indicators are only indicative of socioeconomic and environmental profiles and have to be operationalized for specific policy questions and geographical areas. A main problem is that the number of indicators always tends to grow towards an unmanageable size. A general useful methodology for limiting the number of indicators, while nevertheless maintaining completeness and cohesion, is to use a hierarchical approach, based on a tree-like composition for aggregation and disaggregation of indicators, so that a distinction between the use of single and composite indicators can be made (see Figure 26.2). Such a tree-like structure can, of course, also be further distinguished according to relevant time scales (e.g., medium- and long-term) and geographical scales (e.g., district or country).

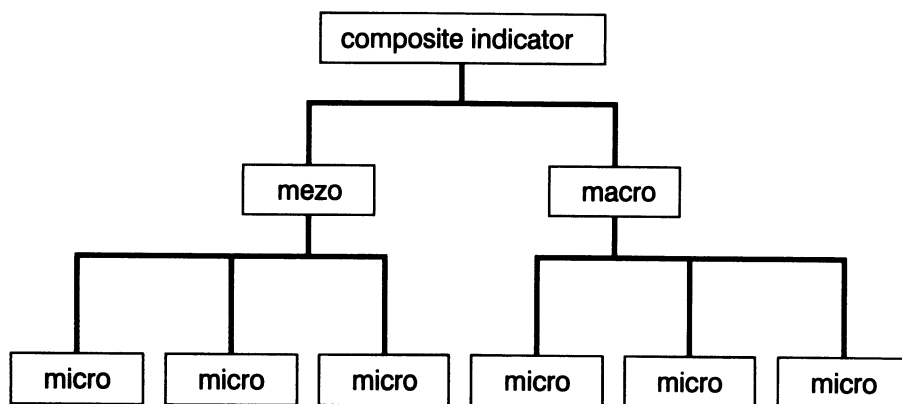


Figure 26.2. A tree structure for indicators based on hierarchical aggregation

It is clear that the identification and definition of such indicators depends not only on the area of agricultural policy concern (e.g., crop production, livestock, forestry), on the intensity of socioeconomic problems, or on the extent of environmental deterioration, but also on the distribution of and access to resources among various groups in the region, and on the level and stage of development in the area concerned.

An example may illustrate the latter point. If, in a first stage of development, the main resource policy concern is to achieve food security, then it is evident that—in addition to income per capita, income growth, and income distribution—a sufficient food supply, a stable growth path of food production over time, and broad social access to food supply are main requirements for environmental security.

The International Fund for Agriculture Development (IFAD, 1992) has developed a composite food security index in order to measure the quantity and quality of food supplies. This index includes, among other things, the food production potential, the import capacity, and the degree of variability in food production and consumption in the area concerned. The index is composed as follows:

- per capita daily calorie supply (as a percentage of requirements);
- per capita food production index;
- food staples self-sufficiency ratio;
- food aid in cereals (as a percentage of cereals imports);
- food imports (as a percentage of total merchandise imports);
- variability of production of food staples; and
- variability of consumption staples.

Another attempt to typify and assess food security has been made by the UNDP (1992). Various indicators are listed but not integrated into one compound index. These indicators are

- food production per capita;
- agricultural production (as percentage of GDP);
- daily calorie supply per capita;
- daily calorie supply (as percentage of requirements);
- food import dependency ratio;
- cereal imports;
- food aid in cereals (as a percentage of cereal imports); and
- total value of food aid.

A problem economists face when attempting to utilize such indicators is that they are *partly* based on supply conditions and *partly* on demand conditions; this means that a combined supply-demand analysis, as sketched in Figure 26.3, might, therefore,

be more appropriate. However, because it is very difficult to assess all indicators in order to identify an equilibrium point, in practice, one must resort to the use of a mixed indicator system.

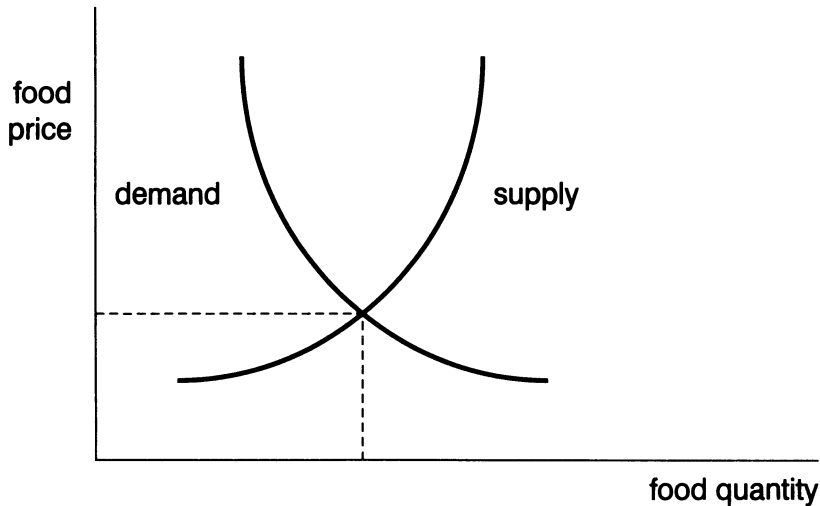


Figure 26.3 Demand and supply curves for food

It is clear that distributional problems are at the heart of environmental insecurity. Since a direct equity index is difficult to identify, one normally resorts to indirect indicators, such as the percentage of people under the standard nutrition level or infant mortality (percentage of infants dying in their first year of life). It is evident that such health indicators are also strongly related to income distribution.

In facing the second developmental phase, the reduction of poverty in rural areas (see Figure 26.1), other indicators might be relevant. In this case, indicators related to basic standards of living or basic necessities may be used. For instance, an attempt has been made by the World Bank (1990) to assess poverty by introducing poverty lines as a critical threshold value. In the 1990 Global Assessment on Poverty, this line appears to vary from \$270 to \$370 per annum. In this case, indicators do not refer to survival conditions, but to basic standards of living. Related indicators may be the unemployment rate or food aid dependency.

Finally, in facing the third developmental stage, the provision of a minimum level of public services, much emphasis is placed on natural resource conservation and environmental protection (including public services such as health care, educational facilities, and other welfare benefits); conventional indicators such as income per capita and public expenditures per capita—and the distribution thereof—are therefore more appropriate security indicators.

Following this discussion on the phase dependency of sustainability and security indicators, a few critical indicators that seem to play an important role in almost all development situations should now be addressed. Agriculture should not be regarded in isolation from the natural resource (water and soil) quality, as these two categories provide for basic life support systems now and in the future. If we take for granted that sustainable development implies that the environmental impact of human activities stay well within the limits of how much environmental impact the biosphere can take, then we have to recognize that, at any given point in time, there are limits to the amount of environmental pressure that the earth's ecosystem can support without irreversible damage to either this system or the life support process that it enables. In this context, the notion of environmental utilization space offers an interesting analytical concept (see Weterings & Opschoor, 1994), as this space determines the regenerative capacity of the environment and the way resources are utilized. The latter notion is also relevant, since natural resources can, in general, be meaningfully subdivided into non-renewable resources (e.g., oil, iron), semirenewable resources (e.g., soil, water), and renewable resources (e.g., forests, fish, crops). For example, it seems plausible to assume that, in the case of nonrenewable resources, a residual stock must be maintained up to a level that will ensure sufficient time for finding substitutes (in most cases, at least one generation). In the particular case of agriculture, the two basic resources are water and soil (see UNEP, 1992). This means that water and soil indicators should be included in any sustainability and security analysis.

For example, with reference to water quality, indicators may relate to per capita annual water use (for both productive and consumption purposes), water pollution per capita (e.g., in terms of BOD) and water purification. In particular, in various studies (e.g., FAO, 1991b) it has been shown that the irrigation efficiency of water is often low (with a water loss of up to 60%). Also, the use of pesticides, herbicides, and fertilizers may deteriorate water quality; thus, information on the use of these contaminants would have to be included.

5. REFERENCE VALUES FOR SUSTAINABILITY AND SECURITY

The previous section focussed on the identification and classification of various sustainability indicators. It argued that there is no generic set of such indicators, as site-specific conditions, policy preferences, and socioeconomic conditions determine the relevance of each specific indicator for policy making. The same remarks also apply to the interpretation to be given to quantitative values of such indicators. The question of whether a given socioeconomic and environmental resource development is balanced—

now and in the long run—is determined by value statements in a political context that may differ over space and time. Nevertheless, certain developments can be classified as clearly unsustainable (e.g., if they lead to irreversible soil erosion, desertification, or unlimited extraction of scarce ground water). In this context, the notion of carrying capacity is of great importance because it indicates the maximum environmental resource use that is still (at least marginally) compatible with ecologically sustainable economic development. The concept of carrying capacity thus refers to a threshold value that cannot be exceeded without causing unacceptably high damage and risk to the environment; it is sometimes referred to as an environmental utilization space or maximum environmental capacity use (see Weterings & Opschoor, 1994). In order to emphasize the need for unambiguous quantification, the remainder of this chapter will use the notion of a *critical threshold value* (CTV). A CTV is a numerical normative expression for an indicator. In case of a cost indicator (e.g., environmental decay, resource extraction), it represents the maximum value of the indicator that is still acceptable at the margin. Exceeding this critical value implies a definite violation of sustainability or security conditions.

How a CTV is to be assessed poses an interesting question. Clearly, assessment must be based on solid scientific research. This means that scientific information and expert opinion are of critical importance when studying, for example, resource availability or human health effects. In addition, however, it must be recognized that several CTVs (e.g., the acceptable level of access to resources) have, by definition, a policy meaning and there is, therefore, a policy involvement in the specification and numerical assessment of CTVs.

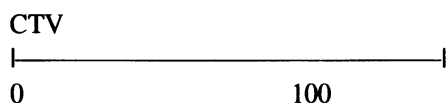
For each sustainability or security indicator, be it environmental or socioeconomic, a separate CTV has to be determined; the entire set of CTVs may therefore act as a reference system for judging actual states or future outcomes of scenario experiments. If, for an indicator, the lower the better holds true, then it is also true that a level higher than the CTV signifies a dangerous or threatening development which is, in a strict sense, unacceptable. Conversely, any value of a sustainability or security indicator that is lower than the CTV is, in principle, acceptable or desirable.

For the sake of simplicity, only cost indicators will be used in the interpretative analysis presented here. Benefit indicators can easily be rescaled into cost indicators.

We may now assume, after rescaling, the following range of values of each sustainability indicator, S :

$$0 < S < \text{CTV} = 100$$

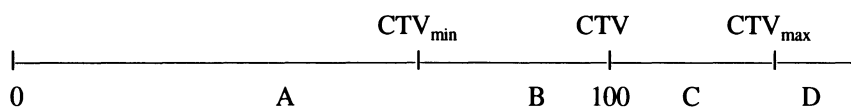
This can easily be depicted in the following way:



It goes without saying that the concept of a CTV has to be used with great caution. It is based on existing knowledge that may be specific to a given area, local socio-economic and natural conditions, and particular local/regional policy ramifications. Furthermore, some natural conditions may have resilience, so that, after a temporary time span of violating critical threshold conditions, a return to sustainable development or an environmentally secure pathway may take place.

A major problem faced in practice is that the CTV level is sometimes ambiguous. In certain areas and under certain circumstances, different experts and decision makers may have different views on the precise level of a CTV. It may even happen that a CTV is fuzzy in nature, so that fuzzy assessment methods have to be used (see Munda, 1995).

A relatively simple and manageable approach to the above uncertainty problem is to introduce a band width for the corresponding value of the CTV, defined as CTV_{min} and CTV_{max} respectively. This band width mirrors the minimum and maximum range of CTV values, expressed by experts or policy makers. CTV_{min} indicates a conservative estimate of the maximum allowable threshold of the corresponding sustainability or security indicator (min-max condition). CTV_{max} , on the other hand, refers to the maximum allowable value of the sustainability or security indicator beyond which an alarming development will certainly start (max-max condition). This can be represented as follows:



The line segments can now be interpreted in the following imaginative way:

- area A: 'green' flag- no reason for specific concern,
- area B: 'orange' flag- be alert,
- area C: 'red' flag- reverse trends, and
- area D: 'black' flag- stop further growth.

This flag model is a visually appealing way to confront decision makers with the state of affairs in a certain area. It can also be represented in a computerized way by colour graphs. In this manner, the basic information for making trade-offs between conflicting objectives is available in a systematic data base.

In the face of multiple sustainability and security indicators, the main problem now becomes how to manage a complex system in case of different perceptions or views on critical values of multiple indicators. This can be carried out by using overlay techniques for each of the indicators of concern, and can be illustrated by means of Figure 26.4-26.6.

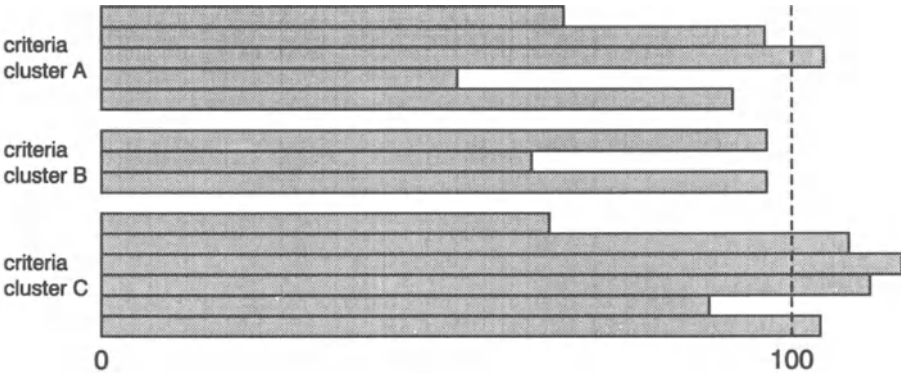


Figure 26.4 Reference (zero or initial) situation

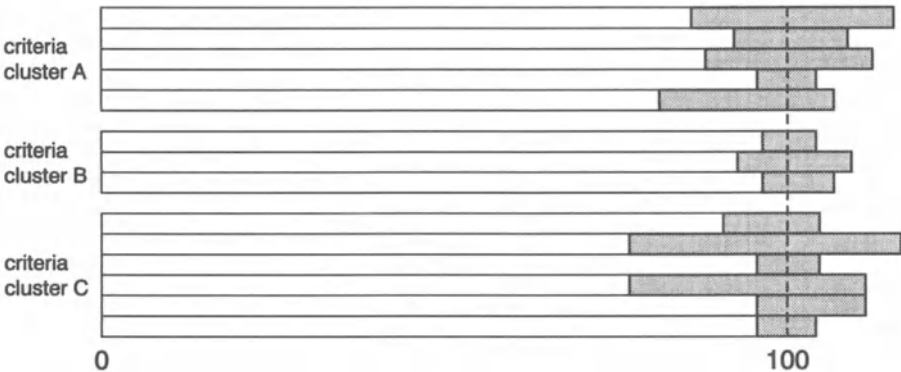


Figure 26.5 Ranges of critical threshold values

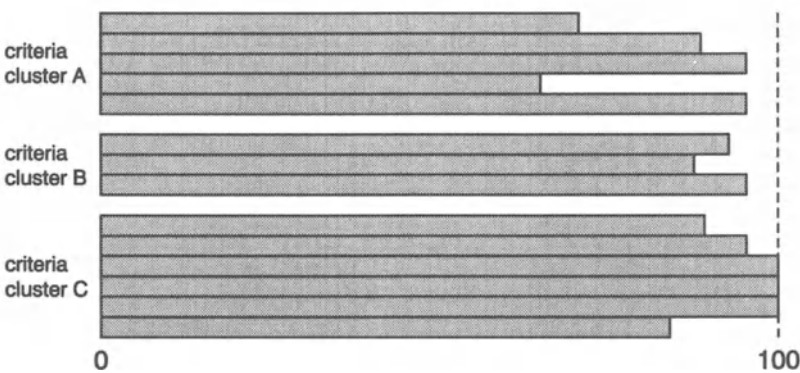


Figure 26.6 Results of new situation

6. AN ASSESSMENT AND EVALUATION APPROACH TO SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL SECURITY

In the previous section, the indicator values could only be compared with their own threshold conditions and with outcomes of new states for the same indicator. The typology used enabled us to infer conclusions on actual or predicted socioeconomic and environmental states of an agricultural system, while respecting local expertise and site-specific or sector-specific conditions. It puts a heavy claim on the establishment of the CTV_{min} and CTV_{max} values, but it is clear that, if no normative standards or threshold values are known, unambiguous conclusions can hardly be drawn on sustainability and security issues in agriculture. A mutual comparison between different indicators requires a joint assessment and evaluation.

In order to analyze conflicts and complementarities among the indicators, we would have to construct a comprehensive systems model for agricultural activities (per sector and per region) depicting, in an empirical quantitative way, the various economic, social, and environmental phenomena of interest. Such a modelling activity could take the form of either an econometric model, validated by empirical data on solid statistical grounds or a simulation model, calibrated (at best) by plausible system parameters. In order to maintain a manageable model size, a hierarchical or modular structure is sometimes preferable. In any case, such an integrated modelling approach would enable researchers to trace the precise quantitative implications of various types of human influences to be envisaged and assessed simultaneously. Unfortunately, such an ambitious model exists in only a limited number of cases, so that one often has to resort to a more pragmatic approach (see Nijkamp & Blaas, 1994).

A first approach would then be to build a relatively simple cause-effect model including only a few key variables. Such an exercise is not comprehensive (e.g., in terms of feedback loops), but it encapsulates the most important key forces of an agricultural system. For example, the amount of soil lost through erosion per crop (or group of crops) may be analysed by investigating the effects of policy actions in favour of specific crops. Problems of incompleteness, uncertainty, and stochasticity can then be handled by exercising systematic sensitivity analyses in a broad range of uncertainty intervals of the parameters used. For example, one could investigate how much erosion would be caused by some percentage shift in demand for given crops, all other things being equal. Such partial sensitivity analyses might certainly be helpful in complex sustainability and security trade-offs.

A second approach would be based on an *ad hoc analysis*, where all available information is used to assess the foreseeable consequences of various types of human intervention. Sources of information might be experts' views, Delphi techniques, producer's surveys, comparative studies on similar cases, simple correlation techniques,

and the like. The uncertainties involved in such an exercise might then be traced by presenting them to a forum of experts to derive broad uncertainty intervals around a central estimate of relevant variables.

Finally, recent developments in the area of meta-analysis, where input stimuli may be connected with a wide variety of output responses, must be mentioned. Since this approach has been proven successful in the medical sciences, there has been an observed increase in its popularity in the social science disciplines, including the environmental sciences (for a survey, see van den Bergh et al., 1997; Button & Nijkamp, 1997).

A major problem which, so far, has not yet been sufficiently addressed in environmental assessment models is the spatial scale of analysis. Although the problems have been well-known for a long time, the spatial resolution of sustainability problems in land use activities is still a difficult task. Fortunately, modern GIS techniques have been very instrumental in developing interactive modes between quantitative modeling and spatial mapping. In the near future, the potential offered by GIS will enable a close correspondence between spatial analysis and spatial representation, at all relevant geographical scales (see also Fischer & Nijkamp, 1993).

It is clear that the lack of a solid impact analysis is the Achilles' heel of environmental sustainability and security analysis. Much effort will be needed to build up a mature type of agricultural sustainability analysis. In this context, scenario analysis, which is briefly discussed below, has become a popular tool.

Having discussed sustainability indicators, critical threshold values, and assessment techniques, it is now important to integrate these building blocks into a comprehensive decision support tool. In general, policy analysis deals with what-if questions, which means that, out of a set of choice options, the most plausible one must be identified. In practice, policy makers are often not interested in the identification of a single future state, but rather in a set of possible states, so that there remains sufficient scope for flexibility in decision making. This means that, based on a systematic scanning of uncertain future choice possibilities, a series of choice options must be generated.

A systematic way of scanning such choice options is scenario analysis, through which a set of possible futures of an agricultural system, characterized by a comprehensive set of values for a set of sustainability indicators, can be identified. Such scenarios may originate from different assumptions on future pathways for agriculture:

- *exogenous* change (e.g., natural conditions, international agreements, etc.);
- *behavioural* change (e.g., transition to other types of crop production, new price settings, etc.); and
- *policy response* (e.g., deregulation, protectionism, etc.).

The art of scenario building is to select, out of an almost infinite number of composite choice possibilities, a subset of relevant and feasible options. The assessment methodology described above may be used to trace the foreseeable impacts of these

scenarios (in terms of consequences for sustainability indicators), while the judgement framework based on reference values via critical threshold levels may be used to identify the degree of sustainability of each of these future scenarios. In this context, expert-built scenarios based on available knowledge on local circumstances may be helpful (see Nijkamp et al., 1998).

It may, in principle, be possible to identify the most plausible (optimal) scenario by applying a multi-objective or multicriteria analysis to the above mentioned choice problem (see also Giaoutzi & Nijkamp, 1994). We refer here in particular to Hermanides and Nijkamp (1997) and Nijkamp and Ouwersloot (1997) for an application of multicriteria decision techniques in the framework of the above described flag model.

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Chapter 27

Mapping Human Insecurity

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This chapter presents the first phase of a project on the development of an index of human insecurity. There has been increased interest in early warning systems and models to identify regions of environmental vulnerability. The present study combines ecological, economic, social, and institutional indicators into a single index in an effort to identify vulnerable regions and to map the changes in these regions over time. Despite major deficiencies with respect to data, the index can be a useful planning tool for decision makers.

Increasingly, we are confronted by countries without leadership, without order, without governance itself. The pyre of failed states is being fired by common fuels: long-simmering ethnic, religious, and territorial disputes; proliferating military stockpiles built dangerously high during the Cold War; endemic poverty; rapid population growth; food insecurity; environmental degradation; and unstable and undemocratic governments.
—Atwood, 1994

1. INTRODUCTION

Research on the relationship between environmental degradation and security arose from a lively, but largely academic, debate that occurred prior to the end of the Cold War on the nature of security. The initial discussion focused on the declining relevance of conventional military conceptions of security and whether threats to security were changing. New nonconventional threats to security, also labeled potential cataclysmic events, were identified. These included religious fundamentalism, resource scarcity, human rights abuses, outbreaks of infectious diseases, impoverishment, famine, and environmental degradation caused by toxic contamination, ozone depletion, global warming, water pollution, and soil degradation. The early literature on environment and security was general and anecdotal (cf., Brown, 1977; Mathews, 1989; Myers, 1986, 1989; Renner, 1989); however, this has changed in recent years as scholars have been providing more rigorous examinations of the potential role of environmental degradation and resource depletion as *causes of violent conflict* (Bächler, 1994; Homer-Dixon, 1991, 1994; Libiszewski, 1992). Such conflict, it is argued, could pose a

serious threat to the security of individuals, communities, states, and regions. The general discussions on the nature of security and the role of environmental degradation as a contributor to insecurity and conflict are described by Levy (1995a) as the first wave of environment and conflict research. Subsequent research attempting to demonstrate a link between environment and conflict is described as the second wave (Levy, 1995b).

Many analysts have accepted uncritically that the competition for territory and resources has been at the root of most violent conflicts in history. What is new in the area of environment and security is the acceptance that *environmental stress caused by global environmental change, coupled with increasingly vulnerable societies, may be a cause of insecurity and conflict*. These nonconventional threats to security are no longer, necessarily, focused on the nation-state; quite to the contrary, it is individuals and communities who face the greatest risks. We are in the midst of a dual process of globalization and localization that affects the traditional role of the nation as a provider of security to individuals (e.g., Rosenau, 1995). As a result, it is crucial that we adopt a perspective that can accommodate both the changing nature of security and the new types of threats that affect security. The most appropriate framework for research and policy may well be one that focuses on *human security*.

The appeal of the term human security is that it recognizes the interlinkages of environment and society, and acknowledges that our perceptions of the environment, and the way we use the environment, are historically, socially, and politically constructed. It also recognizes three key features of the links between environment and security. First, there exists a *cumulative causality* between environment and security; for example, environmental degradation may result in population movement that, in turn, poses a threat to the environment. The ecological impacts of large refugee movements have only recently received serious attention, but it is increasingly acknowledged that large influxes of people can have significant environmental implications for the receiving region. Second, the responses to the insecurities posed by environmental degradation may contribute to other insecurities. In the example noted above, population movement could also threaten other aspects of human security not directly linked to the environment and may, in some situations, result in conflict. Third, and most importantly, human security embodies the notion that environmental problems must always be addressed from a broader perspective that encompasses both *poverty and issues of equity*, as it is these issues that most often lead to insecurity and conflict.

Adopting a human security perspective allows us to view problems of environmental degradation and resource depletion in terms of *insecurities*. That is, human security focuses on individual or collective human perceptions and evaluations of actual and expected conditions of the environment as a source of insecurity. This implies that *insecurity* may result from three factors: (i) actual risk of exposure to environmental stresses; (ii) the perception of risks; and (iii) whether the capacity exists to cope with

environmental stresses. While some authors equate insecurity and vulnerability, we feel the importance of individual or collective human perceptions is what distinguishes insecurity from vulnerability. However, it is difficult on a large scale to measure human perceptions and then use such a measure in the development of appropriate indicators to guide policy and decision making. We can still use vulnerability—defined as an aggregate measure of human welfare that integrates social, economic, and political exposure to and capacity to cope with a range of potential harmful perturbations—as a proxy for insecurity, and in this way attempt to identify and map regions where insecurities may be prevalent.

The purpose of this chapter is to present some preliminary results of an exercise that attempts to map human insecurity. Past attempts at mapping vulnerable spaces or developing early warning systems have met with limited success, due primarily to problems of data and definition. While acknowledging the difficulties, we have attempted to develop an Index of Human Insecurity (IHI) that will fulfill three primary objectives:

- assist in providing a clear conceptual definition and working framework for the measurement of vulnerability and insecurity;
- assess the quality and reliability of data that is used to depict vulnerability; and
- provide a visual mechanism with which to discuss the key issues relating to environment and human security.

The remainder of this chapter is divided into five sections. The next section outlines two recent attempts to develop a computer-based early warning system. Section 3 discusses general issues in indicator mapping and presents the methodology used in this study for mapping human insecurity. Section 4 highlights key aspects of data quality and reliability that are inherent to the development of such a mapping system. Section 5 of the chapter presents the results of the exercise, and Section 6 discusses suggestions for future directions.

2. COMPUTER-BASED EARLY WARNING SYSTEMS

Over the past decade, numerous attempts were made to develop indicator and index systems to describe or predict human conditions. Most were developed for one of four reasons: (i) to provide an alternative to using simple GDP or GNP figures as a measure of development or economic well-being; (ii) to provide an index of the quality-of-life or human well-being; (iii) to provide an index of sustainable development; or (iv) to act as an early warning indicator that would predict human system instability in the short term. Examples include the Index of Sustainable Economic Welfare (Cobb &

Cobb, 1994; Daly & Cobb, 1994), the Human Development Index (UNDP, 1994), and the Famine Early Warning System (see Section 2.1). An exhaustive review of these systems is beyond the scope of this chapter. We have chosen to highlight two early warning indicator systems, as it is the work in this area that has most directly been a response to human insecurities resulting from environmental factors. In particular, we will discuss systems that address famine and humanitarian problems as being illustrative of a typical early warning system structure. Particular early warning systems, though, whether for atomic radiation, disasters, health, or meteorological issues, will vary in their make-up but are common in their desire to use indicators to be predictive in the short-term. However, there is much theory that can also be applied from sustainable development indicator research; in fact, as argued later in this chapter, it is this much broader framework that must be applied to environment and security issues.

2.1. Famine Early Warning System (FEWS)

The Famine Early Warning System (FEWS)¹ is an information system sponsored by the United States Agency for International Aid (USAID) and designed to help decision makers anticipate potential famine conditions in Sub-Saharan Africa. FEWS considers biophysical data on rainfall, crop growth, and crop production in conjunction with remote sensing to help identify regions with potential food shortages. These indicators are then linked to socioeconomic data (market supply, food prices, school attendance, household income), demographic data (population, employment), and health and nutrition data (growth monitoring, malnutrition) in order to identify vulnerable population groups requiring assistance.

The system focuses on early warning of famine risks, and assists in the formation of famine mitigation and prevention strategies to lessen vulnerability. The strength of FEWS is in the development of a centralized database and the use of field experts and offices in 16 Sub-Sahara African countries. Its weaknesses are related to the geographical limitations of the system to Sub-Sahara African nations (which is understandable, given that FEWS focuses on the most famine-prone countries) and the limited emphasis on the predicting of famine conditions, thus making it inapplicable to larger issues of human insecurity.

2.2. Humanitarian Early Warning System (HEWS)

Similar in design to FEWS, the Humanitarian Early Warning System (HEWS; UNDHA, 1995) is a database of statistical and textual information categorized by country that is used to provide an early warning of potential humanitarian crises. Developed by the UN Department of Humanitarian Affairs in New York, HEWS, through the production of country profiles and an analysis of data trends, attempts to provide descriptive and

predictive information to decision makers involved in humanitarian assistance efforts. HEWS has a broader geographical focus than FEWS and a much larger statistical database, including quantitative and qualitative information (including social, economic, environmental, and institutional information) in 14 major categories. The statistical information goes back from 10 to over 25 years. Textual information provides qualitative, detailed information on potential problem spots in the areas of human rights, government situation, conflict/potential conflict, and military/arms and is used in combination with the statistical data to identify critical factors for each country (i.e., more critical indicators are given a higher weight). HEWS is still in its formative stage.

The marriage of quantitative information in the model with qualitative information to adjust indicator weights is an interesting and potentially useful approach. The inability to deal with qualitative and quantitative indicators within the same framework (incommensurability) has long hampered indicator research. The availability of the long-time series assists the predictive ability of HEWS. From our limited review, however, it is not clear which indicators are key to the system, nor why there is a need for the large set of indicators.

2.3. A Note on Early Warning Systems

Are computer-based early warning systems useful in the short-term prediction of potential famine regions or regions where humanitarian crises may develop? Can such systems provide more information than that being provided by agencies in the field, or provide it in such a manner that it can readily be interpreted for a timely response? Will governments respond to early warnings? Computer-based systems can serve as useful supplements to, but not substitutes for, information from the field. However, for short-term predictions, socioeconomic data, and in some instances environmental data, are inherently unreliable and, in some cases, useless. Correlational and cause-effect relationships that determine the predictive power of indicators are more reliable in the long term. In predicting regions of civil unrest, for example, quantitative information may actually be a hindrance if it overshadows the importance of qualitative information provided by observers in the region.

Also, it is doubtful that a computer-based data system will affect the *providers* of such information, since these countries (e.g., Canada, the United States) generally have no vital or important national interest at stake in the regions under stress. Therefore, the type of data and the manner that it is collected may not suit the needs of the particular early warning system (since the selection of particular indicators to be used is critical if one is to achieve any short-term predictive power) and thus not result in timely mitigation or avoidance of famine or humanitarian crises.

Any early warning system that relies more heavily on computer-based models than on information from observers in the field is likely to be of minimal use. Because

indicator sets are better able to be predictive over the medium and long term, they would be more useful in providing information to governments for development assistance planning rather than for immediate response.

3. DEVELOPING AN INDEX OF HUMAN INSECURITY

3.1. General Issues

At the international level, much of the conceptual and theoretical work on developing indices that link environment, economy, and society has been undertaken within the context of sustainable development, revealing two competing paradigms: (i) driving force-state-response, and (ii) the maintenance of capital. These two approaches have been adopted by the United Nations and the World Bank, respectively, and will be discussed as they relate to the development of an Index of Human Insecurity (IHI).

The World Bank (1997a) has identified four broad issue areas for the measurement of development:

- quality of life (including the constituents or outcomes of development and the determinants of development);
- intragenerational entitlements (differences in access to resources);
- social and environmental sustainability (the consideration of social and environmental values and costs); and
- structural transformations (patterns of consumption, production, technology, foreign trade, and resource use).

In developing indicators for sustainability, the World Bank has focused efforts on the measurement of national wealth and “genuine savings,” or the flow which adds to national wealth (World Bank, 1995, 1997b). National wealth is defined as constituting four types of capital:

- produced capital;
- natural capital;
- human capital (the set of human abilities and know-how); and
- social capital (defined by the World Bank, 1997b, p. 78, as “the set of norms, networks and organizations through which people gain access to power and resources, and through which decisions and policy formulation occur” and that affects and is affected by economic outcomes, including aspects of horizontal associations, civil and political society, social integration, and legal and governance aspects).

Genuine savings, the means by which national wealth is created and maintained, is the net investment in all four forms of capital. (Due to methodological difficulties in measuring genuine savings, the World Bank, 1997b, p. 1, currently has a narrower working definition of the true rate of savings of a nation that is assessed "after accounting for the depreciation of produced assets, the depletion of natural resources, investments in human capital, and the value of global damages from carbon emissions.") An analysis of national wealth gives an indication of the resources of capital from which a nation can draw. As a simple notion of sustainable development, it calls for the maintenance of the net stock of all forms of capital (produced, natural, human, and social) through time, allowing for substitution (World Bank, 1995). One might also surmise that exceedingly low levels of the net stock of capital, or significant declines over time, would indicate vulnerability to external stress.

The United Nations Commission on Sustainable Development (CSD) follows the driving force (or pressure)-state-response framework, developed by the Organization for Economic Cooperation and Development (OECD), for indicator selection (United Nations, 1996). This framework has gained wide acceptance around the world and focuses on the development of a coherent indicator set through the selection of relevant indicators from the three categories. Driving force indicators measure the extent of human activities, processes, and patterns that have an effect on sustainable development. Driving forces themselves can be distinguished as being either proximate (actions that actually directly affect sustainable development) or ultimate (the social reasons behind the proximate actions; Turner, 1989). State indicators measure the resulting condition of the development, and response indicators measure society's response to the perceived problems. The CSD advocates the selection of driving force-state-response indicators in each of the three categories of society (including economic), environment, and institutions (United Nations, 1996).

How does either the national wealth (including genuine savings) concept or the driving force-state-response framework assist in identifying indicators that will track human insecurity? By focusing on vulnerability, indicators of human insecurity measure communities' risks of exposure to environmental stress and their capacity to cope with the risks. This provides parallels with the three factors affecting insecurity that were noted earlier (the actual risk of exposure to environmental stress, the perception of the risk, and the capacity to cope with the risk).² Changes in the chosen indicators will reveal regions of potential human insecurity; these regions can then be targeted to further identify the potential risks and improve communities' capacities to cope.

What are indicators that reflect vulnerability? Driving force indicators, being proximate or ultimate, characterize the stress and, indirectly, the risks of community exposure to the stress. State indicators characterize the system's ability to cope with the stress. The genuine savings rate tracks the investments (flows) that affect the stocks of certain forms of capital affecting human insecurity, and can be reflected in

either driving force or state indicators. Thus, indicators of human insecurity should ideally consist of both driving force and state indicators, which in turn reflect key *structural* relationships (linkages, defining characteristics) and *functional* relationships (process flows) within the system.

For our purposes, keeping in mind the necessity of choosing proxy measures for vulnerability, key structural and functional indicators were chosen within the following categories: ecological conditions (including food and resources), economic conditions, social conditions (including health and demographic), and institutional conditions (including political). Theory regarding human insecurity can then be utilised to further inform indicator selection within each category. The schemata is shown in Figure 27.1.

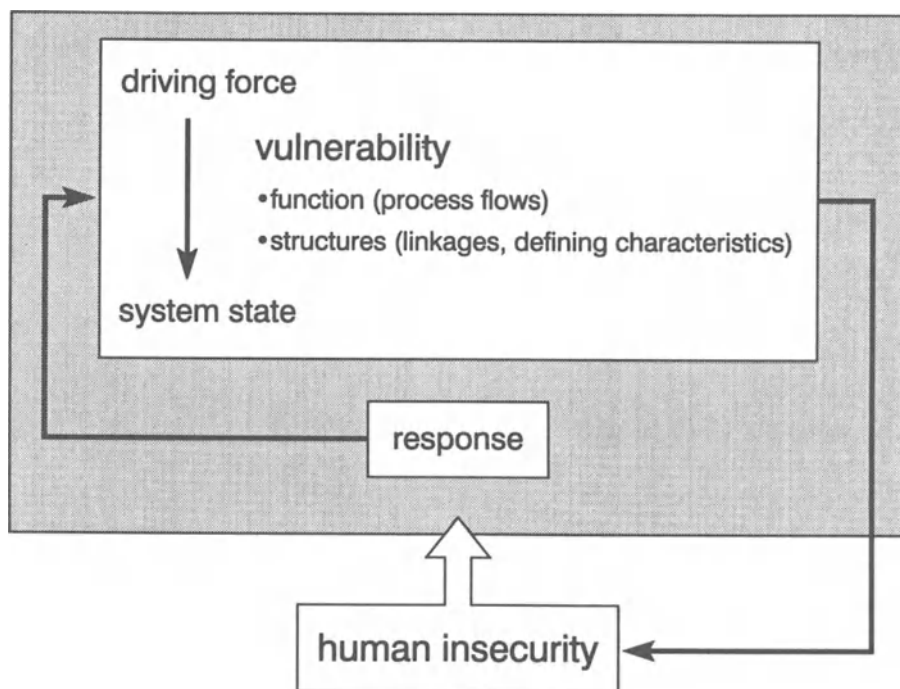


Figure 27.1 The relationship between vulnerability (as a proxy measure for insecurity), the driving force-state-response framework, and human insecurity

3.2. An Index of Human Insecurity (IHI)

We undertook the development of an index of human insecurity for the following reasons. First, there is a need for computer-based information to assist with medium- and long-term development planning efforts. For the reasons noted above, it was not

our intention to produce an early warning index but, rather, to develop a better understanding of the forces that produce human insecurity and some sense of where the most insecure regions may be now and in the future. Second, we deemed it important to consider the potential impact of global change on human security. Such change includes population growth and distribution as well as global warming and ozone depletion. And last, there is a pressing need to produce visual presentations and explanations of the forces that are influencing security. Such presentations and explanations may prove critical in attempts to convince decision makers to redirect public funds toward regions in greatest need.

In addition, four key conditions influenced and constrained the development of an index of human insecurity:

- Previous work by the co-authors (Gustavson et al., 1999) has demonstrated that a small list of indicators is most appropriate and effective for the purposes noted above. We must move away from long lists of indicators that may be overlapping and highly correlated with one another.
- Since environment, economy, and society are interlinked, there must be some sense that changes to one factor will be mitigated by many other factors (at least until some threshold level is reached). Therefore, a standard set of indicators should be used for the base index. Additional indicators can be added to deal with specific issues (e.g., food security or civil unrest).
- Qualitative information is at least, if not more, important than quantitative information in identifying regions of human insecurity. Accordingly, efforts must be made to incorporate both quantitative and qualitative data in the development of an index, and to supplement the index with adequate textual analysis and explanation.
- The index should be developed within a Geographical Information System (GIS) to promote both visual display and allow flexibility in future analysis.

The initial phase of the research focused on the selection of a small set of indicators that would be used to comprise the base index. Indicator selection followed a set of evaluation criteria, the key one being able to measure either structural or functional relationships within either environmental, economic, social, or institutional components (see Table 27.1; some further considerations for indicator selection are discussed above, others can be found in Anderson, 1991). Twelve indicators comprise the initial base index, and each indicator had to be available for, at a minimum, 100 of the 187 countries in the world. The problems with temporal consistency (see below) yielded to selecting the most recent year available for each indicator. Table 27.1 presents the initial 12 state indicators assigned to the system in Figure 27.1, reflecting structural and functional relationships within environmental, economic, social, and institutional components.

Table 27.1 Selected indicators of human insecurity

Environmental	water resources per capita (structure)	food import dependency ratio (structure)
	energy imports as a % of consumption (structure)	access to safe water (structure)
Economic	real GDP per capita (function)	
Social	urban population growth rate (function)	maternal mortality (function)
	fertility rates (function)	child mortality (function)
Institutional	expenditures on defense versus health and education (structure)	degree of democratization (structure)
		human freedom index (structure)

Data for the component indicators was incorporated into ESRI ArcInfo, a standard GIS. Hierarchical cluster analysis was then performed on each indicator, the raw data for each indicator then assigned to one of ten ‘like-data’ clusters. The cluster analysis was performed to ensure that data were commensurate when being combined into an index, and to highlight extremes in the data. The indicators (now with scores of one to ten) were then summed and averaged over the number of indicators to calculate the index. All indicators were given the same weight.

4. DATA QUALITY AND RELIABILITY

Data quality and reliability are major issues in using indicators for any purpose. Data may be out of date, incommensurable, inaccurate, imprecise, and incomplete. The problems with data quality and reliability are so great that they directly influence the use of indicators for policy development. Similar to those in other indicator systems, the data used in the development of the IHI present challenges to both developer and user. In this section, we present a limited examination of the data for indicators used in the IHI according to four criteria: completeness of data set across nations, discrepancy between data sources, reporting year and variability, and resolution of the data.

4.1. Completeness of Data Set Across Nations

The focus of the IHI is on identifying regions of human insecurity. Many of the countries of interest are in the developing world, where the availability of data can be extremely limiting. Table 27.2 gives an indication of data completeness for each indicator. Missing data are almost entirely from developing countries.

There are also spatial patterns to these gaps in data. Virtually no data were available for either the new Soviet Republics or the members of former Yugoslavia. There are marginally more data available for former Eastern Bloc nations, although they are often more than 15 years out of date.

Table 27.2 Completeness of indicator data

<i>Indicator</i>	<i>Year of Data</i>	<i>Number of Nations with Data (total of 165)</i>
human freedom index	1985	156 (94.5% complete)
maternal mortality	1980-1992	154 (93.3%)
urban population growth rates	1990-1995	148 (89.7%)
fertility rates	1990-1995	148 (89.7%)
energy imports as % of consumption	1993	147 (89.1%)
water resources per capita	1995	146 (88.5%)
child mortality	1993	140 (84.8%)
real GDP per capita	1994	133 (80.6%)
access to safe water	1988-1991	131 (79.4%)
food import dependency ratio	1990	128 (77.6%)
degree of democratization	1988	126 (76.4%)
ratio of defense expenditures to expenditures on health and education	1990-1991	123 (74.5%)

4.2. Discrepancy Between Data Sources

Data were collected from a variety of sources and, for almost all indicators, large discrepancies occurred between the various sources. It was often not easy to reconcile these differences, and where possible, multiple data sources were used. To illustrate the extent of the problem, Table 27.3 shows data discrepancies between the World Bank (1993), the UNDP (1996), and the United Nations (1995) for maternal mortality.

Maternal mortality is often used as a key indicator of the level of health services and the general health of the population. As Table 27.3 shows, there are great discrepancies between data sources. Consider the case of Rwanda and Senegal: the UNDP (1996) data shows that the two countries have approximately the same level of maternal mortality rates, while the World Bank (1993) data has Senegal at 3 times the rate for Rwanda. To make matters worse, the UNDP (1996) value for Rwanda is 6 times that reported by *The World's Women* (United Nations, 1995).

The importance of this indicator stands in contrast to the difficulty in obtaining data for which there are few discrepancies among sources. Even when data is sourced from the same international agency, problems are encountered. For maternal mortality, the World Bank (1995, p. 25) notes the following: "Because deaths during childbirth are defined more widely in some countries to include abortion, complications of pregnancy or the period after childbirth, and because many pregnant women die from a lack of suitable health care, maternal mortality is difficult to measure consistently and reliably across countries."

4.3. Reporting Year and Variability

One of the most important aspects of data quality is currency. Although some indicators may change very little over time, most of the ones used in the IHI are quite variable, particularly for developing countries. In some cases, this can be the result of reporting inaccuracies, while in others, rapid economic development has resulted in marked improvements in indicators such as access to safe water. Many organizations rely primarily on data that vary little from year to year to avoid potential problems associated with data inaccuracies.

A related issue is the problem of temporal compatibility. Most large data sets exhibit data for different years within the same indicator. This poses a significant problem when mapping such indicators, since spatial variations in data may be the result of different measurement years rather than real differences in values for a particular indicator for a given year. Because the IHI is designed to detect regional disparities in insecurity, this may introduce significant error into the analysis. Table 27.2 lists the reporting dates for the specific indicators used in the initial calculation of the IHI.

4.4. Resolution

Reported data may be for a specific year, or may be averaged over a number of years. Year-specific data is desirable, but may confound interpretation of data that are highly variable over time (see discussion above). On the other hand, using a running average may effectively account for such extremes, but may also hide unusual variability that may be important for the analysis of certain indicators.

5. MAPPING HUMAN INSECURITY

The base human insecurity map can be seen in Figure 27.2. Not unexpectedly, the highest values of the IHI are exhibited by countries in Sub-Saharan Africa. Figure 27.3 is the same vulnerability index, this time focused on Africa (the black dots represent pivotal states, as defined by Chase, 1996). This base map, or one similar, can then be used in future work. For example, if one wanted to focus on food security as a key issue, then additional indicators of food security (or insecurity) could be added to the base map. One must acknowledge explicitly, however, that there are other environmental, economic, social, and institutional processes that are still active, and that cannot be isolated from the analysis. The process is a dynamic one, and this is reflected in the mapping approach that was taken.

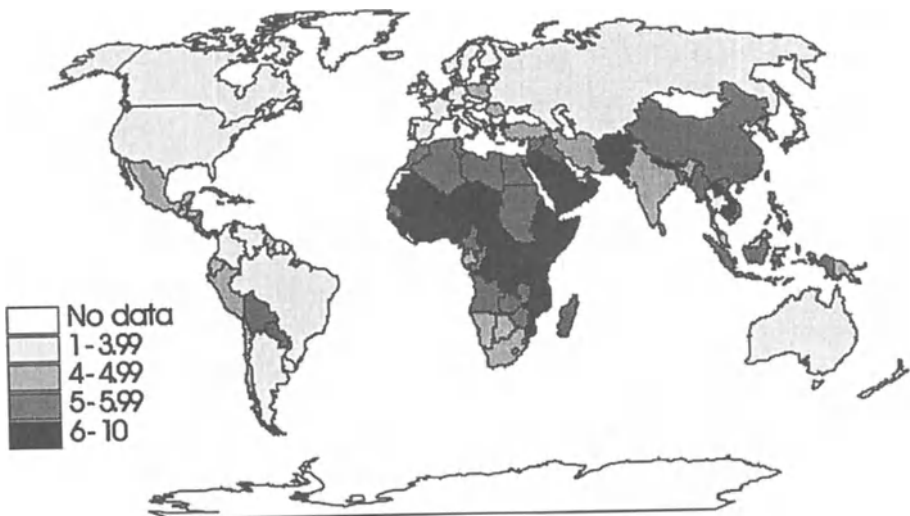


Figure 27.2 Index of Human Insecurity (IHI) values for 1992. Larger index values indicate greater insecurity

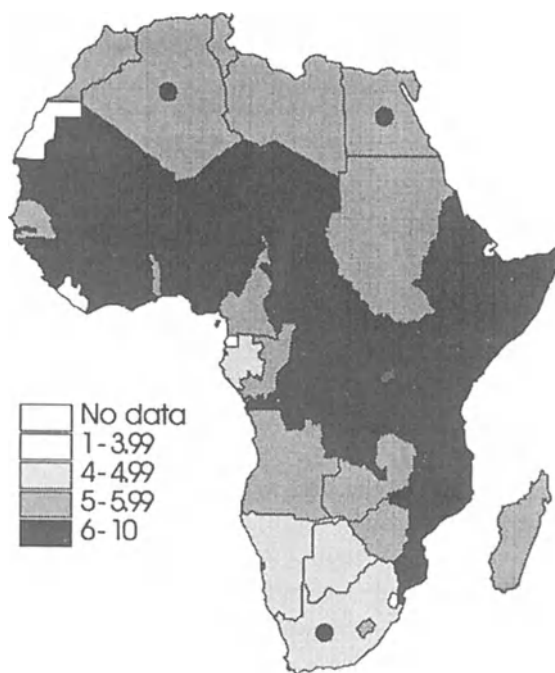


Figure 27.3 Index of Human Insecurity (IHI) values for 1992, showing detail of Africa. Larger index values indicate greater insecurity. Black dots represent the pivotal states of Algeria, Egypt, and South Africa as defined by Chase (1996)

What effect will changes in population have on the hot spots? Figure 27.4 depicts the vulnerability map extrapolated for 2025, based on the UN's medium population projections. In our vulnerability map, only two of the initial indicators were directly dependent on population; as a result, only those two indicators were modified based on the projection and thus the new map differs very little from the original one.

6. FUTURE DIRECTIONS

Future work on the IHI will include exploration of new data sources for the potential replacement of indicators and inclusion of new indicators, further statistical exploration and analyses of criteria for the selection of indicators within the presented framework, statistical analyses of the relationships between individual indicators, and a focus on adding information on specific aspects of security, such as food security or

water security, with definition of a methodology for including such information in the base map. In addition, future work will include the following:

- incorporation of information on thresholds for indicators where possible;
- inclusion of direct participation of environmental and human security analysts from the policy community;
- examination of cross-border issues, where problems in one state or region might affect neighbouring states;
- incorporation of time series analysis; and
- enhancement of the communication functions (such as improved displays, user interface, and incorporation of textual information).

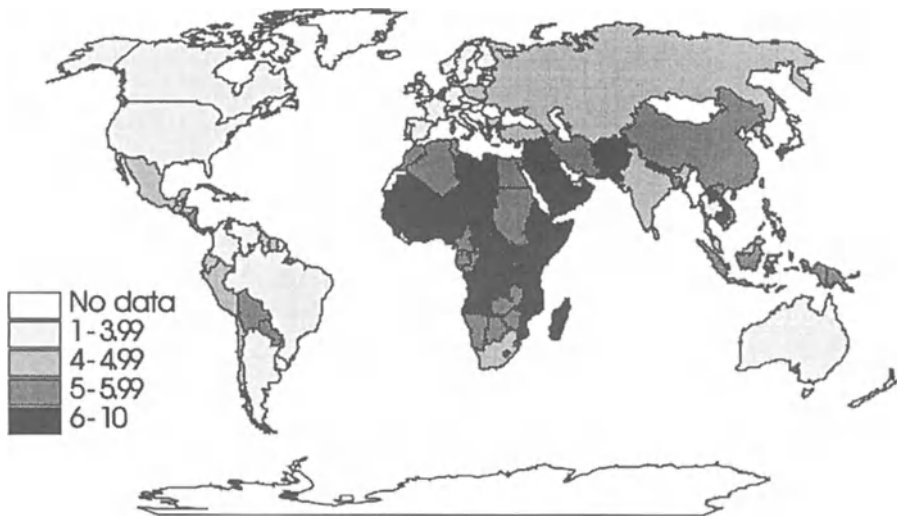


Figure 27.4 Index of Human Insecurity (IHI) values extrapolated for 2025.
Larger index values indicate greater insecurity

7. ENDNOTES

- ¹ The FEWS website is <http://www.info.usaid.gov/fews/fews.html>.
- ² As stated previously, due to the difficulty of measuring human perceptions of risk on a large scale for use in human insecurity indicator development, we are really focusing on vulnerability as a proxy for insecurity. However, this does not negate the need to ideally focus on the concept of insecurity rather than vulnerability.

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